





# Climate Change Scoping Plan Appendices

## VOLUME I:
## SUPPORTING DOCUMENTS AND MEASURE DETAIL

*a framework for change*

**DECEMBER 2008**

*Pursuant to AB 32*
*The California Global Warming Solutions Act of 2006*


*Prepared by*
the California Air Resources Board
for the State of California

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# Appendix A: AB 32: The Global Warming Solutions Act of 2006

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# Assembly Bill No. 32

## CHAPTER 488

An act to add Division 25.5 (commencing with Section 38500) to the Health and Safety Code, relating to air pollution.

[Approved by Governor September 27, 2006. Filed with Secretary of State September 27, 2006.]

LEGISLATIVE COUNSEL'S DIGEST

AB 32, Nunez. Air pollution: greenhouse gases: California Global Warming Solutions Act of 2006.

Under existing law, the State Air Resources Board (state board), the State Energy Resources Conservation and Development Commission (Energy Commission), and the California Climate Action Registry all have responsibilities with respect to the control of emissions of greenhouse gases, as defined, and the Secretary for Environmental Protection is required to coordinate emission reductions of greenhouse gases and climate change activity in state government.

This bill would require the state board to adopt regulations to require the reporting and verification of statewide greenhouse gas emissions and to monitor and enforce compliance with this program, as specified. The bill would require the state board to adopt a statewide greenhouse gas emissions limit equivalent to the statewide greenhouse gas emissions levels in 1990 to be achieved by 2020, as specified. The bill would require the state board to adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions, as specified. The bill would authorize the state board to adopt market-based compliance mechanisms, as defined, meeting specified requirements. The bill would require the state board to monitor compliance with and enforce any rule, regulation, order, emission limitation, emissions reduction measure, or market-based compliance mechanism adopted by the state board, pursuant to specified provisions of existing law. The bill would authorize the state board to adopt a schedule of fees to be paid by regulated sources of greenhouse gas emissions, as specified.

Because the bill would require the state board to establish emissions limits and other requirements, the violation of which would be a crime, this bill would create a state-mandated local program.

The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement.

This bill would provide that no reimbursement is required by this act for a specified reason.

Text of AB 32

*The people of the State of California do enact as follows:*

SECTION 1. Division 25.5 (commencing with Section 38500) is added to the Health and Safety Code, to read:

Division 25.5. CALIFORNIA GLOBAL WARMING SOLUTIONS ACT OF 2006

PART 1. GENERAL PROVISIONS

CHAPTER 1. TITLE OF DIVISION

38500. This division shall be known, and may be cited, as the California Global Warming Solutions Act of 2006.

CHAPTER 2. FINDINGS AND DECLARATIONS

38501. The Legislature finds and declares all of the following:

(a) Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California. The potential adverse impacts of global warming include the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other human health-related problems.

(b) Global warming will have detrimental effects on some of California's largest industries, including agriculture, wine, tourism, skiing, recreational and commercial fishing, and forestry. It will also increase the strain on electricity supplies necessary to meet the demand for summer air-conditioning in the hottest parts of the state.

(c) California has long been a national and international leader on energy conservation and environmental stewardship efforts, including the areas of air quality protections, energy efficiency requirements, renewable energy standards, natural resource conservation, and greenhouse gas emission standards for passenger vehicles. The program established by this division will continue this tradition of environmental leadership by placing California at the forefront of national and international efforts to reduce emissions of greenhouse gases.

(d) National and international actions are necessary to fully address the issue of global warming. However, action taken by California to reduce emissions of greenhouse gases will have far-reaching effects by encouraging other states, the federal government, and other countries to act.

(e) By exercising a global leadership role, California will also position its economy, technology centers, financial institutions, and businesses to benefit from national and international efforts to reduce emissions of greenhouse gases. More importantly, investing in the development of innovative and pioneering technologies will assist California in achieving the 2020 statewide limit on emissions of greenhouse gases established by this division and will provide an opportunity for the state to take a global economic and technological leadership role in reducing emissions of greenhouse gases.

(f) It is the intent of the Legislature that the State Air Resources Board coordinate with state agencies, as well as consult with the environmental justice community, industry sectors, business groups, academic institutions,

environmental organizations, and other stakeholders in implementing this division.

(g) It is the intent of the Legislature that the State Air Resources Board consult with the Public Utilities Commission in the development of emissions reduction measures, including limits on emissions of greenhouse gases applied to electricity and natural gas providers regulated by the Public Utilities Commission in order to ensure that electricity and natural gas providers are not required to meet duplicative or inconsistent regulatory requirements.

(h) It is the intent of the Legislature that the State Air Resources Board design emissions reduction measures to meet the statewide emissions limits for greenhouse gases established pursuant to this division in a manner that minimizes costs and maximizes benefits for California's economy, improves and modernizes California's energy infrastructure and maintains electric system reliability, maximizes additional environmental and economic co-benefits for California, and complements the state's efforts to improve air quality.

(i) It is the intent of the Legislature that the Climate Action Team established by the Governor to coordinate the efforts set forth under Executive Order S-3-05 continue its role in coordinating overall climate policy.

CHAPTER 3. DEFINITIONS

38505. For the purposes of this division, the following terms have the following meanings:

(a) "Allowance" means an authorization to emit, during a specified year, up to one ton of carbon dioxide equivalent.

(b) "Alternative compliance mechanism" means an action undertaken by a greenhouse gas emission source that achieves the equivalent reduction of greenhouse gas emissions over the same time period as a direct emission reduction, and that is approved by the state board. "Alternative compliance mechanism" includes, but is not limited to, a flexible compliance schedule, alternative control technology, a process change, or a product substitution.

(c) "Carbon dioxide equivalent" means the amount of carbon dioxide by weight that would produce the same global warming impact as a given weight of another greenhouse gas, based on the best available science, including from the Intergovernmental Panel on Climate Change.

(d) "Cost-effective" or "cost-effectiveness" means the cost per unit of reduced emissions of greenhouse gases adjusted for its global warming potential.

(e) "Direct emission reduction" means a greenhouse gas emission reduction action made by a greenhouse gas emission source at that source.

(f) "Emissions reduction measure" means programs, measures, standards, and alternative compliance mechanisms authorized pursuant to this division, applicable to sources or categories of sources, that are designed to reduce emissions of greenhouse gases.

(g) "Greenhouse gas" or "greenhouse gases" includes all of the following gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexaflouride.

(h) "Greenhouse gas emissions limit" means an authorization, during a specified year, to emit up to a level of greenhouse gases specified by the state board, expressed in tons of carbon dioxide equivalents.

(i) "Greenhouse gas emission source" or "source" means any source, or category of sources, of greenhouse gas emissions whose emissions are at a level of significance, as determined by the state board, that its participation in the program established under this division will enable the state board to effectively reduce greenhouse gas emissions and monitor compliance with the statewide greenhouse gas emissions limit.

(j) "Leakage" means a reduction in emissions of greenhouse gases within the state that is offset by an increase in emissions of greenhouse gases outside the state.

(k) "Market-based compliance mechanism" means either of the following:

(1) A system of market-based declining annual aggregate emissions limitations for sources or categories of sources that emit greenhouse gases.

(2) Greenhouse gas emissions exchanges, banking, credits, and other transactions, governed by rules and protocols established by the state board, that result in the same greenhouse gas emission reduction, over the same time period, as direct compliance with a greenhouse gas emission limit or emission reduction measure adopted by the state board pursuant to this division.

*(l) "State board" means the State Air Resources Board.*

(m) "Statewide greenhouse gas emissions" means the total annual emissions of greenhouse gases in the state, including all emissions of greenhouse gases from the generation of electricity delivered to and consumed in California, accounting for transmission and distribution line losses, whether the electricity is generated in state or imported. Statewide emissions shall be expressed in tons of carbon dioxide equivalents.

(n) "Statewide greenhouse gas emissions limit" or "statewide emissions limit" means the maximum allowable level of statewide greenhouse gas emissions in 2020, as determined by the state board pursuant to Part 3 (commencing with Section 38850).

## CHAPTER 4. ROLE OF STATE BOARD

38510. The State Air Resources Board is the state agency charged with monitoring and regulating sources of emissions of greenhouse gases that cause global warming in order to reduce emissions of greenhouse gases.

## PART 2. MANDATORY GREENHOUSE GAS EMISSIONS REPORTING

38530. (a) On or before January 1, 2008, the state board shall adopt regulations to require the reporting and verification of statewide greenhouse gas emissions and to monitor and enforce compliance with this program.

(b) The regulations shall do all of the following:

(1) Require the monitoring and annual reporting of greenhouse gas emissions from greenhouse gas emission sources beginning with the sources or categories of sources that contribute the most to statewide emissions.

(2) Account for greenhouse gas emissions from all electricity consumed in the state, including transmission and distribution line losses from electricity generated within the state or imported from outside the state. This requirement applies to all retail sellers of electricity, including load-serving

entities as defined in subdivision (j) of Section 380 of the Public Utilities Code and local publicly owned electric utilities as defined in Section 9604 of the Public Utilities Code.

(3) Where appropriate and to the maximum extent feasible, incorporate the standards and protocols developed by the California Climate Action Registry, established pursuant to Chapter 6 (commencing with Section 42800) of Part 4 of Division 26. Entities that voluntarily participated in the California Climate Action Registry prior to December 31, 2006, and have developed a greenhouse gas emission reporting program, shall not be required to significantly alter their reporting or verification program except as necessary to ensure that reporting is complete and verifiable for the purposes of compliance with this division as determined by the state board.

(4) Ensure rigorous and consistent accounting of emissions, and provide reporting tools and formats to ensure collection of necessary data.

(5) Ensure that greenhouse gas emission sources maintain comprehensive records of all reported greenhouse gas emissions.

(c) The state board shall do both of the following:

(1) Periodically review and update its emission reporting requirements, as necessary.

(2) Review existing and proposed international, federal, and state greenhouse gas emission reporting programs and make reasonable efforts to promote consistency among the programs established pursuant to this part and other programs, and to streamline reporting requirements on greenhouse gas emission sources.

PART 3. STATEWIDE GREENHOUSE GAS EMISSIONS LIMIT

38550. By January 1, 2008, the state board shall, after one or more public workshops, with public notice, and an opportunity for all interested parties to comment, determine what the statewide greenhouse gas emissions level was in 1990, and approve in a public hearing, a statewide greenhouse gas emissions limit that is equivalent to that level, to be achieved by 2020. In order to ensure the most accurate determination feasible, the state board shall evaluate the best available scientific, technological, and economic information on greenhouse gas emissions to determine the 1990 level of greenhouse gas emissions.

38551. (a) The statewide greenhouse gas emissions limit shall remain in effect unless otherwise amended or repealed.

(b) It is the intent of the Legislature that the statewide greenhouse gas emissions limit continue in existence and be used to maintain and continue reductions in emissions of greenhouse gases beyond 2020

(c) The state board shall make recommendations to the Governor and the Legislature on how to continue reductions of greenhouse gas emissions beyond 2020.

PART 4. GREENHOUSE GAS EMISSIONS REDUCTIONS

38560. The state board shall adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions from sources or categories of sources, subject to the criteria and schedules set forth in this part.

38560.5. (a) On or before June 30, 2007, the state board shall publish and make available to the public a list of discrete early action greenhouse gas emission reduction measures that can be implemented prior to the measures and limits adopted pursuant to Section 38562.

(b) On or before January 1, 2010, the state board shall adopt regulations to implement the measures identified on the list published pursuant to subdivision (a).

(c) The regulations adopted by the state board pursuant to this section shall achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions from those sources or categories of sources, in furtherance of achieving the statewide greenhouse gas emissions limit.

(d) The regulations adopted pursuant to this section shall be enforceable no later than January 1, 2010.

38561. (a) On or before January 1, 2009, the state board shall prepare and approve a scoping plan, as that term is understood by the state board, for achieving the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions from sources or categories of sources of greenhouse gases by 2020 under this division. The state board shall consult with all state agencies with jurisdiction over sources of greenhouse gases, including the Public Utilities Commission and the State Energy Resources Conservation and Development Commission, on all elements of its plan that pertain to energy related matters including, but not limited to, electrical generation, load based-standards or requirements, the provision of reliable and affordable electrical service, petroleum refining, and statewide fuel supplies to ensure the greenhouse gas emissions reduction activities to be adopted and implemented by the state board are complementary, nonduplicative, and can be implemented in an efficient and cost-effective manner.

(b) The plan shall identify and make recommendations on direct emission reduction measures, alternative compliance mechanisms, market-based compliance mechanisms, and potential monetary and nonmonetary incentives for sources and categories of sources that the state board finds are necessary or desirable to facilitate the achievement of the maximum feasible and cost-effective reductions of greenhouse gas emissions by 2020.

(c) In making the determinations required by subdivision (b), the state board shall consider all relevant information pertaining to greenhouse gas emissions reduction programs in other states, localities, and nations, including the northeastern states of the United States, Canada, and the European Union.

(d) The state board shall evaluate the total potential costs and total potential economic and noneconomic benefits of the plan for reducing greenhouse gases to California's economy, environment, and public health, using the best available economic models, emission estimation techniques, and other scientific methods.

(e) In developing its plan, the state board shall take into account the relative contribution of each source or source category to statewide greenhouse gas emissions, and the potential for adverse effects on small businesses, and shall recommend a de minimis threshold of greenhouse gas emissions below which emission reduction requirements will not apply.

(f) In developing its plan, the state board shall identify opportunities for emission reductions measures from all verifiable and enforceable voluntary actions, including, but not limited to, carbon sequestration projects and best management practices.

(g) The state board shall conduct a series of public workshops to give interested parties an opportunity to comment on the plan. The state board shall conduct a portion of these workshops in regions of the state that have the most significant exposure to air pollutants, including, but not limited to, communities with minority populations, communities with low-income populations, or both.

(h) The state board shall update its plan for achieving the maximum technologically feasible and cost-effective reductions of greenhouse gas emissions at least once every five years.

38562. (a) On or before January 1, 2011, the state board shall adopt greenhouse gas emission limits and emission reduction measures by regulation to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions in furtherance of achieving the statewide greenhouse gas emissions limit, to become operative beginning on January 1, 2012.

(b) In adopting regulations pursuant to this section and Part 5 (commencing with Section 38570), to the extent feasible and in furtherance of achieving the statewide greenhouse gas emissions limit, the state board shall do all of the following:

(1) Design the regulations, including distribution of emissions allowances where appropriate, in a manner that is equitable, seeks to minimize costs and maximize the total benefits to California, and encourages early action to reduce greenhouse gas emissions.

(2) Ensure that activities undertaken to comply with the regulations do not disproportionately impact low-income communities.

(3) Ensure that entities that have voluntarily reduced their greenhouse gas emissions prior to the implementation of this section receive appropriate credit for early voluntary reductions.

(4) Ensure that activities undertaken pursuant to the regulations complement, and do not interfere with, efforts to achieve and maintain federal and state ambient air quality standards and to reduce toxic air contaminant emissions.

(5) Consider cost-effectiveness of these regulations.

(6) Consider overall societal benefits, including reductions in other air pollutants, diversification of energy sources, and other benefits to the economy, environment, and public health.

(7) Minimize the administrative burden of implementing and complying with these regulations.

(8) Minimize leakage.

(9) Consider the significance of the contribution of each source or category of sources to statewide emissions of greenhouse gases.

(c) In furtherance of achieving the statewide greenhouse gas emissions limit, by January 1, 2011, the state board may adopt a regulation that establishes a system of market-based declining annual aggregate emission limits for sources or categories of sources that emit greenhouse gas emissions, applicable from January 1, 2012, to December 31, 2020, inclusive, that the state board determines will achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions, in the aggregate, from those sources or categories of sources.

(d) Any regulation adopted by the state board pursuant to this part or Part 5 (commencing with Section 38570) shall ensure all of the following:

(1) The greenhouse gas emission reductions achieved are real, permanent, quantifiable, verifiable, and enforceable by the state board.

(2) For regulations pursuant to Part 5 (commencing with Section 38570), the reduction is in addition to any greenhouse gas emission reduction otherwise required by law or regulation, and any other greenhouse gas emission reduction that otherwise would occur.

(3) If applicable, the greenhouse gas emission reduction occurs over the same time period and is equivalent in amount to any direct emission reduction required pursuant to this division.

(e) The state board shall rely upon the best available economic and scientific information and its assessment of existing and projected technological capabilities when adopting the regulations required by this section.

(f) The state board shall consult with the Public Utilities Commission in the development of the regulations as they affect electricity and natural gas providers in order to minimize duplicative or inconsistent regulatory requirements.

(g) After January 1, 2011, the state board may revise regulations adopted pursuant to this section and adopt additional regulations to further the provisions of this division.

38563. Nothing in this division restricts the state board from adopting greenhouse gas emission limits or emission reduction measures prior to January 1, 2011, imposing those limits or measures prior to January 1, 2012, or providing early reduction credit where appropriate.

38564. The state board shall consult with other states, and the federal government, and other nations to identify the most effective strategies and methods to reduce greenhouse gases, manage greenhouse gas control programs, and to facilitate the development of integrated and cost-effective regional, national, and international greenhouse gas reduction programs.

38565. The state board shall ensure that the greenhouse gas emission reduction rules, regulations, programs, mechanisms, and incentives under its jurisdiction, where applicable and to the extent feasible, direct public and private investment toward the most disadvantaged communities in California and provide an opportunity for small businesses, schools, affordable housing associations, and other community institutions to participate in and benefit from statewide efforts to reduce greenhouse gas emissions.

PART 5. MARKET-BASED COMPLIANCE MECHANISMS

38570. (a) The state board may include in the regulations adopted pursuant to Section 38562 the use of market-based compliance mechanisms to comply with the regulations.

(b) Prior to the inclusion of any market-based compliance mechanism in the regulations, to the extent feasible and in furtherance of achieving the statewide greenhouse gas emissions limit, the state board shall do all of the following:

(1) Consider the potential for direct, indirect, and cumulative emission impacts from these mechanisms, including localized impacts in communities that are already adversely impacted by air pollution.

(2) Design any market-based compliance mechanism to prevent any increase in the emissions of toxic air contaminants or criteria air pollutants.

(3) Maximize additional environmental and economic benefits for California, as appropriate.

(c) The state board shall adopt regulations governing how market-based compliance mechanisms may be used by regulated entities subject to greenhouse gas emission limits and mandatory emission reporting requirements to achieve compliance with their greenhouse gas emissions limits.

38571. The state board shall adopt methodologies for the quantification of voluntary greenhouse gas emission reductions. The state board shall adopt regulations to verify and enforce any voluntary greenhouse gas emission reductions that are authorized by the state board for use to comply with greenhouse gas emission limits established by the state board. The adoption of methodologies is exempt from the rulemaking provisions of the Administrative Procedure Act (Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code).

38574. Nothing in this part or Part 4 (commencing with Section 38560) confers any authority on the state board to alter any programs administered by other state agencies for the reduction of greenhouse gas emissions.

PART 6. ENFORCEMENT

38580. (a) The state board shall monitor compliance with and enforce any rule, regulation, order, emission limitation, emissions reduction measure, or market-based compliance mechanism adopted by the state board pursuant to this division.

(b) (1) Any violation of any rule, regulation, order, emission limitation, emissions reduction measure, or other measure adopted by the state board pursuant to this division may be enjoined pursuant to Section 41513, and the violation is subject to those penalties set forth in Article 3 (commencing with Section 42400) of Chapter 4 of Part 4 of, and Chapter 1.5 (commencing with Section 43025) of Part 5 of, Division 26.

(2) Any violation of any rule, regulation, order, emission limitation, emissions reduction measure, or other measure adopted by the state board pursuant to this division shall be deemed to result in an emission of an air contaminant for the purposes of the penalty provisions of Article 3 (commencing with Section 42400) of Chapter 4 of Part 4 of, and Chapter 1.5 (commencing with Section 43025) of Part 5 of, Division 26.

(3) The state board may develop a method to convert a violation of any rule, regulation, order, emission limitation, or other emissions reduction measure adopted by the state board pursuant to this division into the number of days in violation, where appropriate, for the purposes of the penalty provisions of Article 3 (commencing with Section 42400) of Chapter 4 of Part 4 of, and Chapter 1.5 (commencing with Section 43025) of Part 5 of, Division 26.

(c) Section 42407 and subdivision (i) of Section 42410 shall not apply to this part.

PART 7. MISCELLANEOUS PROVISIONS

38590. If the regulations adopted pursuant to Section 43018.5 do not remain in effect, the state board shall implement alternative regulations to control mobile sources of greenhouse gas emissions to achieve equivalent or greater reductions.

38591. (a) The state board, by July 1, 2007, shall convene an environmental justice advisory committee, of at least three members, to advise it in developing the scoping plan pursuant to Section 38561 and any other pertinent matter in implementing this division. The advisory committee shall be comprised of representatives from communities in the state with the most significant exposure to air pollution, including, but not limited to, communities with minority populations or low-income populations, or both.

(b) The state board shall appoint the advisory committee members from nominations received from environmental justice organizations and community groups.

(c) The state board shall provide reasonable per diem for attendance at advisory committee meetings by advisory committee members from nonprofit organizations.

(d) The state board shall appoint an Economic and Technology Advancement Advisory Committee to advise the state board on activities that will facilitate investment in and implementation of technological research and development opportunities, including, but not limited to, identifying new technologies, research, demonstration projects, funding opportunities, developing state, national, and international partnerships and technology transfer opportunities, and identifying and assessing research and advanced technology investment and incentive opportunities that will assist in the reduction of greenhouse gas emissions. The committee may also advise the state board on state, regional, national, and international economic and technological developments related to greenhouse gas emission reductions.

38592. (a) All state agencies shall consider and implement strategies to reduce their greenhouse gas emissions.

(b) Nothing in this division shall relieve any person, entity, or public agency of compliance with other applicable federal, state, or local laws or

regulations, including state air and water quality requirements, and other requirements for protecting public health or the environment.

38593. (a) Nothing in this division affects the authority of the Public Utilities Commission.(b) Nothing in this division affects the obligation of an electrical corporation to provide customers with safe and reliable electric service.

38594. Nothing in this division shall limit or expand the existing authority of any district, as defined in Section 39025.

38595. Nothing in this division shall preclude, prohibit, or restrict the construction of any new facility or the expansion of an existing facility subject to regulation under this division, if all applicable requirements are met and the facility is in compliance with regulations adopted pursuant to this division.

38596. The provisions of this division are severable. If any provision of this division or its application is held invalid, that invalidity shall not affect other provisions or applications that can be given effect without the invalid provision or application.

38597. The state board may adopt by regulation, after a public workshop, a schedule of fees to be paid by the sources of greenhouse gas emissions regulated pursuant to this division, consistent with Section 57001. The revenues collected pursuant to this section, shall be deposited into the Air Pollution Control Fund and are available upon appropriation, by the Legislature, for purposes of carrying out this division.

38598. (a) Nothing in this division shall limit the existing authority of a state entity to adopt and implement greenhouse gas emissions reduction measures.

(b) Nothing in this division shall relieve any state entity of its legal obligations to comply with existing law or regulation.

38599. (a) In the event of extraordinary circumstances, catastrophic events, or threat of significant economic harm, the Governor may adjust the applicable deadlines for individual regulations, or for the state in the aggregate, to the earliest feasible date after that deadline.

(b) The adjustment period may not exceed one year unless the Governor makes an additional adjustment pursuant to subdivision (a).

(c) Nothing in this section affects the powers and duties established in the California Emergency Services Act (Chapter 7 (commencing with Section 8550) of Division 1 of Title 2 of the Government Code).

(d) The Governor shall, within 10 days of invoking subdivision (a), provide written notification to the Legislature of the action undertaken.

SEC. 2 No reimbursement is required by this act pursuant to Section 6 of Article XIIIB of the California Constitution because the only costs that may be incurred by a local agency or school district will be incurred because this act creates a new crime or infraction, eliminates a crime or infraction, or changes the penalty for a crime or infraction, within the meaning of Section 17556 of the Government Code, or changes the definition of a crime within the meaning of Section 6 of Article XIIIB of the California Constitution.

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# Appendix B: List of Acronyms and Glossary

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## ACRONYMS

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| AB | Assembly Bill |
| A/C | Air Conditioning |
| ADC | Alternative Daily Cover |
| AF | Acre Foot |
| Ag | Agriculture |
| APCD | Air Pollution Control District |
| AQMD | Air Quality Management District |
| ARB | Air Resources Board |
| ARMINES | School of Mining Engineering of Paris |
| ASHRAE | American Society of Heating, Refrigerating and Air Conditioning Engineers |
| ATCM | Airborne Toxic Control Measure |
| BACT | Best Available Control Technology |
| BAR | (California) Bureau of Automotive Repair |
| BAU | Business as Usual |
| BBEEs | Big Bold Energy Efficiency Strategies |
| BC | British Columbia (Canada) |
| BEAR | Berkeley Energy and Resources |
| BG | Billion Gallons |
| BIPV | Building Integrated Photovoltaic |
| BMP | Best Management Practices |
| BNSF | Burlington Northern Santa Fe |
| BOD | Biological Oxygen Demand |
| BOF | (California) Board of Forestry and Fire Protection |
| BSFC | Brake Specific Fuel Consumption Value |
| BTUs | British Thermal Units |
| CAFO | Confined Animal Feeding Operation |
| CAISO | California Independent System Operator |
| CalEPA | California Environmental Protection Agency |
| CalTrans | California Department of Transportation |
| CAPCOA | California Air Pollution Control Officers Association |
| CARB | California Air Resources Board |
| CAT | Climate Action Team |
| CBSC | California Building Standards Commission |
| CCA | Community Choice Aggregators |
| CCAR | California Climate Action Registry |

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|---|---|
| CCGT | Combined Cycle Gas Turbine |
| CCRC | Climate Change Research Center |
| CCS | Carbon Dioxide Capture and Sequestration |
| C&D | Construction and Demolition |
| CDE | California Department of Education |
| CDFA | California Department of Food and Agriculture |
| CD-ROM | Compact Disc Read-Only Memory |
| C-E | Cost Effectiveness |
| CEC | California Energy Commission |
| CEFS | California Emission Forecast System |
| CEIDARS | California Emission Inventory Development and Reporting System |
| CEQA | California Environmental Quality Act |
| $C_2F_6$ | Hexafluoroethane |
| CFC | Chlorofluorocarbons |
| CFIP | California Forest Improvement Program |
| CFL | Compact Fluorescent Lighting |
| CFR | Code of Federal Regulations |
| CGBSC | California Green Building Standards Code |
| $CH_4$ | Methane |
| CHP | Combined Heat and Power |
| CHPS | Collaborative for High Performance Schools |
| CICS | California Institute for Climate Solutions |
| CIF | Carbon Intensity Factor |
| CIWMB | California Integrated Waste Management Board |
| CMUA | California Municipal Utilities Association |
| CNG | Compressed Natural Gas |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon Dioxide |
| $CO_2E$ | Carbon Dioxide Equivalent |
| CPUC | California Public Utilities Commission |
| CR | Commercial and Residential (Energy Use) |
| CRC | Carbon Regenerated Catalyst |
| CREB | Clean Renewable Energy Bonds |
| CRF | Capital Recovery Factor |
| CSA | Consumer Service Agent |
| CSAC | California State Association of Counties |
| CSI | California Solar Initiative |
| CSU | California State University |

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|---|---|
| CTE | Career and Technical Education |
| CVD | Chemical Vapor Deposition |
| CY | Calendar Year |
| DCA | (California) Department of Consumer Affairs |
| DFG | (California) Department of Fish and Game |
| DPH | (California) Department of Public Health |
| DG | Distributed Generation |
| DGS | (California) Department of General Services |
| DIY | Do-it-yourself |
| DMV | (California) Department of Motor Vehicles |
| DOC | (California) Department of Conservation |
| DOE | (California) Department of Energy |
| DOF | (California) Department of Forestry and Fire Protection |
| DOT | (California) Department of Transportation |
| DWR | (California) Department of Water Resources |
| DX | Direct Expansion |
| E-85 | Ethanol |
| EAP | Energy Action Plan |
| EB | Existing Buildings |
| EBI | Energy Biosciences Institute |
| E-DRAM | Environmental Dynamic Revenue Assessment Model |
| EE | Energy Efficiency |
| EF | Efficiency Factor |
| EIA | Energy Information Administration |
| EJ | Environmental Justice |
| EJAC | Environmental Justice Advisory Committee |
| EMFAC | Emission Factors Model |
| EMS | Environmental Management System |
| EO | Executive Order |
| EOL | End-of-life |
| EPAct | Energy Policy Act |
| EPEAT | Electronic Product Environmental Assessment Tool |
| EPP | Environmentally Preferable Purchasing |
| EPR | Extended Producer Responsibility |
| EPRI | Electric Power Research Institute |
| EPEAT | Electronic Product Environmental Assessment Tool |
| EPS | Emissions Performance Standard |
| ESCO | Energy Services Companies |

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|---|---|
| ESP | Economic Strategy Panel |
| ESPs | Electric Service Providers |
| ETAAC | Economic and Technology Advancement Advisory Committee |
| ETP | Employment Training Panel |
| EU | European Union |
| FAMS | Fleet Assessment Management System |
| FCC | Fluidized Catalytic Cracking |
| FED | Functionally Equivalent Document |
| FHWA | Federal Highway Administration |
| FJD | First Jurisdictional Deliverer |
| FRAP | Fire and Resources Assessment Program |
| GB | Green Building |
| GBI | Green Building Initiative |
| GBSC | Green Building Standards Commission |
| $gCO_2E/MJ$ | Grams of $CO_2$ Equivalent per Mega-Joule |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas |
| GIS | Gas-Insulated Substations |
| GMERP | Goods Movement Emission Reduction Plan |
| GPS | Global Positioning System |
| GSA | General Services Administration |
| GSP | Gross State Product |
| GVW | Gross Vehicle Weight |
| GVWR | Gross Vehicle Weight Rating |
| GWh | Gigawatt Hours |
| GWP | Global Warming Potential |
| HCCI | Homogenous Charge Compression Ignition |
| HCD | (California Department of) Housing and Community Development |
| HCFC | Hydrochlorofluorocarbons |
| HERS | Home Energy Rating System |
| HFC | Hydrofluorocarbons |
| HFE | Hydrofluoroethers |
| HHDD | Heavy Heavy-Duty Diesels |
| HSC | Health and Safety Code |
| HSR | High Speed Rail |
| HVAC | Heating, Ventilation, and Air Conditioning |
| I.C. | Internal Combustion |
| ICAP | International Carbon Action Partnership |

| | |
|---|---|
| ICE | Internal Combustion Engine |
| ICLEI | International Council for Local Environmental Initiatives |
| ICTF | Intermodal Container Transfer Facility |
| IEPR | Integrated Energy Policy Report |
| IGEM | Institution of Gas Engineers and Managers |
| IID | Imperial Irrigation District |
| ILG | Institute for Local Governments |
| I/M | Inspection and Maintenance (Smog Check) |
| IOU | Investor Owned Utilities |
| IPCC | Intergovernmental Panel on Climate Change |
| ISO | Independent Systems Operation |
| ISR | Indirect Source Rule(s) |
| IT | Information Technology |
| IWMP | Integrated Waste Management Plan |
| $kgCO_2E$ | Kilograms of Carbon Dioxide Equivalent |
| kw | Kilowatt |
| kWh | Kilowatt Hours |
| kWh/y | Kilowatt Hours per Year |
| LADWP | Los Angeles Department of Water and Power |
| LAFCO | Local Agency Formation Commission |
| $Lb/yd^3$ | Pound per Cubic Yard |
| LCCP | Lifecycle Climate Performance |
| LCD | Liquid Crystal Display |
| LCFS | Low Carbon Fuel Standard |
| LDAR | Leak Detection and Repair |
| LDCs | Local Distribution Companies |
| LDT | Light-Duty Truck |
| LDV | Light-Duty Vehicle |
| LEA | Local Solid Waste Enforcement Agencies |
| LED | Light-Emitting Diode |
| LEED | Leadership in Energy and Environmental Design |
| LEED- EB | Leadership in Energy and Environmental Design for Existing Buildings |
| LEED- NC | Leadership in Energy and Environmental Design for New Commercial Buildings |
| LEV | Low-Emission Vehicle |
| LID | Low Impact Development |
| LIEE | Low Income Energy Efficiency |
| LIOB | Low-Income Oversight Board |

| | |
|---|---|
| LMID | Labor Market Information Division |
| LNG | Liquefied Natural Gas |
| LPG | Liquefied Petroleum Gas |
| LSE | Load Serving Entities |
| LSI | Large-Spark Ignition |
| LUSCAT | Land Use Subgroup of the Climate Action Team |
| LWDA | Labor and Workforce Development Agency |
| MAC | Market Advisory Committee |
| MAF | Million Acre Feet |
| MAP | Million Annual Passengers |
| MG | Million Gallons |
| MHDD | Medium Heavy-Duty Diesels |
| MIT | Massachusetts Institute of Technology |
| MMBtu | Million Metric British Thermal Units |
| $MMTCO_2$ | Million Metric Tons of Carbon Dioxide |
| $MMTCO_2E$ | Million Metric Tons of Carbon Dioxide Equivalents |
| MOU | Memorandum of Understanding |
| MPG | Miles per gallon |
| MPO | Metropolitan Planning Organization |
| MRF | Material Recovery Facility |
| MSW | Municipal Solid Waste |
| MT | Metric Tons |
| $MTCO_2E$ | Metric Ton of $CO_2$ Equivalent |
| MVAC | Motor Vehicle Air Conditioning System |
| MW | Megawatt |
| MWh | Megawatt Hour |
| MWH/AF | Megawatt Hours per Acre-foot |
| MY | Model Year |
| N/A | Not Applicable |
| NAAQS | National Ambient Air Quality Standard |
| NC | New Construction |
| NEPA | National Environmental Policy Act |
| NESHAP | National Emissions Standards for Hazardous Air Pollution |
| $NF_3$ | Nitrogen Trifluoride |
| NGO | Non-Governmental Organization |
| $NH_3$ | Ammonia |
| nm | Nautical Miles |
| $N_2O$ | Nitrous Oxide |

| | |
|---|---|
| $NO_x$ | Oxides of Nitrogen, Nitrogen Dioxide |
| NPV | Net Present Value |
| NRC | National Research Council |
| NSHP | New Solar Homes Partnership |
| ODS | Ozone-Depleting Substances |
| OEMs | Original Equipment Manufacturers |
| O&G | Oil and Gas |
| OPR | (Governor's) Office of Planning and Research |
| OPSC | Office of Public School Construction |
| PAYD | Pay-As-You-Drive |
| PC | Passenger Cars |
| PERS | (California) Public Employees Retirement System |
| PFC | Perfluorocarbon |
| PFPE | Perfluoropolyethers |
| PG&E | Pacific Gas and Electric |
| PIER | Public Interest Energy Research |
| PM | Particulate Matter |
| PM2.5 | Particulate Matter less than 2.5 microns |
| POU | Publicly Owned Utilities |
| PPM | Parts Per Million |
| PRC | Public Resources Code |
| PSP | Proposed Scoping Plan |
| PUC | Public Utilities Commission |
| PV | Photovoltaic |
| RA | Resources Agency |
| RAC | Refrigeration and Air Conditioning |
| RAD | Responsible Appliance Disposal |
| RCx | Retro-commissioning |
| R&D | Research and Development |
| RD&D | Research, Development, and Demonstration |
| REAP | Rural Energy for America Program |
| RECs | Renewable Energy Credits |
| RECLAIM | Regional Clean Air Incentive Market |
| REDD | Reducing Emissions from Deforestation and Forest Degradation |
| RETI | Renewable Energy Transmission Initiative |
| RFS | Renewable Fuels Standard |
| RGGI | Regional Greenhouse Gas Initiative |
| RIN | Renewable Identification Number |

| | |
|---|---|
| RFS | Renewable Fuel Standard |
| ROG | Reactive Organic Gas |
| RPS | Renewables Portfolio Standard |
| RS | Renewables Standard |
| RTP | Regional Transportation Plan |
| R&WM | Recycling and Waste Management |
| SAB | State Allocation Board |
| SACOG | Sacramento Area Council of Governments |
| SAFETEA-LU | Safe, Accountable, Flexible Transportation Equity Act-Legacy for Users |
| SB | Senate Bill |
| SCAQMD | South Coast Air Quality Management District |
| SCE | Southern California Edison |
| SCIG | Southern California International Gateway |
| SCM | Supplementary Cementitious Material |
| SDG&E | San Diego Gas and Electric |
| $SF_6$ | Sulfur Hexaflouride |
| SFP | School Facility Programs |
| SGIP | Self Generation Incentive Program |
| SHWEA | Solar Hot Water Efficiency Act |
| SIA | Semiconductor Industry Association |
| SIP | State Implementation Plan |
| SJVAPCD | San Joaquin Valley Air Pollution Control District |
| SL | Secondary Loop |
| SMUD | Sacramento Municipal Utility District |
| SOx | Sulfur Oxide |
| $SO_2$ | Sulfur Dioxide |
| SSI | Systematic Solutions, Inc. |
| STAR | Science to Achieve Results |
| STIP | State Transportation Improvement Program |
| STRS | (California) State Teachers Retirement System |
| SUV | Sports Utility Vehicle |
| SWH | Solar Water Heating |
| SWP | State Water Project |
| SWRCB | State Water Resources Control Board |
| TAA | Trade Adjustment Assistance |
| TAC | Toxic Air Contaminant |
| TBD | To Be Determined |

| | |
|---|---|
| TCR | The Climate Registry |
| T&D | Transmission and Distribution |
| TEAP | Technology and Economic Assessment Panel |
| TEWI | Total Equivalent Warming Impact |
| TLC | Timberland Conversion |
| TPD | Tons Per Day |
| TRU | Transport Refrigeration Units |
| TWh | Terawatt Hours |
| UC | University of California |
| UP | Union Pacific Railroad |
| USDA | United States Department of Agriculture |
| USDOE | United State Department of Energy |
| U.S. EPA | United States Environmental Protection Agency |
| UTO | Useful Thermal Output |
| VFD | Variable Frequency Drive |
| VMT | Vehicle Miles Traveled |
| VOCs | Volatile Organic Compounds |
| VSR | Vessel Speed Reduction |
| WCI | Western Climate Initiative |
| WDR | Waste Discharge Requirement |
| WECC | Western Electricity Coordinating Council |
| WESTCARB | West Coast Regional Carbon Sequestration Partnership |
| ZEH/C | Zero Energy Heating and/or Cooling |
| ZEV | Zero Emission Vehicle |
| ZNE | Zero Net Energy |

## GLOSSARY OF CLIMATE CHANGE TERMS

**Afforestation:** Planting of new forests on lands that historically have not contained forests.

**Allocation:** Process by which emission allowances are periodically distributed both initially and on an on-going basis under an emissions cap and trade system.

**Allowance:** An authorization to emit, during a specified year, up to one ton of carbon dioxide equivalent. (HSC §38505(a))

**Berkeley Energy and Resource (BEAR) Model:** A dynamic general equilibrium forecasting model that simulates the way that changes in energy investment, price and use affect how Californians live their lives.

**Cap:** A limit on emissions.

**Cap and Trade:** An environmental regulatory program that limits (caps) the total emissions of a certain pollutant by issuing tradable allowances and requiring that allowances be surrendered to cover actual emissions. The limit on the number of tradable allowances issued ensures that emissions will not exceed the desired amount.

**Carbon Dioxide Equivalent (**$CO_2E$**):** A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential. Carbon dioxide equivalents are commonly expressed as "million metric tons of carbon dioxide equivalents ($MMTCO_2E$)".

**Carbon Intensity:** Intensity of an energy supply, defined as the amount of carbon emitted per unit of energy.

**California Climate Action Registry (CCAR):** A private non-profit organization originally formed by the State of California. The California Registry serves as a voluntary greenhouse gas (GHG) registry to protect and promote early actions to reduce GHG emissions by organizations.

**Cost-Effectiveness:** The cost per unit of reduced emissions of greenhouse gases adjusted for its global warming potential. (HSC §38505(d))

**Criteria Pollutants:** U.S. EPA has identified six "criteria pollutants," ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead as indicators of air quality, and for each is an established maximum concentration above which adverse effects on human health may occur.

**Discrete Early Action:** Greenhouse gas reduction measures enforceable by January 1, 2010. (HSC §38560.5)

**Early Action:** Greenhouse gas reduction measures to be initiated by ARB in the 2007-2012 timeframe. These measures may be regulatory or non-regulatory.

**Environmental Dynamic Revenue Assessment Model (E-DRAM):** A dynamic general equilibrium forecasting model that simulates the way that changes in energy investment, price and use affect how Californians live their lives.

**Energy 2020:** An economy-wide energy use model that predicts the investment behavior of both energy suppliers and consumers.

**Economic and Technology Advancement Advisory Committee (ETAAC):** A committee which advises ARB on activities that will facilitate investment in and implementation of technological research and development opportunities including, but not limited to, identifying new technologies, research, demonstration projects, funding opportunities, developing state, national, and international partnerships and technology transfer opportunities, and identifying and assessing research and advanced technology investment and incentive opportunities that will assist in the reduction of greenhouse gas emissions. (HSC §38591(d))

**Environmental Justice Advisory Committee (EJAC):** A committee created by AB 32 whose mission is to advise ARB in developing the Scoping Plan and any other pertinent matter in implementing AB 32. (HSC §38591(a))

**Global Warming Potential (GWP):** The index used to translate the level of emissions of various gases into a common measure in order to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations. GWPs are calculated as the ratio of the radiative forcing that would result from the emissions of one kilogram of a greenhouse gas to that from emission of one kilogram of carbon dioxide over a period of time (usually 100 years).

**Greenhouse Gas (GHG):** Any gas that absorbs infra-red radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), halogenated fluorocarbons (HCFCs), ozone ($O_3$), perfluorocarbons (PFCs), sulfur hexafluoride ($SF_6$) and hydrofluorocarbons (HFCs). (HSC §38505(g))

**Intergovernmental Panel on Climate Change (IPCC):** Established jointly by the United Nations Environment Programme and the World Meteorological Organization in 1988 for the purpose of assessing information in the scientific and technical literature related to all significant components of the issue of climate change.

**Investor Owned Utilities (IOUs):** A private company that provides a utility, such as water, natural gas or electricity, to a specific service area.

**Kyoto Gases:** Carbon dioxide ($CO_2$), nitrous oxide ($N_2O$), methane (CH4), sulfur hexafluoride (SF6), hydrofluorocarbons, and perfluorocarbons.

**Leakage:** A reduction in emissions of greenhouse gases within California that is offset by an increase in emissions of greenhouse gases outside the state. (HSC §38505(j))

**Montreal Gases:** Ozone depleting substances covered by the Montreal Protocol, including chlorofluorocarbons, hydrochlorofluorocarbons, carbon tetrachloride, methyl chloroform, and brominated gases.

**Offsets:** Verifiable emission reductions whose ownership can be transferred to others.

**Ozone Depleting Substance (ODS):** A compound that contributes to stratospheric ozone depletion. These substances include chlorofluorocarbons, hydrochlorofluorocarbons, halons, methyl bromide, carbon tetrachloride, and methyl chloroform.

**Public Owned Utilities (POUs):** Non-profit utility providers owned by a community and operated by municipalities, counties, states, public power districts, or other public organizations.

**Reforestation:** Planting of forests on lands that have previously contained forests but that have been converted to some other use.

**Sequestration:** The process of increasing the carbon content of a carbon reservoir other than the atmosphere. Biological approaches to sequestration include direct removal of carbon dioxide from the atmosphere through land-use change, afforestation, reforestation, and practices that enhance soil carbon in agriculture. Physical approaches include separation and disposal of carbon dioxide from flue gases or from processing fossil fuels to produce hydrogen- and carbon dioxide-rich fractions and long-term storage in underground in depleted oil and gas reservoirs, coal seams, and saline aquifers.

**Set-Aside:** An allowance set-aside is a pool of allowances which are distributed using criteria alternative to the primary method of allocation. Allowance set-asides direct a certain portion of allowances from within the cap to recognize actions previously taken or further incentivize future actions which benefit the policy goal

**Voluntary Measures:** Measures to reduce GHG emissions that are adopted in the absence of government mandates.

**Western Electricity Coordinating Council (WECC):** A regional forum for promoting regional electric service reliability in Western Canada and the Western United States.

# Appendix C: Sector Overviews and Emission Reduction Strategies

# INTRODUCTION

This appendix describes each of the economic sectors and individual measures outlined in the Scoping Plan. The measure descriptions include estimated emission reductions and the associated estimated net cost of the measure, the lead agencies associated with each measure, and the timeframe for adoption and implementation of the measure. Please note that there are additional greenhouse gas emission reduction strategies included in this Appendix, that are not listed in, or counted upon, in the Scoping Plan. These additional strategies could provide additional GHG emission reductions to fill potential shortfalls in emission reductions as discussed in the *Tracking and Measuring Progress* section of the Scoping Plan.

The measures identified in this Appendix were developed by ARB with input from state agencies, sector specific Climate Action Teams subgroups (Sub-CATs) and the public. Many of these measures are in developmental stages and the estimated costs, emission reductions, applicable technologies, and other factors will likely change as they move through the regulatory process.

# Appendix C Table of Contents

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# 1. CAP AND TRADE

**This section includes the following measures:**

**Recommended Actions**
**California Cap-and-Trade Program Linked to Western Climate Initiative**

## Background

A cap-and-trade program can help meet the requirements of AB 32 by providing cost-effective GHG reductions. The cap establishes a limit on emissions that declines over time. The ability to trade gives regulated sources greater incentive to pursue low-cost emission reduction strategies at their facilities than a source by source program would. Like all regulatory programs, an effective cap-and-trade system must be well designed, and include strong monitoring, reporting and enforcement rules, including strict penalties for non-compliance. In addition, AB 32 includes specific criteria that ARB must consider before adopting regulations for market-based measures, and directs the Board to the extent feasible to design any market-based compliance mechanisms to prevent any increase in the emissions of toxic air contaminants or criteria air pollutants. (HSC §38570(b))

A well-designed cap-and-trade system provides certainty that the program will meet the emissions limit while creating a price for GHG emissions that reflects the cost of the reductions needed to meet the environmental goal. This price signal affects decisions by both producers and consumers about the energy and services that they provide or use. Facilities have a continuous incentive to reduce emissions in order to reduce their compliance costs. The market creates an opportunity for facilities that can reduce emissions at lower cost to do so. One example of a cap-and-trade program is the U.S. EPA's acid rain trading program, a national program to decrease acid rain by reducing emissions of sulfur dioxide ($SO_2$) and nitrogen oxides ($NO_x$) from power plants. The acid rain program has successfully achieved the environmental goal of the cap at a cost of several billion dollars less than originally expected.[1]

California is working closely with other States and Provinces in the Western Climate Initiative (WCI) to design a cap-and-trade program that can deliver significant GHG reductions throughout the region from each of the Partner jurisdictions. ARB will develop a cap-and-trade program for California that links with the programs in the other WCI Partner jurisdictions. Other WCI Partner jurisdictions will do the same, creating a western regional emissions reduction program.[2] ARB will continue to work with the WCI Partner jurisdictions to ensure that the resulting program design is one that provides real emission reductions and enables the California program to meet all the requirements

[1] "The Acid Rain Program and Environmental Justice: Staff Analysis" (September 2005) U.S. Environmental Protection Agency, Office of Air and Radiation, Clean Air Markets Program.
[2] The WCI Partner jurisdictions released the program design document on September 23, 2008. The WCI program design is summarized in this Appendix; the program design and supporting documents are reproduced in Appendix D.

of AB 32, including the need to consider any potential localized impacts, ensures market security (avoid gaming), and is enforceable .

### Fundamentals of Cap-and-Trade

A cap-and-trade program establishes an enforceable limit (or cap) on the aggregate total emissions for those entities covered by the program. The cap is set for each compliance period of the program by the State, and emission reductions increase as the cap declines over time.

A key component of a cap and trade program is a permit, typically called an allowance. Each allowance represents a temporary permit to emit one unit of GHG emissions. In California, this unit would be one metric ton of carbon dioxide equivalent ($MTCO_2E$). Allowances are issued in the program in an amount equal to the total emissions limit for a compliance period. At the end of each compliance period, all entities in a cap-and-trade program must surrender allowances equal to their total emissions during the compliance period.

The limited number of allowances issued creates a binding cap on emissions, while issuing fewer allowances over time ensures declining emissions. The ability of allowances to be bought and sold creates an allowance price that reflects the marginal cost of reducing emissions. Unneeded allowances held by one entity can be sold to another source or banked for future use.

Cap-and-trade program rules will define specific compliance periods, at the end of which facilities would be required to surrender allowances equal to what they emitted. Failure of a facility to surrender sufficient allowances to cover their emissions would result in significant penalties. To maintain the environmental integrity of the system, non-compliance penalties must include purchasing and surrendering allowances at least equal to the facility's excess emissions.

New facilities that begin operation in sectors included in a cap-and-trade program would need to obtain allowances through an auction, from a reserve, or from other allowance holders. This process provides a mechanism for new facilities to operate while guaranteeing that there is no increase in overall greenhouse gas emissions when new facilities are built.

A cap-and-trade system could also allow facilities to retain or "bank" allowances for future use. Allowance banking provides an incentive for capped sources to reduce emissions below their allowance holdings in early periods with the knowledge that they can use or sell the extra allowances in the future. Where allowed, banking has been used extensively, resulting in greater early emissions reductions than would otherwise have taken place. Having allowances in the bank creates a hedge against any number of unexpected developments that could lead to higher-than-expected market prices.

### Cap-and-trade program and regulatory measures

Because it sets a firm limit on the quantity of greenhouse gases emitted, a well-designed cap-and-trade program complements other measures that may be adopted for capped sectors. The proposed cap-and-trade program would include up to 85 percent of the State's emission sources by 2020, covering the electricity, transportation fuels, natural gas, and industrial sectors. Overall, the cap represents a 147 $MMTCO_2E$ reduction from projected business-as-usual (BAU) emissions from the sources covered under the cap.

Emissions or energy use from most of the capped sectors would be reduced in part by measures other than the cap-and-trade program, including increased energy efficiency programs, the Renewables Portfolio Standard, the light duty vehicle greenhouse gas emission standards, and the Low Carbon Fuel Standard. Because such measures for capped sectors reduce the need for those covered by the cap-and-trade program to purchase and surrender allowances, these other measures benefit affected entities under the cap. In addition, the cap-and-trade program provides an enforceable limit on emissions that ensures that the reductions needed from the covered sectors occur. The emission reductions needed to meet the cap beyond those required by other measures would come from sources in the program that are able to reduce emissions in the most cost-effective manner.[3]

### Western Climate Initiative

California is working within the Western Climate Initiative (WCI) to design a western regional market system. WCI is a collaboration of states and Canadian provinces established to develop regional strategies to reduce GHG emissions. Launched in February 2007, the WCI currently consists of the states of California, Arizona, Montana, New Mexico, Oregon, Utah, and Washington, and the Canadian provinces of British Columbia, Manitoba, Ontario, and Quebec. In addition to these Partner jurisdictions, six U.S. states, one Canadian province, and six Mexican states are participating in WCI as observers. The WCI Partner jurisdictions have set an overall regional goal for reducing GHG emissions, and are working together to develop a framework for the regional program. By participating in a western regional system, California maximizes its potential to achieve greenhouse reductions in the most cost-effective manner possible, helps create a system that will generate greater reductions than can be achieved by California action alone, and creates a level playing field for California businesses within the WCI region.

A cap-and-trade program is one element of the effort by the WCI Partner jurisdictions to identify, evaluate, and implement ways to reduce GHG emissions and achieve related co-benefits. The WCI Partner jurisdictions released recommendations for a regional cap-and-trade program in September 2008. Those recommendations and background documents providing additional information on the design are presented in Appendix D. These recommendations were developed collaboratively by the WCI Partner jurisdictions, including California, with a goal of achieving regional GHG reduction targets equitably and effectively. The WCI's recommendations are largely consistent

[3] For a further discussion of this issue, see Box 2-2, page 13 of the California Market Advisory report at: http://www.climatechange.ca.gov/market_advisory_committee/index.html

with the recommendations provided in June 2007 by the California Market Advisory Committee (MAC),[4] with the recommendations provided to ARB by the California Public Utilities Commission and the California Energy Commission in March 2008,[5] and the proposed decision issued by the two Commissions in September 2008.[6]

In addition to the work on developing a regional cap-and-trade program, the WCI Partner jurisdictions have committed to promoting increased energy efficiency, vehicle performance standards, promoting the development and use of clean and renewable energy resources, and advocating national and regional climate policies that reflect the needs and interests of western states, tribes and provinces. The Partner jurisdictions recognize that emission reduction limits ultimately established under the cap-and-trade program will need to be augmented with other strategies to reach the individual partner goals and the regional goal. Therefore, all the WCI Partner jurisdictions will continue to examine a wide range of complementary policies, including regulations, laws, and other measures at the state and provincial level as part of the analyses for a cap-and-trade approach.

While ARB is looking to participate in a regionally coordinated cap-and-trade program as developed through the WCI, the California program will need to meet the requirements of AB 32. The program would be integrated with the overall implementation of the range of regulatory measures and policies that the Board includes in the Adopted Scoping Plan. Participating in a cap-and-trade program will not excuse facilities from obligations imposed on them by other measures adopted under AB 32. Rather, reductions achieved through those other measures will result in reduced emissions and the need for fewer allowances to comply with the cap-and-trade program. With appropriate environmental safeguards in place, a regional cap-and-trade approach will result in statewide co-benefits of improved air quality and lower health-based risk from air toxics.

ARB would develop regulations to implement the cap-and-trade system by the end of 2010, based on the authority and requirements of AB 32, with the program beginning in 2012. This rule development schedule would be coordinated with that of the WCI timeline for a regional cap-and-trade program.

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[4] The Report, "Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California," was released in June 2007 and can be found online at: http://climatechange.ca.gov/market_advisory_committee/index.html. The Market Advisory Committee (MAC) consisted of a consortium of economists, policy makers, academics, government sector public servants, and environmental advocates who came together through the auspices of Cal/EPA, pursuant to Executive Order S-20-06 from Governor Arnold Schwarzenegger.

[5] Joint Agency Decision of the CEC and the CPUC, *Final Adopted Interim Decision on Basic Greenhouse Gas Regulatory Framework for Electricity and Natural Gas Sectors*, March 13, 2008, CEC publication number CEC-100-2008-002-F..

[6] Joint Agency proposed final opinion of the CEC and the CPUC, *Proposed Final Opinion on Greenhouse Gas Regulatory Strategies*, published September 12, 2008 and to be considered for adoption on October 16, 2008 by the CEC and the CPUC. The document is CEC publication # CEC-100-2008-007-D, available through links at: http://www.energy.ca.gov/ghg_emissions/index.html and is also known as CPUC Proposed Decision of September 12, 2008, CPUC Proceeding R06-04-009 posted at http://docs.cpuc.ca.gov/EFILE/PD/89317.htm.

### Draft program design summary

**Scope:** The scope of a cap-and-trade program defines the emission sources and types of gases included within the program. Compared to direct regulations alone, a broad-based cap-and-trade program is likely to yield additional opportunities for lower cost reductions, thereby reducing the cost of achieving the overall emission target. However, other considerations must also be weighed in determining program scope. These include the ability to monitor, report, and verify emissions to a high degree of accuracy; the incorporation of adequate environmental safeguards to prevent harm in communities that already experience disproportionate impacts that affect their health and air quality; the potential for economic impacts on industry or consumers; and the effectiveness of the cap in providing incentives for emission reductions in different sectors.

The proposed cap-and-trade measure phases in the following sectors:

Starting in the first compliance period (2012):

- In-state electrical generating facilities that emit over 25,000 metric tons $CO_2E$ per year,[7] including imports not covered by a WCI Partner jurisdiction
- Large industrial facilities above 25,000 metric tons $CO_2E$ per year, including high global warming potential gases[8]

Starting in the second compliance period (2015):

- Upstream treatment of industrial fuel combustion at facilities with emissions at or below 25,000 metric tons $CO_2E$ per year, and all commercial and residential fuel combustion regulated where the fuel enters into commerce[9]
- Upstream treatment of transportation fuels regulated where the fuel enters into commerce

As required under AB 32, California will account for and regulate emissions from all electricity produced and consumed in the state, including electricity from both in-state generation and out-of-state generation. This requirement could be met through a regionally coordinated cap-and-trade program with a generator-based approach if all jurisdictions in the Western Electric Coordinating Council (WECC) were participating.

If some WECC jurisdictions do not link with the WCI cap-and-trade program, a first jurisdictional deliverer approach that covers all emissions generated in WCI and all emissions attributable to electricity delivered in WCI but generated outside WCI, or some

[7] Allowances will not be required for emissions from combustion of carbon-neutral projects.
[8] The Scoping Plan is also proposing an emissions fee on high GWP gases. This proposed measure would be assessed upstream on the sale of these gases or products containing these gases in California. If during rule development, ARB determines that assessment of this fee and inclusion of industrial process emissions of high GWP gases are duplicative, it will determine which approach would lead to the most cost-effective reductions.
[9] For a description of 'upstream' versus 'downstream' coverage, see Chapter 4 of the Market Advisory Committee Report.

similar method, will be needed to address emissions from electricity imported into California from non-participating jurisdictions. This approach is generally consistent with the recommendations from the MAC and the approach recommended to ARB by the California Public Utilities Commission and the California Energy Commission based on their joint proceeding for implementing AB 32 in the electricity sector.

For energy intensive industrial sources, such as cement manufacturing, stringent reduction requirements in California, either through inclusion in a cap-and-trade program or through direct regulation, have the potential to drive manufacturing activity out of California unless those locations have similar requirements (e.g. WCI). This type of 'leakage' can result in reduced employment and economic activity in California without reducing overall greenhouse gas emissions. Several policy options offer the potential to minimize this leakage by including consideration of emissions outside of California associated with the production of products eventually sold into the California market. [10] ARB is evaluating these policy options including life cycle intensity standards and allowance allocation/submission strategies that account for out of state emissions, and will coordinate with the other WCI Partner jurisdictions on these issues.

**Setting the Cap for California:** The Scoping Plan must be designed to meet the AB 32 goal of reducing statewide emissions to 1990 levels by 2020. To meet that target, the emissions allowed under a cap-and-trade program, plus expected emissions from sources not included under the program's cap, must be no greater than the 2020 emissions goal. This cap must also be realistic in terms of the emission reduction opportunities within the capped sectors.

As shown in Table 1, a preliminary estimate of the GHG emissions cap in 2020 for the sectors included in the cap-and-trade program is 365 $MMTCO_2E$. This covers about 85 percent of California total GHG emissions in 2020.[11] Capped sectors would include electricity, transportation fuels, natural gas, and large industrial sources. Emissions or energy use from most of the sectors covered by a cap-and-trade program would also be governed by other complementary measures, including performance standards, efficiency programs, and direct regulations.

[10] The cement sector is an example of a sector that may be susceptible to this type of leakage, and the Draft Scoping Plan included consideration of a measure to institute an intensity standard at concrete batch plants that would consider this type of life-cycle emissions. While this measure is not recommended in this Proposed Plan, ARB will evaluate whether this type of intensity standard could be incorporated into the cap-and-trade program or instituted as a complementary measure during the cap-and-trade rulemaking.
[11] The actual cap for the program will be established as part of the rulemaking process. The preliminary cap of 365 $MMTCO_2E$ assumes that all of California's electricity imports would be covered under a California cap. Because a significant portion of California's imported electricity is from power plants located in other WCI Partner Jurisdictions, emission from those sources could be included in the cap of the states within which the power plants are located. In establishing the California cap, ARB will need to consider the degree to which emissions from these sources are addressed as part of the WCI regional market.

**Appendix C: Cap and Trade**
**Table 1 Sector Responsibilities under Cap-and-Trade Program**
**($MMTCO_2E$ in 2020)**

| Sector | Projected 2020 Business-as-Usual Emissions | | Preliminary 2020 Emissions Limit under Cap-and-Trade Program |
|---|---|---|---|
| | By Sector | Total | |
| Transportation | 225 | 512 | 365 |
| Electricity | 139 | | |
| Commercial and Residential | 47 | | |
| Industry | 101 | | |

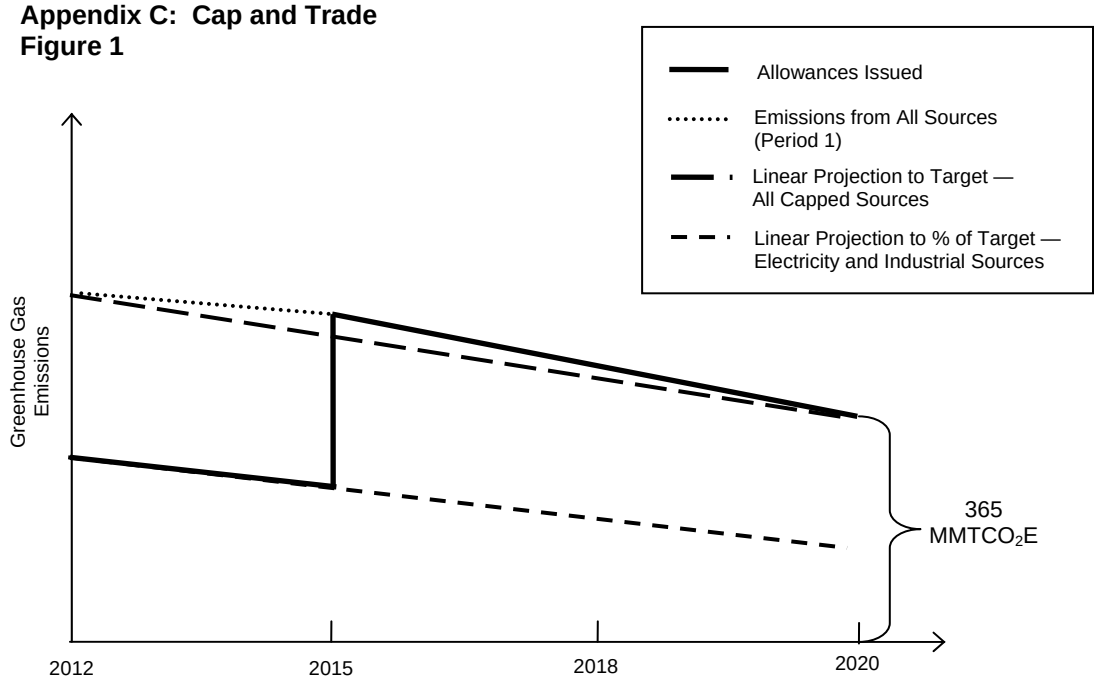
In developing the Preliminary Recommendation that was included in the Draft Scoping Plan, ARB, working with other Climate Action Team agencies, conducted a broad review of possible emission reduction strategies for all sectors of the California economy. This review resulted in identification of the broad range of measures included in the Draft Plan, both as recommended measures and as measures still under evaluation. Considered together, the full set of measures provided possible reductions between 120 to more than 150 $MMTCO_2E$ from BAU projections for the capped sectors. The preliminary emissions limit of 365 $MMTCO_2E$ in 2020 that was included in the Draft Plan would require emission reductions of 147 $MMTCO_2E$, which was a realistic level given the range of measures that were recommended or being evaluated.

ARB has determined that some of the measures for these sectors that were still under evaluation in the Draft Scoping Plan are not appropriate to pursue as regulations. However, for many of them, the types of reductions that were being evaluated are likely to be undertaken by facilities covered by the cap-and-trade program in the locations where they are most cost effective. ARB believes, based on the review of emission reduction opportunities conducted for the Scoping Plan, that significant reduction opportunities exist in the industrial sector that are more readily achieved through market mechanisms than through direct measures.

For these reasons, ARB believes that the preliminary limit of 365 $MMTCO_2E$ recommended in the Draft Scoping Plan remains a reasonable and appropriate cap.

The 2012 cap and the trajectory of the cap between 2012 and 2020 could greatly impact the success of the cap-and-trade program. The WCI Partner jurisdictions have proposed a trajectory similar to that shown in Figure 1. The 2012 cap will be set at a level that can be meet with the technologies and regulations in place in 2012 and the trajectory will be established as a straight-line reduction in the cap between 2012 and 2020, with an adjustment in 2015 to account for the sectors added to the program at the start of the second compliance period.

**Appendix C: Cap and Trade**
**Figure 1**




As California links to the WCI Partner jurisdictions' programs to create a regional trading market, California's cap and apportionment will be consistent with the AB32 economy-wide emissions goal. The ultimate success of WCI will depend on the ability and willingness of all partners to maintain their commitment to meeting their economy-wide GHG emission reduction goals. A firm regional cap with strong reporting and enforcement rules will provide a high degree of certainty that emissions will not exceed targeted levels. ARB will ensure the system as a whole has integrity before California participates in the WCI market system.

**Reporting:** ARB's mandatory GHG reporting regulations provide a solid foundation for establishing a cap-and-trade system. As a cap-and-trade program is developed, these reporting requirements will be tailored to that program design.

Because sources in the program would be required to submit allowances equivalent to the reported level of their GHG emissions, accurate measurement and reporting of all emissions covered by the cap would be required to assure accountability, establish the integrity of allowances, and sustain confidence in the program. Additionally, all market participants need accurate reporting to make decisions on whether or not to buy, sell, or bank allowances. Penalties for non-compliance need to be both certain and stringent enough to ensure that all capped sources have a clear incentive to comply. The WCI program design would require facilities to obtain and surrender three allowances for

every metric ton of CO2e not covered by an allowance at the deadline, and allows Partner jurisdictions to include other penalties.

**Allocation:** Allocation is the process by which emissions allowances are periodically distributed under an emissions cap-and-trade system. Allowances can be distributed in a number of ways: through auctions, free distribution, or a combination. As was noted in the MAC report, the allowance allocation method will have a significant effect on how "the economic impact of a cap-and-trade system is distributed among regulated entities, consumers and other parties."[12]

ARB will establish the details for distribution of allowances within the general guidelines established in the WCI program design framework. WCI Partner jurisdictions have agreed to a minimum percentage of allowances auctioned increasing from 10 percent in the first three-year compliance period to 25 percent in 2020. The WCI is also proposing the use of an allowance reserve price for a certain percentage of allowances in the regional cap. Such a reserve will help to ensure that the cap is binding and that reductions that can be achieved for less than the reserve price are pursued. The allowance reserve also provides the opportunity for the regional cap-and-trade program to provide reductions that exceed the regional target.

Each WCI Partner jurisdiction, including California, is free to auction a greater portion of its allowance budget in any compliance period. The distribution of California's allowances and the percent auctioned would be determined during the cap-and-trade rulemaking process. The California Public Utilities Commission and the California Energy Commission have considered this question of free allocation or auction of allowances in their joint proceeding on implementation of AB 32 for the electricity and natural gas sectors. They have recently released a proposed decision that recommends to ARB a transition to 100 percent auction for the electricity sector by 2016.[13] The MAC also recommended a transition to full auction within the cap-and-trade program, noting that a system in which California ultimately auctions all of its emission allowances is consistent with fundamental objectives of cost-effectiveness, fairness and simplicity.[14] ARB agrees that a transition to a 100 percent auction is a worthwhile goal for distributing allowances. However a broad set of factors must be considered in evaluating the potential timing of a transition to a full auction including competiveness, potential for emissions leakage, the effect on regulated vs. unregulated industrial sectors, the overall impact on consumers, and the strategic use of auction revenues..

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[12] Market Advisory Committee, "Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California," June, 2007, [http://climatechange.ca.gov/market_advisory_committee/index.html], p. 55

[13] Joint Agency proposed final opinion of the CEC and the CPUC, *Proposed Final Opinion on Greenhouse Gas Regulatory Strategies*, published September 12, 2008 and to be considered for adoption on October 16, 2008 by the CEC and the CPUC. The document is CEC publication # CEC-100-2008-007-D, available through links at: http://www.energy.ca.gov/ghg_emissions/index.html and is also known as CPUC Proposed Decision of September 12, 2008, CPUC Proceeding R06-04-009 posted at http://docs.cpuc.ca.gov/EFILE/PD/89317.htm

[14] Page 55-60, MAC report.

For any allowances that are distributed for free, ARB, in concert with other WCI Partner jurisdictions, will decide who should receive allowances and on what basis. For example, free distribution can be based on performance standards (benchmarks), historical emissions (grandfathering), or some other relevant metric. The MAC recommended that the State initially retain flexibility to allocate some of the allowances free of charge as a means of managing competitiveness and economic transition issues, but that any initial free distribution be limited to those entities that are not able to pass through costs to consumers and should quickly transition to a full auction with strategic use of the proceeds. In addition, the MAC recommended that any free allocation of allowances be based on environmental performance benchmarks, and that the auction process be designed to encourage voluntary early reductions by firms, municipalities, and individual consumers.

With an auction, the primary decisions relate to design of the auction process and what to do with the auction proceeds. ARB will work with the WCI Partner jurisdictions to develop a coordinated regional auction process that will allow California and the other WCI Partner jurisdictions to auction allowances throughout the WCI region and receive their proceeds from the auction.

The State may want to incentivize certain actions and activities through the allocation process. This can be accomplished through allowance set-asides. An allowance set-aside is a pool of allowances which are distributed using criteria alternative to the primary method of allocation. Allowance set-asides direct a certain portion of allowances from within the cap to recognize actions previously taken or further incentivize future actions which benefit the policy goal. Allowance set-asides could be used with any method of allocation and can provide a permanent or temporary means for incentivizing certain actions. It is important to note that there will be a fixed number of allowances for California and those allowances will have a direct financial value in the program.

Given that allowance allocation and revenue use decisions have the potential to greatly affect the equity of a cap-and-trade system, addressing both these issues will be a major part of the rulemaking process. ARB will seek input from a broad range of experts in an open public process regarding the options for allocation and revenue use under consideration by ARB and the WCI Partner jurisdictions.. This process will evaluate various mechanisms ARB is considering for allowance distribution and potential uses of allowance value, including the recommendations offered by CPUC and CEC. In order to incorporate the broadest cross-section of views, the ARB will provide for significant stakeholder involvement and interaction throughout the process. Input and perspective from representatives involved in the WCI partnership and federal climate policy efforts will be included. Issues to be considered will include the appropriate timing and structure of a transition to full auction of allowances, the potential need to harmonize allocation regionally by sector with our WCI Partner jurisdictions and intra-sector equity here in California. Among the principles that ARB will follow in developing its recommendations to the Board on these issues are the following:

- Minimize the economic burden of the program on consumers (especially low-income consumers), workers, local governments, and businesses

- Ensure fair treatment amongst and within included sectors—including new market entrants
- Minimize cost volatility for covered sectors
- Maximize market liquidity and minimize opportunities for market manipulation
- Avoid GHG leakage and overall employment loss
- Recognize and reward early action from covered sectors
- Avoid windfall profits and other unnecessary wealth transfer
- Encourage energy efficiency and the development of low GHG-emitting technologies
- Avoid criteria and toxic air pollutant emissions increases, especially in communities already disproportionately impacted by those pollutants

Further, the ARB should consider funding for adaptation to and further mitigation of climate change, and evaluate the role of offset levels and costs and the implications for allocation.

**Offsets:** Within the context of a cap and trade program, ARB would adopt regulations for verifying and enforcing any offsets used. Offsets can provide regulated entities a source of low-cost emission reductions, and can encourage the spread of clean, efficient technology within and outside California. The locations of offset projects are an important consideration.

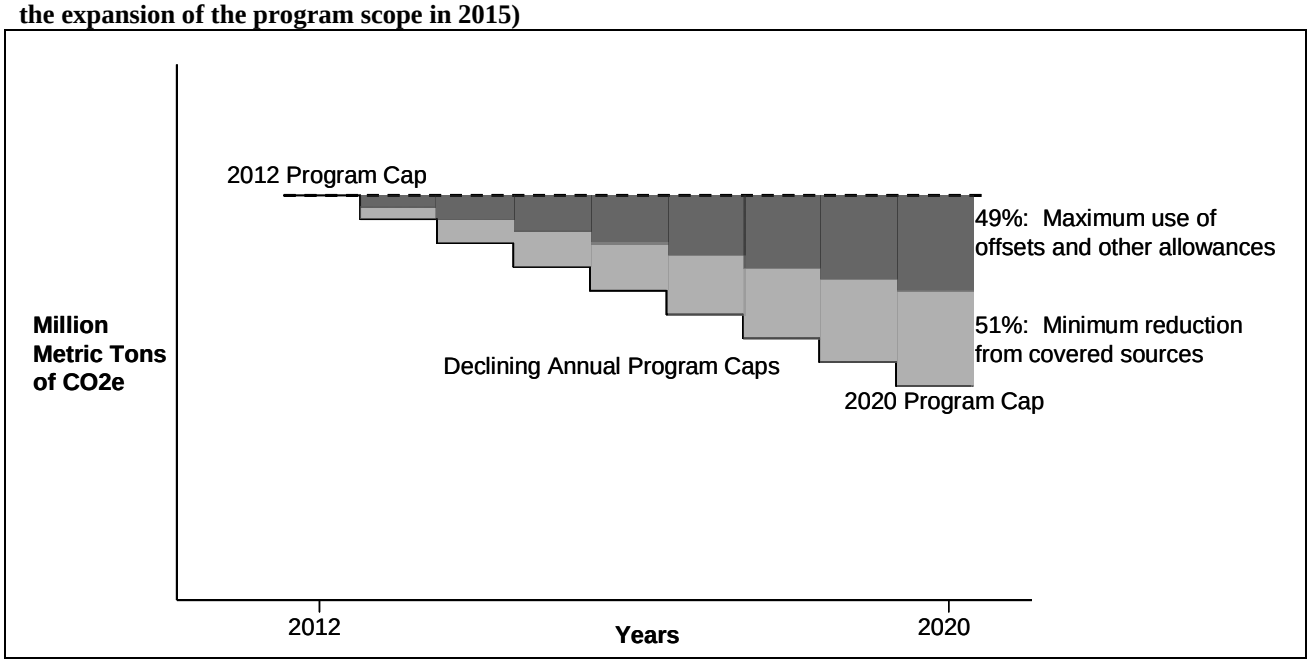
In developing this offsets program, California will work with the WCI Partner jurisdictions to ensure that the western regional market includes clear and consistent rules for use of offsets. For compliance purposes, the WCI Partner jurisdictions are considering allowing individual regulated entities to use a limited amount of tradable units (offsets and allowances) from other government-regulated GHG emission trading systems. To be used for compliance, the WCI Partner jurisdictions would need to formally recognize such units as meeting similarly rigorous criteria for environmental performance. Limits are also being considered on the amount of offsets and non-WCI tradable units that could be used for compliance by individual regulated entities.

High quality offset projects located outside California can help lower compliance costs in California while reducing GHG emissions in areas that would otherwise lack the resources needed to do so. Projects in the Mexican border region may be of particular interest, providing the opportunity to realize considerable co-benefits on both sides of the border. Additionally, defining project types related to imported commodities (such as cement) would enable California to provide incentives to reduce emissions associated with products that are imported into the state for our consumption.

ARB will establish a quantitative limit on offsets to ensure that a majority of the required emission reductions come from within the capped sectors. This type of quantitative limit would help achieve meaningful emission reductions from capped sources while leveraging opportunities for lower-cost reductions that offsets can provide. Because some goals of the AB 32 program, such as the development of clean, innovative and pioneering technologies, require reductions to occur within the California energy

economy, it is important that meaningful emission reductions are achieved from actions taken at capped facilities throughout the program. The WCI program design states that no more than 49 percent of each Partner jurisdiction's total emission reductions come from offsets or other trading systems (see Figure 2). This requirement ensures that a majority (at least 51 percent) of emissions reduction come from within capped sectors. Furthermore each Partner jurisdiction has the opportunity to establish a tighter limit within its jurisdiction. ARB will establish a limit of at most 49 percent and apply this limit to each of the compliance period and will work with our WCI Partner jurisdictions to do the same to ensure real reductions from capped sectors within the first compliance period.

**Figure 2: Illustration of the 49 Percent Offsets Limit (for simplicity, this illustration does not show the expansion of the program scope in 2015)**




Offset projects can potentially be located throughout the world. Concerns about the geographic scope of an offset program relate to how effectively projects can be evaluated, monitored, reported, and verified within the system by the program authority. The development of offset projects located within California's borders will help capture the public health, social and environmental co-benefits within the state that are associated with some offset projects.

While allowing offset projects from outside California to count for compliance under AB 32 could result in fewer reductions occurring within the state, and so reducing the local economic, environmental and public health co-benefits from GHG emission reductions, out-of-state projects can still have significant advantages. Beyond simply improving the economics of the cap-and-trade program, acceptance of out-of-state offsets demonstrate that Californians recognize the global nature of the climate crisis and demonstrate our commitment to developing a global solution. Rapidly escalating greenhouse gas emissions in developing countries can negate efforts undertaken in

California unilaterally. Because California is part of the global economy, our demand for manufactured goods create greenhouse gas emissions outside the boundaries of our State. California is committed to working at the international level to reduce greenhouse gas emissions globally and finding ways to support the adoption of low-carbon technologies and sustainable development in the developing world. Therefore, ARB would work in the rulemaking with our WCI Partner jurisdictions to establish an offsets program without geographic restrictions that includes sufficiently stringent criteria for creating offset credits to ensure the overall environmental integrity of the program.

One concept being evaluated for accepting offsets from the developing world is to limit them to those jurisdictions that pledge to achieve a greenhouse gas intensity target in certain carbon intensive sectors (e.g. cement). This could be achieved through a joint agreement with California to develop a minimum performance standard ("sectoral benchmarking"). Such agreements would encourage early action in developing countries toward binding commitments and could also reduce concerns about competiveness and risks associated with carbon leakage.

### Next steps on program design

If the Board adopts this proposal, ARB will initiate regulatory development for a cap-and-trade system, working in close coordination with the other WCI Partner jurisdictions. Starting in January 2009, ARB will initiate outreach to stakeholders to establish a formal structure for involvement. Invitations to participate in the process will be extended to the regulated community, environmental and community advocates and other public interest groups, prominent academics with expertise in cap-and-trade issues and new technology development, local air pollution control districts, regional players in the WCI, and other State agencies with existing authority for regulating capped sectors. This process will integrate practical economic and administrative design considerations within the program to address environmental and public health concerns within already adversely impacted communities.

In order to develop comprehensive regulations for the cap-and-trade program, ARB, in cooperation with the aforementioned stakeholder groups and climate policy partners, will address key issues through a series of stakeholder working group and technical group meetings. ARB will need to develop specific regulatory language to address a wide range of issues, including but not necessarily limited to the following:

- California's allowance budget in 2012
- California's allowance budget in 2015 with inclusion of transportation fuels and natural gas
- The trajectory of the allowance budget between the compliance periods
- The threshold for inclusion in the cap-and-trade program
- The length of the compliance period
- The design of the auction
- Limitations (if any) on banking of allowances
- Method of allowance distribution
- Use of auction revenue
- Rules for use of offsets

- Recognition for early action
- Recognition for voluntary action
- Rules for and potential limits on trading
- Methods for ensuring that criteria and toxic pollutants do not increase in communities already disproportionately impacted by them
- Reporting and verification of compliance
- Enforcement and penalties for non-compliance

Another important consideration of the stakeholder and technical working groups will be establishing a methodology for tracking program success. By identifying metrics for success at the start of the program, ARB will be able to collect and more quickly analyze critical data as the program progresses.

As each of these issues is addressed to the satisfaction of ARB and the working groups, ARB staff will begin to draft regulations for the specific elements of the California cap-and-trade program. All regulations for the program will need to be adopted by the Board by January 1, 2011 for an implementation date of January 1, 2012.

# 2. STATE GOVERNMENT

**This section includes the following subchapters:**

**Business Travel**
**State Fleet**
**Facilities**
**Energy Production/Procurement & Non- Facility Energy Use**
**Environmentally Preferable Purchasing**
**Employee Practices**
**State Government's Carbon Shadow**

The sector-specific CAT subgroups worked closely together to develop this section of the Plan. This input was evaluated and analyzed by ARB and is reflected in the write-up of this section.

## Overview

State government includes college campuses, veterans homes, medical, military, and law enforcement facilities, prisons, parks, water, energy and public works projects, and hundreds of office buildings, each having its own specific carbon footprint. With approximately 356,000 employees at more than 100 agencies, 290 million square feet of building space, 50,000 vehicles, and $6 billion in annual goods and services procurements, State government is a considerable source of GHG emissions and must do its share to reduce emissions.

State government must play a leadership role in reducing greenhouse gas emissions (GHG), not only as a regulatory entity that creates programs to reduce emissions from industry, commercial endeavors, and the general public, but also by reducing emissions from its own facilities and operations. This section focuses on State government facilities and operations and on the State Government's "Carbon Shadow". State government is committed to reduce its own GHG emissions by 30 percent in 2020 – a 15 percent reduction from current levels.

Many agencies have taken aggressive approaches to energy conservation and efficiency, however, a system-wide approach to reduce GHG emissions is still in the early stages. The priority system-wide approaches to State government's emission reductions should include:

- Focus on energy efficiency and resource conservation. Immediate and significant emission reductions can be easily attained through simple steps to conserve the energy we do use.

- Adopt a system-wide GHG reduction policy that encourages a reduction in both vehicle and air travel. Since travel is such a large source of emissions, a policy

will provide strong support for telecommuting, alternate work week schedules and tele- and video conferencing.

- Establish an inventory of GHG emissions from State government projects and operations. This is critical to establishing a baseline from which impact and progress can be measured. Register with the California Climate Action Registry or similar climate registry to facilitate the process.

- Conduct a review of laws, regulations, policies and procedures to evaluate their effect on the procurement of vehicles. Over the years, older mandates can become contradictory or redundant when newer directives are added. A review will identify where clarification is necessary.

- Require each board, department, office to coordinate and integrate GHG reductions in all areas of their operations in concert with program services delivery to ensure that all aspects minimize GHG emissions.

- Take advantage of current and future technologies to reduce GHG emissions. Through strategic automation and consolidation of cross-departmental processes and effective use of the Internet, staff can reduce paper and energy use while dramatically improving service to the public and regulated entities. E-government, appropriately designed, enables government to better meet its business needs by delivering timely and efficient services, greater transparency and better access.

- Reduce, reuse, recycle, and buy environmentally preferred goods and services. Solid waste management practices are a quick, easy, and effective area to focus efforts to reduce the amount of products and materials being used, to get the maximum use out of them, and to ensure recycling occurs at the end of their useful life. Purchasing products that have recycled-content, and are energy efficient, long lasting, and easily repaired, maximizes the economic and environmental benefits from the purchases that are made.

The remainder of this section will discuss current and potential future GHG emission reduction efforts within business travel, state fleet, facilities, energy production, procurement and non-facility use, environmentally preferable purchasing, employee practices, and the State government's "Carbon Shadow".

## A. BUSINESS TRAVEL

Transportation is one of the largest emission sources. Minimizing travel whenever possible and choosing the least emitting mode when transportation is necessary will yield GHG reductions. Reducing travel related emissions results in correlating reductions in fuel, maintenance, and vehicle replacement expenditures. This is an opportunity for

significant cost savings while having a minimal impact on the services the State government provides.

## GHG Reduction Efforts

With budgets tightening and costs rising, many agencies have already responded by limiting travel. Some travel is always necessary as many types of work, events, and presentations must be conducted in person. However, there are many opportunities to minimize travel by relying more on video conferencing, teleconferencing and similar meeting and information sharing technologies.

The Department of General Services' (DGS) current vehicle rental contract offers hybrid, low emission, and high efficiency vehicles. Advanced requests may be needed to ensure a vehicle is available when needed, but emphasizing the need for these vehicles, will increase their availability. Alternate fuel and bio-fuel vehicles, including ethanol (E-85), compressed natural gas (CNG), and electric hybrid vehicles are available through the State garage and should be used to the maximum extent possible. Because of the increased availability of flex-fuel vehicles, an ethanol pump has been installed at the State garage in downtown Sacramento and at the California Highway Patrol facility in West Sacramento. Also, ARB is working on a low carbon fuel standard (LCFS) that will reduce emissions from fuel use throughout State government and California.

Some agencies and campuses are making use of electric carts and bicycles for short local trips. Groundskeepers and maintenance staff also find carts and bikes are quick and easy ways to get around.

## Potential Future Efforts

State government should consider a statewide policy limiting air and vehicle travel and requiring an analysis of the least emitting travel options to the most travelled destinations. Agencies should encourage greater use of public and alternative transportation for State employee travel. Especially in areas of high density state offices, incentives and policies that promote the benefits of walking, riding bikes, and using electric carts for short, local trips should be established. These zero emission transportation options should be expanded upon to increase their availability and use.

DGS has a number of initiatives to encourage the State employees to travel "greener" and "smarter." A requirement for contractors to provide accurate and timely reporting data to DGS will enable the department to determine emissions of State travel activities. Improving travel services through airline, automobile rental and credit card vendors could also make travel more efficient. Following a common practice of most trucking and delivery services, GPS tracking of certain percentages of fleet vehicles would foster better understanding of travel routes and provide for coordinated trip planning and alternative fueling stations.

The State car rental contracts expire in 2008 providing an opportunity to increase the supply of alternative and hybrid vehicles in the contracts. Automobile rental vendors currently under contract with the State, nationally operate 73,000 flex-fuel cars and trucks

that can use E-85, along with 4,000 hybrid cars. The State's new contract should require car rental companies to provide alternative fuel and hybrid vehicles to State employees traveling on business. Earlier this year, one of the State's automobile rental vendors, launched a car-sharing program, enabling downtown dwellers, State employees who carpool, or those who use mass transit to rent hybrid cars by the hour for use during the day. DGS Fleet should pilot this program in larger cities in the state.

The State airline contract is also up for renewal this year, and language should be incorporated into the contract that requires airlines to calculate emissions on frequently traveled pairs of city destinations for State business. This data should be provided to DGS on a quarterly basis to enable more strategic travel planning. City destinations should be selected that require less auto travel to get to meeting locations, and alternative means of travel or the use of video and teleconferencing technology should be considered.

DGS will also host the State Green Lodging Program. As part of this program, DGS will instruct State agencies to book certified green and sustainable hotels/motels for their overnight stays. Also, DGS Fleet is planning to develop a Meeting & Conference Unit, which will provide State agencies with meeting planning services. The unit will recommend that agencies book their lodging in the same hotel they have scheduled meetings and conferences whenever possible to minimize travel to and from the location.

Agencies will be encouraged to use pre-arranged shuttle transportation from car rental companies and hotels to and from the airport. DGS Fleet also plans to centralize taxi cab service and will require contracted taxi companies to provide emissions data to DGS and to incorporate alternative fuel vehicles into their fleets. DGS will continue to encourage the use of local transit and alternative fuel van shuttle services.

## B. STATE FLEET

This sub-section consists of practical strategies on coordination, vehicle management, and operations that State government should implement to reduce the emissions of its own fleet. Many of the recommendations can be applied to fleets and vehicles outside of State government, such as cities, counties, and the private sector. It is also acknowledged that the measures taken to reduce GHG emissions must be coordinated with other existing state and federal laws and regulations. Because many of these recommendations are extensions or expansions of existing efforts, this section does not follow the format of the other sections.

The State fleet consists of approximately 50,000 vehicles and pieces of mobile equipment, operated by over 100 entities. About 40,000 of the State's vehicles are light-duty, passenger vehicles. The State fleet represents about 0.2 percent of the 33 million

vehicles registered with DMV and accounts for about 0.34 MMTCO2E per year of GHG emissions[15].

This section is focused on the executive branch, but State agencies should actively share information and practices with the UC, CSU, and Community College systems, local agencies that purchase vehicles through State contracts, and federal agencies. This sharing and coordination can be achieved through a statewide task force of agencies with fleets and/or with an interest in vehicle emissions.

Actions to reduce GHG emissions include the conversion of the California Highway Patrol (CHP) Fleet to Ethanol-85 vehicles and the installation of E-85 pumps at the CHP West Sacramento Fleet facility and at the DGS State garage in downtown Sacramento. These and many other efforts, as described below, have been implemented, but may have a long lead time before realizing substantial reductions.

### Coordination & Information Management Strategies

A single database that contains detailed information on each vehicle with fuel use and maintenance history will improve the management and emissions calculations of the fleet. At the end of 2008, DGS Fleet is due to complete the installation of an automated Fleet Asset Management System (FAMS) to capture this data from State agencies and fuel purchasing systems. State agencies should report their entire fleet into FAMS to insure the most accurate emissions calculations and other vehicle related metrics.

As FAMS improves the coordination and information management of fleet data, it will identify how agencies can operate "leaner and cleaner" fleets– practices that could be modeled and implemented statewide. FAMS can also be used to create best practices to be shared with all State agencies, local jurisdictions, and private sector fleets.

To increase the State government's cognizance of vehicle procurement and sales, DGS Fleet should work with the DOF and the DMV to consider becoming the title-holder for State vehicles. A reduction in the number of title-holding entities from about 100 to just a few could make fleet data far more accurate, which would enable the State to set and monitor proactive objectives to meet the goal of reducing State government emissions by 30 percent. This would require a major reorganization of DGS Fleet resources to provide efficient service to operating agencies and to insure a close working relationship with the DMV. The State Equipment Council exists to assist in the management of the state's mobile assets, so DGS Fleet should also work through the Council to determine whether or not to proceed with this recommendation.

### Vehicle Management Strategies

One of the fastest ways to reduce fleet emissions is to replace old vehicles with new, more efficient ones. Vehicles often stay in the fleet for ten years or more and, with age, become less efficient and require more maintenance. At some point, it is a better investment to procure replacement vehicles. Also, newer vehicles usually have more

[15] Calculations derived from ARB, Feb 28, 2008 AB32 Implementation Update: Transportation. Information by fuel is available at http://www.arb.ca.gov/cc/inventory/data/data.htm

advanced pollution control systems than older vehicles, reducing smog-forming co-pollutants. State agencies should identify the most polluting vehicles in the fleet and replace those vehicles as a priority. With FAMS information, DGS Fleet, DGS Procurement, and the Bureau of Automotive Repair should work with operating agencies to present cost-benefit analyses of vehicle replacement.[16] During this process, DGS Fleet should work through the State Equipment Council to identify inefficient vehicle assignments and work to consolidate those assignments to reduce the overall number of vehicles in the fleet.

### Fuel Use

About 43 percent of the fuel used by the State fleet is purchased at private sector gas stations. DGS Fleet is working with Caltrans and US Bank, manager of the Voyager Fleet Credit Card system, to identify the locations of these gas stations. With this information, ARB and CEC should direct alternative fuel infrastructure funds to locations with the highest amount of State use to make the fueling of the State's alternative fuel vehicles as easy and convenient as possible.

To analyze State government's use of transportation fuels, DGS Fleet should develop a comprehensive, annual report of fuel use and make it available to the public online.

### Alternative fuels, hybrids, and infrastructure

An immediate, concerted effort is needed to make alternative fuel available to State vehicles and the private sector. Considering the array of alternative fuel technologies available today, a portfolio for the State fleet, in the near term, should mostly consist of biofuels, hybrids, electric, and CNG. Additionally, ARB is developing a Low Carbon Fuel Standard that will reduce emissions by reducing the carbon intensity of fuel sold throughout California.

To comply with federal Energy Policy Act[17] (EPAct) and other laws, State agencies have adjusted their procurement policies to buy alternative fuel vehicles. The principal technology that California's fleet and many others have adopted is flex-fuel E85 (flexible-fuel from 100 percent gasoline to 85 percent ethanol/15 percent gasoline). Today, there are over 3,000 flex-fuel vehicles in the State fleet, and possibly 350,000 flex-fuel vehicles[18] on the road in California.

The use of biofuels is detailed in the State's Bio-Energy Action Plan, the Low Carbon Fuel Standard, and the CEC's Alternative Fuels Plan. But the implementation of these plans is limited by the lack of a robust infrastructure. Today, only four E85 pumps are available to the public, and there may be only a few more by the end of 2008. In contrast,

[16] The federal government keeps passenger vehicles for 3 years or 60,000 miles. See FMR 102-34.280 at http://tinyurl.com/3tum57

[17] The federal Energy Policy Act (EPAct 1992, 2005) requires certain fleets to purchase alternative fuel vehicles for 75 percent of their light-duty vehicles acquired in each model year (Sept 1 - Aug 31).

[18] According to the California Ethanol Vehicle Coalition, there are an estimated 350,000 flex-fuel vehicles in California. http://www.calevc.org/docs/CEVC1007Support.pdf

there are thousands of retail gasoline service stations in California.[19] As a result, the majority of the flex-fuel vehicles in the state currently operate on gasoline only.

Expanding the statewide infrastructure of commercial, alternative fuel stations could contribute to the reduction of emissions far more than any strategy that affects the State's fleet alone. A thorough review of existing regulations could lead to a streamlining of requirements while improving the needed safeguards. An immediate action must be to convene a taskforce of federal, state, and local regulatory agencies to design and implement a "one-stop-shop" for the permitting of alternative fuel manufacturing and distribution infrastructure. This program should be closely coordinated with funding from AB 1811 (2006, ARB), AB 118 (2007, CEC) and any federal programs.

For diesel vehicles, renewable diesel fuel is a viable option as most manufacturers warrant their engines for the use of renewable diesel fuel up to 20 percent (B20), although some are still limited to 5 percent (B5). A transition by Caltrans from 100 percent petroleum diesel to various percentages of renewable diesel fuel could result in a reduction of hundreds of thousands of gallons of petroleum diesel annually. Therefore, it is recommended that all State government bulk diesel contracts provide at least 5 percent (B5) renewable diesel fuel.[20]

Hybrid electric vehicles can make a significant reduction in petroleum use. Plug-in hybrid electrics promise to make an even greater contribution to the reduction in petroleum use, and therefore, emissions. DGS should work through the State Equipment Council to study the infrastructure needed to plug in the State government's dedicated-electric and plug-in hybrid vehicles where they are stored. State agencies should determine if their building electrical systems are sufficient for vehicle recharging. Based on the cost, which could be the cost of an extension cord in many cases, the State should consider funding the infrastructure as part of its strategy to reduce emissions.

Manufacturers no longer produce bi-fuel Compressed Natural Gas (CNG) vehicles, and only one manufacturer remains a bidder for annual State vehicle procurement contracts in the dedicated CNG passenger vehicle category. However, CNG, and its relative, propane, will probably continue to play important roles in centralized, municipal fleet operations, especially in non-attainment areas for criteria pollutants. Today there are only 193 natural gas fueling stations located in California.[21] Many of these stations have public access but do not recognize or accept the State's Voyager fuel card. While CNG remains in use by the State, DGS Fleet should work through the State Equipment Council to identify CNG and propane fueling stations and with US Bank to enable those stations to accept the Voyager card. This would make it easier for State employees to use the stations and increase the State's ability to track the use of these fuels.

[19] CEC, 2001-2002 data, http://www.energy.ca.gov/gasoline/gasoline_stations/index.html
[20] Renewable diesel includes low carbon biodiesel.
[21] DOE Alternative Fueling Station Locator: http://afdcmap2.nrel.gov/locator/FindNearResult.asp

### Operations & Maintenance

Other strategies that can immediately reduce fuel use and emissions include a strict adherence to proper tire inflation pressures, correct viscosity oil use, replacing engine air filters based on environmental operating conditions, and properly recharging air conditioning units. Cruise control, though sometimes viewed as a luxury, should be required in State passenger vehicles as it can also reduce fuel consumption.[22]

DGS should work with CEC, ARB, and vehicle manufacturers to develop ways to efficiently reduce vehicle cabin temperatures. Some suggestions include passive air circulation, reflective roof paint, and improved window glazing. Vehicle air conditioning can use a significant amount of energy, and in most passenger cars today, the air conditioner is automatically engaged when using the windshield defrost. DGS Procurement should work with DGS Fleet and operating agencies to add a requirement to vehicle procurement specifications to enable the driver to control the use of the air conditioner in any air handling mode, and to ensure that vehicles are compliant with the requirements contained in the Pavley legislation.

For the last ten years, DGS Fleet has coordinated the use of re-refined motor oil throughout the fleet, which has contributed to a reduction in petroleum use. This program should be studied by an appropriate regulatory agency to determine its success and share any best practices with other fleets and the private sector.

There are additional best practices for vehicle maintenance that should be implemented. For example, the federal General Services Administration (GSA) manages the maintenance and repair of approximately 300,000 vehicles through five call centers that approve and track maintenance costs. Once call centers collect repair data from commercial vendors previously authorized to perform specific services, GSA notifies its fuel card provider (Voyager) to initiate payment of the charges. This system allows GSA to control maintenance and repair costs, and to collect operational data. Payments to vendors are also expedited using the Voyager card as a payment tool rather than utilizing the government's regular invoice payment system. Usually, this type of information is not collected by State vehicle operating agencies, but it has the potential to significantly improve the management of the fleet and reduce energy use and environment impacts. Therefore, it is recommended that DGS Fleet implement a program similar to GSA's.

## C. FACILITIES

In large part, our primary objective in reducing GHG emissions is to reduce the amount of energy we use and to ensure the energy we do use is produced as cleanly as possible. In this Appendix, we have separated the discussion on energy use into two sections – Part C on facilities/building use and Part D on Non-facility energy use such as traffic signals and lighting for roadways, parks, tunnels, and bridges.

[22] ARB and CEC ongoing efforts on cool paints, tire inflation, cruise control, and air conditioning.

State government is taking aggressive action to "green" State buildings by implementing a wide variety of efforts to address climate change, reduce pollution and waste, and increase energy efficiency. According to DGS, the Executive Branch owns and operates 103 million square feet of building space – much of which is in the form of office buildings. A recent analysis of the 2004 California GHG inventory estimated that buildings represent approximately 25 percent of the total 480 $MMTCO_2E$ generated in 2004. For additional information on specific measures, see the Green Building section in part 7 of Appendix C.

## *GHG Reduction Efforts*

In the following discussion, you will see many references to Leadership in Energy and Environmental Design (LEED). It is important to note that commercial buildings as defined by standard building codes are eligible for certification under a number of categories including LEED for New Construction (NC) and LEED for Existing Buildings (EB). There are also multiple levels to the rating system, including certification, or achieving higher silver, gold, and platinum levels.

### Green Building Initiative

Executive Order (EO) S-20-04, known as the "Green Building Initiative" or GBI, requires State agencies to reduce the amount of electricity purchased from the grid that is used in State-owned buildings by 20 percent by 2015, and, in so doing, reduce greenhouse gas emissions associated with the production of fossil fuel-based power. It also requires all new and renovated State-owned facilities to be designed, constructed and operated as certified LEED Silver or higher buildings. The Governor's EO also urges all schools built with State funds to be resource and energy efficient.

### Baseline & Benchmarking: Measuring a Building's Energy Performance

The EO also calls for benchmarking the energy performance of all State-owned buildings. The California Energy Commission's Benchmarking Workgroup, California utility companies, and State agencies are working collaboratively to measure the energy efficiency of State-owned buildings by using the federal Energy Star Portfolio Manager benchmarking tool.

In addition to analyzing energy performance against a baseline, State agencies can use benchmarking to compare a building with properties of similar characteristics, such as geographic location, size, operations and age. The Benchmarking Workgroup will collect and summarize energy consumption data provided by State agencies and will report annually on the progress toward attaining the energy reduction goal including recommendations on any changes in rules or procedures to ensure the goal is met.

### New State Facilities

All new State government buildings and major renovations of 10,000 sq. ft. and over, subject to Title 24, are required to be designed, constructed and certified at a minimum of LEED-NC Silver or higher. Smaller buildings are being designed to meet LEED standards.

Some agencies, such as Caltrans, have adopted LEED standards for all in-house new construction and rehabilitation projects. In support of this effort, Caltrans project engineers and architects are working with DGS to become LEED certified. Caltrans is also near completion of a LEED policy directive that guides all internal facility projects.

### Leased State Facilities

DGS and other State agencies are seeking U.S. EPA Energy Star rating for facility leases of 5,000 square feet or more beginning in 2006 for new leases, and beginning in 2008 for renewal leases (including meeting an Energy Star rating for purchasing or operating electrical equipment such as computers, printers, copiers, refrigerators, and unit air).

The State leases almost nine million square feet of office, storage and other space. Under EO S-20-04, preference is given to the most energy efficient buildings. California is seeking leases with a U.S. EPA Energy Star energy efficiency score of no less than 75 (out of a possible 100 points) or higher. In addition, LEED certification is being sought for build-to-suit (where the project will be built as the buyer or lessee specifies) leased facilities. The Department of Motor Vehicles (DMV) office in Riverside is the first build-to-suit lease that has been certified with a LEED Silver rating.

### Existing State Facilities

The EO requires all existing State buildings larger than 50,000 square feet to meet LEED existing building requirements no later than 2015. A minimum of LEED – EB Certified is required to ensure energy-efficient, green building operations and maintenance, however, DGS has voluntarily increased this goal to LEED – EB Silver.

DGS has received approval from the U.S. Green Building Council, the architect of the LEED rating system, to participate in a pilot program for volume LEED-EB registration for the entire DGS-owned portfolio. This pilot program will be a major undertaking and yield major energy savings through product, system, and maintenance upgrades, while streamlining the LEED certification process.

The DMV has worked with the State's Investor Owned Utilities to identify energy conservation measures and accompanying incentives for its State-owned facilities. A DMV study indicates a potential for reduced annual electricity consumption by approximately 6 million kWh, about a 20 percent savings, which will equate to approximately a 2652 metric tons CO2E reduction of greenhouse gas emissions and a savings of over $750,000, each year. DMV is currently working with DGS to pursue a portfolio-wide approach to complete the identified measures.

### Energy Efficiency by Retro-commissioning/Retrofitting

Statewide, commercial buildings (state owned and privately owned) use approximately 36 percent of the State's electricity and account for a large percentage of GHG emissions. Since the State government spends approximately $500 million on electricity per year for all State-owned buildings including the UC and CSU system, the State is committed to aggressively reduce building electricity usage. Executive branch buildings 50,000 square

feet and larger are undergoing the retro-commissioning process to optimize existing energy systems and improve energy performance.

Retro-commissioning (RCx) or Existing Building Commissioning is a process that identifies operational problems and repairs them rather than relying on major equipment replacement. The process involves a diagnostic monitoring and functional testing of building systems with the implementation of measures to capture energy savings. Each building will be re-commissioned every five years after initial retro-commissioning to take advantage of new energy technologies.

Thus far, 25 State RCx projects are at or near completion. The RCx projects completed to date are projected to achieve an average estimated savings of 10.6 percent in electricity consumption and 15.8 percent in natural gas use.

### Energy Services Companies

Following EO S-20-04, DGS is establishing an energy services companies (ESCO) program to perform energy services performance contracts for State buildings. A performance contract is an agreement made between the State and an ESCO, in which an ESCO guarantees energy savings that are expected to result from the implementation of an energy project, such as installing new equipment, doors, and windows, or adding insulation. Performance contracts are an essential component of a comprehensive State energy efficiency program, as described in the Governor's Green Building Initiative. The State's primary energy efficiency investment goal is to capitalize on energy efficiency measure opportunities at each facility through equipment performance savings. Post implementation measurement and continuous monitoring of the energy systems will allow the project to automatically generate real-time mandated reports as required by EO S-20-04.

### Locating State Facilities

State government needs to site its facilities in a manner that is consistent with the State's planning priorities (Chapter 1016, Statutes of 2002) and the regional planning process outlined in the Scoping Plan. By locating its facilities in a way that promotes resource-efficient development and supports public transit, the state can enhance its partnership with local and regional governments in meeting the greenhouse gas reduction targets.

## *Future GHG Reduction Efforts*

### New Sacramento Central Heating and Cooling Plant in Sacramento

State and Consumer Services Agency and DGS are spearheading the greening efforts to build the new Central Plant according to LEED Gold certification. The new Central Plant will serve the heating and cooling needs of the State Capitol and 22 other State-owned buildings in downtown Sacramento's Capitol Area when it is completed towards the end of 2010.

The new plant will have increased energy efficiency and a greatly reduced need for water. The new facility will have cooling towers for extracting heat from the buildings,

eliminating the need to use well water or to discharge water into the Sacramento River. The plant will also feature a 4.25 million gallon, thermal energy storage tank. With the tank in place, DGS will be able to produce reserves of chilled water during off-peak energy demand times. The new plant will reduce water use by 90 percent compared to the existing plant. Solar panels will also be installed on the new facility to power the energy needs of the office space within the plant.

#### California Utilities Join Forces to Save Energy In State Buildings

In its effort to significantly increase the level of energy efficiency in state-owned buildings, DGS is collaborating with Southern California Edison, Pacific Gas and Electric Company, San Diego Gas & Electric and Southern California Gas Company, to provide nearly $17 million in incentives for the implementation of energy-saving programs in State facilities. SMUD and other publicly owned utilities have also been strong allies in the State's efforts to cut GHGs.

#### Energy Efficiency Building Tools

DGS has developed a standardized building management manual, "*Better Building Management for a Better Tomorrow,"* for use in all DGS-managed buildings. The manual establishes green policies and procedures to ensure energy and resource-efficient practices are implemented and maintained. The manual is available to other State agencies and the general public as an example of a policy manual that meets the criteria of several LEED-EB credits requiring management policies.

In addition, Lawrence Berkeley Lab's EnergyIQ building benchmarking tool can also be used to benchmark government buildings and help determine their efficiency and potential for GHG emission reductions.

# D. ENERGY PRODUCTION, PROCUREMENT, & NON-FACILITY USE

This section focuses on efforts to produce/purchase clean energy and to reduce non-facility energy use.

## *GHG Reduction Efforts*

#### Clean Energy Production and Procurement

State agencies are working with energy suppliers to increase the procurement of energy from renewable sources such as solar, hydro-electric, and natural gas. Increased deployment of renewable resources is essential for reducing greenhouse gas emissions and reaching AB 32 goals. Over the last three decades, California has built one of the largest and most diverse renewable generation portfolios in the world. Currently, about 11 percent of the State's electricity is from renewable energy sources including solar, wind, geothermal, and biomass.

The Green Building Initiative (Executive Order S-20-04) tasks State government to demonstrate leadership in energy efficiency and environmental responsibility in State buildings, while also reducing their impact on climate change. In response, a number of State agencies have invested in solar energy projects. For instance, photovoltaic (PV) powered remote telecommunications, cathodic protection of bridges (using a low level electrical charge to retard the chemical decay/rust), and emergency call boxes have been in place since the late 1980s. The Department of Agriculture (local fairs and CalExpo) has implemented PV systems that generate more than 8 MW of power, and DGS has a number of projects underway (for more detail see Part C. Facilities).

Through these and many other efforts, 4.2 megawatts of clean, on-site solar energy has been installed at State-owned facilities since 2006, and more are on the way. An additional 23 megawatts of on-site solar energy are planned for installation at State prisons, mental hospitals and CSU campuses beginning in 2008. Stationary fuel cell applications are also being evaluated for State facilities.

Another effort is the DGS purchases of natural gas for large State government "non-core" users - those with meters that use more than 250,000 therms per year. The bulk of the gas used by these agencies is provided through the DGS contract, however, there is still some gas provided by the gas utilities. Currently, 8 agencies and almost all eligible UC and CSU campuses use about 200 million therms of natural gas annually. Approximately 60 percent of this natural gas goes to boiler use and 40 percent for on-site electricity co-generation. As the rules that penalize “departing load” (customers who elect to generate their own power in an effort to escape higher contracted electricity supply rates are currently charged a fee by the utility) will end over the next few years, there are already increasing signs of interest in co-generation projects which offer opportunities for increased efficiencies and clean energy production.

### Efficient Energy Use and Conservation

The Governor's Executive Order (EO) S-20-04 requires State agencies to reduce grid-based energy purchases for state-owned buildings by 20 percent by 2015, through cost-effective efficiency measures and distributed generation technologies. In response, many State agencies have taken significant steps to achieve the needed reductions that can be transferred to other agencies. Many reductions achieved at State facilities are detailed in Part C. *Facilities* of this section.

The following is an example of energy conservation efforts undertaken by Caltrans:

- Traffic Signals - Statewide conversion of signals to energy efficient light emitting diode (LED) fixtures was completed in 2002. The next generation of higher efficiency LED signals are starting to replace units installed in the 1990’s.

- Roadway Lighting - “Points of Conflict” on State-owned roadways (Federal Interstate Highways, State Highways and roads) are lighted at intersections, on/off ramps, and points of merging and separation. Higher efficiency lighting, control, and location options are all under study to improve efficiencies and safety.

- Roadway Sign Lighting - Illumination of informational signage located over the roadway. Statewide deployment of high efficiency induction lighting systems are almost complete.

- Bridge and Tunnel - Lighting systems used on bridges and tunnels are being reviewed for energy use reductions.

- Bulk Green Energy Procurement - Savings as a direct result of buying bulk discount energy, leads to more clean energy purchasing and less coal generated electricity use.

If all conservation projects are found cost effective and fully implemented, 2004 data forecasts that Caltrans would:

- Reduce daytime and/or nighttime electrical grid loads.
- Save over 205 million kilowatt-hours in annual energy consumption.
- Payback project costs through savings in energy and maintenance costs.
- Save approximately $162 million in forecasted ten-year net present value (NPV) from implemented projects.

Caltrans is also engaged in efforts to improve inter-modal centers at ports, develop new pavement products like rubberized asphalt using old tires, reuse of old concrete on-site as base and sub-base fill rather than transporting it to a landfill, change wharf and pier piling treatments, manage storm water run-off, reduce herbicide use, increase use of native plantings to reduce water use, and fund field testing as part of a long term continuing quality improvement program.

## *Potential Future Efforts*

State government should focus efforts on low-cost, high return energy conservation efforts. The supply of renewable energy should be increased through both production and procurement, including increasing solar and other distributed renewable generation capacity. State government will continue to pursue technologies that reduce the load on water pumps and other large electric motors, and increase compact fluorescent lighting (CFL) and LED lighting in parks, tunnels, bridges, parking, and roadways. For instance, Caltrans has targeted numerous PV projects to be funded by the Internal Revenue Service Clean Renewable Energy Bonds (CREB) program.

Encouraging appropriate State agencies to facilitate state and local government infrastructure improvements may yield energy savings beyond buildings, i.e. pumping water, traffic signals, and outdoor lighting. Funding and financial incentives should be sought for these infrastructure improvements and to increase the supply of clean renewable energy.

# E. ENVIRONMENTALLY PREFERABLE PURCHASING

Environmentally preferable purchasing (EPP) focuses on using goods and services that have a reduced negative impact on human health and the environment compared to competing products. These products use fewer materials, water and energy, are produced locally, are reusable and/or recyclable, and require less end-of-life management. All of these attributes result in a reduced impact on the natural environment. With State government annually purchasing approximately $6 billion in goods and services, State buyers have a responsibility to promote EPP while providing quality products and excellent value, environmental benefits, and a solid market to suppliers.

## *GHG Reduction Efforts*

### State Law Requires EPP

California law (AB 498, Public Contract Code, sections 12400-12404) and Executive Orders (EO S-20-04, S-7-04, and S-3-04) requires DGS to promote and to increase EPP by coordinating with other agencies, creating training programs, and publishing an EPP Best Practices Manual. The State's new "Environmentally Preferable Purchasing Best Practices Manual" provides State purchasing officials with information on dozens of environmentally friendly products and services. It contains information outlining environmental guidelines for purchasing many common items. Additionally, the manual identifies ways to reduce waste in the office, shop, or facility; allows buyers to choose from numerous product categories; and identifies the impacts associated with the manufacture and purchase of numerous products and services.

### Recycled Content Product Contracts

The State Agency Buy Recycled Campaign (SB 1106, PCC 12200-12217) is a joint effort between the California Integrated Waste Management Board (CIWMB) and DGS to implement State law requiring State agencies and the Legislature to purchase products with postconsumer recycled content. The Procurement Division at DGS has established contracts that offer recycled content products to assist agencies in meeting the mandate of ensuring a minimum of 50 percent of the dollars spent on products within 11 categories is spent on recycled products. Recycled content products are defined as having various quantities of postconsumer content.

### Current Recycled Content and Green Contracts

- Open Office Panel Systems Contract: The new Open Office Panel Systems (modular cubicles) contract has raised the bar substantially by moving to a best value procurement contract that allows up to 40 percent of the scoring to be applied to environmentally preferable attributes. The contract requires the use of recycled content materials, energy efficient task lighting (additional points for LED task lighting), and reduced emissions of volatile organic compounds (VOCs). It also encourages manufacturers to eliminate certain hazardous substances from their products and to reduce solid waste through reusable and recyclable shipping and packaging materials.

- The California Lamp Contract: The California Lamp Contract is a mandatory low-mercury lamp contract for T-8, T-12, and compact fluorescent lamp purchases. The California Lamp Contract reduces mercury levels in fluorescent lamps to less than 5 milligrams per lamp and offers electronic ballasts to increase the efficiency of lighting fixtures. All three suppliers provide for the collection and responsible disposal of used lamps as part of their contracts.
- Recycled Latex Paint Contract: This contract provides paint in a wide variety of colors containing up to 50 percent postconsumer paint. Recycled latex paint reduces the solid waste stream by recovering extra paint that may otherwise require disposal as hazardous waste and it reduces the emission of VOCs.
- California Gold Sustainable Carpet Standard: The California Gold Sustainable Carpet Standard requires up to ten percent postconsumer material content in new carpet and the recycling of old carpet to divert the material from landfills. This comprehensive standard also reduces specified toxic compounds and VOCs. The California Gold Sustainable Carpet Standard will become the basis of a new national standard. LEED credits are available for the use of carpet meeting this standard.
- Personal Computer Goods Solicitation: The current DGS personal computer (PC) Goods solicitation requiring Electronic Product Environmental Assessment Tool (EPEAT) Silver or better for Desktops, Notebooks, Tablets and Monitors is scheduled to be awarded in June, 2008. The evaluation process awards additional points to products that are certified EPEAT Gold.
- Copy Paper Contract: The new paper contract requires all State agencies to purchase copy paper with a minimum of 30 percent postconsumer content. However, many agencies and departments use 50 – 100 percent postconsumer content copy paper, much of it produced without the use of chlorine compounds for bleaching. The Office of State Publishing uses postconsumer content paper and soy-based inks whenever possible. Janitorial paper products and paper bags with a minimum of thirty percent postconsumer content are also available.
- Vehicle Contract: California is revising the methodology for evaluating vehicle purchasing contract bids to comply with the mandates of AB 236, which requires DGS to consider GHG emissions and fuel efficiency in fleet purchases. Current specifications also restrict the use of chrome plating and lead wheel weights. Recycled motor oil and antifreeze are used to maintain state vehicles, and retreaded tires are used for trucks and heavy-duty vehicles.
- Disposable Food Service Supplies: California has mandated the elimination of polystyrene in all line items of this contract and will purchase bio-based alternatives.

## Potential Future Efforts

State government will continue its leadership role by undertaking a thorough analysis of goods and services it uses, and developing strategies to ensure a system-wide application of product evaluation methodologies that consider carbon intensity in purchase decisions. These policies and practices should also extend to the contractors that provide State agencies with goods, services or consultation.

DGS Procurement may propose modifications to the vehicle and equipment bidding process to increase the variety of vehicles available for departments' needs. This is consistent with the need to consider total value, not just lowest bid, in procurement. For example, the cost of replacing tires that require frequent changing due to lower quality may outweigh any savings gained by accepting the lowest bid. Fewer tires purchased generally means fewer emissions through the entire product lifecycle, particularly as State agencies increase their efforts to calculate end-to-end emissions of its procurement and operations.

A related effort includes revising existing contract language to address GHG emissions, including the need to identify the carbon intensity of products, and to reduce emissions from the delivery to end-of-life management. Work is needed to research GHG values for other products to develop metrics and specifications to be included in bid documents. Those values could then be used to conduct a review of State government purchasing to identify the high priority products and services for GHG emissions reduction potential and establish a priority list of contracts to revise.

Ensuring that purchasing documents, specifications, and contracting procedures do not contradict each other and do not deter or inhibit the purchase of environmentally preferable products is an effort that will yield definite results. Once completed, designing and implementing programs and processes to increase the purchase of environmentally preferable products will be a much simpler task. Efforts such as restricting the purchase of single-sided printers and copiers, and requiring all State government documents to be printed duplex will be much easier to enact with clear direction and authority.

The development of an automated procurement tracking tool to be used by all State agencies for all purchasing that tracks EPP, and specifically GHG emissions will facilitate tracking and reporting progress. The tool should also enable contractors to report on the carbon footprint of their products, operations and supply chain, including a third-party certification of the data provided. This effort will need to be targeted first to the largest suppliers and then phased in to others over time.

California participated in the drafting of the Midwest Governor's Association's Bio-based Product Procurement Initiative and is currently working with the USDA to establish a national data base of bio-based products. These products will then become available on statewide contracts. Future contracts for industrial cleaning supplies will require that all catalog items identified as "green" be certified to acceptable standards by an independent third party. State agencies will be blocked from buying any non-certified

items where a comparable certified option is available, and regular and accurate reporting will be required on environmentally preferable purchases.

Efforts are underway to develop carbon labels for consumer products that will allow consumers to compare products by their carbon footprint. Also, the coolcalifornia.org carbon calculator will soon have a built-in decision-support tool that will help users estimate the change in their GHG footprint if they take specific actions. These efforts will help provide the raw data needed by buyers to track and report the emissions their purchases are responsible for.

# F. EMPLOYEE PRACTICES

The initial carbon footprint audits conducted by a number of agencies have made it apparent that employees play a huge role in reducing GHG emissions. Choices regarding employee commutes, air and business travel, lodging, lighting use, and plug load all heavily impact energy use and the resulting GHG emissions. With employees having such an impact on these areas, all State agencies must involve employees in adopting policies to cut emissions and to conduct a consistent education and training effort.

## *GHG Reduction Efforts*

### GHG Emissions Audit

All the cabinet level State agencies, the CSU system and most UC campuses have joined the California Climate Action Registry (CCAR). By joining CCAR, they are obligated to prepare and submit annual GHG emissions inventories. CCAR registration establishes an emissions baseline and gives the agency a blueprint for future reduction efforts.

### Environmental Management System (EMS)

An EMS is an integrated set of management processes designed to continually identify, prioritize, and improve the environmental impacts of an organization. An EMS integrates environmental management throughout daily operations, budget and human resource planning, and strategic planning. Cal/EPA has been involved in an agency-wide EMS since 2001. The EMS effort focuses on building-related operations and on the business processes and employee and stakeholder practices that relate to business operations. EMS is an excellent process to both institutionalize GHG reduction efforts and harness the power and influence of staff to maximize impact and achievement.

### Agency-wide Policy Development

Many agencies have been actively involved in reducing energy use for years. With the recent push from AB 32, much effort and attention is again focused on the burning of fuel for various purposes causing GHG emissions. More information is available now about the development of baseline emissions from which reductions can be measured, as well as technological advancements and case studies. The quantity and quality of this information is increasing daily. Sharing the successes and case studies among all State

government is needed now so that all agencies can implement best practices to their fullest.

This flow of information within and among agencies can best be achieved by adopting policies. Policies are effective ways of communicating the same measure to a large number of people. They are especially effective in ensuring that efforts made by dedicated people are not lost over time as those employees move to other jobs or retire. Many agencies have policies already, while others like ARB's Carbon Neutral Policy are being drafted or considered.

### Information Technology (IT) Efforts

IT equipment is one of the fastest growing segments of energy use in office buildings. Many efforts are under way to reduce energy consumption from IT equipment. For example, DGS has installed centralized server-based power management software that yields energy savings of thirty to forty percent. DMV and Caltrans have or are considering implementation of this software.

DMV's Desktop Support Unit developed an in-house energy management solution, using existing software programs designed to aggressively adjust computers to a more energy efficient mode when not in use. Since the initial implementation on nearly 3,000 computers, the initiative has reduced average monthly electricity consumption by more than 86,000 kWh, reduced average monthly greenhouse gas emissions by more than 53.5 metric tons and saved California taxpayers an average of more than $11,000 per month.

Implementation of the department's total inventory of more than 5,000 computers is nearly complete and, when fully implemented, will reduce the department's annual electricity consumption by more than 1,700,000 kWh, reduce annual greenhouse gas emissions by more than 1100 metric tons and save California's taxpayers more than $230,000 per year.

Caltrans estimates there are about 18,000 computers distributed statewide, and along with servers, printers, plotters, modems, hubs, fax machines, and attached devices (like hard drives, scanners, CD-ROM burners, etc.), consume from 27 to 35 million kWh/yr. "Energy Star" systems reduce energy consumption when units are not used for set periods of time. This reduction in operation may save up to forty percent of normal operational cost, although turning off equipment when it is not needed is still the best form of energy conservation.

### Other Non – IT Energy Conservation Efforts

Simple conservation efforts such as turning off lights when not in use, including non-essential overhead lighting in day-lit areas, lighting in unoccupied rooms, equipment and storage areas reduces energy use. Turning off overhead lighting as appropriate and using task lighting if daylight is inadequate for workspaces, switching off decorative lighting, signage and other lighting inside and out (if not necessary for security and safety) are simple yet effective ways to reduce energy use. Security and safety lighting should be maintained at the lowest acceptable levels.

Techniques used to make efficient use of natural daylight include closing blinds and window coverings on all solar exposed windows during appropriate times of the day or when rooms are not in use to block direct sunlight which increases room temperature. When not in direct sunlight, open blinds and shades to reduce or eliminate the need for overhead lighting. After business hours, turn off monitors, printers, and other equipment except for essential equipment needed for after hours operation (e.g., e-mail, email servers, fax machines or other essential equipment). Some offices will need to leave personal computers on after hours for security reasons, however, they can be set to energy-saving modes.

Thermostats should not be set below 78 degrees F in summer unless such a temperature in a particular job or occupation may expose employees to a health and safety risk. It is also critical to keep windows and doors closed when HVAC systems are in use to prevent loss of conditioned indoor air to the outside and minimize use of portable electric devices (e.g., microwaves, toaster ovens, electric heaters, or personal fans). Employees should consider dressing in appropriate warm weather business attire.

## *Potential Future Efforts*

Some State agencies have adopted policies that impact emissions but encouraging more agencies to adopt specific GHG emission reduction policies would increase and coordinate efforts statewide. This may be an opportunity to revitalize existing energy conservation policies as well, or to address other issues in a combined environmental protection policy or EMS with strong executive support and training. The policy should ensure employee orientation and training stresses energy and GHG emission reduction practices. EMS and LEED training should be provided where appropriate.

These policies should all promote telework and flex schedules to reduce commute miles. With such a high percentage of emissions emanating from employee commuting and travel, it is imperative to increase participation in these emission reduction strategies. A centralized information clearing houses for alternative transportation options in major State employment centers should also be maintained.

Agency policies will also be an appropriate place to discourage driving on short trips. Particularly in the downtown area where agencies are clustered together and on college and university campuses, staff should be encouraged to walk, bicycle or make use of electric carts on short trips. Agencies should provide bicycles and carts for these purposes and conduct surveys on there usefulness on various lengths of travel.

There are myriad efforts that agencies can undertake to reduce emissions. One such area is updating office equipment so that there are fewer devices and increased efficiency, e.g., multi-purpose printer/copier/faxes instead of 1 device for each purpose. An overall reduction of print jobs through reminders on printers and copiers and messages sent via email about reducing paper use with save both electricity and paper. Ensuring all new printers/copiers purchased are duplex capable and are defaulted to duplex, while a common practice by some, is not yet a universal statewide practice.

High parking costs can be an incentive to carpool or to use public transportation. It is recommended that DGS examine parking costs at State garages and compare them to local private lots. If rates charged to drivers are significantly lower, then the rates should be increased to discourage individual driving and reduce emissions. Parking subsidies for State employees should also be factored into this review as they reduce parking costs for individuals at an expense to agency budgets.

Perhaps the single most important action any agency can take is to conduct a GHG emission audit. While many agencies have conducted audits or registered with CCAR already, a concerted effort must be made to continue to encourage additional agencies to follow suit. It is imperative to establish a baseline to begin identifying priority areas to cut emissions and maximize efficiencies.

## G. STATE GOVERNMENT'S CARBON SHADOW

The previous discussion has focused on specific actions that can reduce GHG emissions directly attributable to State government projects and operations (the traditional view of "carbon footprint"). The following discussion will briefly outline a strategy to leverage the capabilities of State government to influence GHG reductions by entities with which the state does business and which are affected by State policies and decisions. This has come to be referred to as State government's "carbon shadow".

A prime example of the influence the State can generate is as an investor. Through its two largest pension systems, the State has an investment portfolio in excess of $400 billion . These funds can be leveraged to support companies, programs, and projects that reduce GHG emissions. Public Employees Retirement System (PERS) and State Teachers Retirement System (STRS) should continue to examine their real estate portfolio for opportunities to increase energy savings, invest in energy efficient buildings, and/or devote a greater portion of the Clean Technology Investment Portfolio to advanced energy efficiency/green technologies.

Another GHG reduction opportunity for the State is in the use of bond funds. Ownership of the GHG emission reductions resulting from State bond funded projects will remain with the State. Those emission reductions should not be considered the property of the entity that received the bond funds, nor shall they be entitled to seek further financial gain from those reductions. Instead the GHG emissions reductions should belong to the State, and ultimately be used to promote the goals of AB 32.

The influence of State government's carbon shadow can also be exerted in the area of evaluating legislative bills, administrative directives, regulations, policies, projects, and programs, in terms of their impact on GHG emissions. State government must institutionalize the evaluation of GHG emissions as part of the review and approval process for all major funding requests and projects. This policy should be mirrored by local jurisdictions and the private sector, thereby ensuring that GHG emissions are factored into all major decisions and long range planning processes throughout the State.

Another shadow effect that the State can have is in the area of employee commutes. While not technically considered business travel, emissions related to employee commutes should be addressed by State government system wide. Agencies must take steps to further reduce commute emissions by increasing telecommuting and flex schedules to reduce the number of days employees need to travel to work. When coming into the office, employees should be rewarded for taking public transportation, carpooling, biking, or other means of reduced emission travel. These practices will also be picked up by local government and the private sector to amplify the influence of State government.

### Green Insurance Policies for Homeowners and Commercial Businesses

The main features of "Green Buildings" are enhanced energy efficiency and reduced energy use. The most economical time to integrate these cost-effective green building features is either during new construction or when repairs are needed. While homeowners have been encouraged to consider rebuilding with green technologies after a loss, the State should encourage insurance companies to provide policies that would allow building owners to rebuild in the most environmentally beneficial manner.

There are currently several insurers offering this incremental insurance for both homeowners and commercial building owners. Some policies allow for rebuilding to the latest environmental efficiency standards, including recycled-content building materials, rapidly renewable and sustainably produced products, low VOC interior finish materials, and Energy Star lighting and appliances. Other policies are available for homeowners who generate their own power with solar, wind, or geothermal energy, and others for landscaping that reduces the cost of heating or cooling such as shade trees or wind-block vegetation.

For commercial building owners, an option is available allowing policyholders to rebuild an already-existing LEED certified building to the next highest level of LEED certification, or, if the building was not LEED certified, policyholders can rebuild to a LEED silver certification level. [23]

Through the increased use of these policies, the State can work with insurance companies and property owners to increase the number of energy efficient homes that have a lower carbon profile and reduced greenhouse gas emissions.

### "Carbon Shadow" Contributions to a Green and Clean Economy

The ARB and numerous other State agencies are focused on green and clean practices, more informed policies and changed behaviors to save energy, convert to renewable and sustainable materials and fuels, all with an end in mind to reduce State government's carbon footprint. We expect these reductions will give a boost to the California economy, and are gearing up to meet the expected demand. State agencies are mustering their resources to address labor market and economic issues to prepare the workforce for

[23] http://www.reuters.com/article/pressRelease/idUS145859+03-Mar-2008+BW20080303

changing working conditions. With the passage of AB 3018[24], ARB will coordinate with the newly created Green Collar Jobs Council to develop a comprehensive array of programs, strategies, and resources to address the workforce needs in the emerging green economy. Following are some examples of current "Carbon Shadow" activities of State agencies that work intimately with the economic development, employment, and workforce preparation fields in California:

### *Studying the Green Economy*

The **California Economic Strategy Panel** (ESP) is focusing on Green and Clean initiatives, and how they will impact the California economy. For more information, see their monograph *Clean Technology and the Green Economy* published in March 2008. http://www.labor.ca.gov/panel/pdf/DRAFT_Green_Economy_031708.pdf The ESP is sponsoring a series of regional forums throughout the state to gain further input on the impact of changes in the economy.

The **Employment Development Department**'s Labor Market Information Division (LMID) is working to define "Green" industries and occupations. Clear definitions will be essential to measuring the labor market effects and needs of a greener economy. There are many aspects of work that could be considered green, such as using new materials, methods, products, and services. However, we do not yet have a common language capturing the broad and varied nature of green industries and jobs. Several states and many local organizations are working collaboratively to better understand and promote the effects of clean and green technology on our economy. LMID is working with partners to survey the literature, analyze legislation, and track economic issues. See more at http://www.labormarketinfo.edd.ca.gov/?pageid=1032.

### *Workforce Training Programs*

The **California Community Colleges** are strategically positioned to help California's businesses adapt to the green economy and to help students to connect with existing green collar jobs. The Colleges offer courses in Green or environmentally sensitive areas, and can adapt existing programs to meet industry need for Solar Panel Worker Certification and Utility Worker Certification. Programs range from 1 year Certificate, to 2-year Associate's Degree. To date, 40 colleges are offering courses, with plans to adapt existing programs in other colleges as well. Other courses are offered in Construction & Landscaping, Conservation and Ecology Management, Hazard Waste Management and Alternative Energy. More than 4000 degrees and certificates for these programs were conferred in 2006-7 alone. For more information on the Community Colleges programs, see http://www.cccco.edu/Home/tabid/189/Default.aspx.

In addition, the Community College **Centers of Excellence** have been conducting research, working with business and developing coursework related to solar and wind energy and green construction. To learn more, see http://cccewd.net/resource.cfm?c=27.

[24] AB 3018, (Nuñez, Chapter 312, Statutes of 2008)

The **California Workforce Investment Board** (State Board) recognizes that Green technology will impact the entire California economy. The State Board is addressing the current and future workforce needs in the green economy through an industry sector approach. Using information and data from the Economic Strategy Panel's Regional Economies Project, the Board's strategy will support and enhance local workforce board initiatives (see http://www.labormarketinfo.edd.ca.gov/contentpub/GreenDigest/WIB-CA-GreenInitiatives.pdf) that engage businesses in their areas in preparing workers for emerging job opportunities in the green economy.

The strategy will include, but is not limited to:

- Transformation roundtables featuring experts in Industry Cluster and Sector Strategy methodologies and Green Technology.
- The development of a repository of Clean and Green projects and career technical and educational programs that feature the latest green technology.
- A focused initiative designed to connect local and regional partnerships to multiple funding sources including grants, philanthropic organizations, funding collaboratives and the Governor's discretionary funds.

For more information about the California Workforce Investment Board, see http://www.calwia.org/.

### *Funding the Training and Retraining of Workers*

In addition to the Workforce Investment Act funded activities of the **California Workforce Investment Board** and **local workforce investment boards** referenced in the prior section, the **Employment Training Panel** has given funding of training and retraining workers for new duties in the green economy a strategic focus. In support of the State's efforts to maintain a healthy environment and foster the emerging green sector, the ETP will continue to disperse training funds directly to employers and other entities to help workers acquire the skills demanded by occupations in the green economy. Since July 2006, the Panel has approved $26 million in 53 green/clean technology related contracts for more than 23,000 workers. For more information on the ETP, see http://www.etp.ca.gov/

**Appendix C: State Government**
**Table 2**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| State Government | 1-2 | TBD | Various | TBD/Ongoing |

# 3. THE ROLE OF LOCAL GOVERNMENT

## Introduction

Local governments are essential partners in achieving California's greenhouse gas reduction goals. They have broad influence and, in some cases, exclusive authority over significant emission sources through their planning and permitting processes, local ordinances, outreach and education efforts, and municipal operations. In fact, many of the measures identified in the Scoping Plan rely on actions that local governments can take. These actions, outlined later in this section, demonstrate how local governments taking a sustainability approach to their decisions can greatly impact GHG emission reductions within their community and collectively, the state. In order to most effectively achieve the goals of AB 32, cities and counties statewide will need to actively engage in implementing Scoping Plan measures at the local level and undertake other emission reduction actions that make sense for each community.

Many local governments have already implemented programs to reduce greenhouse gas emissions. Over 120 California cities have signed on to the U.S. Conference of Mayors Climate Protection Agreement. In addition, over 30 California cities and counties have committed to developing and implementing Climate Action Plans. These communities have not only demonstrated leadership in taking initiative to reduce GHG emissions, they are also reaping important co-benefits, including local economic benefits, more sustainable communities, and improved quality of life. Lessons learned from these early efforts can help inform actions by other local governments going forward.

### *Comprehensive Local Approaches*

ARB encourages cities and counties to develop a collaborative, comprehensive approach to reducing GHG emissions and address climate change within their own communities.

A local government's comprehensive approach to reducing GHG emissions can be included in their General Plan or take the form of a separate Climate Action Plan. For example, many local governments are incorporating appropriate climate objectives within each existing element of their general plan. This method may facilitate a more timely, comprehensive, and coordinated response. Key elements of any comprehensive plan addressing greenhouse gas emissions should include (1) development of municipal and community-level GHG emissions inventories, (2) adoption of local emissions reductions mechanisms and strategies that can be implemented through local plans, programs, codes and ordinances, (3) establishment of emission reduction goals and 4) development of an emissions reporting mechanism to track progress toward those goals.

To provide local governments guidance on how to inventory and report greenhouse gas emissions at both municipal and community level ARB will provide protocols for accurate measurement. ARB recently adopted the Local Government Operations Protocol which inventories emissions from government buildings, facilities, vehicles, wastewater and potable water treatment facilities, landfill and composting facilities, and

other governments operations. ARB is also developing an additional protocol for community wide emissions. This protocol will go beyond just municipal operations and include emissions from the community as a whole including residential and commercial energy consumption and transportation activity.

Once an accurate inventory has been established, ARB encourages local governments to adopt a reduction goal for municipal operations emissions and move toward establishing similar goals for community emissions that parallels the State commitment to reduce greenhouse gas emissions by 15 percent from current levels by 2020.[25] Local governments that meet or exceed this level of reductions prior to 2020 should be properly recognized as discussed below. Early emission reduction actions taken by and fully accounted by jurisdictions should also be counted toward any reduction goals. To consolidate climate action resources and aid local governments in their emission reduction efforts, the ARB is developing various tools and guidance for use by local governments, including the next generation of best practices, case studies, a climate calculator, and other decision support tools.

As local governments assess the GHG impacts of their community, transportation-related emissions represent one component that should be evaluated at the local level and within the larger regional context. The relationship between GHG inventories at the local and regional level is complex and will be worked out during the protocol development process. Local governments should look to reduce local transportation related emission through local transit, parking policy, bike/walk infrastructure and other related programs. In addition to action at the local level, local governments should also work collaboratively with neighboring jurisdictions and the regional agencies, in the context of regional transportation planning efforts, to ensure regional transportation-related GHG reductions targets are met or exceeded.

In recognition of local achievements, the Institute for Local Governments (ILG) is developing a program to recognize local governments that take progressive action to reduce GHG emissions at the municipal and community scale. Part of that program is a goal-setting structure. Under its current draft form, local governments would be recognized as they achieve various performance standards with a gold level of 20 percent below current levels indicating the highest standard. A platinum level is also being considered for local governments whose actions result in emission reductions above and beyond these levels. In order to achieve recognition, local governments must prepare a baseline inventory, develop a climate action plan, implement climate actions in 10 opportunity areas, and report progress. ARB views this as an opportunity for local governments to showcase their leadership role as they pursue more aggressive reduction goals and is considering ways to provide additional considerations for State funding programs linked to performance

Table 3 provides an illustration of measures in the Scoping Plan in which local government plays a role to achieve greenhouse gas reductions.

[25] For the state this is approximately equivalent to a 30 percent reduction from projected 2020 levels.

**Appendix C: Role of Local Government**
**Interaction of Local Government with Scoping Plan Measures**

**Table 3**

| Scoping Plan Measures | Potential Local Government Actions |
|---|---|
| Energy Efficiency | • Increase Utility Energy Efficiency Programs (either as municipal owners or partnership with local Utilities)<br>• Reduce energy consumption and install solar water heating systems within local government owned/operated facilities and operations<br>• Promote the following programs within the jurisdiction:<br>  ○ Reduction in energy consumption through programs to promote better home insulation, solar water heating systems, and solar and geothermal heating/cooling systems in homes/businesses<br>  ○ Incentives for building owners and developers to participate in "Million Solar Roofs" project for solar-electrical systems, which includes overall efficiency upgrades to eligible structures. |
| Renewable Portfolio Standard | • Achieve a minimum of 33 percent renewables portfolio standard for local government owned utilities. |
| Green Buildings | • Facilitate green building construction, renovation, operation and maintenance at local government owned/operated facilities.<br>• Implement the State adopted green building code (effective 2010), and provide training to local architects, engineers and developers.<br>• Site buildings close to public transportation and services, and providing amenities that encourage walking and cycling, offering further GHG reducing potential.<br>• Promote (lead by example) by requiring all new buildings and new residential and commercial developments to exceed existing energy standards and meet nationally-recognized building sustainability standards, such as LEED Gold standards. |

| Scoping Plan Measures | Potential Local Government Actions |
|---|---|
| Recycling and Waste | • Control landfill methane emissions (for jurisdictions that own/operate landfills).<br>• Adopt Zero Waste and Environmentally Preferable Purchasing policies.<br>• Increase diversion from landfills (commercial and residential recycling and composting/purchase of compost). |
| High GWP Gases | • Ensure proper maintenance of fleet vehicles and prevent leakage of motor vehicle A/C refrigerants.<br>• Ensure proper handling/disposal of waste refrigerants. |
| Sustainable Forests | • Encourage land-use decisions that conserve forest lands.<br>• Promote urban forest projects (shading/energy co-benefits).<br>• Make public investment to purchase and preserve forests and woodlands. |
| Water | • Improve municipal water system energy efficiency/usage.<br>• Increase water recycling.<br>• Reuse urban runoff. |
| Transportation | • Participate in regional blueprint planning efforts and in the development of sustainable communities and alternative planning strategies to achieve regional GHG goals.<br>• Incorporate local transportation GHG reduction measures in General Plans including funding and promotion of local transit systems, bike/walk infrastructure, local parking policies, car sharing, etc..<br>• Promote employee transit incentive programs, including, telework, carpooling, and parking cash-out policies. |
| Vehicle Efficiency | • Properly inflate tires and practice routine fleet maintenance. |

Comprehensive local programs will address all greenhouse gas emissions that occur within a local government's jurisdiction. These not only include local government operations as discussed above, but also apply to businesses, residences, local transportation activity, agricultural operations and various other industries. ARB encourages local governments to partner with special districts, such as school districts, transportation planning agencies and waste and water utilities that provide services within their jurisdictions. Among the areas that local governments can focus on include:

- *Municipal and Community Energy.* Local governments can influence the carbon content of energy provided to their community through municipal utility operations, as well as the amount of energy used by community businesses and residents through building codes, conservation programs and other mechanisms.

- *Municipal and Community Waste and Recycling.* Local governments can change the carbon footprint of their jurisdiction's waste and recycling operations through collection system adjustments and promoting waste prevention and recycling to community businesses and residents.

- *Municipal and Community Water and Wastewater Systems.* Local governments can support community-wide water conservation and reclamation program efforts.

- *Urban Greening and Urban Forests*. Local governments can reduce greenhouse gas emissions and provide additional benefits to communities through the creation, enhancement, and expansion of community green spaces that provide multiple benefits. Urban forests that are strategically and properly planned, planted, and maintained, can provide reductions in energy use through shading buildings, homes, streets, pedestrian walkways, and densely-developed urban cores; thereby reducing surface and ambient temperatures and requiring less energy to cool.

- *Community Transportation*. Local governments can directly influence the local transportation planning processes to increase the use of low carbon travel such as transit, bicycling, walking and carpooling. They can also partner with regional planning agencies to create a sustainable vision for the future that accommodates population growth in a carbon efficient way. The recent passage and signing of SB 375 (Steinberg, Chapter 728, Statutes of 2008) creates a process whereby regions work to integrate development patterns, the transportation network and other transportation measures and policies to achieve GHG emission reductions. The implementation of regional transportation-related GHG emission targets and SB 375 are discussed in more detail in the transportation sector in this appendix.

- *Community Design.* Local governments have the ability to directly influence both the siting and design of new residential and commercial developments in a way that reduces GHG associated with energy, water, waste, and vehicle travel, which may include zoning for more compact and mixed-use residential and commercial development and adopting policies to promote infill and affordable housing.

## Supporting Local Action

State, regional, local, and non-governmental stakeholders must work together to prioritize and create policies, programs, incentives, guidance, and funding to assist local actions to help meet the State's climate change goals. These will be developed on an ongoing basis. Currently, there are many supporting agencies and programs available to assist local governments in their efforts to reduce greenhouse gases. Guidance to measure community GHG emissions and resources for best practices continue to be developed and are being refined. Here are just two examples:

- In partnership with the ARB, California Climate Action Registry, ICLEI-Local Governments for Sustainability, and The Climate Registry have developed a Municipal Operations Protocol and are developing a Community Level Protocol to provide a standardized set of guidelines to assist local governments in quantifying and reporting greenhouse gas emissions associated with their community.

- The California Climate Action Network, created by the Institute for Local Government, has developed a best practices framework that offers suggestions for local action in 10 opportunity areas, including energy efficiency, water and wastewater systems, waste reduction and recycling, and efficient transportation, land use and community design. They are also working with local governments and the ARB, among others, to establish a climate leadership recognition program that encourages support for local efforts and acknowledgement of successful programs.

Because ARB recognized early that many of the proposed measures to reduce GHG emissions rely on local government actions, ARB identified Early Action measures to develop tools in support of local government. ARB will continue to work closely with local agencies to encourage and provide tools for the active involvement of all cities and counties in the effort to reduce greenhouse gases and ensure a sustainable future. To consolidate climate action resources and aid local governments in their emission reduction efforts, the ARB is developing various tools and guidance for use by local governments, including the next generation of best practices, case studies, a climate calculator, and other decision support tools. ARB will also work to help identify resource needs and funding opportunities for local governments to undertake these efforts. As outlined in AB 32 Section 38565, a priority of ARB is for public and private investment to be directed to the most disadvantaged communities, and that small businesses, schools and other community institutions are able to participate in and benefit from statewide efforts to reduce greenhouse gas emissions.

# 4. TRANSPORTATION

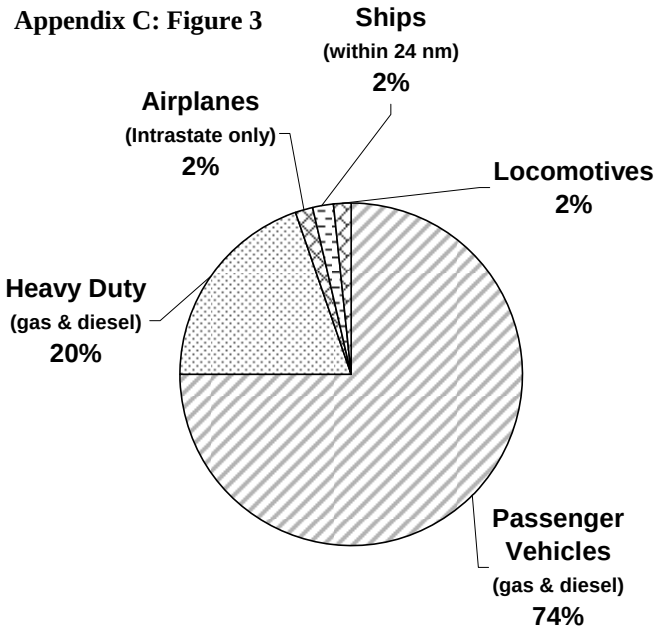
**This section includes the following measures:**

**Recommended Actions**
**California Cap-and-Trade Program Linked to the Western Climate Initiative**
**(T-1) Pavley I and Pavley II– Light-Duty Vehicle GHG Standards**
**(T-4) Vehicle Efficiency Measures**
**(T-2) Low Carbon Fuel Standard (Discrete Early Action)**
**(T-5) Ship Electrification at Ports (Discrete Early Action)**
**(T-6) Goods Movement Efficiency Measures**
**(T-7) Heavy-Duty Vehicle GHG Emission Reduction—Aerodynamic Efficiency (Discrete Early Action)**
**(T-8) Medium- and Heavy-Duty Vehicle Hybridization**
**(T-3) Regional Transportation-Related Greenhouse Gas Targets**
**(T-9) High Speed Rail**

## Overview

The transportation sector is integral to the people and economy of California. California has a long, successful history of improving the environmental footprint of transportation-related activities. These efforts have resulted in significant reductions of criteria and toxic air pollutants, improved air quality and public health. In addition, the clean vehicle technologies developed in response to California regulatory efforts have provided benefits across the nation and throughout the world. To achieve our GHG emission reduction goals, it is vital that we build on our past successes in reducing criteria and toxic air pollutants to achieve significant reductions in GHG emissions from transportation and goods movement activities. GHG emission reductions will come from three overarching strategies: more efficient vehicles, lower-carbon fuels, and reduction of vehicle use or vehicle miles traveled (VMT). The GHG emission reductions in this sector will be achieved through regulations, market mechanisms, incentives, and land use policy.

**Appendix C: Figure 3**




Transportation activities are responsible for 38 percent of the greenhouse gas (GHG) emissions in California – or 182 $MMTCO_2E$ (2004). Because of its size, it is critical that the transportation sector achieve significant emission reductions toward the State's 2020 goal. If the transportation sector does not provide significant GHG reductions, it would be difficult

for another sector to make up the emission reductions. These reductions in GHG emissions can be achieved through the use of currently available and emerging technologies and behavior change.

### Vehicles

Passenger vehicles (cars and light trucks) are responsible for 74 percent of the emissions from the transportation sector and are the primary focus of reduction strategies for the transportation sector. The Pavley (AB 1493) regulation, which has already been adopted by ARB, requires GHG emission reductions from passenger cars and light trucks. This regulation will provide about 27 $MMTCO_2E$ reductions in 2020—an 18 percent fleet wide reduction. The State of California is currently challenging a U.S. EPA decision that prevents the implementation of this regulation. Although ARB is confident that California will prevail, staff is also pursuing additional strategies to ensure that new California vehicles achieve the maximum feasible and cost-effective reductions in GHG emissions as required by law.

Although the Pavley regulation results in significant GHG reductions, more is needed. ARB is proposing additional strategies to ensure that new California vehicles achieve the maximum feasible and cost-effective reductions in GHG emissions including strengthening GHG tailpipe emission standards from passenger cars and light trucks and improving overall vehicle efficiencies.

Medium- and heavy-duty trucks account for about 20 percent of the transportation GHG emissions. ARB is pursuing strategies to increase the efficiency of medium- and heavy-duty vehicles through both engine specifications and devices that reduce aerodynamic drag and rolling resistance. These strategies will improve vehicle efficiency and reduce GHG emissions.

### Fuel

The fuel used in cars and trucks also has a significant impact on emissions. ARB is currently developing a comprehensive regulatory proposal for the Low Carbon Fuel Standard (LCFS), which the Board will consider in late March 2009. It is anticipated that the proposed regulation will provide a 10 percent reduction in carbon intensity by 2020, which translates to approximately 15 $MMTCO_2E$ of emission reductions. Furthermore, ARB and WCI plan to include transportation fuels in the cap and trade program in 2015.

Jet fuel used in intrastate plane trips accounts for approximately 2 percent of California's GHG emissions[26]. Emissions from the fuel used in planes is an important consideration, however, the State does not have regulatory authority over aviation. ARB has not identified aviation specific measures; nevertheless, successful deployment of High Speed Rail could divert some air passengers to rail.

[26] These emissions do not include interstate air travel.

### Vehicle Use

The other factor in GHG emissions from transportation is the use of the vehicle. In the case of passenger vehicles, the metric for use is most commonly referred to as vehicle miles traveled (VMT). Statewide VMT increased about 35 percent from 1990 to 2007, and with current trends is expected to increase another 20 percent by 2020 and more than double between now and 2040. For California to meet its long term GHG emission reduction goal, this trend must be slowed.

The key to addressing the VMT challenge is providing people with more choices through diversified land use patterns, greater access to alternative forms of transportation including transit, biking and walking, and promoting development patterns where people can live work and play without having to drive great distances. Altering land use patterns to bring people closer to more destinations and enhance transit can result in VMT reduction over the long term. Current regional planning efforts are starting to move in a direction to create the choices that are needed to reverse projected VMT growth. A strategy of coordinated State, regional, and local land use and transportation planning, policies and finance, must be developed to encourage reductions in VMT. Land use strategies that provide for more compact growth not only reduce VMT, but can also reduce the carbon footprint of developments by reducing land consumption, energy use, water use, and waste. While these strategies are likely to provide modest reductions in GHG emissions by 2020 because of the time required to change land use patterns, they are a central element in ensuring that California gets on a low-carbon trajectory as we get to and beyond 2020.

### Goods Movement

A significant portion of transportation activities are associated with the movement of freight or goods throughout the State. Reducing GHG emissions from the vehicles and equipment used in goods movement activities through increasing efficiency of the way goods move throughout the State and other measures has the benefit of not only reducing GHG emissions, but also emissions of smog precursors and air toxics. With traffic at California ports projected to increase by 250 percent by 2020, reducing GHG emissions from this sector will be necessary to help meet the State's 2020 GHG goal. Proposed measures include implementation of two already adopted regulations for port drayage trucks and the use of shore power for ships at berth, and several new measures designed to improve the overall efficiency of goods movement throughout California, reduce fuel consumption, improve operational efficiencies such as improvements in dock-side container handling procedures, transportation mode shifts, and the application of new technologies and alternative fuels. Proposition 1B funds, as well as clean air plans being implemented by California's ports, will also help reduce greenhouse gases while cutting criteria pollutant and toxic diesel emissions. California's goal for the long-term is to identify and develop programs that will help bring the State closer to the 2050 target. Bringing the goods movement system to a low- or zero-carbon future will require California to begin work now on fostering the development of cutting edge low carbon technologies, creating partnerships to improve the overall efficiency of the goods movement infrastructure, implementing programs to leverage the consumer in promoting

a greener goods movement system, and identifying and implementing public policies that promote a low-carbon goods movement system.

#### Conclusion

California has the opportunity to lead the nation in reducing emissions from the transportation sector. While the further deployment of existing technologies will allow California to achieve the 2020 goal, meeting California's long-term GHG goals will require substantial reductions from all areas including lower GHG vehicle/fuel systems, increased transportation efficiency, changes in the delivery of goods and services, expanded transit, and more efficient land use patterns.

# Recommended Actions

## *Cap-and-Trade Program*

California is working closely with other states and provinces in the Western Climate Initiative (WCI) to design a regional cap-and-trade program that can deliver GHG reductions throughout the region. ARB will develop a cap-and-trade program for California that will link with the programs in the other WCI Partner states and provinces to create this regional market.

WCI has made a decision to include transportation fuels in the cap-and-trade program in 2015. WCI and California are assessing potential points of regulation for including transportation fuels in the cap-and-trade program. WCI's work to date has identified the point at which transportation fuels enter into commerce in each state and province as a candidate point of regulation. In California, this point of regulation could be at the terminal rack or the point of final blending. By setting an overall limit on the quantity of greenhouse gases emitted, a well-designed cap-and-trade program will complement other regulatory measures for transportation fuels and achieve additional reductions in greenhouse gases in this sector.

# A. LIGHT DUTY VEHICLES

## *(T-1) Pavley I and Pavley II– Light-Duty Vehicle GHG Standards*

AB 1493 (Pavley), Health and Safety Code Section 43018.5, directed the Air Resources Board (ARB) to adopt a regulation requiring the maximum feasible and cost effective reduction of greenhouse gas (GHG) emissions from new passenger vehicles.

In September 2004, the ARB approved regulations to reduce GHG emissions from new passenger vehicles. The regulations apply to new passenger vehicles and light-duty trucks beginning with the 2009 model year and phased-in through the 2016 model year. These regulations add four GHG air contaminants to the vehicular criteria and toxic air contaminant emissions that California was already regulating – carbon dioxide ($CO_2$),

methane (CH4), nitrous oxide ($N_2O$), and hydrofluorocarbons (air conditioner refrigerants). The rulemaking established a declining fleet average standard for these pollutants, with separate standards for the lighter and heavier portions of the passenger vehicle fleet. The regulations also provide alternative compliance methods including credit generation from alternatively-fueled vehicles, and averaging, banking, and trading of credits within and among manufacturers.

The technical modifications needed to meet the standards will increase the cost of new vehicles. However, because these technology improvements will also reduce the operating cost of the vehicles, staff estimates that the average consumer will ultimately save $30 per month.

Under the Clean Air Act, California is required to apply for a waiver before implementing vehicle tailpipe emission standards. ARB applied for a waiver and was denied by the U.S. EPA. California and other states have challenged this ruling in court and expect to prevail. Nevertheless, AB 32 specifically states (section 38590) that if the Pavley (AB 1493) regulations do not stay in effect, the State shall implement alternative regulations to control mobile sources to achieve equivalent or greater GHG reductions. ARB currently plans to pursue a Feebate regulation to backstop the Pavley regulations if they cannot be implemented.

A Feebate proposal would require fees on the purchase of high GHG emitting vehicles that would then be returned as rebates to buyers of low GHG emitting vehicles. The fee schedule would need to be designed to obtain cumulative emission reductions equivalent to those that would have been achieved under the Pavley regulations. A more detailed description of this measure is in the next section.

In addition to Pavley I, ARB proposes to further strengthen the vehicle tailpipe emission standards beginning with the 2017 model year. The new standards will follow up on the existing standards that reach maximum stringency in 2016. The technologies that might be employed include highly efficient hybrid vehicles, use of lightweight materials to reduce vehicle mass, and reductions in air conditioning-related emissions through the use of low-GWP refrigerants or other approaches.

It is anticipated that there will be other benefits associated with Pavley I and the proposed Pavley II measures, such as a reduction in criteria pollutants. The regulations will reduce “upstream” smog-forming emissions from refining, marketing, and distribution of fuel.

### *Zero Emission Vehicles*

The ZEV program plays a critical role in meeting California’s greenhouse gas reduction goals of 2020 and 2050. The ZEV program drives research, development, and deployment of zero emission vehicles. It also encourages advanced technology commercialization through introduction of ZEV enabling technology. In the near term, the ZEV program requires placement of hundreds of ZEVs in order to meet emission reduction goals. In the long-term, the ZEV program goals mandate the placement of

thousands of ZEVs and near-zero emission vehicles (plug-in hybrids, conventional hybrids, compressed natural gas vehicles, and clean gasoline vehicles) in California.

Zero emission hydrogen fuel cell vehicles will also play a critical role in both California's greenhouse gas reduction goals and ZEV mandate. The California Hydrogen Highway Network is an initiative established to support commercialization of hydrogen vehicles by promoting the development of fueling infrastructure in areas where vehicles are being placed. The Environmental Standards for Hydrogen Fuel Act (SB1505), passed in 2006, requires that as the hydrogen fueling infrastructure in California grows, greenhouse gas emissions associated with hydrogen production, delivery and use will continue to be less than well-to-wheel emissions from conventional gasoline vehicles.

The current ZEV program (planned until 2014) requires 22 automakers to produce the cleanest cars and deliver them for sale in California. In 2009, the Board will consider a proposal that is currently being developed to ensure that the ZEV program is optimally designed to help the state meet its 2020 target and put us on the path to meeting our 2050 target of an 80 percent greenhouse gas reduction.

### *Alternative and Renewable Fuel and Vehicle Technology Program*

Under AB 118, ARB is administering the Air Quality Improvement Program (AQIP) to provide $50 million per year in funding for clean vehicle/equipment projects and research on the air quality impacts of alternative fuels and advanced technology vehicles. ARB's program is required to reduce emissions of criteria pollutants by the enabling legislation. However, advanced technologies funded by AQIP, including those that promote fuel efficiency, may also achieve reductions in GHG emissions.

AB 118 also created the Alternative and Renewable Fuel and Vehicle Technology Program and authorized the California Energy Commission (CEC) to spend approximately up to $120 million per year for over seven years (from 2008-2015) to develop, demonstrate, and deploy innovative technologies to transform California's fuel and vehicle types. This will assist the State in meeting its alternative fuel use and petroleum reduction goals in a manner consistent with the State's climate change and air quality objectives. CEC published a draft Investment Plan in July 2008 for the first and second year of funding. The proposed focus of the first year is:

- Support incentive programs to purchase and deploy alternative and renewable fueled vehicles,
- Incent production of low-carbon alternative and renewable fuels, and
- Implement a public outreach campaign to highlight the availability and benefits of alternative and renewable fuel vehicle options.

The proposed focus of the second year is:

- Develop an incentive program to retrofit light-, medium-, and heavy-duty vehicles with ARB-certified equipment,
- Support competition for advancement of alternative and renewable fuel vehicles,
- Support development and commercialization of lower-cost technologies to produce fuel at in-state facilities from waste feed stocks,

- Provide incentives for installation of new alternative fuel dispensing facilities,
- Support development of science curriculum about alternatives and renewable fuels and vehicles, and
- Implement a program with new car dealers to encourage delivery and sale of alternative and renewable fuel vehicles.

The AB 118 program creates the opportunities for investment in technologies and fuels that will help meet the Low-Carbon Fuel Standard, AB 1007 goal of increasing alternative fuels, AB 32 goal of reducing GHG emissions to 1990 levels by 2020, and the State's overall goal of reducing GHGs 80 percent below 1990 levels by 2050. ARB is coordinating closely with the CEC in the implementation of AB 118; participating as a member of the CEC's advisory committee, as well as providing technical assistance on air quality issues and to ensure that their alternative fuels programs work in concert with ARB's LCFS.

**Appendix C: Transportation**
**Table 4**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Pavley (AB 1493) | 31.7 | -10,009 | ARB | 2004/2009-2016* |
| Pavley II – Light-Duty Vehicle GHG Standards | | -1,049 | ARB | 2010/2017 |

* This regulation has already been adopted. Implementation of the regulation is pending the outcome of the legal challenge to the waiver denial.
†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## *Feebates—In lieu of Pavley regulations*

AB 32 specifically states that if the Pavley regulations do not remain in effect, ARB shall implement alternative regulations to control mobile sources to achieve equivalent or greater greenhouse gas reductions (HSC §38590). As part of the regulatory process, ARB is commissioning a study to analyze the implementation of Feebates in California both in place of and in addition to the Pavley standards. The study will assess elements of program design including fee and rebate levels, point of regulation, implementation strategy, consumer response, and interaction with other AB32 programs. If California were to be ultimately prevented from implementing the Pavley regulations, an aggressive Feebate schedule could be implemented to achieve equivalent or greater cumulative reductions that would have occurred under the Pavley regulations. In 2020, a Feebate

program advanced in the absence of the Pavley regulation would translate to equivalent Pavley reductions of 31.7 $MMTCO_2E$. If U.S. EPA grants a waiver for the Pavley regulation during the Feebate rulemaking process, ARB will evaluate the effectiveness and necessity of continuing with a complimentary Feebate program.

A Feebate regulation would combine a rebate program for low emitting vehicles with a fee program for high emitting vehicles. A vehicle would be determined to be low or high emitting in relation to a GHG emissions benchmark. The GHG emissions benchmark could take into account criteria beyond GHG emissions. Criteria such as gross vehicle weight (GVW), size of vehicle, or seating capacity could all factor into the calculation of a GHG emissions standard. Further, there could be multiple emissions benchmarks to account for different vehicle classes. The magnitude of the fee or rebate assigned to a vehicle would be determined by the difference between the GHG emissions of the vehicle and the applicable GHG emissions benchmark. In other words, a vehicle that is low emitting, relative to the GHG emissions benchmark, would receive a rebate, making it more affordable, and a vehicle which is high emitting, relative to the GHG emissions benchmark, would be charged a fee, making it more expensive. The program could include a limit on the maximum fee or rebate assigned to any vehicle. The schedule of fees and rebates and the maximum fee or rebate will be determined through the public process.

The Feebate program would advance the production and adoption of low-emission vehicles and cleaner technologies. Feebates would make low-emission vehicles more affordable. Vehicle manufacturers would include cleaner technologies in their new fleets to take advantage of the rebates offered to low-emission vehicles. At the same time, the rebates would make low-emission vehicles more attractive to new vehicle buyers. The majority of emissions benefits would stem from improvements in the vehicles themselves with minimal impacts on the range or volume of vehicles available for purchase.

The Feebate program would have an immediate and cumulative effect on GHG emissions from new vehicles. Both GHG and criteria pollutant benefits would be expected as cleaner technologies enter the passenger vehicle and truck fleet. As the existing vehicle stock turns over and auto manufacturers respond to the Feebate program by marketing cleaner and more efficient technologies, the GHG and criteria pollutant reductions would grow.

The Feebate program would be self-financing, with a small portion of the revenue generated from the program going to its administration. From year to year the program may generate a net loss due to a greater than expected demand for rebated vehicles or generate a net surplus due to a greater than expected demand for vehicles that carry a fee. Over the life of the program, ARB would adjust the fee and rebate schedules by modifying the GHG emissions benchmark to compensate the program for losses or surpluses generated. However, the level of the emissions benchmark will not determine the total emission reductions as much as the fee (or rebate) for each additional gram of GHG emitted (or avoided) per mile.

**Appendix C: Transportation**
**Table 5**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Feebates (In lieu of Pavley regulations) | 31.7 | 0 | ARB | Pending legal challenge |

## *(T-4) Vehicle Efficiency Measures*

Several measures would further reduce tailpipe GHG emissions by increasing vehicle efficiency. These measures include: ensuring proper tire inflation and adopting a low rolling resistance tire standard, use of low friction engine oils, and solar-reflective automotive paint and window glazing. ARB identified the tire inflation measure as a Discrete Early Action in 2007, which means a regulation to implement the measure, must be enforceable starting in 2010.

### *Tires*

A properly inflated tire helps to reduce fuel GHG emissions by reducing tire rolling resistance. Low rolling resistance tires for passenger and light duty vehicles can result in a 1 to 2 percent reduction in GHGs. The tire inflation and tire program would affect vehicle service facilities such as dealerships, maintenance garages, oil change facilities, tire centers, and smog check facilities. For the tire inflation program, it is clear that not all vehicles are serviced at regular intervals and that many individuals maintain or service their own vehicles, therefore, public education about proper tire inflation is also necessary. For the tire tread program, a two-phased approach is needed, beginning with data gathering and education, followed by the development and adoption of tire rolling resistance standards.

### *Low Friction Engine Oils*

Engine oil formulations can also impact a vehicle's GHG emissions, because the more easily the internal parts of the engine move, the more efficiently the engine will run. This, in turn, reduces the engine load and fuel used. Requiring passenger cars to use low friction engine oils can result in a 2 percent GHG reduction. Entities that could be affected by the low friction engine oils measure, depending on the point of regulation, include lube oil manufacturers, automobile manufacturers, and auto-repair shops.

### *Solar-Reflective Automotive Paint and Window Glazing*

The use of solar-reflective automotive paint and window glazing would reduce the solar heat gain in a vehicle parked in the sun. Solar-reflective automotive paints are formulated with pigments that have low absorption (high reflectance) of sunlight. The more solar energy is reflected from a vehicle, the less the vehicle's interior will heat up when it is parked in the sun. A cooler interior would require less air conditioner use, which improves vehicle efficiency. Also, because the trend over time has been towards increased glass in vehicles, this measure would likely include a requirement that window glazing also meets certain solar reflectivity requirements. The solar heat gain reductions

that can be accomplished with reflective glazing are even more substantial than those that can be obtained with solar-reflective automotive paints. The affected entities for this measure would be the vehicle manufacturers, paint vendors and manufacturers, and window/window film suppliers.

**Appendix C: Transportation**
**Table 6**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Tire Pressure Program* | 0.55 | -72 | ARB | 2009/2010 |
| Tire Tread Standard | 0.3 | -123 | CEC | 2009-2010? |
| Low Friction Engine Oils | 2.8 | -630 | ARB | Pending |
| Solar-Reflective Automotive Paint and Window Glazing | 0.89 | -5.7 | ARB | 2009/2012 |
| ***Total:*** | 4.5 | | | |

*Discrete Early Action, to be enforced beginning on January 1, 2010.
†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

# B. FUELS

## *(T-2) Low Carbon Fuel Standard (Discrete Early Action)*

In January 2007, Governor Schwarzenegger issued an Executive Order (S-01-07) establishing a Low Carbon Fuel Standard (LCFS). ARB approved the LCFS as a discrete early action measure and is set to adopt the regulation in March 2009, with implementation beginning in 2010. With close to 16 billion gallons of gasoline and approximately 4 billion gallons of diesel sold per year, sales of petroleum-based fuels make up approximately 96 percent of all transportation fuel sold in California. The LCFS is a key part of the State's strategy to reduce GHG emissions from the transportation sector and is being developed to reduce the carbon intensity of the State's transportation fuels by at least 10 percent by 2020.

The LCFS would require fuel providers[27] in California to ensure that the mix of fuel they sell into the California market meets, on average, a declining standard for GHG emissions measured in carbon dioxide equivalent grams per energy unit[28] of fuel sold.

[27] The LCFS would apply to all transportation fuel providers, including: refiners, blenders, producers or importers of transportation fuels in California and applies to providers of gasoline, diesel, natural gas, LPG (propane), electricity, hydrogen, ethanol, biodiesel and other mixed blends.
[28] Units expressed are grams of $CO_2$ equivalent per mega joule ($gCO_2E/MJ$).

Fuels used for both on-road and off-road consumption would be covered. However, the LCFS would not apply to certain aviation and marine fuels that ARB lacks the authority to regulate.

Transportation fuels would be evaluated and assigned carbon intensity values measured on a full fuel cycle basis. This full-fuel cycle assessment would include the direct emissions from resource extraction (or production), transportation, refining/distillation and distribution. In addition, indirect land use GHG emissions would also be calculated and assigned where appropriate. For example, GHG impacts would be estimated from changes in land use patterns (i.e., converting forest lands to farms in South America).

Reducing the aggregate carbon intensity of fuels may be achieved through flexible compliance mechanisms whereby providers exceeding the required performance standard would receive credits that may be applied to future obligations or traded with providers not meeting the LCFS. Declining carbon intensity standards would be determined separately for gasoline and diesel.

It is currently proposed that regulated parties may meet the standard by various means, including: 1) providing only fuels that meet the standard; 2) providing a mix of higher and lower carbon fuels that on average meet the standard; 3) using previously banked credits in an amount that equals the credit deficit; and 4) acquiring credits from other parties who earned credits by exceeding the standard such that the amount of credits acquired equals the credit deficit. For example, a producer may choose to meet the LCFS by a combination of selling low carbon fuels (e.g., ethanol derived from waste resources), and by buying credits from other LCFS regulated parties.

Utilizing flexible compliance mechanisms would allow fuel providers flexibility to choose how they reduce emissions and realize GHG reductions at the lowest cost and in the most consumer-responsive manner. For example, providers could purchase and blend more low-carbon ethanol into gasoline products, purchase credits from electric utilities supplying low-carbon electrons to electric passenger vehicles, diversify into low-carbon hydrogen as a product, and employ other new strategies yet to be developed.

The LCFS should result in several co-benefits, including bringing about meaningful changes in the fuels market by giving low carbon fuels a market edge over high carbon fuels. The LCFS should spark research in alternatives to petroleum-based fuels, leading to GHG emission reductions over the long term. This may provide important benefits as the state diversifies its fuel mix and becomes less dependent on petroleum.

ARB is performing a complete environmental analysis of LCFS during the regulatory process. In addition, ARB is evaluating potential localized impacts associated with the LCFS, as well as, various sustainability issues. Fuels, such as natural gas, liquefied petroleum gas (LPG), electricity, and hydrogen, would contribute to the LCFS by displacing some gasoline and diesel fuel. To the extent that such displacement occurs, vehicles operated with these fuels are likely to have lower criteria and toxic emissions.

There will be additional costs associated with the development of new alternative fuels such as the production of ethanol from cellulosic feedstock or the production of biodiesel or renewable diesel from various biomass-related feedstocks. Moreover, there will be added costs associated with infrastructure needs. However, the costs of producing these fuels, given the current cost of gasoline and diesel production, are expected to be highly competitive. Therefore, ARB estimates that there will be no net difference in the costs of producing fuels to meet the LCFS versus the cost of producing gasoline and diesel.

The LCFS is scheduled to be presented to the Board in the March 2009 timeframe with full implementation starting in 2010.

**Appendix C: Transportation**
**Table 7**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Low Carbon Fuel Standard (Discrete Early Action) | 15 | 0 | ARB | 2009/2010 |

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

# C. GOODS MOVEMENT

In October 2007, ARB approved three early action measures that affected goods movement activities. One of these, ship electrification at ports, was a discrete early action and the other, the Port Drayage Truck rule, was an early action measure. The Board adopted these two measures in December 2007. The third, Vessel Speed Reduction, is currently under development. These three, and several new measures, being proposed for consideration in the Scoping Plan are described below.

## *(T-5) Ship Electrification at Ports (Discrete Early Action)*

In December 2007, ARB adopted the shore power regulation, a Discrete Early Action measure enforceable starting in 2010. This regulation requires most container, passenger, and refrigerated cargo ships to shut off their auxiliary engines while at dock and receive power from the electrical grid, or reduce their emissions by a similar amount via the implementation of other technologies.

## *(T-6) Goods Movement Efficiency Measures*

There are many opportunities to reduce GHG emissions from goods movement. Efficiency improvements can be implemented for the equipment or vehicles that transport goods at facilities such as ports, intermodal rail yards, and distribution centers. More broadly, there are likely opportunities to improve the overall efficiency of how goods are transported to, through, and within California. Several new strategies are proposed for evaluation and consideration that will reduce GHG emissions from goods movement activities. These strategies include near-term measures that rely on available low carbon technologies and operational efficiencies and longer-term measures that will help bring California closer to the 2050 emission reduction target by promoting a low carbon and sustainable goods movement system. These strategies, which are being combined under measure T-6, are briefly described below.

Overall, the emission reduction goal for measure T-6 is to achieve a combined 3.5 $MMTCO_2E$ reduction in GHG emissions by 2020. This represents about a 20 percent reduction in the projected 2020 GHG emissions from this sector. Because of the complexity of this sector and the need for a thorough investigation of a variety of approaches to determine how best to improve goods movement efficiency, ARB has assigned an overall emission reduction goal for the goods movement sector to assist with meeting the AB32 emission reduction target rather than assigning emission reduction targets to individual measures. Furthermore, it is conceivable, that in addition to the strategies outlined below, new ideas and approaches will be identified through our public process that can be implemented to meet or exceed the targeted 3.5 $MMTCO_2E$ reduction in GHG emissions.

### *Goods Movement System-Wide Efficiency Improvements*

Under this proposed measure, California ports, railroad operators, shipping companies, terminal operators, ship owners/operators, importers, exporters, trucking companies serving ports and rail operation, government agencies, and the public would participate in developing and implementing programs to achieve system-wide reductions in GHG emissions from goods movement activities. These programs would be in addition to existing measures for goods movement sources, and would be developed over time through a public process. In many cases, these programs would involve innovative, incentive based approaches, or unique strategies specific to a company, port, or facility, that may not be feasible across an entire industry segment.

There are two components to this measure. One that focuses locally on California's four key goods movement corridors (Bay Area, Central Valley, Los Angeles/Inland Empire, and San Diego/Border Region), with particular emphasis on ports and intermodal rail operation. This component would achieve improvements in efficiency prior to 2020. The second component, which is discussed later in this section, focuses more globally and further into the future. This component would begin the process for identifying how to move from the current system to a low carbon, sustainable goods movement system, and evaluating opportunities to reduce GHG emissions from the overall goods movement system supply chain.

Key elements of the first component would be to:

- Estimate emissions and key contributors to the emissions;
- Assign emission reduction goals to the key contributors with particular emphasis on ports and intermodal rail operations;
- Identify and develop approaches to achieve the emission reduction goals;
- Develop trade corridor emission reduction plans; and
- Monitor implementation of the progress in achieving the emission reduction targets.

In addition to the Goods Movement System-wide Efficiency Improvement strategy discussed above, several other strategies have been identified as early action measures or will be considered in the near-term to reduce GHG emissions from goods movement activities. These strategies help to achieve the 3.5 $MMTCO_2E$ reductions in GHG emissions from goods movement activities and may be developed separately, or in conjunction with the Goods Movement System-wide Efficiency Improvements Measure. These strategies include:

### *Ships*

Ocean-going vessel speed reduction (VSR) is an early action measure primarily designed to reduce NOx emissions. The measure also provides reductions in diesel PM, SOx, and $CO_2$ emissions resulting from reduced fuel consumption. A voluntary VSR program is currently in place at the Ports of Los Angeles and Long Beach. For this measure, ARB would conduct a technical assessment of the impacts associated with VSR for ocean-going vessels. As part of the technical assessment, ARB would evaluate emission reduction benefits of a VSR measure for vessels entering and leaving California ports and vessels traveling along the California coast within 24 nautical miles (nm) and 40 nm. Both voluntary and regulatory approaches will be evaluated.

Another ship measure being proposed is the clean ship (or green ship) measure. Under this measure, the concept is to reduce fuel consumption and associated $CO_2$ emissions through a variety of technologies and strategies that improve the efficiency of ocean-going vessels. Concepts to be investigated include hull and propeller design in new ships, air cavity system to reduce hull resistance, advanced hull and propeller coatings and maintenance programs, advanced engine design optimized for efficiency, advanced heat recovery, operational controls, and wind power assistive devices.

### *Port Trucks*

In December 2007, the ARB approved a regulation to reduce GHGs, diesel PM, and NOx emissions from drayage trucks operating at California's ports and rail yards through retrofits and turnover of pre-1994 trucks. This early action measure will be implemented in two phases. The first phase requires all pre-1994 model year drayage trucks to be replaced or retired with newer model year trucks. The second phase requires all engines to meet or exceed the 2007 California and federal engine emission standards by December 31, 2013.

### *Long-Haul Trucks*

A heavy-duty engine efficiency measure could reduce emissions associated with goods movement through improvements which could involve advanced combustion strategies, friction reduction, waste heat recovery, and electrification of accessories. ARB will consider setting requirements and standards for heavy-duty engine efficiency, if higher levels of efficiencies are not being produced either in response to market forces (fuel costs) or federal standards.

### *Commercial Harbor Craft*

In 2007, the Board adopted an airborne toxic control measure (ATCM) for commercial harbor craft. ARB now proposes development of an educational program to help commercial harbor craft owners and operators improve efficiencies in the operation of commercial harbor craft by utilizing maintenance practices and operational improvements that would reduce GHG emissions. Examples of practices being evaluated that would reduce GHG emissions include: vessel speed optimization, optimized scheduling to reduce fuel consumption, regular engine maintenance, improved hull surface finish (smoothness), reduced hull fouling (seaweed and barnacles), greater use of navigational technologies (GPS, electronic charts, etc.), and improved propeller design and maintenance.

### *Cargo Handling Equipment*

In 2005, the Board adopted an ATCM for cargo handling equipment at ports and intermodal rail yards. Cargo handling equipment includes diesel-fueled vehicles operating at a ports or intermodal rail yards that are used to move cargo or are used for scheduled maintenance or repair activities. ARB would investigate and potentially develop a new measure to restrict unnecessary idling, which would reduce fuel consumption and associated greenhouse gases, criteria pollutants, and toxic air contaminants.

### *Transport Refrigeration Units*

Transport refrigeration units (TRUs) are refrigeration systems powered by internal combustion engines designed to control the environment of temperature sensitive products that are transported in trucks, trailers, shipping containers, and railcars. In 2004, the TRU ATCM was adopted to reduce diesel particulate matter (PM) emissions from TRU engines. A new measure is being proposed for TRUs that would go beyond the current ATCM and would be designed to limit the use of internal-combustion engine-powered TRUs on trucks, trailers, shipping containers, and railcars for extended cold storage at California distribution centers, grocery stores, and elsewhere.

Another strategy proposed for TRUs is the development of energy efficiency guidelines for refrigerated trucks and trailers. There are many possible energy efficiency improvements that translate into fuel savings and GHG emission reductions. To help educate the industry about these efficiency improvements a best practices guidance document, specific to perishable goods transport, would be developed.

### *Locomotives*

While no specific measures that address locomotives individually have been identified at this time, there are emerging technologies that show promise in reducing greenhouse gas emissions from locomotives. Technologies to reduce emissions from locomotives include replacement of conventional switcher locomotives with propulsion systems using multiple (two or three) diesel generators. Locomotives with these systems use engine power more efficiently by being able to better match engine power to the load being moved. These newer switcher locomotives are estimated to reduce fuel consumption by about 20 to 40 percent.

Another technology for switcher locomotives is the battery-hybrid drive, where a smaller diesel generator is used to charge a battery pack that provides power to an electric motor. The diesel generator shuts down when the battery pack is fully charged.

An emerging concept that is under evaluation is the use of a magnetically-levitated ("maglev") cargo system that is electrically propelled. Such a system is under evaluation for a 5 mile stretch from terminals at the Ports of Long Beach or Los Angeles, to the proposed Burlington Northern Santa Fe (BNSF) Southern California International Gateway (SCIG) rail yard facility, and the existing Union Pacific (UP) rail yard Intermodal Container Transfer Facility (ICTF).

Overall, ARB expects that, in addition to GHG reductions, these strategies would reduce diesel particulate matter (PM), NOx, SOx, and fuel consumption. Reductions from many of these measures are already counted in the Diesel Risk Reduction Plan and the Goods Movement Emission Reduction Plan. In addition, many of these reductions will benefit communities impacted by air pollution from goods movement.

## Long-Term 2050 Strategies

The electronic toys, clothing, and foodstuffs that California consumers purchase arrive here via a complex and integrated supply chain network that extends beyond California's borders. Achieving our 2050 goals will require California to take a serious look at the overall goods movement system or network and to begin now to put into motion the steps necessary to establish a low carbon sustainable goods movement network. To begin this process, ARB proposes to establish a Goods Movement Vision 2050 taskforce that would be charged with developing the steps needed to move toward a low-carbon, sustainable goods movement network in California by 2050. As part of this element, the taskforce would identify:

- Infrastructure improvements that foster efficient logistics systems and goods movement networks;
- Public policies that support and promote low-carbon goods movement networks;
- Programs to encourage consumer choices that promote efficient transport of goods to and through California; and
- Programs to foster and implement low-carbon transportation innovations.

It is envisioned that this effort will evaluate and consider a wide range of policies and programs that can be leveraged to help improve the overall goods movement system efficiency. Examples of just a few of the types of strategies include product labeling, consumer education, environmental awards, economic incentives, fiscal or technical assistance programs, and infrastructure improvements.

### *Emissions and Emission Reductions*

Measure T-6 targets an emission reduction of 3.5 $MMTCO_2E$ in 2020. ARB estimates that about 90 percent of the emission reductions will result from efficiency improvements that will reduce fuel consumption, and the remaining 10 percent will result from the conversion of diesel engine supplied power to grid supplied electrical power.

ARB also estimates that some of the strategies in this measure will achieve additional GHG emission reductions beyond California. For example, vessel design improvements such as advanced hull and propeller designs would achieve GHG emission reductions wherever the ship travels. Consumer labeling programs that encourage the purchase of lower carbon products could also result in benefits beyond California. These benefits are not quantified.

### *Estimated Costs and Savings*

The costs and cost savings due to Measure T-6 are difficult to estimate at this time because of the variety of control options covered under this measure, the flexibility provided to sources to determine the strategies that work best for them, and because some of the listed strategies are emerging technologies for which cost data is limited or unavailable. However, as shown in Table 8, ARB anticipates that the overall savings due to efficiency improvements and lower energy demand will offset the costs associated with implementing the strategies.

**Appendix C: Transportation**
**Table 8**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Ship Electrification at Ports (Discrete Early Action)* | 0.2 | 0** | ARB | 2007/2010 |

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Goods Movement Efficiency Measures<br>• Goods Movement System-Wide Efficiency Improvements<br>• VSR<br>• Clean Ships<br>• Port Drayage Trucks<br>• Commercial Harbor Craft Maintenance and Design Efficiency<br>• Cargo Handling Equipment Anti-Idling<br>• Transport Refrigeration Units Cold Storage Prohibition and Energy Efficiency | 3.5 | TBD | ARB | 2009-2010 |

*This measure has already been adopted by ARB.
**Costs and savings for Ship Electrification at Ports are the result of existing state policies and therefore are not attributed to the AB32 GHG emissions reduction program.

ARB assumes the overall cost of the measure will be offset by savings derived from improvements in energy efficiency because of the variety of technologies currently available with relatively short payback periods (e.g. where long-term fuel savings exceed capital costs). For example, a major tug operator is building an advanced hybrid, diesel-electric tugboat that will be launched in late 2008. The tug can use battery power for idle and low load operation when diesel engines are less fuel efficient, and for short bursts of power that supplement the diesel engines. The added cost of the hybrid tug is about $2 million higher than the standard tugboat. However, lower fuel and maintenance costs are expected to result in a payback period of about four years at current diesel fuel prices. The design also incorporates an electric winch system with regenerative braking that can help recharge the batteries. The batteries can also be charged using grid power when the tug is docked.[29]

The use of advanced heat recovery on ocean-going vessels provides another example of a strategy to reduce GHG emissions that can ultimately yield savings. This technology captures the exhaust heat from a ship's engine exhaust to produce steam that can operate a turbine. The power provided by the turbine can produce electric power that would otherwise be provided by diesel powered generators. The manufacturer of one system published a detailed technical paper estimating a pay-back period for this control option

[29] Foss Maritime. Personal communication with ARB staff, August 19, 2008.

ranging from about 5 to 10 years depending on the size of the main engine.[30] However, this estimate was prepared assuming a heavy fuel oil cost of $160 per metric ton. Fuel prices are now about four times higher, so the payback period would be substantially lower.

# D. MEDIUM- AND HEAVY-DUTY VEHICLES

## *(T-7) Heavy-Duty Vehicle GHG Emission Reduction (Aerodynamic Efficiency)—Discrete Early Action*

This measure would require existing trucks/trailers to be retrofitted with the best available technology and/or ARB approved technology. This measure has been identified as a Discrete Early Action, which means it must be enforceable starting in 2010. Technologies that reduce GHG emissions and improve the fuel efficiency of trucks may include devices that reduce aerodynamic drag and rolling resistance. The requirements would apply to California and out-of-state registered trucks that travel to California. The cost of these retrofits would be recovered over the life of the vehicle through reduced fuel use. This measure would require in-use trucks and trailers to comply through a phase-in schedule starting in 2010 and achieve 100 percent compliance by 2014. Additionally, new 2011 and later tractors and trailers that are sold in or service California would need to be certified for aerodynamic efficiency requirements. The 2020 estimated GHG reductions could be up to 6.4 $MMTCO_2E$ nationwide, of which about 0.93 $MMTCO_2E$ or about 15 percent would occur within California. The Board will consider this regulation in December 2008.

## *(T-8) Medium- and Heavy-Duty Vehicle Hybridization*

Hybrid electric technology offers the potential to significantly reduce GHG emissions and improve fuel efficiency. Hybrid technology provides the greatest benefit when used in vocational applications that have significant urban, stop-and-go driving, idling, and power take-off operations in their duty cycle. Such applications include parcel delivery trucks and vans, utility trucks, garbage trucks, transit buses, and other vocational work trucks. These entities may be affected by this measure. The implementation approach for this measure is to adopt a regulation and/or incentive program that reduces the GHG emissions of these types of new trucks sold in California.

[30] MAN B&W Diesel A/S. "Thermo Efficiency System (TES) for Reduction of Fuel Consumption and $CO_2$ Emissions." Undated.

**Appendix C: Transportation**
**Table 9**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Heavy-Duty Vehicle GHG Emission Reduction (Aerodynamic Efficiency)* (Discrete Early Action) | 0.93† | -521 | ARB | 2008/Phased-In Schedule for large fleets: 20% by end of 2010; 40% by end of 2011; 65% by end of 2012; 100% by end of 2013 |
| Medium- and Heavy-Duty Vehicle Hybridization | 0.5 | -6.4 | ARB | Pending |

*This measure would result in 5.5 $MMTCO_2E$ outside of California that ARB has not accounted for in this plan. In addition, while the net annualized cost of this measure accounts for the full cost of the equipment, only the fuel savings realized when the vehicle is operating in the State are accounted for as a benefit in the calculation. Analysis of the similar U.S. EPA SmartWay program indicates fuel savings can pay for the equipment within a few years.

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

# E. VEHICLE USE

## *(T-3) Regional Transportation-Related Greenhouse Gas Targets*

On September 30, 2008, Governor Arnold Schwarzenegger signed Senate Bill 375 (Steinberg, Chapter 728, Statutes of 2008) which establishes mechanisms for the development of regional targets for passenger vehicle greenhouse gas reductions. Through the SB 375 process, regions will work to integrate development patterns, the transportation network, and other transportation measures and policies in a way that achieves greenhouse gas emission reductions while meeting regional planning objectives. This new law reflects the importance of achieving significant additional greenhouse gas reductions from changed land use patterns and improved transportation to help achieve the goals of AB 32.

Senate Bill 375 requires ARB to develop, in consultation with metropolitan planning organizations (MPOs), passenger vehicle greenhouse gas emission reductions targets for 2020 and 2035 by September 30, 2010. It sets forth a collaborative process to establish

these targets, including the appointment by ARB of a Regional Targets Advisory Committee to recommend factors and methodologies to be considered for setting greenhouse gas emission reduction targets. The bill creates incentives for local governments and developers by providing relief from certain California Environmental Quality Act (CEQA) requirements for development projects that are consistent with regional plans that achieve the targets.

### Reaching the Targets

Transportation planning is done on a regional level in major urban areas, reflecting local land use patterns and decisions. Through efforts such as the "Blueprint" planning model, regions can select future growth scenarios that lead to more environmentally and economically sustainable and energy efficient communities. Blueprint plans are developed through an extensive public process which provides for local participation and accountability and allows regions to plan for population and employment growth along with housing needs, improved transportation infrastructure, retail services, recreation, resource protection and other regional needs. Blueprints have shown how such integrated planning can also lead to substantial financial savings for local and regional governments and the State because of reduced need for roadway expansion, maintenance, and other infrastructure. SB 375 states that it is the Legislature's intent to build upon the successful Blueprint process by requiring metropolitan planning organizations to develop and incorporate sustainable communities strategies that strive to reach regional greenhouse gas reduction targets. MPOs would use the sustainable communities strategy for the land use pattern underlying the region's transportation plan. If the strategy does not meet the target, the MPO must document the impediments and show how the target could be met with an alternative planning strategy. ARB will work closely with MPOs to develop and successfully implement sustainable communities strategies that meet the target.

Local governments will play a significant role in the regional planning process to reach passenger vehicle greenhouse gas reduction targets. Local governments have the ability to directly influence both the siting and design of new residential and commercial developments in a way that reduces greenhouse gases associated with vehicle travel, as well as energy, water, and waste. A partnership of local and regional agencies is needed to create a sustainable vision for the future that accommodates population growth in a carbon efficient way. Integration of the sustainable communities strategies or alternative planning strategies with local general plans will be key to the achievement of these goals.

State, regional, and local agencies must work together to prioritize and create the supporting policies, programs, incentives, guidance, and funding to assist local actions to help ensure regional targets are met. The supporting foundation needed to implement these land use and transportation strategies includes the following:

*Exercise State Leadership.* Promote low-impact development and reduce greenhouse gas emissions across all levels of government through the State's own building, operation, and planning efforts. The State will work to implement the State's planning priorities as stated in AB 857 (Wiggins) Infrastructure Planning: Priorities and Funding (Chapter 1016, Statutes of 2002). The State will use the Strategic

Growth Council as a coordination mechanism for meeting State government greenhouse gas reduction goals. The State will provide technical, fiscal, and regulatory priority to projects and developments consistent with regional blueprints that meet established targets. In addition, the Business, Transportation, and Housing Agency (BTH) will convene a group to identify regulatory barriers to housing and efficient land use and prepare recommendations on how such barriers can be addressed.

*Pursue Funding Sources and Allocate Effectively.* Align existing funding sources and help secure new funding to implement blueprints at the local level, support local climate change planning and projects, and incentivize the desired high-quality, low-impact projects. State agencies will allocate infrastructure bonds, where appropriate, to best promote efficiency, sustainability, and California's environmental, social equity, and economic goals. All levels of government should include greenhouse gas considerations in their funding decisions related to development.

*Improve Measurement through Partnerships.* Develop local government quantification protocols, improve transportation demand estimation tools, and develop better land use and transportation models that reflect the benefits of high-quality, low-impact development. The State will work with regions and local governments to identify existing models and tools for planning and progress measurement that better meet local and regional needs. The State will also partner with regional governments on the funding for and ongoing development of activity-based travel models in the major regions of the State, as recommended by the California Transportation Commissions' Regional Transportation Plan Guidelines, to enhance the quality of information and analysis presented to educate decision-makers and the public at large regarding the implications of various land use and transportation policy options.

*Promote High-Quality, Low-Impact (Resource-Efficient) Communities.* Establish a variety of mechanisms to recognize and support the building of livable, innovative projects and communities with low-carbon footprints to provide prototypes for future development. This includes support for infill, affordable and transit-oriented housing development and the land use changes necessary to increase such developments. Additionally, there must be recognition of broad community planning issues that will assure the overall success of the land use measures in the plan. State, regional, and local governments will pursue supporting mechanisms including regulatory actions, targeted incentives, and targeted funding.

*Identify Funding Sources for Local Level GHG Reduction Strategies.* Local governments need financial resources to engage in blueprint planning processes, update general plans and zoning codes, as well as to develop strategies to comprehensively reduce municipal and community GHG emissions. There is also a need for local government infrastructure funding to support more compact, infill development. ARB will pursue and investigate strategies to provide stable funding for these activities. The State will work with local governments to identify and

provide guidance on best practices to reduce GHG emissions from new and existing development. Specific attention and focus will also be given to strategies and resources that address GHG emissions reductions from existing development.

*Adopt Proven Measures*. Pursue proven emission reduction strategies, such as indirect source rules that mitigate high carbon footprint development and pricing measures that more accurately reflect the cost of driving and provide people with more transportation choices. All levels of government should adopt and implement feasible strategies, placing a high priority on measures with public health co-benefits.

*Amend CEQA Guidelines to Account for Greenhouse Gas Emissions*. Provide state guidance for determining significance and mitigating the GHG emissions of new projects. The Office of Planning and Research and the Resources Agency are developing proposed amendments to the CEQA Guidelines to provide guidance on how to address GHG emissions in CEQA documents. As required by Senate Bill 97 (Chapter 185, statutes of 2007) the amended CEQA Guidelines will be adopted by January 1, 2010. These guidelines will support projects that lower the carbon footprint of new development, and encourage programmatic mitigation strategies that may include reliance on adopted regional blueprint plans, Climate Action Plans, and general plans that meet regional and local GHG emissions targets and that have also undergone CEQA review.

*Conduct Outreach and Engage the Public*. Secure public support for the actions necessary to reduce greenhouse gas emissions from land use and transportation, and provide outreach and public education programs necessary to promote individual actions that help reduce greenhouse gas emissions. All levels of government, the business and development community, and the environmental and public health communities will work together to provide information on models/protocols, training, best practices, and funding sources for these outreach programs. The State will support and coordinate public engagement processes, including supporting public outreach efforts as integral elements in local and regional comprehensive planning efforts.

Any regulations, policies or guidelines that might impact residential development must ensure that housing supply and affordability needs, including the Regional Housing Needs Assessment, are advanced and not impeded.

Enhanced transit service combined with incentives for land use development that provides a better market for transit is key to reaching regional targets. Operating expenses comprise about 80 percent of regional transit spending, so funding of transit expansion is challenging. An ongoing and secure source of additional transit funding should be pursued to help regions integrate smart land use decisions with effective transit options. The reauthorization of the federal transportation funding bill, SAFETEA-LU, provides one opportunity to pursue funding for transit. This is one of several key issues California's transportation stakeholders have agreed to pursue next year during reauthorization efforts.

SB 375 and the regional target process established by the bill maintain the regions' flexibility in the development of their sustainable communities strategies. There are many different ways regions can plan and work toward reducing the growth in vehicle travel. Increasing low-carbon travel choices (transit, carpooling, walking and biking) and the need for development of the land use patterns and infrastructure that support these low-carbon modes of travel decrease average vehicle trip lengths by bringing more people closer to more destinations. The need for integrated strategies is supported by the modeling literature which indicates that land use and transit strategies on their own do not achieve very significant impacts but in combination provide more robust benefits. To achieve these results, barriers to more efficient land use and transit strategies must be addressed and could include the State and regions providing guidance or incentives for streamlining local approval processes and reducing discretionary approvals for multifamily, infill and affordable housing developments.

Supporting measures that should be considered in both the regional target-setting and sustainable communities strategy processes include the following:

- Congestion pricing strategies can provide a method of efficiently managing traffic demand while raising funds for needed transit, bike and pedestrian infrastructure investment. These strategies also have the potential to provide additional funds to augment declining transportation gas tax revenues. Federal approval and State authorization, however, must be provided for regional implementation of most pricing measures.

- Indirect source rules for new development have already been implemented by some local air districts and proposed by others for purposes of criteria pollution reduction. Regions should evaluate the need for measures that would ensure the mitigation of high carbon footprint development outside of the sustainable communities strategies or alternative planning strategies that meet the targets established under SB 375. In developing and implementing indirect source rules, local governments should consider the full spectrum of factors including affordable housing availability, economic impacts, other existing mitigation requirements (including fees), and potential unintended consequences.

- Programs to reduce vehicle trips, like employee transit incentives, telework programs, car sharing, parking policies, public education programs and other strategies that can enhance and complement land use and transportation strategies can be implemented and coordinated by regional and local agencies and stakeholder groups.

Separate emission reduction estimates for these three strategies are not quantified here. As regional targets are developed in the SB 375 process, ARB will work with regions to quantify the benefits in the context of the targets.

Another way to encourage greenhouse gas reductions from vehicle travel is through the concept of Pay-As-You-Drive Insurance (PAYD). Under a PAYD insurance structure,

drivers realize a direct financial incentive from driving less as premiums are heavily weighted on actual mileage. The California Insurance Commissioner recently announced support for PAYD and has proposed regulations that would allow insurance companies to make PAYD insurance available on a voluntary basis in California.

### Estimating the GHG Benefits of Regional Targets

The ARB estimate of the statewide benefit of regional transportation-related greenhouse gas emission reduction targets is based on research results quantifying the current effects of land use and transportation strategies on passenger vehicle greenhouse gas emissions. The estimate does not establish the statewide metric for regional targets that must be developed as SB 375 is implemented.

To help staff estimate the possible impacts of land use and transportation strategies for the Scoping Plan, ARB co-funded a study conducted by the UC Berkeley Transportation Sustainability Research Center, led by Dr. Caroline Rodier, to review the modeling literature of land use, transit, and auto pricing strategies.[31] The UC Berkeley study analyzed the results of over twenty modeling studies from California (including modeling scenarios from the major MPOs), other states, and Europe. The final report for the study, which was completed on August 1, 2008, found that the modeling estimates fell in a range of 0.4 to 7.7 percent reduction in per capita vehicle miles traveled (VMT) from a trend or business-as-usual base case due to land use and transit strategies over a 10-year time horizon. This estimate does not include the potential reductions from other policies such as pricing which will be considered during the target setting process. To provide a reasonable estimate of the reductions achievable from this strategy, ARB chose to use the study's median value of 4 percent per capita VMT reduction, which calculates to a statewide reduction of 6.4 $MMTCO_2E$ from the 2020 passenger vehicle baseline that is modified to 5 $MMTCO_2E$ reductions when taking into account the emission reductions from the vehicle technology and efficiency measures in the Scoping Plan. This value should not be interpreted as the final estimate of the benefits of this measure. The current academic literature supports this realistic statewide estimate of potential benefits, but the ultimate benefit will be determined as an outcome of SB 375 implementation on a regional level. The incentives for sustainable planning in SB 375 can set a new path for California. ARB's establishment of regional targets in 2010, combined with the Regional Targets Advisory Committee process, provides a clear mechanism for maximizing the benefits of this measure.

The estimate for regional targets in the Discussion Draft was "at least 2 MMT" which the Appendices indicated was a preliminary estimate that may change as a result of further analysis. ARB staff based its higher estimate on several factors, including data from the UC Berkeley study that was not available at the time of the draft.

- The modeling scenario analysis performed in the UC Berkeley review indicated that the studies reporting the highest impacts tended to be those that used the most

[31] Rodier, Caroline, UC Berkeley, Transportation sustainability Research Center, *"A Review of the International Modeling Literature: Transit, Land Use, and Auto Pricing Strategies to Reduce Vehicle Miles Traveled and Greenhouse Gas Emissions," August 2008.*
http://www.arb.ca.gov/planning/tsaq/docs/rodier_8-1-08_trb_paper.pdf

sophisticated land use and travel models which more accurately assess the travel effects of integrated land use and transit strategies so common in California blueprint planning. The review also suggested that the lower impact estimates were often those with less sophisticated modeling tools or very modest strategies.

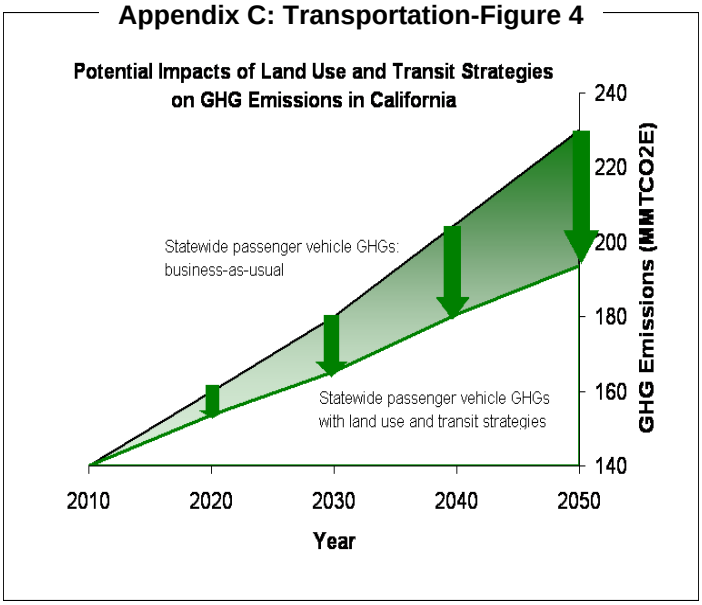
- It is common practice for modeling studies to show results for all on-road vehicle travel; so the range of percentage impacts reported in the UC Berkeley review would show higher percentage impacts if passenger vehicles were assessed separately.
- Modeling literature includes very few results for a 10-year time horizon. The UC Berkeley analysis took the time to perform a uniform extrapolation method to estimate 10-year results from all the modeling scenarios reviewed, allowing ARB staff to more fully consider the possible impacts from a shorter time horizon.
- A recent analysis on the impact of gas prices on transportation behavior indicates a growing market for infill development closer to job centers and transit that could possibly speed up the rate of land use strategies in a 10-year time horizon (SACOG, Item #08-8-14, Transportation Committee, July 30, 2008).

The UC Berkeley literature review helps point out that a range of impacts in different regions is due to many factors, including the capacity for reductions that takes into account the current built environment of development patterns, housing and job densities, the transportation system, and other factors; modeling capabilities of regions which can effect policy making as well as estimates; and the aggressiveness of land use and transportation planning policies in a region, including the projected level of more compact, mixed-use development with higher residential and employment densities served by transit. Thus, just as the impact estimate of regional targets does not establish a statewide metric for regional targets, the estimate does not presume a uniform percentage reduction from each region in the State.

### Long-Range Benefits of Land Use and Transportation Strategies

It is important to emphasize the long-range benefits of land use and transportation strategies, especially in helping California reach its 2050 goal of 80 percent below 1990 levels. The benefits of integrated land use and transportation strategies accumulate over time as new development patterns become a larger and larger part of the overall regional picture. Population is estimated to increase by 13 percent between 2010 and 2020, but is projected to increase 52 percent by 2050. The impact of land use and transportation strategies may be modest by 2020, but if we begin now, the accumulation of benefits over the next 20, 30, 40 years can result in very significant benefits compared to business as usual. The UC

**Appendix C: Transportation-Figure 4**



Berkeley review indicates that per capita vehicle travel reductions due to land use and transportation strategies could double in the 20-year time horizon and double again by 2050. Figure 4 above illustrates the potential long-range benefits of land use and transportation strategies based on the scenario modeling median values in the UC Berkeley review[32]. These benefits, in combination with our vehicles and fuel standards will help California to cost-effectively achieve its 2050 greenhouse gas goals.

### Additional GHG Benefits of Regional Targets and Land Use Strategies

Land use and transportation measures that help reduce vehicle travel will also provide multiple benefits to Californians. Quality of life will be improved by increasing access to a variety of mobility options such as transit, biking, and walking, and will provide a diversity of housing options focused on proximity to jobs, recreation, and services. Other important State and community goals that could be met through better integrated land use and transportation planning include agricultural, open space and habitat preservation, improved water quality, positive health effects, and the reduction of smog forming pollutants.

The impact of growing more sustainably by building more compact, mixed-use developments near jobs and transit will also provide real greenhouse gas energy savings. Heating and cooling less space results in less energy used. These land use-related energy conservation savings will help the Scoping Plan's Energy Efficiency measure to achieve the goal of reducing electricity and natural gas usage. ARB is continuing to evaluate the GHG reductions that may be additional to the proposed measures in this plan.

### Costs

Total cost of emissions reductions for this measure will ultimately depend on the selection of strategies to be implemented. Overall, changes in this sector are anticipated to result in long term cost savings for all levels of government. While some savings may accrue in the 2020 timeframe, current research and practice indicates that much greater cost savings from smarter growth strategies and reduced vehicle travel are likely to accrue in the 2050 timeframe, and most significantly from avoided capital cost expenditures. Recent scenario planning work reveals order of magnitude figures for cost savings on state- and region- wide bases. At the regional level, the Sacramento region's Blueprint planning process has projected that implementation of their compact regional growth plan will yield a savings of about 12 percent ($1.8 billion) in transportation system capital spending from a business as usual scenario in 2050 (SACOG Blueprint 2004). In 2000, the statewide Envision Utah scenario planning process estimated that implementation of a statewide compact growth plan would yield a potential 17 percent ($4.5 billion) infrastructure cost savings from business as usual development (Ewing et al. 2007, Envision Utah 2000).

Recognizing that resource allocation is often a balancing act, local, regional, and state agencies will need to work together to identify, leverage, and use existing funds, resources, and tools to advance GHG efficient land use and transportation efforts, with

[32] Note that Figure 4 here does not include the benefits from continued reduction in vehicle and fuel GHG's due to our other programs.

special attention towards investments that also help forward other economic, health, social, and environmental goals.

**Appendix C: Regional Targets**
**Table 10**

| Reduction Measure | Potential 2020 Reductions MMT$CO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Regional Transportation-Related Greenhouse Gas Targets* | 5 | -1554 (aggregated) | Local Governments / ARB / Regional Planning Agencies | Local actions have begun already in some areas<br><br>Set targets by January 1, 2010 |

*This is not the SB 375 regional target. ARB will establish regional targets for each MPO region following the input of the regional targets advisory committee and a consultation process with MPO's and other stakeholders per SB 375
†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## Other State Agencies' Supporting Measures

The Land Use Subgroup of the Climate Action Team (LUSCAT) April 2008 submittal to ARB included actions that State agencies have committed to implementing that will help create the supporting foundation for actions by local and regional agencies. The Department of Housing and Community Development, the State Water Resources Control Board, the California Energy Commission, the California Department of Transportation, the Department of Conservation, and the Governor's Office of Planning and Research all submitted strategies to LUSCAT. No greenhouse gas emission reduction estimates were included in most actions; however, in aggregate they may result in substantial assistance for the local actions necessary to reach regional targets.

### *Technical Assistance*

*Housing Element Technical Assistance.* The State Department of Housing and Community Development will update technical assistance and outreach efforts to include climate change considerations for housing elements.

*Energy-Aware Planning Guide Update.* The California Energy Commission will update the existing Energy Aware Guide to provide policy and technical assistance to regional and local governments.

*GHG Mobile Source Technical Guidance.* The California Department of Transportation will set up a framework that ensures that GHG emissions from mobile sources are addressed in the transportation plans and projects. The framework would include

development of appropriate mitigation measures, technical guidance and modeling tools, and incorporate analysis of economic and environmental benefits associated with energy efficiency measures and emission reduction strategies into the State Transportation Plan and subsequent Action Plan.

*2010 State Transportation Improvement Program (STIP) Guidelines.* The California Transportation Commission will update the STIP Guidelines to describe policy, standards, criteria and procedures for the development, adoption and implementation of the STIP. Potential strategy metrics include the number of projects that promote pedestrian, bicycle, transit and rail access.

*Staff Training and Public Education.* The California Department of Transportation will include the subject of climate change and GHG emissions in the Department's training program, enhance outreach efforts, maintain a website and convene educational forums.

### *State Guidelines*

*Regional Transportation Plan (RTP) Guidelines Update.* The California Transportation Commission and California Department of Transportation will update the RTP Guidelines to incorporate meeting AB 32 GHG emission reduction targets and to enhance the use of regional blueprint plans.

*GHG Emissions in CEQA Guidelines.* The Governor's Office of Planning and Research will develop CEQA guidelines for mitigation of GHG emissions. Per SB 97, the guidelines must be submitted to the Resources Agency by July 1, 2009 and the Resources Agency shall adopt the guidelines by January 1, 2010.

*Watershed-Friendly Landscape Guidelines.* The California Integrated Waste Management Board is developing a set of landscape guidelines for use throughout the State. A well-designed and maintained landscape can cost less to maintain in the long run by consuming fewer resources. Although the primary objective is to protect watersheds through the use of sustainable landscaping practices, a secondary motivation is the reduction or avoidance of GHG emissions. These guidelines will be consistent with the provisions of AB 1881, signed by the Governor on September 28, 2006. This legislation requires the California Department of Water Resources (DWR) to update the State Model Water Efficient Landscape Ordinance, based on recommendations set forth in the Landscape Task Force report, by January 1, 2009.

### *Funding, Incentives and Grants*

*Affordable Housing Finance Incentives.* State Department of Housing and Community Development will promote emission reductions and energy conservation in HCD administered funding programs.

*Climate Change Criteria for State Water Resources Control Board Grants.* The State Water Resources Control Board will incorporate climate change criteria in the new grant programs under the Safe Drinking Water, Water Quality and Supply, Flood Control,

River and Coastal Protection Bond Act of 2006 (Proposition 84) – Clean Beaches, Storm Water, and Agricultural Water Quality grant programs.

### *Updated and New Programs or Policies*

*Complete Streets.* The California Department of Transportation will provide improved safety and convenient access to all users of streets, roads and highways. Implementation of greening policies (street trees and green landscaping) are essential components to this measure. Other components include the use of alternate paving, retrofit of existing signals and crosswalks with improved technologies, inclusions of Complete Streets policies and strategies in General Plans, among other infrastructural improvements.

*Smart Mobility Framework.* This framework, under development by Caltrans, U.S. EPA, and a consultant team, will create an assessment screening tool that will advise transportation infrastructure planning and investment decisions consistent with "Smart Mobility" principles. The tool will foster implementation of the Governor's Strategic Growth Plan and will help the Department address GHG reductions within its own operations. Through Caltrans' leadership and extensive collaboration with local and regional partners, the tool will be expanded and made available for use by local and regional agencies to assess their plans, programs, and projects against smart mobility principles.

*Reverse Perverse Incentives to Develop Agricultural Lands.* The Department of Conservation will determine whether state and federal tax law encourages the conversion of agricultural lands to urban or other uses.

*Working Lands Protocol Pilot Program.* The Department of Conservation proposes a strategy to develop a model planning program to guide local land use decision makers in valuing ecosystem services on land.

*Transfer of Development Rights.* The Department of Conservation proposes to allow an individual with a zoning or other planning right to develop residences, to sell that development right to another person, gaining the seller income and allowing an increase of residential density for the buyer. This could be used as a method to support other (Blueprint) planning goals and objectives.

*Subsurface Cleanup Technology.* The State Water Resources Control Board may, upon approval, set up a strategy to require the lifecycle of GHG emissions to be calculated for contaminant removal technologies. Emissions calculations would be considered when evaluating the preferred technology for a given cleanup site. Periodic cleanup reports would be required to include actual GHG emission data, based on hours of operation, utility bills or other readily available information.

# F. RAIL

## *(T-9) High Speed Rail*

This measure supports implementation of plans to construct and operate a High Speed Rail (HSR) between Northern and Southern California. As planned, the HSR is a 700 mile long high speed rail system capable of speeds in excess of 200 miles per hour on dedicated, fully-grade separated tracks with state-of-the-art safety, signaling and automated rail control systems. The system will serve the major metropolitan centers of California in 2030 and is projected to displace between 86 and 117 million riders from other travel modes in 2030. For Phase 1 of the HSR system, between San Francisco and Anaheim, 2020 is projected to be the first year of service, with 26 percent of the projected full system 2030 ridership levels.

Development of HSR presents a significant opportunity to reduce greenhouse gas emissions by offering the state more GHG efficient travel options and alternatives to business as usual.

HSR implementation was approved by the voters in November 2008. Construction of HSR is anticipated to begin in 2010, with full implementation anticipated in 2030.

Based on best available data, construction costs of the HSR system are currently estimated to be $40 billion, and by 2030, the system is projected to generate nearly $900 million in revenues and return a surplus to the state of more than $300 million. Neither the costs of, nor the revenues from the High Speed Rail measure are attributable to AB 32 implementation because they were already underway.

In order to ensure GHG emissions benefits from HSR, it is imperative that supplementary land use strategies are implemented. These strategies should ensure that growth around the rail is accommodated by GHG efficient land use patterns. There are a number of different approaches to accomplish this that would need to be further analyzed. One example would be to create an interregional transportation and land use body that would identify ‘smart corridor’ development areas around the rail system for preferential funding and permitting incentives.

**Appendix C: Transportation**
**Table 11**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| High Speed Rail | 1* | 0** | TBD | 2010-2030 |

*Estimates are based on the benefits of displacing air passengers and motor vehicle passengers minus the energy to operate HSR.
**Costs and savings for High Speed Rail are the result of existing state policies and therefore are not attributed to the AB32 GHG emissions reduction program.

# 5. ELECTRICITY AND NATURAL GAS

**This section includes the following measures:**

**Recommended Actions**

**California Cap-and-Trade Program Linked to the Western Climate Initiative**

**Energy Efficiency**

- **(E-1 and CR-1) Energy Efficiency**
- **(CR-2) Solar Water Heating[33]**
- **(E-2) Increasing Combined Heat and Power**

**Renewable Energy**

- **(E-3) Renewables Portfolio Standard**
- **(E-4) Million Solar Roofs**

ARB worked closely with the CAT and its sector-specific subgroups in developing the measures included in this Plan. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

## Overview

The California economy, and indeed the well-being of all California's citizens, depends on an adequate, reasonably-priced, and environmentally-sound supply of energy. Yet, uncontrolled fossil-fuel combustion produces greenhouse gases (GHGs), the primary contributor to climate change. California's challenge, like that of the rest of the world, is to maintain a growing economy while decreasing energy-related contributions to GHG emissions and resulting adverse environmental consequences. Two overarching strategies for obtaining GHG reductions from the electricity and natural gas sectors are demand-side strategies that reduce energy use, and supply-side strategies that lower GHG emissions associated with electricity generation.

California has a long history of pursuing energy efficiency and other demand-side management strategies, as a cost-effective and successful means of reducing California's energy needs and forestalling the need for additional power plants. Looking ahead, energy efficiency will be California's most effective tool for achieving GHG reductions in the electricity and natural gas sectors. California must enhance existing efficiency programs and institute new policies and programs to achieve unprecedented levels of energy savings.

Supply-side strategies complement demand-side strategies by reducing the emissions associated with electricity generation. California has made commitments to renewable energy and will continue to push the electric utilities and other electric service providers (ESPs) to meet increasing portions of their energy resource portfolios with both large-scale and distributed

[33] Solar Water Heating is both an Energy Efficiency and Renewable Energy measure. In many applications, solar water heating supplements natural gas water heating. Both solar water heating and increased efficiency in natural gas water heating results in a reduced on-site gas consumption. From a "supply side of the meter, " or carbon emissions reduction viewpoint, efficient use of solar water heating are indistinguishable.

renewable generation, including solar resources. Emission reductions will also come from increased use of other forms of distributed generation such as fuel cells, and combined heat and power (CHP) systems.

Finally, there are mechanisms that could specifically target high-emitting sources of electricity, such as coal, by putting limitations on the emissions associated with electricity that retail providers purchase and/or deliver to California consumers. The Emissions Performance Standard (EPS), is an existing law[34] that precludes California's electric service providers from making investments in, or using long term contracts to procure baseload electricity generation that emits more carbon dioxide than a combined cycle gas turbine (CCGT). The EPS effectively prohibits the procurement of baseload energy from coal-fired power plants (unless they sequester $CO_2$) and other higher-emitting power plants. During its rulemaking proceedings for the proposed EPS for investor-owned utilities, the CPUC noted that the measure had helped prevent the development of 30 coal-fired power plants that had been proposed to serve California's electricity market. This measure's could influence the power-development market in the western U.S., potentially resulting in reduced development of other high carbon- or high GHG-emitting facilities in the future.

### *Background*

This section of the Scoping Plan addresses emissions associated with electricity production for the residential, commercial and industrial sectors, and natural gas consumption in residential and commercial applications. Emissions due to the extraction, refining, and transportation of fuels, and industrial uses of natural gas, are addressed in the Industrial Sector. CHP is discussed here and in the Industrial Sector; however, GHG reductions are attributed to the Electricity Sector.

Electricity generation from central power plants and distributed sources such as CHP systems was responsible for approximately one quarter of all greenhouse gas emissions in California in 2004, or about 120 $MMTCO_2E$. This makes electricity production second only to transportation in terms of its contribution to California's carbon footprint. Natural gas consumption in residential and commercial buildings accounted for about nine percent of GHG emissions, and the additional emissions are attributable to the heat output portion of CHP.

### *Electricity Overview*

California's energy ownership and delivery structure is complex and involves many different players. Five major utilities provide about 80 percent of the electricity currently consumed in California. These utilities are: Pacific Gas and Electric Company, Southern California Edison, San Diego Gas & Electric; Los Angeles Department of Water and Power, and Sacramento Municipal Utility District. About 70 other entities provide the remaining 20 percent. These include Energy Service Providers (ESPs), small and multi-jurisdictional investor-owned utilities, small publicly-owned utilities, irrigation and water districts, rural cooperatives, Native American utilities, and the California Department of Water Resources. This electricity is delivered through a network of transmission and distribution lines that connect California to the other western states. Distribution systems transfer high-voltage power from the transmission grid through

[34] CCR §§2900-13 and PUC §§340-341. The EPS requirement was established by regulation pursuant to AB 1368. The performance standard was developed for investor-owned utilities by the CPUC, and for publicly-owned utilities by the Energy Commission. The standards are equivalent, and limit emissions to 1,100 pounds of $CO_2$ per MWh.

substations, where the voltage is reduced. From the substation, distribution lines deliver power to customers.

California's electricity supply is quite diverse, with electricity coming from: fossil fuels; renewable resources such as small hydroelectric, wind, solar, biomass, and geothermal; distributed sources such as CHP and solar photovoltaic systems; large hydroelectric sources such as Shasta and Bonneville Dams; and nuclear facilities. This resource mix has changed over the years. In the late 1970s, petroleum was the fuel source for over half of the state's electricity. Today, cleaner-burning natural gas produces between 40 and 45 percent of the state's electricity, and renewable resources account for about 12 percent[35]. The fuel diversity in this electricity mix helps to insulate California's economy from price shocks and supply disruptions, increases the reliability of the electricity system, and provides multiple environmental benefits.

The exact makeup of California's electricity supply varies from year to year primarily as a result of two factors: the variability of hydroelectric resources, and increasing amounts of renewable energy resources over time. The availability of energy from hydroelectric resources varies significantly depending upon precipitation patterns in California and the Pacific Northwest. A year in which there is below average rainfall or snowpack means that less electricity is produced from hydro-electric resources, and other resources (usually natural gas) must pick up the difference.

Over the last three decades, the state has built one of the largest and most diverse renewable generation portfolios in the world. As California meets its Renewables Portfolio Standard, renewables displace fossil fuels in the overall mix. It should be noted, however, that conventional resources – natural gas, nuclear, coal and large hydroelectric – will continue to be the mainstay of the state's resource mix through the 2020 timeframe. Even when California reaches its 33 percent renewable energy target, two-thirds of the state's electricity will still come from large hydropower, natural gas, and other conventional sources.

Between two-thirds and three-quarters of electricity consumed in California is generated in state, with the rest being imported from other western states, British Columbia and northern Mexico. A disproportionate share of California's electricity-related GHG emissions can be attributed to these imports. While imported electricity accounts for about 25 to 30 percent of total electricity consumed in-state, out-of-state power plants contribute more than half of the GHG emissions associated with California's electricity consumption. This is because California's imports are dominated by coal-generated electricity. California's Emission Performance Standard (EPS), discussed in greater detail in the *GHG Reduction Strategies for 2020*, below, will help to reduce emissions related to out-of-state coal generation.

Power plant emissions of criteria pollutants and toxics are strictly regulated in California. Fossil fuel-based electricity generation emits ozone precursors (VOC and $NO_x$) and particulate matter, both of which are serious public health concerns in our urban nonattainment areas. The Clean Air Act State Implementation Plan control measures will continue to reduce power plant-related emissions of criteria pollutants, and ARB's existing toxics program will continue to focus on

[35] As a percentage of 2007 total system power. See California Energy Commission, April 2008, 2007 Net System Power Report, Commission Report, CEC-200-2008-002-CMF, http://www.energy.ca.gov/2008publications/CEC-200-2008-002/CEC-200-2008-002-CMF.PDF.

emissions of toxic air contaminants. Further reductions in statewide emissions of these pollutants are expected as California's electricity mix shifts to increased percentages of renewable resources.

Several agencies regulate or oversee various parts of the industry. The California Public Utilities Commission (CPUC) has authority to regulate investor owned utilities (IOUs), community choice aggregators (CCAs), and ESPs. The publicly owned utilities (POUs) are largely self-governed, but recent legislation gives the CEC authority to track their energy efficiency programs and renewable energy purchases, and to regulate new long-term POU energy contracts and investments for baseload power, including an emission performance standard for GHG emissions associated with long-term POU contracts[36]. ARB and local air districts provide air regulation over in-state generation facilities, and the CEC has permitting authority over large thermal power plants.

### *Natural Gas Overview*

The largest use of natural gas is as fuel for electrical generation, which is responsible for nearly half of all natural gas consumed in the state. Residential customers use another 22 percent of the natural gas and of that amount, 88 percent is used for space and water heating. The remainder is used for commercial and industrial purposes. Commercial and industrial uses generally include boilers, heaters, and gas turbines (such as those used for CHP).

In 2006, California produced 13.5 percent of its own natural gas, with the remaining 86.5 percent coming from the southwest, Canada, and the Rocky Mountain region by pipeline. Once the gas arrives in California, 98 percent of it is distributed by the state's three major gas utilities – SDG&E, Southern California Gas Company, and PG&E. These utilities pipe natural gas to industrial, commercial, and residential customers.

California's natural gas demand growth is expected to be slower than the rest of the nation's, due largely to the state's energy efficiency programs and the use of renewable energy for electricity generation. Nevertheless, under a business-as-usual scenario, the demand for natural gas is projected to steadily increase.

This section of the Scoping Plan addresses GHG emissions related to commercial and residential use of natural gas for space heating, cooking, hot water (otherwise known as the "commercial / residential sector"), electricity generation, and CHP. CHP is also addressed in the Industrial Sector but the GHG reductions are attributed to the Electricity Sector.

## Energy Efficiency and Conservation

Energy efficiency is the cornerstone of California's energy strategy and is the state's highest priority energy resource. For more than three decades, California has led the nation with aggressive building and appliance standards and utility energy efficiency programs. These combined efforts are saving more than 40,000 GWh of electricity annually[37] – enough to power almost six million California homes. Due in part to these successful standards and programs, California uses less electricity per person than any other state in the nation. While per capita

[36] For more information, see the Energy Commission's web page on SB 1368 Emission Performance Standards, http://www.energy.ca.gov/emission_standards/.
[37] California Energy Commission, 2005, *Integrated Energy Policy Report*, CEC-100-2005-007CMF

electricity consumption in the United States increased by nearly 50 percent over the past 30 years, California's per capita electricity use remained virtually flat as illustrated in Appendix C Figure 5**.** Except for its use in generating electricity, natural gas consumption has also decreased on a per capita basis as building and appliance codes reduced the amount of natural gas needed to heat water, homes, and offices. California has only begun to tap its potential energy efficiency resources and can continue to achieve significant energy savings through further investments in energy efficiency technologies, standards, and programs.

Conservation is another strategy that reduces energy demand. Energy efficiency and conservation both have the effect of reducing the need for energy generation and fuel use, to the extent that they outweigh increased demand due to population and economic growth. Whereas energy efficiency is accomplished through better technology, conservation refers to changes in behavior. Buying a more efficient light bulb is an example of energy efficiency; turning it off as you leave the room is an example of conservation. During the electricity crisis of 2001, California consumers responded to the Flex Your Power campaign with impressive levels of conservation, proving that conservation is a viable strategy for reducing energy use.

**Appendix C: Electricity and Natural Gas**
**Figure 5: Per Capita Electricity Sales in Kilowatt Hours – California versus the United States**


Source: California Energy Commission

## Challenges to Meeting Future Demand

### *Population Growth and Energy Consumption Trends*

Unless efficiency and conservation programs are greatly expanded, population growth and changes in consumer behavior are expected to exceed the ability of current standards and utility programs to hold down energy consumption. Between now and 2020, the State's population is expected to grow to 44 million, or about 1.4 percent annually. The Southland's Inland Empire, and the Sacramento and San Joaquin Valleys are experiencing the highest rates of growth. The warmer and longer summers in these areas translate to more air conditioning use, especially during peak periods that coincide with the hottest time of the day. Further, if past trends

continue, consumers will purchase increasingly larger homes and appliances as well as a growing number of electronics and gadgets. These trends, taken together, will cause per capita energy consumption to increase, rather than decline, unless they are countered with much more aggressive energy efficiency measures.

### *Electrification of Transportation*

A second challenge for this sector is likely to come from transportation fuel switching – switching from gasoline and diesel to electricity. Examples are port electrification, plug-in vehicles, and the production of hydrogen (via electrolysis) for vehicles powered by fuel cells or internal combustion engines. As the transportation sector increasingly looks to alternative fuels in an effort to reduce GHG emissions, electricity consumption is expected to increase commensurately.

### *Climate Change Effects*

Another significant challenge in the energy sector may be climate change itself. Increasing average temperatures and incidences of heat waves – a result of climate change – has the potential to increase the demand for space cooling. Given the current infrastructure in place, this could force our less efficient power plants to run more often to meet demand. During the summer months, California also imports energy generated by hydropower from the Northwest to meet peak demand. Decreasing snowpack within California and throughout the west is likely to reduce the availability of this clean and relatively inexpensive hydropower source, further exacerbating the problem. In addition, a large number of power plants in California are located along the coast. The potential for sea level rise associated with climate change could have detrimental effects on the operation of those plants. In effect, the electricity sector must adapt to aspects of climate change that may already be unavoidable even as it plans to meet AB 32 GHG reduction goals to reduce the likelihood of further climate change.[38]

### *Building Transmission for Renewables and Modernizing Electricity Infrastructure*

Population growth in hot areas and the need to reach remote renewable generation regions both require adding electricity transmission capability. Without new transmission lines, a 33 percent target for the Renewable Portfolio Standard (RPS) is unlikely to be met. Several recent developments are enhancing the likelihood that these new lines can be built by 2020. The Renewable Energy Transmission Initiative (RETI) is bringing together utilities, government agencies, renewable developers, the California ISO, environmental groups, land owners, and Native American representatives to identify the highest priority renewable energy zones and transmission paths to deliver electricity to urban areas. In addition, federal and State transmission corridor planning processes aim to reduce the time needed for permitting and environmental review of new transmission.

Equally important to building transmission is modernizing the transmission and electricity distribution system. Advanced control, communications, and metering technologies, as well as improvements in control of both conventional and renewable generation, can create a more reliable, resilient grid. Such a grid will better accommodate the addition of large amounts of

[38] For an extended discussion of the expected impacts of climate change in California, see the webpage for the Fifth Annual California Climate Change Research Conference sponsored by the California Energy Commission, California Environmental Protection Agency, and California Resources Agency, http://www.climatechange.ca.gov/events/2008_conference/indix.html.

utility-scale intermittent wind and solar generation and distribution-level renewable energy. Smart grid improvements will also facilitate the use of demand side resources (for example, automated load-shedding) to maintain system reliability in the face of both increased "ramping" from growing residential cooling loads in the summer and increased daily and seasonal variability in electricity generation.

### *Power plant permitting and AB 32*

California's energy agencies have established a loading order for adding new resources to the electricity supply mix though the Energy Action Plan. The loading order specifies the new electricity supply resources will be added in the following order:

- increased conservation and energy efficiency to minimize increases in electricity and natural gas demand
- renewable energy resources and distributed generation
- additional clean, fossil fuel, central-station generation.

The Commissions also stated their support for improvements to the bulk electricity transmission grid and distribution facility infrastructure to support growing demand centers and the interconnection of new generation.

The CPUC has also established a 'carbon adder' as part of its process for reviewing procurement decisions by the state's investor-owned utilities. This adder, currently approximately $12.50 per short ton of $CO_2$[39], is intended to protect California's ratepayers from the financial risk associated with regulation of greenhouse gases in the future. The CPUC established this policy prior to adoption of AB 32, and this policy will help guide procurement decisions through the implementation process for AB 32.

While these policies make clear that the State's energy policy provides a strong foundation for the necessary transition to a low-carbon electricity supply, the existing permitting process for power plants in California does not allow these policies to take precedence. In part due to the decision under AB 1890 to eliminate the 'needs' test for new power plants being permitted by the California Energy Commission, permitting decisions on new fossil-fired power plants are no longer tied to consistency with the State's energy policies. Rather, the decisions on whether to apply for permits and whether to build permitted power plants are left to private developers. As the electricity market in California has changed through the years, this has resulted in a large number of power plants being proposed by developers that have either not been pursued through the permitting process or that have not been built after receiving a permit.

The Energy Commission, which has exclusive permitting authority for thermal power plants over 50 MW in California, is planning to initiate an investigation into how to better align its permitting process with the State's greenhouse gas and renewable energy policy goals. ARB intends to work closely with the Energy Commission during this proceeding. New power plants will be a critical part of the state's electricity mix in coming decades. Because the investments that are made in this new infrastructure in the next several years will become part of the backbone of the state's electricity supply for decades to come, this timely investigation will be a critical element of California's ability to meet both the AB 32 emission reduction target for 2020 and for the more ambitious target set by the Governor for 2050.

[39] Equivalent to approximately $13.80 per metric ton

## GHG Reduction Strategies for 2020

Slowing global warming requires meeting energy needs with zero- or low-carbon energy sources. Two overarching strategies for obtaining GHG reductions from the energy sector are demand-side strategies that reduce energy use, and supply-side strategies that limit or reduce the emissions associated with electricity generation.

Reducing energy demand through energy efficiency and conservation will continue to be California's most cost-effective tool for achieving GHG reductions in the energy sector. While California's past achievements in energy efficiency are impressive, we need to do much more in order to meet the AB 32 greenhouse gas targets. California must take actions that reduce per capita energy demand *significantly faster* than the rate of population growth. Among other things, this will require: dramatic improvements in how we build our homes and the appliances we use; making significant improvements to existing buildings; and replacing or increasing the efficiency of existing appliances. Because of the urgent need to reduce energy consumption as much as possible, California must put renewed emphasis on motivating consumers to conserve by using energy wisely.

Emission reductions will also come from the supply side, through increased use of renewable energy and other forms of clean, distributed generation, and through measures that limit the use of electricity generated from high GHG sources. Existing programs and policies already lay the groundwork for renewable energy in California. The enhanced Renewables Portfolio Standard (RPS) recommended in this Plan and in the recent joint CPUC-CEC Proposed Final Opinion will require IOUs, ESPs, and CCAs to meet 33 percent of their electricity sales with qualifying renewable power, such as wind, solar, biomass, geothermal, and small-hydropower resources. Additional savings will come from California incentive programs for small-scale solar photovoltaic and solar water heater systems. By tapping into these existing policies and programs, increasing targets, and addressing key infrastructure barriers, California will achieve significant GHG reductions. Other GHG savings can be achieved by removing financial barriers and developing supportive policies for combined heat and power and other forms of clean, distributed generation.

Feed-in tariffs may well be an important mechanism to increase the pace of development of new CHP and RPS-eligible renewable energy. AB 1613 (Blakeslee, Chapter 713, Statutes of 2007) authorizes the OUC to require feed-in tariffs for combined heat and power under 20 MW. Feed-in tariffs are in use in 16 European countries and have had marked success in stimulating rapid increases in the proportion of total electricity generation supplied by renewable generation technologies, and are a significant part to the European Union's GHG emissions reduction efforts. Ontario has recently adopted a set of feed-in tariffs, and several states in the US have limited feed-in tariffs and/or are considering legislation to establish feed-in tariffs.

Activities related to feed-in tariffs for RPS-eligible renewable resources include the following:

- SCE offers a limited set of standard offer contracts for biomass generation under 20 MW.[40]

[40] Southern California Edison Company, Biomass Program, website at: http://www.sce.com/NR/rdonlyres/AAEFDE22-AFD9-49EE-86AB-4248EC31949C/0/080314_BSC_FAQ.pdf. This program is not a true feed in tariff. As stated in the program introduction on the SCE website, "SCE reserves the right to accept or reject any contract submitted to SCE for its approval and execution." Because the utility is not

- The CPUC has directed investor-owned utilities to offer a limited quantity (about 480 MW) of feed-in tariffs for RPS-eligible projects up to 1.5 MW.[41]
- The CPUC is considering expanding the use of feed-in tariffs for renewable energy under 20 MW.[42]
- Currently the Energy Commission is exploring possible further expansion of feed-in tariffs in the 2008 IEPR Update proceeding.

In addition, the EPS, and other potential measures that could reduce net GHG emissions from emissions-intensive fossil fuel power plants, can ensure that cleaner power is delivered to California consumers[43]. The EPS is existing law[44] that precludes California's electric utilities from making investments in, or entering long-term purchase contracts for, baseload electricity generation with very high GHG emissions. While technology and fuel neutral, the EPS effectively reduces emissions from imported, coal-generated electricity as current contracts expire and are not renewed. EPS regulations were adopted by the CPUC for investor-owned utilities and by the Energy Commission for publicly-owned utilities. Both commissions adopted a maximum allowable emissions standard of 1,100 lbs CO2 per megawatt-hour (MWh).These regulations prohibit California utilities from entering new contracts of more than five years with power plants that emit in excess of what a modern, efficient combined-cycle natural gas baseload power plant would emit. Existing coal plants cannot meet this standard. Carbon capture and sequestration (CCS) would almost certainly be required for coal generation to meet this standard. In the absence of cost-effective CCS or some other solution for coal, California's coal-intensive utilities must plan to replace electricity from coal plants with power from less carbon-intensive resources when existing contracts expire.

Emissions reductions required by SB 1368 are not considered a separate measure in the Scoping Plan. However, carbon-intensive electric utilities will be able to take advantage of these mandated reductions to minimize their need for allowances under cap and trade. Such utilities will need to plan to replace high carbon-generated electricity with energy efficiency, renewables, and, if necessary, less carbon-intensive fossil resources.

California's utilities have contracts and/or ownership arrangements with five out-of-state coal power plants that will either expire by 2020, or change such that less coal-generated electricity is

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required to take generation at an feed-in tariff rate, this kind of standard offer may do little to solve the problems faced by small renewable energy developers. However, the program has had some success. The expiration date for SCE's Standard Contract for Biomass is 12/31/2008 or 250 MW, whichever comes first. As of early June 2008, SCE has 11 MW under contract, 23 MW in negotiation, and 22 MW of inquiries. If SCE does not reach 250 MW by 12/31/2008, SCE may consider continuing to offer the contracts in 2009.

[41] The CPUC has two options for these feed-in tariffs: one is "full buy sell and RECs;"the second option is "sale of excess and RECs." For further details, see Decision 07-07-027 in Rulemaking 06-05-027.

[42] CPUC, June 5, 2008, "Amended scoping memo and ruling of assigned commissioner regarding Phase 2 of tariff and standard contract implementation for RPS generators," in CPUC Rulemaking 06-05-027, http://docs.cpuc.ca.gov/efile/RULC/83784.pdf, p,A-2 through A-5. Also see documents related to feed-in tariffs in the Energy Commission's 2008 IEPR proceeding, http://www.energy.ca.gov/2008_energypolicy/documents/index.html.

[43] Interstate commerce in electricity is federally regulated by FERC. The EPS regulations are technology and fuel neutral. To a large extent, FERC regulations have been generally technology and fuel neutral until recently.

[44] CCR §§2900-13 and PUC§§340-341, established by SB 1368 (Perata, Chapter 598, Statutes of 2006)

imported to serve California customers[45]. Expiration of and changes to these contracts will mean that, by 2020, California will reduce coal-based generation from imports by approximately 10,000 GWh, responsible for about 9.7 $MMTCO_2e$. The table below lists the specific coal plants and corresponding utilities that have contracts which will terminate by 2020:

- Intermountain Power Plant: LADWP, Riverside, Anaheim, Pasadena
- Navajo Generating Station: LADWP
- Boardman Plant: SDG&E, Turlock Irrigation District
- Deseret Plant: Riverside
- Reid Gardner Plant: Anaheim, Azuza, Redding, Imperial Irrigation District, Modesto, Silicon Valley Power, Department of Water Resources

Assuming that electricity from these plants is replaced with electricity from combined cycle natural gas, the EPS will reduce California's emissions from imported electricity by almost five million metric tons of CO2E emissions annually[46]. Larger reductions are possible if *renewable* electricity is used to replace coal power. However, it is important to note that leakage could be a problem if these plants, instead of reducing or ending production, merely sell coal-generated power to utilities in other states. This potential leakage could be mitigated under the anticipated regional, Western Climate Initiative (WCI) cap-and-trade system.

### GHG Reduction Strategies for 2050

Looking beyond 2020, research and deployment of new technologies will play an essential role in delivering the technologies needed to change the way we generate and use energy. The Economic and Technology Advancement Advisory Committee recognized the importance of pursuing technologies that are transformative in nature.[47] Two of the technologies that they highlighted are "smart grids" and carbon capture and sequestration:

- **Smart Grids.** Today's power grid was designed primarily to transmit electricity from central generation source to the point of consumption. A "smart" and interactive grid and communication infrastructure would allow the two-way flow of energy and data needed for widespread deployment of distributed renewable generation resources, plug-in hybrids or electric vehicles, and end-use efficiency devices.[48] Smart grids can accommodate increasing amounts of distributed generation resources located near points of consumption, which reduce overall electricity system losses and corresponding GHG emissions. Such a system would allow distributed generation to become mainstream, and would support the use of plug-in electric vehicles as an energy storage device by charging at night and supplying electricity to the grid during peak hours. The two-way flow of energy and data would also

[45] Ownership structures or contracts for the output of coal plants are complex and varied. The Intermountain plant, which alone was responsible for 14 MMTCO2e of GHG emissions in 2007, is under arrangements in which 97 percent of its current electric output serves customers of publicly-owned California utilities that are members of the Southern California Power Pool Authority. Under inter-related contracts, the share from Intermountain going to California utilities will decrease to 75 percent by 2020. Data from the CEC.
[46] If some or all of the generation is replaced by renewable generation, there would be additional reductions in GHG emissions.
[47] http://www.arb.ca.gov/cc/etaac/ETAACFinalReport2-11-08.pdf
[48] The demand side actions would be accomplished through efficiency, conservation, and fuel substitution strategies discussed elsewhere in this document.

allow customers to respond to price signals, and give consumers the ability to lower their electricity bills by reducing demand during peak times. Improved demand response capabilities would in turn allow grid operators more flexibility in responding to fluctuations on the generation side, which can help alleviate the current difficulties with integrating intermittent resources such as wind.

- **Carbon capture and storage (CCS).** CCS is any process that "captures" $CO_2$ emissions and stores or sequesters them away from the atmosphere. Geologic sequestration involves using gas separation technologies to capture $CO_2$ from large point sources, such as power plants, cement factories, or refineries, and injecting it deep underground. While the likely rate of deployment of CCS may not yield substantial reductions before 2020, CCS within California and the Western Electricity Coordinating Council (WECC) region has the potential to play a significant role in helping to achieve the GHG goals for 2050.

To reduce emissions to the level needed by 2050, California needs to promote innovation that produces significant improvement in technology and infrastructure. Furthermore, we must ensure that the policies and technologies deployed over the next few years do not detract from the implementation of even more promising technologies that emerge in the future.

### Economic Benefits

California can serve as a model for the nation by demonstrating that dramatic greenhouse gas reductions through energy measures are not only possible, but economically beneficial. Investments in energy efficiency are often highly cost-effective, and many consumers and businesses will find that it is possible to lessen their carbon footprint while simultaneously saving money. Other economic benefits will be gained as new energy technologies are developed to meet the climate change challenge. Investments in energy efficiency and clean energy technologies have been shown to provide numerous benefits on an economy-wide scale, by reducing the need for energy imports, cutting emissions and associated health-related costs, and creating high-paying jobs. As an added benefit of being a leader in clean energy technologies, many California companies will find that their technology innovations can be exported to other states and nations, creating additional jobs and other economic benefits that will ripple through the economy. Thus, there is no need to choose between the environment and the economy. We can create more jobs, reduce societal costs, *and* protect the environment by adopting policies that enhance energy efficiency and clean energy technologies. This can be accomplished through innovation and investment back into the California economy to stimulate the rigorous development of "green" industry.

Achieving these long-term benefits does not mean that customer rates for electricity and natural gas will not increase in the short term, even if overall system costs and average consumer energy bills, adjusted for inflation, are lower than they would have been with continued high consumption of fossil fuels. Modeling done as part of the CEC-CPUC joint AB 32 proceeding suggests that rates will increase significantly by 2020 in both a "business-as-usual" fossil fuel-intensive scenario or in scenarios based on high levels of efficiency and renewable energy. Increased rates in conjunction with reduced electricity or natural gas customer bills can result as energy efficiency is increased. This is because systems costs (transmission, distribution, and generation) will necessarily increase to meet population growth even as fewer kilowatt hours or therms are consumed. Thus, total costs are spread over fewer kilowatt hours or therms, leading to increased "per-energy-unit" rates. The costs of various potential future resource mixes for

electricity generation depend on many unknowns and are difficult to predict. Nonetheless, as demonstrated in California's previous energy efficiency and renewable energy investments, the numerous economic benefits from these programs can significantly outweigh the short-term costs.

This Plan is, in part, an initial look at economic costs and benefits of this and other recommended Emission Reduction Measures. ARB plans more detailed analysis to ensure that the overall AB 32 program does not have unreasonable near term costs and that small businesses, low-income communities, and all Californians share in the benefits.

#### Overlap with Other Sectors

The energy sector overlaps and intersects with many of the other GHG sectors discussed in the Scoping Plan. Because buildings use almost 70 percent of all electricity consumed in the state, green building measures hold promise for additional demand side energy reductions. Measures addressed in the Green Buildings and Local Government sections of the Scoping Plan therefore have significant implications for the electricity and natural gas sectors. Transportation is another area of significant crossover. Electricity and natural gas represent two alternative fuels for the transportation sector that are less GHG-intensive than gasoline or diesel, but shift emissions to the electricity and natural gas sectors. The Forest and Agricultural, and Recycling and Waste Sectors also offer GHG reduction measures that affect the Energy Sector. Biomass from forests or agricultural waste can be used as fuel for electricity production. Similarly, electricity can also be generated from landfill gas. In some cases, methane can be captured for direct injection into natural gas pipelines. The Water Sector is important as well. The conveyance, treatment, use, and disposal/recycling of water account for approximately one-fifth of the electricity and one-third of the non-power plant natural gas consumed in the State. Energy is also consumed through the use of water in buildings – for example, in water heaters and clothes washers. Not only can the Water Sector contribute to energy savings through water system and end use efficiency efforts, it can also support the development of renewable resources co-located with existing water-related infrastructure.

# Recommended Actions

## *Cap-and-Trade Program*

California is working closely with other states and provinces in the Western Climate Initiative (WCI) to design a regional cap-and-trade program that can deliver GHG reductions throughout the region. ARB will develop a cap-and-trade program for California that will link with the programs in the other WCI Partner states and provinces to create this regional market.

Consistent with the recommendations in the proposed decision issued September 12 by the CPUC and CEC[49], the WCI proposes to include the electric sector in the cap-and-trade program. As required under AB 32, California is examining the First Jurisdictional Deliverer as the point of regulation for the electric sector, ensuring that California and the WCI Partners cover

[49] Joint Agency proposed final opinion, *Final Opinion On Greenhouse Gas Regulatory Strategies*, September, 2008. The Executive Summary, Frequently Asked Questions, and a Joint Agency News Release summarizing the decision are available at: http://www.energy.ca.gov/ghg_emissions/index.html. The full text of the decision is available at: http://docs.cpuc.ca.gov/efile/PD/89317.pdf (CPUC website).

emissions from electricity generated in the Partner jurisdictions as well as emissions from electricity imported into the jurisdictions.

The WCI also proposes that emissions from residential, commercial, and industrial natural gas users be included in the cap-and trade program. Large users of natural gas would have a direct regulatory obligation under the program based on their facility emissions. WCI recommends that for small users (such as residential and commercial natural gas customers), the emissions be phased into the program, with the point of regulation being the natural gas local distribution companies (LDCs). These LDCs would have the compliance obligation under the cap-and-trade program.

Both mandated actions (such as compliance with the Emission Performance Standard for electricity generation) and voluntary actions (such as additional renewable generation beyond RPS requirements) will help some electric utilities and other capped entities stay under the cap. For example, under the EPS, utilities with coal contracts that expire before 2020 will not be able to enter new long-term contracts for coal-generated electricity without CCS. Thus, they will see a drop in emissions as imported coal power is replaced by renewable resources or less carbon intensive natural gas power. Although compliance with the EPS will not create offsets, changes in emissions resulting from existing law may help certain electric utilities meet their caps without buying allowances.

By setting a limit on the quantity of greenhouse gases emitted, a well-designed cap-and-trade program will complement other regulatory measures for electricity and natural gas and achieve additional reductions in greenhouse gases within this sector.

## *(E-1 and CR-1) Energy Efficiency*

Energy efficiency is first in California's "loading order" for meeting State electricity and natural gas needs, as expressed in the State's Energy Action Plan (EAP). The EAP, first adopted by the CPUC and CEC in 2003, represents a critical strategy for reducing this sector's GHG emissions. In order to meet our climate change goals, California must pursue very high levels of energy efficiency using more advanced approaches that go beyond traditional programs, standards, and delivery mechanisms.

This Plan sets statewide energy demand reduction targets of 32,000 GWh (E-1) and 800 million therms (CR-1) relative to business as usual projections for the year 2020.[50] These projected electricity and natural gas savings are based on the joint CPUC-CEC goal of achieving "all cost-

[50] The 32,000 GWh target is based on two reports: an IOU energy efficiency potential goals study done for the CPUC (Itron, prepared for CPUC, *Assistance in Updating the Energy Efficiency Savings Goals for 2012 and Beyond*, March 2008); and, a CEC report that projects potential energy efficiency savings for the POUs (California Energy Commission. *Achieving All Cost-Effective Energy Efficiency for California*, CEC-200-2007-019-SF, December, 2007.) The two energy agencies use somewhat different approaches to modeling their preferred policy scenarios for "all cost effective energy efficiency" combined with the 33 percent RPS goal. The CPUC and its contractor, E3, developed a "High Energy Efficiency and 33 Percent RPS" scenario, while CEC staff has used E3's model to develop a "100 Percent Economic Potential Energy Efficiency and 33 Percent RPS" scenario. Because they choose different economic assumptions for 2020, the agencies have used two different assumptions for 2020 energy efficiency potential in their scenarios. However, both assume energy efficiency potential at close to 32,000 GWh. In both agencies' scenarios, it is assumed that the 32,000 GWH of savings are net of about 15,000 GWh of energy efficiency believed to be "embedded" in the CEC's baseline demand forecast.

effective energy efficiency" as defined by a specific set of energy efficiency measures currently available "off the shelf." While aggressive, these targets do not comprise the full potential electricity and natural gas savings that would be achieved by 2020 if all energy efficiency strategies discussed below can be completely and successfully implemented. With strong success in all these strategies, ARB estimates potential energy efficiency savings of 40,000 GWh and over 1 billion therms relative to business as usual for 2020[51] could occur. This higher level of savings would better position California along the trajectory needed to meet the 2050 GHG reduction goal.

Achieving these levels of energy efficiency will require new approaches, now being developed, that go beyond building and appliance standards and beyond utility efficiency programs. The new paradigm needed for energy efficiency efforts will necessarily include groundbreaking activities across all economic sectors, leveraging past successes into new and bolder actions. It will require increased efforts, additional resources, commitments, and new levels of collaboration among state agencies such as the Building Standards Commission, the Department of Housing and Community Development, the

**Twelve Strategies for Maximizing Energy Efficiency**

**Cross-cutting Strategy for Buildings**

- *"Zero Net Energy" buildings*

**Codes and Standards Strategies**

- *More stringent building codes and appliance standards*
- Broader standards for new types of appliances and for water efficiency
- Improved compliance and enforcement for existing standards
- *Voluntary efficiency and green building targets beyond mandatory codes*

**Strategies for Existing Buildings**

- Voluntary and mandatory whole-building retrofits for existing buildings
- Innovative financing to overcome first-cost and split incentives for energy efficiency, on-site renewables, and high efficiency distributed generation

**Existing and Improved Utility Program Strategies**

- More aggressive utility programs to achieve long-term savings

**Other Needed Strategies**

- Water system and water use efficiency and conservation measures
- Local government programs that lead by example and tap local authority over planning, development, and code compliance
- Additional industrial and agricultural efficiency efforts
- Providing real time energy information to help consumers conserve and optimize energy performance

CEC, and the CPUC, as well as with investor-owned and publicly owned utilities, local governments, builders and property investors, and the manufacturers and installers of building

[51] Achieving the higher level of 40,000 GWh electricity savings would require additional actions not included in the Itron goals framework. Several of those actions, including water system electricity efficiency and consumer response to real time energy cost information, are among the strategies discussed in this section.

systems and equipment. Moreover, there must be equivalent efforts targeting owners and stakeholders serving our industrial and agricultural sectors. Beyond new technologies, better designs, and programs that facilitate improvements, California also can achieve GHG reductions through efforts that promote consumer awareness of and responsive action to manage energy costs and waste. If California is to capture maximum levels of energy efficiency, all of the 12 strategies listed in the preceding table, and additional strategies at earlier stages of development, will need to be aggressively implemented.

Discussed below are current efficiency strategies and new approaches that are needed to meet and exceed the recommended efficiency targets. For the new, more innovative strategies, specific efficiency programs are yet to be developed; however, meeting the minimum targets would likely require at least partial implementation of most of the energy efficiency strategies discussed below. In order to reach the higher projected efficiency potential, California would need to pursue these strategies more aggressively and completely. Following the discussion of the 12 strategies, this section discusses the need to continue research into advanced energy efficient technologies, systems and operations. The section concludes with an assessment of benefits and costs.

New energy efficiency strategies will target industrial, agricultural, commercial, and residential end-use sectors. For the building sector, new strategies include "zero net energy" (ZNE) buildings - a unifying concept that has been endorsed by both the CPUC and the Energy Commission in recent policy documents. California will need these new initiatives, strengthening of traditional building sector strategies of building standards and utility programs, and development of additional approaches to ensure leaving no efficiency opportunities overlooked.. All of the building strategies both support, and are enhanced by, the Green Building measures discussed elsewhere in Appendix C.

### Cross-cutting Strategy for Buildings

"Zero Net Energy" (ZNE) buildings provide an overarching framework for building energy efficiency while providing the features and amenities consumers want in a home. Such buildings are extremely energy efficient and generate enough energy on-site[52] to completely offset the energy consumed within the building over the course of a year. ZNE buildings are a step toward carbon-neutral buildings; green building strategies for construction, demolition and waste management are also needed.

#### *"Zero Net Energy" Buildings*

The Big Bold Energy Efficiency strategies (BBEEs) for ZNE buildings proposed by the CPUC[53] and called for in the Energy Commission's 2007 policy report[54] would require all new residential and commercial buildings to use zero net energy by 2020 and 2030, respectively.

[52] "Zero Net Energy" is not yet fully defined by the energy agencies. It may be possible for a building to rely on renewable energy generation from a nearby renewable, distributed generation facility and still meet the definition of zero net energy.

[53] These strategies were proposed by CPUC in 2007 and further developed in CPUC's draft Strategic Plan: CPUC, 2008. *California's Long Term Energy Efficiency Strategic Plan: Achieving Maximum Energy Savings in California for 2009 and Beyond*. http://docs.cpuc.ca.gov/efile/PD/86800.pdf

[54] California Energy Commission, *2007 Integrated Energy Policy Report*,CEC-100-2007-008-CMF, httpJc://www.energy.ca.gov/2007publications/CEC-100-2007-008/CEC-100-2007-008-CMF.PDF.

In addition to employing on-site electricity generation, true ZNE buildings must either replace natural gas with renewable energy for space and water heating, or compensate for natural gas use by producing surplus electricity for sale into the grid. Although not yet a goal of the energy agencies or the legislature, it may be possible to retrofit some existing buildings to a level of ZNE, providing even greater potential for emissions reductions. There are several concepts that must become standard practice in order to reach the targets set for ZNE buildings:

- Intermediate targets and stretch goals
  In the 2007 Integrated Energy Policy Report, the CEC recommends increasing standards for new buildings and appliance in each new iteration of the standards through 2020. With each revision, standards will bring buildings closer to the ultimate ZNE goal, in support of the ZNE targets for new homes (2020) and new commercial buildings (2030) established by the CPUC. The CEC plans to speed progress toward these goals by providing options to builders in the forms of "tiers." The first tier will be the traditional mandatory standard that increases in stringency with every code cycle. Additional tiers will be voluntary and represent a "reach" or "stretch" goal for advanced levels of energy efficiency. Establishing these "beyond code" options for new buildings provides a mechanism for testing new building efficiency strategies, and it is the testing of these new strategies that provides a pathway to the betterment of subsequent minimum codes.

  In order to quickly advance building practices such that zero energy homes become mainstream by 2020, California must establish programs and targets that encourage builders to exceed minimum codes, as this will be the proving ground for new building technologies and strategies. There are several specific measures in the Green Buildings section that would require local jurisdictions to meet "beyond code" targets.

- Zero Energy Heating and/or Cooling Technologies (ZEH/C)
  In Europe, many communities and buildings are heated and cooled through zero- or near-zero emissions technologies and systems that combine multiple technologies. Foremost among these technologies are geothermal heat pumps, advanced solar thermal water heating, fuel cells, and absorption chillers that can use heat from various renewable and low-emission sources to provide the work energy to cool water. These technologies are often most cost effective at the community or campus scale, combined with district heating and cooling. The California Alternative Energy and Advanced Transportation Financing Authority recommends that all electric and gas utilities be required to establish performance based incentives for ZEH/C systems. The ARB believes that this may be a promising mechanism for achieving additional emissions reductions as the technologies are further developed and introduced into California.

- Integrated Design
  Integrated design is a comprehensive strategy for delivering energy-efficient, high performance buildings at little or no additional cost. The approach brings all relevant players (architects, engineers, construction professionals) together at the start of the project, to analyze and optimize building performance and cost from the earliest design stages. As simple and obvious as it sounds, integrated design is not the norm. Making this process the norm would require guidelines and training for both practicing professionals and emerging design professionals in architectural and engineering schools.

- Passive Solar Design
  Another strategy that supports ZNE buildings is passive solar design. With our current understanding of building systems, it is possible to design most buildings (particularly residential buildings) such that the energy required for heating and cooling is minimal or nil. Even in cities as hot as Phoenix, well-designed homes can be substantially cooled by intelligent use of shade, orientation, and appropriate building materials. Such buildings will also require less heating energy in the winter. Orienting buildings to face south allows the sun to provide free heating in the wintertime, while window overhangs, strategically placed landscaping, and minimizing windows along the west side prevent overheating in the summertime. Exposing or adding thermal mass to the building allows it to "store" energy in its walls and floors, thus enabling the temperature inside to remain at a comfortable level for most of the day. Using simple, time-honored passive solar design strategies, buildings can be made to require much less energy than they do today. Some of these design principles will be captured in the new building standards, but there is a gap in the knowledge base. In order to ensure that building designers understand these concepts, it may be necessary to require passive solar design as part of architectural programs, exams, and ongoing professional education credits.

- Enable Sales of Surplus Generation into the Grid
  Under current law, customers of electric utilities may receive incentives for installing solar photovoltaic systems and several other less common renewable energy systems. However, with a few exceptions, customers participating in the Million Solar Roofs programs cannot sell electricity into the grid if they produce more than they consume on an annualized basis. This is a significant disincentive that makes it difficult for homeowners and businesses to create true ZNE buildings, because a true ZNE building, in most cases, would need to offset gas usage by producing "surplus" or "excess" electricity. To encourage zero energy buildings, utilities should be required to purchase surplus electricity generation at a fair rate that takes into consideration the time-value of electricity, the costs of production, the grid benefits, and the environmental benefits of solar and other distributed renewable generation. The CEC's 2007 policy report recommends that the CEC and the CPUC "work together to establish an appropriate feed-in tariff for excess generation from customer-owned solar installations based on the RPSA market price referent and time of delivery adjustment." [55]

- Moving Toward Zero Net Energy Existing Buildings
  Existing buildings use far more energy than the relatively small number of new buildings built each year. Existing homes can approach becoming zero net energy homes through improvements that combine solar (for electricity, heating water, and/or space heating) with efficiency retrofits of lighting, heating, cooling and duct systems and building envelope improvements. A major challenge is addressing the many housing types built as construction styles changed over the decades. Carefully targeted comprehensive ZNE programs could test and prove the concept of ZNE, or close-to-ZNE existing homes, retrofitted with measures appropriate to various vintages, styles and types of construction.

  ZNE existing commercial buildings are more challenging. However, such buildings are possible through major efficiency improvements combined with significant on-site

[55] CEC, *2007 Integrated Energy Policy Report*, CEC-100-2007-008-CMF.

renewable generation. Alternatively, the combination of combined heat and power (CHP) systems and energy efficiency "makeovers" can significantly reduce the carbon footprint of existing commercial buildings.

### Codes and Standards Strategies

Four of the twelve strategies listed above for electricity and natural gas are based on further development of the State's building and appliance energy efficiency codes and standards. These strategies will make standards more rigorous and will extend them to cover all energy used in buildings. In addition, increased focus on compliance and enforcement is needed. Finally, voluntary "tiers" above the minimum requirements will push technology development and mainstreaming, speeding progress toward reduced emissions. These strategies, along with an emphasis of on-site renewable energy, move California toward zero net energy buildings.

This section discusses current standards, recent changes in law and policy, and then specifically addresses the four strategies that will make building and appliance standards more effective in reducing GHG emissions to targeted levels by 2020.

Under California's Public Resources Code, the CEC is authorized to adopt and update Building Energy Efficiency Standards and Appliance Efficiency Regulations. Dating back to the mid-1990s, the IOUs efficiency programs have funded an important portion of the work to adopt tighter standards. These building and appliance standards are one of the most effective tools for achieving energy efficiency. Each successive version of the building and appliance standards requires new technologies and tighter performance standards, thereby generating new energy savings. By increasing the efficiency of buildings and appliances, the standards also help consumers and businesses save money on utility bills.

The building standards include both prescriptive and performance standards for new construction, and for alterations and additions to existing buildings. Alterations, especially to existing commercial buildings, are responsible for a significant part of the energy savings gained from the building standards. The CEC updates the standards at its discretion but typically on a three year cycle. The most recent update occurred in 2008, and several update cycles are expected to occur between now and 2020.

California's appliance standards improve the operation and efficiency of refrigerators, freezers, air conditioners, and other appliances. The Appliance Efficiency Regulations include standards for both federally-regulated appliances and non-federally-regulated appliances. The standards apply to appliances sold or offered for sale in California, with a few exceptions. As with the building standards, the CEC updates the appliance standards at its discretion. The CEC adopted the most recent appliance standards in 2007 and expects to go through several more update cycles between now and 2020.

By law, the building and appliance standards must be cost effective, when taken in their entirety and amortized over the economic life of the structure and/or appliance. The CEC includes an estimate of "avoided costs" as part of this life cycle cost analysis. Future iterations of the standards will incorporate updated fuel prices and a "carbon adder" in the calculation of avoided costs, and may also account for the likelihood that the installed cost of energy efficient technologies will decline with increased market penetration and resulting economies of scale.

Thus, future standards are expected to include a more accurate representation of the types of measures that are truly cost effective in today's world.

All of the technologies utilized to implement these energy efficiency standards are considered "off the shelf" in that they are readily available in the marketplace. As part of the process of updating the standards, the CEC evaluates new and emerging technology for possible inclusion in the next iteration. For the building standards, the CEC administers an ongoing "compliance option" process that evaluates what compliance credit should be approved for new technologies. Once a compliance option has been in existence for a period of time, the CEC considers whether it should be added to the standards. In that way, the compliance option offers a testing ground for new technologies and a pathway to becoming part of the standards. The CEC's Buildings and Appliances Office also works with the Public Interest Energy Research (PIER) program and the utility efficiency programs to identify promising new technologies for possible inclusion in the standards.

Recent policies have placed priority on and established specific goals for updates to the standards:

- The California Green Building Initiative (Executive Order S-20-04) calls for a 20 percent energy efficiency improvement in nonresidential building standards by 2015.
- The West Coast Governors' Global Warming Initiative established joint commitments for the States of Washington, Oregon, and California to improve their building energy codes (both residential and nonresidential) by 15 percent by 2015.
- The Energy Action Plan and the Integrated Energy Policy Report call for ongoing updates to the standards that meet energy efficiency goals, address demand response, and promote the combination of solar photovoltaics and high energy efficiency buildings.
- Zero Net Energy goals, discussed above, have been established by the CPUC and CEC for all new residential and commercial construction. Significant changes to the building and appliance standards will be required if California is to meet these targets on a statewide basis.
- Assembly Bill 662 (Ruskin, Chapter 531, statutes of 2007), AB 1881 (Laird, Chapter 559, Statutes of 2006), and AB 1560 (Huffman, Chapter 532, Statutes of 2007) give the CEC authority to regulate water efficiency. This legislation allows the CEC to develop efficiency standards that apply to both indoor and outdoor water use.
- Assembly Bill 1109 (Huffman, Chapter 534, statutes of 2007) requires the CEC to adopt minimum energy efficiency standards for general purpose lighting, to reduce electricity consumption 50 percent for indoor residential lighting and 25 percent for indoor commercial lighting.

In addition to the background and recent policy changes discussed above, the following four strategies, already under development at the Energy Commission, will play an extremely important role in meeting the 2020 electricity and natural gas energy efficiency targets. Thus, they are critical to achieving CO2e reduction goals.

### *More stringent building codes and appliance standards*

The Energy Commission regularly updates building and appliance standards, but past iterations have not yet set a path to zero net energy. To achieve emission reduction goals, each new iteration of standards must aggressively ratchet down building energy use, and must ultimately require on-site renewable energy production. The CPUC's Energy Efficiency Strategic Plan recommends progressive advances toward zero with each generation of standards.

Because energy efficiency is more cost-effective than on-site renewable generation, a measure of success will be how close good design can approach zero energy, minimizing the need for on-site generation.

### *Broader standards for new types of appliances and for water efficiency*

Current appliance standards cover a limited set of appliances and energy systems. Many consumer products that are not currently subject to California energy efficiency requirements offer significant potential for efficiency improvements. Standards must be broadened to cover all devices using significant amounts of energy, and, as required by Assembly Bill 662, AB 1881, and AB 1560, standards for water efficiency must also be set.[56]

The Energy Commission is expanding appliance standards to cover consumer electronics, a growing source of energy demand that has not previously been addressed by the standards. In addition, the Energy Commission is moving rapidly to cover other building "plug loads" such as small home appliances, and office computers and equipment. Other energy using devices, from plasma televisions to internal power supplies must eventually be covered to enable zero net energy new and existing buildings. Furthermore, new integrated systems, such as solar assisted space and water heating, need to be incorporated among the choices available to meet building performance requirements.

Future appliance standards should address the energy consumption of electronic devices that offer significant potential for efficiency improvements, such as flat screen TVs, computers, and portable electronics that with rechargeable batteries. These new "appliances" represent a significant (estimated at 15 percent) and growing portion of the overall energy use within a home. As an example, depending on technology developments and market penetration rates, future standards proposed by PG&E[57] for plasma and LCD TVs may be able to save approximately 6,500 GWh per year compared to what these devices would use without standards.

For some appliances, federal law preempts State authority to set more aggressive standards. (The federal government may grant waivers from preemption, but the legal criteria for waivers are stringent and so far the U.S. Department of Energy has been unwilling to grant them.) However, California is exploring whether regulation of appliance efficiency through the state's performance-

*New Heating Technologies*

Technology improvements which increase the energy efficiency of gas-fired water and space heaters continue to be developed. Condensing heaters, tankless gas-fired on-demand heaters and other super efficient gas-fired heating appliances will replace less efficient water and space heaters by attrition as they fail. As transitional technologies, these will, in turn, be replaced by carbon-free solar and new technologies as they reach the end of their life. The transition to carbon-free heating systems will occur over several decades.

[56] Assembly Bill 662, (Ruskin, Chapter 531, Statutes of 2007) gives the Energy Commission authority to set water efficiency standards.

[57] Energy Solutions, Codes and Standards Enhancement (CASE) Initiative For PY2008: Title 20 Standards Development: Analysis of Standards Options for Televisions (Revised Proposal), prepared for PG&E, July, 2008. Available online at: http://www.energy.ca.gov/appliances/2008rulemaking/documents/2008-07-16_workshop/proposals/PGE_Revised_Television_Proposal.pdf

based building standards can avoid some of the worst restrictions of federal law.

Further analysis is needed regarding the interaction of expanded use of plug-in vehicles, zero net energy homes, and remote renewable energy generation. While zero-net energy homes can reduce peak demand for afternoon off-site energy in California (usually met with fossil-fuel generation), increasing the night-time electricity load through plug-in electric vehicles could help utilize night-time renewable energy from remote, utility-scale wind generators.

### *Improved compliance and enforcement for existing standards*

Lack of compliance and enforcement of building and appliance energy standards has been identified as a significant barrier, especially in the application of standards to remodels and retrofits. The Energy Commission is beginning to increase its compliance activities, but more is needed. Additional state resources for compliance would enable the State to work more thoroughly with a greater number of local governments. This is important because local governments have the primary responsibility for building code enforcement, yet need additional support to be more effective in enforcing compliance with energy standards. The State could assist local governments with additional training activities for local building department inspectors and plan checkers, training for contractors and builders, training for energy related trades (e.g., plumbers, electricians, controls technicians and engineers). The state could also support enforcement activities by developing and providing to localities information on best practices for energy efficiency code enforcement. Furthermore, the CEC is in the process of streamlining compliance verification tools and mechanisms; additional work may be needed in this area if resources are available. Work in this area will need to fully involve local government building departments, utilities, the Building Standards Commission, the Department of Housing and Community Development, home and building raters and rating organizations, builders and designers, and other private and non-profit stakeholders.

### *Voluntary targets for efficiency and green buildings beyond mandatory codes*

State building energy standards set minimum acceptable levels of building performance. To drive innovation and rapid growth of the best new technologies, it is important to encourage builders to go “beyond code.” There are a variety of mechanisms for doing this. First, there are the high efficiency “tiers” established by the Energy Commission, currently required for new homes that receive solar incentives. To receive solar incentives, a building must be 15 percent (tier 1) above standards. Meeting the second tier (35 percent above standards) brings additional benefits to the owner or builder.

Second, the Buildings Standards Commission, working with the Green Building community, has developed voluntary green building standards that have energy requirements beyond current code, as well as other green building measures. Much of the current voluntary green building code will become mandatory in 2010. However, new, tighter voluntary green building standards must also be developed as previous iterations become mandatory. Voluntary codes can push improvements in “state-of-the-art” techniques leading to new best practices for sustainable, low-carbon building design and construction.

The Building Standards Commission and the Department Housing and Community Development, working with the CEC and green building community, must develop and regularly tighten voluntary standards written in code language that push the frontier of building best practices. Such voluntary standards can be made mandatory by local jurisdictions where they can

be tested and proven for later adoption into state mandatory standards, without creating disparate local standards that make builder compliance difficult. Voluntary and mandatory green buildings standards are discussed in detail in the green building section.

## Strategies for Existing Buildings

### *Voluntary and mandatory whole-building retrofits for existing buildings*

Because most of California's older buildings were built to lesser or non-existent building efficiency standards, improving the energy efficiency of existing residential and commercial buildings in California could produce substantial GHG benefits. In fact, improving the efficiency of California's existing building stocks is the single most important activity to reduced GHG emissions within the electricity and natural gas sectors. The CPUC's Energy Efficiency Strategic Plan[58] addresses the need for whole-house energy retrofits and establishes goals for reducing energy consumption in existing homes by 20 percent by 2015 and 40 percent by 2020. Consistent with these goals, ARB recommends establishing an environmental performance rating system for existing homes,[59] and adopting mechanisms to encourage and require retrofits for existing buildings that do not meet minimum standards of performance.

Besides the overall targets for existing buildings set in the energy efficiency strategic plan, the CPUC specifically targets additional, more comprehensive energy efficiency services for the 30 percent of California residences that qualify for low-income programs. The CPUC's vision is to transform the existing Low Income Energy Efficiency (LIEE) program to include both comprehensive retrofits and education to help residents use best practices for conservation and prudent, effective, energy system operation.

It is important to note that many of the Title 24 and Title 20 building and appliance energy efficiency standards currently apply to existing buildings. Appliance standards are applicable to all appliances sold in the state. Building design standards apply to retrofits, remodels and renovations in most cases, for both residential and commercial buildings. To gain the benefits of efficiency improvements in existing buildings, "trigger events," such as the sale of a building, should initiate voluntary and mandatory efficiency improvements that modernize building stock and reduce energy costs. Many local governments currently, or in the past, have experimented with, or are continuing to enforce, triggered mandatory building energy upgrades.[60]

[58] CPUC, 2008. *California's Long Term Energy Efficiency Strategic Plan: Achieving Maximum Energy Savings in California for 2009 and Beyond*.

[59] This environmental performance rating system could be developed based on the California Energy Commission's Home Energy Rating System which is currently used for new homes, with input from the green building community, real estate agents, and other stakeholders.

[60] San Francisco, Berkeley, Davis, Santa Monica and many other cities had, or now have, limited residential and/or commercial retrofit requirements that are mandatory at time of sale or at other "trigger events." These programs, initiated in the 1970s and 1980s, are the source of "lessons learned" that can be considered as local jurisdictions plan their climate change activities. Typically residential mandates are known as "RECOs" (Residential Energy Conservation Ordinance) and correspondingly, commercial ordinances are called "CECOs."

Achieving or exceeding targeted levels of efficiency in existing buildings can be accomplished through a combination of aggressive utility, local government, and "set-aside" programs, incentives, the establishment and mandatory disclosure of environmental performance ratings for buildings, and time-of-sale environmental performance requirements. Additional information on efficiency measures for existing buildings is included in the Green Building section.

**Implementing Recent Legislation and Policy Affecting Existing Buildings**

- The 2007 *Guidelines for California's Solar Electric Incentives Programs* includes an eligibility criteria requirement for existing commercial buildings to receive an energy benchmark when a solar electric (PV) system will be installed. The intent of this requirement is for all cost-effective energy efficiency options to be considered before an investment in renewable energy is made. Understanding how a building's energy use compares to its peers is an important first step to identifying appropriate efficiency improvements.
- AB 1103 (Saldana, Chapter 533, Statutes of 2007) requires energy use benchmarking and disclosure by all commercial building owners to prospective buyers, lessees, or lenders starting January 1, 2010. The intent of this legislation is to include energy performance in the building's valuation at the time of a financial transaction. This could create a regional voluntary market for efficient buildings by including energy performance in the disclosures used to comparatively rate real estate properties.

### *Innovative financing to overcome first-cost and split incentives for energy efficiency, on-site renewables, and high efficiency distributed generation*

As discussed below in the Green Building section, it is crucial that aggressive energy efficiency measures be accompanied by better financing alternatives. While energy efficiency is typically cost effective over the life of a building, building owners cannot always manage the up-front cost of these investments. For new or resale homes, a small number of lenders already offer "energy efficient mortgages" that allow the buyer to qualify for a larger loan if the home is energy efficient. In order for such offerings to become standard, lenders and appraisers alike could be required to factor the energy saving features of a home into their estimates of the home value and monthly utility bill outlay. In an energy efficient home, the utility bills will be much lower, and these bill reductions can more-than-offset the increase in mortgage payments. For homes undergoing an energy efficient retrofit, creative funding strategies like on-bill financing (offered by utilities or a third party) can allow the building owner to implement improvements without having to front the initial investment. As with the energy efficient mortgage, these financing mechanisms would allow the homeowner to pay off the investment with utility bill savings over time.

ARB and other State agencies will explore innovative financing options to help building owners spread the costs over the lifetime of the building and allow the measures to more than pay for themselves. Local governments have been pioneers in this area; Governor Schwarzenegger recently signed legislation[61] that allows any city to provide loans for energy efficiency and solar installations that may be repaid through tax assessments.

[61] AB 811 (Levine), Chapter 159, Statutes of 2008. This mechanism, based in part on a recent City of Berkeley ordinance, allows the cost of building improvements to stay with the building, and should help reduce the reluctance

To offer multiple options and give consumers choices, efforts to expand efficiency financing mechanisms would require coordinated action by private lenders, local governments, and many State agencies including the Business, Transportation and Housing Agency, the State and Consumer Services Agency, the Public Utilities Commission, the California Energy Commission, and the Department of General Services. Public-private partnerships also show promise; the City of Berkeley is considering partnering with private lenders to offer energy-related loans.

Building owners who install on-site solar generation currently have access to incentives under the Million Solar Roofs initiatives. In 2006, legislation was passed to establish the California Solar Initiative (CSI), discussed in detail under the Million Solar Roofs section of this Appendix. Currently, this program allows building owners to install just enough renewable generation to meet their annual load. However, many buildings have the potential to produce surplus electricity beyond that used on-site. Currently there is no financial mechanism for homeowners or commercial building owners to be compensated for producing additional renewable electricity. Creating an appropriate mechanism for compensation for surplus electricity would encourage additional zero energy new and existing buildings and would reduce demand for conventional electricity produced from fossil fuels.

### Existing and Improved Utility Program Strategies

California's electric and gas utilities all offer, to various degrees, programs designed to reduce the gas and electric demand of the residential, commercial, industrial and agricultural customers they serve. Many of the programs use a combination of education, technical assistance and financial incentives to help consumers save energy. Utility programs will need to be strengthened and reconfigured to address all building energy systems more comprehensively. To maximize industrial energy efficiency, utility industry programs would need to be better targeted toward particular industry's needs, while being enlarged to cover more industrial sectors. The CPUC strategic plan, envisions energy efficiency provided by many other actors in addition to utilities, while also recommending many important changes that can inform a new generation of utility and non-utility programs.

Utilities – both investor-owned and publicly-owned – will continue to play a central role in developing and implementing energy efficiency programs, and will be expected to achieve higher efficiency targets than in the past. Innovation in energy efficiency delivery methods that deliver comprehensive building retrofits is needed. The "third-party" energy efficiency programs and utility-local government partnerships have pioneered comprehensive small business retrofits. Similar residential programs must be developed that leverage local resources to achieve maximum block-by-block participation while targeting all home energy systems, rather than just the "low hanging fruit."

This section discusses existing utility programs of both investor-owned and public utilities (IOUs and POUs), and also recommends changes to make programs more effective.

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of current owners, be they occupants or landlords, to make improvements that will produce benefits for subsequent owners.

### *More aggressive utility programs to achieve long-term savings*

IOU Programs. The Investor Owned Utility (IOU) programs were initially funded exclusively through an electric Public Goods Charge and a natural gas Demand Side Management charge on customers' bills, capped at $228 million per year for electricity and $45 million gas, respectively. As of 2006-08, the efficiency budgets were greatly expanded, with more than half of the funding for efficiency coming from the utilities procurement budgets (funds used to contract for energy supplies) based upon cost effectiveness tests. These energy efficiency programs typically include discounts or rebates for the purchase or installation of efficient appliances, custom projects for large commercial and industrial processes, consumer awareness campaigns, energy audits, and other demand-side management efforts. The CPUC approves each utility's plan for efficiency programs every three years, which the utility implements with CPUC oversight. A number of programs are also coordinated on a statewide basis.

During the course of planning for energy efficiency programs the CPUC establishes a level of energy efficiency that is termed "economic potential." This level of efficiency potential is considered a theoretical maximum savings for which the value of the energy saved exceeds the theoretical total societal cost[62].

Annual savings targets for IOU energy efficiency programs that run through the year 2011 are currently designed to capture approximately 70 percent of the economic potential identified for that period. In 2008 the CPUC adopted longer-term goals through 2020 to lead the development of longer-term program strategies and, keeping in mind the 2020 initial target for California's GHG reductions under AB 32. The adoption in 2009 of utility efficiency portfolio plans for 2009-2011 is expected to reflect a mix of proven program designs and implementation strategies in combination with approaches to solicit new, innovative designs and savings technologies to enhance overall portfolio performance, both in the short- and long-term.

The CPUC recently adopted a "risk-reward mechanism" to bolster incentives towards achieving these targets. Under the new framework, IOUs earn an increased return on energy efficiency investments if they achieve at least 85 percent of their efficiency target, or face economic penalties if they achieve less than 65 percent of the target.

In addition, the CPUC working with the CEC, California's IOUs and numerous stakeholders, prepared the Long Term Energy Efficiency Strategic Plan scheduled to be adopted by the CPUC on September 18, 2008. This long-term plan offers unprecedented scope, vision and action targets to achieve very high levels of efficiency that can be integrated well with aggressive objectives for demand response and renewable distributed generation. It recommends strategies that can enable the utilities and other actors to achieve energy efficiency goals for the 2009-2020 period and beyond, contributing ignorantly to the State's AB 32 goals. It outlines key strategies

[62] The current theoretical economic potential, for IOUs only, is analyzed in the draft final California Energy Efficiency Potential Study, published in May 2008 and available at http://www.calmac.org/publications/PG&E_EE_FcstModelReport_DraftFinal.pdf This study was prepared for PG&E and other IOUs by consulting firms Itron and KEMA. Because the study includes only a limited set of energy efficiency technology measures, most of which are in incentivized in currentIOU energy efficiency programs, it does not provide a full analysis of potential energy efficiency. Some of the strategies proposed in this Plan, and in the CPUC's Long Term Energy Efficiency Strategic Plan, and under consideration for upcoming codes and standards, go beyond what was considered in the Itron-KEMA report to the IOUs.

and actions by IOUs, California agencies, businesses, research institutes and other entities necessary to achieve energy efficiency savings goals for 2020 that surpass the aggressive ten-year targets adopted by the CPUC in 2004 . Two crucial targets adopted by the CPUC, and supported by the CEC, are as follows:

1. By 2020, all new residential buildings will be zero net energy[63]; and
2. By 2030, all new commercial buildings will be zero net energy.

An third goal developed jointly by CEC and CPUC staff, is to transform California's Heating, Ventilation, and Air Conditioning (HVAC) practices, technologies, and industry such that HVAC systems installed in California are optimized to California's climate, properly sized, highly energy efficient, and effective at reducing peak demand for electricity. A fourth goal of the long-term energy efficiency plan is that all eligible low-income customers should have an opportunity to participate fully in the low income energy efficiency programs, and should be provided all cost-effective efficiency measures for their residences by 2020. The strategic plan includes many other goals and strategies, targeting industrial and agricultural sectors as well as buildings.

To achieve these goals, existing IOU programs will be increasingly coordinated with other state programs, such as building and appliance codes and standards programs, emerging technology programs, local government programs, and clean energy workforce development and training efforts. New programs, to be offered by other actors and/or utilities, will need to be expanded or developed, such as benchmarking building energy use and rating and labeling buildings, certifying industrial facilities for their energy management practices, local or state mandatory retrofit or retro-commissioning programs, and improved low or no-cost financing for energy efficiency improvements. Additionally, clean energy marketing and education programs will be linked with other statewide programs and ongoing AB 32 implementation activities. While the long-term benefits of these programs outweigh their costs, some programs could create short-term costs that result in customer rate increases.

POU programs. There are important differences between IOUs and POUs (and among POUs) that affect their ability to fund and affect energy efficiency within their territories. POUs account for 25 percent of the electricity provided in California, but only 5 percent of the utility efficiency savings total. This is primarily because up until the last decade, POUs were not required to invest in energy efficiency, the result being that most POUs have relatively little experience in this area. Also, some POUs are very small and simply do not have the staff to implement efficiency programs. The two largest POUs in the state – SMUD and the LADWP – have had energy efficiency programs for many years. SMUD has had more aggressive and successful energy efficiency programs than most other large POUs. SMUD and LADWP together account for about 60 percent of the POU savings. SMUD's savings are significantly larger than LADWP's savings in proportion to each utility's market share.[64]

[63] The CPUC has defined "Zero Net Energy" as the implementation of a combination of building energy efficiency design features and on-site clean distributed generation that result in no net purchases from the electricity or gas grid, at the level of a single "project" seeking development entitlements and building code permits.

[64] California Municipal Utilities Association, December 2006, *Energy Efficiency in California's Public Power Sector: A Status Report.*

AB 1890 (Brulte, Chapter 854, Statues of 1996) required the POUs to implement a non-bypassable surcharge to fund public benefit programs, with total funding percentages set at a level similar to those of the IOUs. Assembly Bill 2021 (Levine, Chapter 734, Statutes of 2006) obligates the CEC to develop statewide estimates of energy efficiency and demand reduction potential, and to establish energy savings targets for the POUs. The CEC is required by law to report POU program investments and savings to the Legislature and the POU governing boards, but AB 2021 does not mandate the POUs to meet their energy savings targets. Further, no statutory requirements currently exist for ESPs or CCAs to invest in energy efficiency for their customers, though their customers fund a portion of the IOU energy efficiency programs through their distribution charges and are currently eligible to participate in IOU-administered energy efficiency programs.

The CPUC and CEC have recommended that ARB adopt mandatory minimum levels of cost effective energy efficiency savings for POUs, consistent with the programs and goals adopted by the CPUC for IOUs.[65] ARB supports the establishment of mandatory levels of energy efficiency for POUs.

Utility Energy Efficiency Programs Overall. While achieving energy efficiency savings exceeding current levels is possible, capturing such savings by way of voluntary incentive programs of the sort typically run by utilities will become difficult over time, as achievement of existing goals themselves will require unprecedented rates of program success. Increasingly, additional energy efficiency will necessitate more stringent codes and standards, innovative means of delivery, and technological innovations.

Much of the current technology utilized to implement utility efficiency programs such as compact fluorescent light bulbs and efficient refrigeration are considered "off the shelf," meaning they are readily available in the marketplace. However, until these technologies become mainstream in the market, they often require incentives to be price-competitive with older less efficient technologies. Upstream incentives or rebates are designed to promote market adoption, acceptance and, ultimately, market transformation. As market penetration is achieved, incentives for some technologies can be reduced or dropped completely. This "market transformation" is best maintained by incorporating the high efficiency technologies into mandatory building codes and appliance standards. In addition, many larger business and institutional customers use IOU energy efficiency incentive funds to implement custom on-site measures such as installation of efficient boilers, HVAC systems, and overall energy management tools. Without incentive funds, many of these types of installations would not be deemed cost-effective by customers in the near term, even though the payback may occur in as little as three to seven years.

## Other Needed Strategies

### *Water system and water use efficiency and conservation measures*

Large amounts of energy are required for the conveyance, treatment, use, and the disposal or recycling of water. The Water section of the Scoping Plan provides detail on needed strategies and actions, and recommends four measures related to energy efficiency. One of these, Water System Energy Efficiency (W-3) sets a target of reducing water-related energy usage by 20

[65] CPUC and CEC Joint Agency Decision, March 2008, *Interim Decision on Basic Greenhouse Gas Regulatory Framework for Electricity and Natural Gas Sectors*, CEC-100-2008-002-F

percent, or approximately 4,400 GWh. The other three (Water use Efficiency, Water Recycling, and Reuse of Urban Runoff – measures W-1, W-2 and W-4) are water supply reliability measures and will help the State meet increased demand for water from population and economic growth. All four measures contribute to the overall energy efficiency goal.

### *Local government programs that lead by example and tap local authority over planning, development, and code compliance*

California has over 600 local governments, including cities, counties and special districts. They are diverse in size, in economic base and in their approaches to energy efficiency. Some have been leaders in energy efficiency and renewable energy since the 1970s. Many more local governments and their communities are paying significant attention to climate change and doing what they can to develop and take action on aggressive GHG reduction targets. Because local governments have significant regulatory authority over building design and construction, and are responsible for enforcing the state's Title 24 and Title 20 energy efficiency building codes, they are in a strong position to promote energy efficiency. Local governments have also been leaders in promoting green building, water use efficiency reduced use of water in buildings and landscaping.

The Energy Commission, since the 1970s, has provided financial and technical assistance to help local governments retrofit buildings for energy efficiency, and design and build new efficient, green buildings. Since 2004, the investor-owned utilities have been formally partnering with local governments to improve the reach and efficacy of energy efficiency efforts by involving local communities. Public utilities are using similar strategies with communities in their jurisdictions. Other communities are in the process of becoming Community Choice Aggregators[66], a strategy they may use to more aggressively pursue local GHG reduction targets primarily through energy efficiency and community-scale renewables.

Local governments have a history of adopting local energy ordinances that may go beyond state minimum standards. By routinely updating statewide voluntary (or "stretch") green building standards in code language, the state can make it convenient for many more localities to raise the bar for construction and retrofits in their jurisdictions by adopting the state voluntary codes as mandatory within their jurisdictions. These jurisdictions can serve as proving grounds for advanced energy efficiency solutions that are close to being incorporated into statewide energy standards.

Other roles for local government include educating their constituencies and businesses about climate change and energy efficiency actions, setting an example by ensuring the public buildings are green and efficient, and integrating energy efficiency into community development and redevelopment programs.

Cities, counties, and special districts are likely to play an increasingly important role in delivering energy efficiency programs to the public. Additional detail on local government

[66] Community Choice Aggregators, of CCAs, are local governments or joint power authorities that elect to serve as the default provider of electricity commodity (generation) over wires owned by utilities. CCAs gain access to a proportional share of public goods charge funds paid by their customers and implement their own energy efficiency and renewable energy programs under the auspices of the CPUC.

potential and current activities is included in the Local Government and Green Building sections of the Scoping Plan and the appendices.

### *Additional industrial and agricultural efficiency efforts*

Support to industry must focus on integrated business solutions that minimize costs and optimize total impact by addressing on-site GHGs, electricity use, criteria pollutants, waste management, water management and industrial process efficiency. The food processing industry has proposed a pilot demonstration project along those lines that could be undertaken in 2009.[67] Increased profits and public rankings for corporate social/environmental responsibility both can be major motivations for action. Typically both must be supported by centralized technical and regulatory assistance – a one stop clearinghouse with industry-specific information -- could provide information on emerging technologies, and leverage USDOE and USEPA research. Some public utilities – Silicon Valley Power is a prominent example – are targeting specific local industries such as data centers and semiconductor manufacturers, and can serve as models for industry specific programs.

Like industry, agriculture can be challenged to meet environmental regulations from multiple agencies. The CPUC's strategic plan recognizes that coordinated assistance is needed to help agricultural energy consumers manage energy, air, waste and water resources in the face of potential reduced water availability. The DWR's 2005 Water Plan Update also recognizes the opportunity to improve agriculture's water use efficiency practices which could help lower energy demand for pumping. Specific programs warranting coordination include the Energy Commission's research in agricultural water use and process efficiency, local air quality improvement funds, federal tax credits, and the federal Rural Energy for America (REAP ) program.

### *Providing real time energy information to help consumers conserve and optimize energy performance*

Except for specific advanced metering and real time pricing pilot programs, the current electricity metering system provides insufficient information to motivate commercial and industrial electricity users to conserve. Similarly, on the residential side, several pilot programs have shown display information on energy use and cost can help citizens achieve meaningful conservation in their homes. Automated price signals combined with voluntary automated demand response can help commercial and industrial customers save money, reduce unnecessary usage, and make the electric system more reliable. The most successful parts of pilot real time energy information projects must be mainstreamed to achieve their full potential, Furthermore, additional improvements are needed to maximize emissions reductions from advances in metering and communications technologies.

Because informed consumers make better energy decisions, efforts to help consumers make the connection between their actions, their utility bills, and their environment play an important role in achieving California's energy reduction targets. Building upon the past successful efforts of the Flex Your Power campaign, the CPUC has authorized a statewide energy awareness campaign to motivate consumers to conserve energy and to invest in energy efficiency.[68]

[67] CPUC Energy Efficiency Strategic Plan, page 39.
[68] CPUC Decision 07-10-032, October 18, 2007, p. 57.

Even more powerful than education campaigns, however, is energy-use feedback provided to consumers via in-home displays. Providing feedback on how daily activities in the house translate to energy costs is a simple concept that empowers consumers to take control of their utility bills. These devices relay information about energy consumption and energy costs to the consumer on a real-time basis and have been shown to induce conservation. An Emerging Technologies Report prepared for the American Council for an Energy Efficient Economy surveyed the results from roughly 20 studies on energy use feedback over the past 35 years and found energy savings ranging from four percent and 15 percent.[69] The authors chose five percent as a reasonably reliable and conservative estimate of expected energy savings from the use of energy displays, based on a 2004–2005 controlled pilot study by Hydro One in Canada.[70] Based on this research, it is reasonable to assume that the installation of energy use displays could cause consumers to reduce their energy use by five percent on average. This response would be above and beyond the typical consumer response to energy price.

Energy use monitors have three basic components: a sensor that collects energy use data from the meter or circuit panel, a wall or desk-mounted display, and a means of communication between the two. After collecting demand data from the meter, the devices can display both instantaneous power usage and cumulative energy usage over selected time periods; in some cases, the device can also provide projected energy use and cost estimates and even show other home diagnostic data such as temperature, humidity, and estimated greenhouse gas emissions.[71]

California could require that all new homes come equipped with an energy use display that provides real-time feedback to occupants on whole-house electricity consumption, electricity production (for homes with rooftop solar installations), and if possible, natural gas and water use. For existing homes, these devices or other information feedback mechanisms could be required for installation at time-of-sale or upon installation of a new HVAC system.

While there are home energy-use displays currently on the market, the technology is still relatively new and can be improved in terms of ease of installation, ease-of-use, and integration with other home systems such as thermostats, gas use, and possibly water use as well. California could set performance standards for these technologies and work with manufacturers to develop, test, and demonstrate display systems for use in a wide variety of homes (i.e. homes that may have different metering infrastructure).

### Tapping into Emerging Technologies

The CEC's Public Interest Energy Research (PIER) program and the IOU Codes and Standards Support programs promote research, development and demonstration of new and emerging energy savings technologies. To achieve increased savings, emerging technologies would need to be more rapidly brought into utility incentive programs, and into voluntary and then mandatory standards.

PIER currently is planning solicitations for research and development projects that address zero energy new and existing buildings, buildings systems integration, and best practices training

[69] http://www.aceee.org/emertech/2006_EnergyDisplays.pdf
[70] In the Hydro One pilot project, the utility provided no energy savings guidance and still achieved aggregate savings of 5% in base-load electricity that persisted over the 18-month test period.
[71] http://www.aceee.org/emertech/2006_EnergyDisplays.pdf

materials to enable architects and engineers to design buildings and retrofits that maximize energy efficiency. The PIER program works closely with the Energy Commission's Building and Appliance Standards Office to ensure that new technologies can rapidly become part of either mandatory standards, or higher, voluntary "tiers". Continued strong state support for public interest energy research is needed to develop and bring to market tomorrow's technologies that will get California to its 2050 emissions reductions goals.

## Benefits and Costs

California has and continues to pursue energy efficiency for a variety of energy and environmental reasons, including:

- Reducing energy supply costs and lowering bills for customers,
- Reducing peak energy demand,
- Maintaining reliable energy services and reducing price volatility, and
- Achieving other environmental objectives such as reducing local air pollution and other environmental impacts of electricity generation.

Investments in energy efficiency also provide numerous benefits on an economy-wide scale, by reducing the need for energy imports, cutting emissions and the associated health-related costs, and creating technical jobs, jobs in construction trades, and other high-paying professional jobs. Based on past experiences, each dollar spent on energy efficiency in California provides about two dollars in net benefits.[72]

End-use efficiency investments inherently result in reduced electricity generation and therefore provide both environmental justice and public health benefits. Utility energy efficiency programs are designed to provide a fair distribution of funds among residential and nonresidential customers, while maximizing energy savings. In addition, there are targeted programs overseen by the Low-Income Oversight Board that provide energy efficiency services specifically for low-income households. The CPUC's strategic plan targets broader, more comprehensive, and more effective energy efficiency services for low-income households.

The potential costs and emissions reductions from meeting the recommended targets and the expanded targets under evaluation are summarized in the table below. For purposes of this analysis, ARB assumed a 7.8 percent avoided line loss for electricity saved.

**Appendix C: Electricity and Natural Gas**
**Table 12**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| E-1: Energy Efficiency (Electricity) | 15.2 | -1,663 | CPUC & CEC | Ongoing |
| CR-1: Energy Efficiency (Natural Gas) | 4.3 | -470 | CPUC & CEC | Ongoing |

[72] California Environmental Protection Agency, 2006, *Climate Action Team Report to Governor Schwarzenegger and the Legislature*

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## *(CR-2) Solar Water Heating*

Solar water heating (SWH) systems represent what is likely the largest untapped potential for natural gas savings in California. California residences and commercial buildings consume at least 2.5 billion therms of natural gas annually to heat water. With statewide implementation of solar water heating, a significant portion of this could be saved.

A solar water heating system uses the sun to heat water. It commonly consists of two parts: a roof-mounted solar collector to heat the water and a storage tank. Most SWH systems augment rather than replace the conventional water heating system. A typical residential SWH system reduces the need for conventional water heating by about one-half to two-thirds, depending on the technology used.

Solar water heating is an enabling technology for zero net energy buildings,[73] and successful implementation of the zero net energy targets will require significant growth and improvements in California's SWH system manufacturing and installation industry. Looking out to the 2050 emission reduction goals, solar water heating will be even more essential because the technology can provide carbon-free water heating. At this time, California's SWH industry is still quite small and not well established, lacking the experience and economies of scale to deliver cost-effective solar water heating for most applications.[74] This needs to change if California is to meet its GHG reduction targets.

The widespread use of SWH technology in Israel, Japan, China, and Europe demonstrates that these systems can be cost effective, and can gain high levels of market share compared to traditional, carbon- intensive hot water technologies. If California can create sufficient sustained demand for these systems, it will allow the industry to mature, and to reap economies of scale that result in cost savings. New developments in SWH technologies, and improved business models for delivering these systems to customers, will further enable successful transformation of the SWH market.

[73] A "zero net energy" building must produce enough electricity to offset both the electrical and natural gas use of the building on an annual basis. Heating water with high-efficiency gas or electric technologies is a valid approach but solar water heating coupled *with* high-efficiency gas or electric heating is a better approach because it enables a downsizing of the onsite renewable generation system.

[74] As the price of carbon is reflected in the price of electricity and natural gas, SWH technologies will begin to be more cost-effective. Also, SWH technologies may be cost-effective already for certain commercial applications.

**Solar Space Heating and Cooling**

While less well-known, solar water heating can be used to provide the heat for forced air and/or radiant heating systems, and can even be used for cooling using absorption chillers. These technologies have been installed in limited numbers, but offer tremendous potential for cost-effective and carbon-free space heating and cooling. Space heating and water heating are each responsible for about 44% of California's residential $CO_2$ emissions. Combining water heating and space heating system components to create a single system to provide both capabilities is expected to become more widely available. The reduction in natural gas consumption and $CO_2$ emissions associated with residential space heating could potentially be equal to or greater than those being targeted for residential water heating.

The California Legislature took an initial step towards these goals with AB 1470, also known as the Solar Hot Water and Efficiency Act of 2007 (SHWEA). SHWEA authorized the CPUC to undertake a ten-year, $250-million incentive program for solar water heaters with a goal of promoting the installation of 200,000 solar water systems in California by 2017. The CPUC is currently running a pilot program to evaluate the potential impacts on equipment prices, demand, and overall cost-effectiveness of a SWH incentive program. If the pilot program proves to be cost effective, the CPUC will design and implement a statewide incentive program.

Regardless, the current legislative target of 200,000 units is relatively small and will unlikely create the economies of scale necessary for market transformation and significant cost reductions. Therefore, ARB recommends that California pursue other approaches with the goal of developing a viable SWH industry for 2020 and beyond. For example, California agencies could develop partnerships with U.S and foreign manufacturers, installers, and non-profits to:

- improve and expand upon current SHW technologies;
- develop commercialization strategies based on those that have effectively and rapidly launched other environmentally-preferred technologies;
- establish incentive programs, where appropriate; and
- incorporate these technologies into local government green building codes, and eventually into the CEC building standards.

### Greenhouse Gas Reductions

For this analysis, ARB staff assumed gas savings of 130 therms per year per system, based on preliminary estimates from the California Center for Sustainable Energy pilot project in southern California. This estimate is based on a typical residential unit but would be extremely conservative for most commercial applications. Note that the AB 1470 program is already funded and is not linked to the AB 32 effort. Therefore, the cost of GHG reductions for the AB 1470 program is assumed to be zero.

**Appendix C: Electricity and Natural Gas**
**Table 13**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2e$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| CR-2 - SWH: AB 1470 | 0.1 | 0 | CPUC | 2010-2020 |

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## *(E-4) Million Solar Roofs Program*

As part of Governor Arnold Schwarzenegger's Million Solar Roofs Program, California has set a goal to install 3,000 megawatts of new, solar capacity by 2017 - moving the state toward a cleaner energy future and helping lower the cost of solar systems for consumers. The Million Solar Roofs Program is a ratepayer-financed incentive program aimed at transforming the market for rooftop solar systems by driving down costs over time. Created under Senate Bill 1 (Murray, Chapter 132, Statutes of 2006), Million Solar Roofs builds on previous ratepayer-funded programs[75] and provides up to $3.3 billion in financial incentives that decline over time.

Solar-generated electricity produces no emissions and requires very little maintenance. Yet, for many applications, the technology is not yet cost competitive with electricity from conventional sources. Meeting California's solar targets, therefore, requires incentives, at least until new technologies and steady market demand bring about cost reductions.

The Million Solar Roofs Program has three distinct program components, each with a portion of the statewide budget and solar installation goals:

- The California Public Utility Commission's $2.17 billion portion of the program, known as the California Solar Initiative,[76] directs incentives to customers in investor-owned utility territories (about 70 percent of the state's total retail and wholesale electricity use) for existing residential and new and existing non-residential buildings. The goals for this program component are: 1,750 MW of installed capacity from the mainstream incentive program and 190 MW from the forthcoming low-income resident incentive program.
- The CEC provides incentives for solar in new home construction through its New Solar Homes Partnership (NSHP). The NSHP also is limited to investor-owned utility customers and is authorized to use up to $400 million over the program term with a goal of installing 400 MW of solar on new homes.
- The POUs component requires each municipal utility to offer an equivalent incentive program, an aggregate commitment of $784 million over the duration of the program, toward a goal of installing 660 MW of solar.

[75] Renewable energy incentive programs that preceded CSI include the CEC's Emerging Renewables Program and the California Public Utilities Commission's Self Generation Incentive Program. These programs no longer include solar, but still provide incentives for wind energy and fuel cells. A number of publicly owned utilities also have asolar programs.

[76] "California Solar Initiative" is also used to describe the entire program – including the portions managed by the CEC and the publicly owned utilities. To avoid possible confusion with the CPUC's program, however, ARB is using "Million Solar Roofs" when referencing the program in its entirety.

As directed by SB 1, the CEC recently established eligibility criteria, conditions for incentives, and rating standards for solar energy system incentive programs. Per the new guidelines, obtaining the incentives requires that building owners or developers meet certain efficiency requirements: specifically, that new construction projects meet energy efficiency levels that exceed the state's Title 24 Building Energy Efficiency Standards, and that existing building owners conduct an energy audit. By requiring greater energy efficiency for projects that seek solar incentives, the state is able to reduce both electricity and natural gas needs and their associated GHG emissions. Thus, the program can help to achieve ARB's recommended efficiency targets.

Progress towards the 2017 target is promising, though the net metering cap and the lack of compensation for "surplus" generation could pose a challenge. Under California's net metering law, participants are credited for any excess electricity generated during the day, and are allowed to draw down that credit at night or any time when the on-site electrical load exceeds what the system produces. Under existing law, the amount of customer "demand side" generation eligible for net metering is subject to a statewide cap and to a size whose production is no greater than the annual demand of each participating host customer. If customers produce more than they consume, the surplus is used by the electric utility without any compensation to the customer. To ensure good progress toward the program goals, the net metering cap must be increased[77] in order for additional solar systems to participate, and customers must be allowed to install systems that produce "surplus electricity" and receive fair compensation. .Compensation for surplus generation is critical both for meeting the program goals and for supporting zero energy buildings.[78]

### Benefits and Costs

The installation of solar electric technologies and the requisite energy efficiency measures will result in savings to customers via lower energy bills. Further, the solar industry provides in-state jobs to solar manufacturers, retailers and installers.

To realize greater energy efficiency benefits, the CEC could require more advanced levels of energy efficiency as a condition for solar incentives. It should be noted that such a requirement is not widely supported by the solar industry due to fears that aggressive energy efficiency rules would hurt solar sales.

The estimated costs and potential GHG reductions from the solar elements of the Million Solar Roofs program and the expanded Measure under Evaluation are shown below. Both assume a 17 percent capacity factor for solar photovoltaics, and a 7.8 percent avoided line loss for each kWh

[77] Senate Bill 1 raised the net metering cap from .5 percent to 2.5 percent of peak demand. However, it is anticipated that this cap will support only half the state's solar goal and needs to be raised again before the state reaches the 3,000 MW solar capacity goal.

[78] Most buildings use electricity and natural gas. To be "zero net energy," buildings will have to balance gas use by producing surplus electricity, except for those few buildings, like all-electric buildings with heat pumps or dairy facilities, able to supply their own space and water heating needs. The 2007 IEPR recommended that the Energy Commission and the CPUC "work together to establish an appropriate feed-in tariff for excess generation from customer-owned solar installations based upon the RPS market price referent (MPR) and time-of-delivery adjustment." However because the MPR does not consider the grid benefits of distributed solar generation, a higher feed-in tariff should be considered. Such a tariff could speed progress toward GHG reduction goals and more rapidly achieve the market transformation goals of the Million Solar Roofs programs.

saved. (This estimate does not include the potential emissions reductions as a result of the new efficiency requirements associated with the program. Because program participants generally receive energy efficiency rebates from the utility company in addition the rebate for solar, the GHG reductions due to energy efficiency improvements are shown under the Energy Efficiency measure described elsewhere in this section.)

If tradable renewable energy credits (RECs) from the Million Solar Roofs Program are allowed in the RPS program, care must be taken not to double count the associated GHG emission reductions.[79] Also, as the scale of distributed generation PV in California grows, greater coordination of tracking mechanisms may be needed to avoid double counting GHG emission reductions from Million Solar Roof RECs sold in the voluntary REC market.[80]

**Appendix C: Electricity and Natural Gas**
**Table 14**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| E-4 – Million Solar Roofs: 3,000 MW by 2017 | 2.1 | 0** | CPUC/CEC | Current program |

* Excluding the cost of net metering credits

** Costs of this measure are the result of other programs and are not attributed to the AB 32 GHG reduction program

† The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## *(E-2) Increasing Combined Heat and Power*

ARB recommends that California take steps to encourage the development of new CHP facilities, with a target of an additional 4,000 MW of installed CHP capacity by 2020. This amount of CHP would be enough to displace approximately 30,000 GWh of demand from other power generation sources.[81]

CHP systems, also referred to as cogeneration, generate electricity and useful thermal energy in an integrated system. Combustion-based power plants do not convert all of their available energy into electricity and typically lose more than half as excess heat. By producing both heat

[79] CPUC Decision 07-01-018 in Rulemaking 06-03-004, January 11, 2007, Opinion Adopting Methods to Determine the Renewable Energy Credits from Renewable Distributed Generation, http://docs.cpuc.ca.gov/WORD_PDF/FINAL_Decision/63678.PDF. In CPUC Decision 08-08-028 in Rulemaking 06-02-012, the CPUC defines a REC to include "all renewable and environmental attributes associated with the production of electricity from the eligible renewable energy resource…" with the caveat that "[a]voided emissions may or may not have any value for GHG compliance purposes."

[80] For more information on the voluntary REC market, see http://www.green-e.org/getcert_re.shtml. For information on tracking in compliance and voluntary REC markets, see p. 8-12 of US DOE NREL, Lori Bird and Elizabeth Lokey, October 2007, Interaction of Compliance and Voluntary Renewable Energy Markets, NREL/TP-670-42096, http://apps3.eere.energy.gov/greenpower/pdfs/42096.pdf.

[81] Accounting for avoided transmission line losses of seven percent, this amount of CHP would actually displace 32,000 GWh from the grid.

and electricity, CHP systems use more of the energy contained in fuel, thereby increasing efficiencies and reducing GHG emissions. The widespread development of CHP systems would help displace the need to develop new or expand existing power plants. This should produce statewide and regional benefits.

CHP systems are generally used in distributed generation applications located at or near electrical and thermal loads. The electricity generated from a CHP system can be either consumed on site or delivered to the grid; the useful thermal energy can be exported to neighboring facilities but is typically consumed on site. By simultaneously reducing fuel requirements for on-site process heaters and electricity generation, CHP systems can be an extremely fuel-efficient and cost-effective form of distributed generation. Some CHP units can be fueled with renewable resources,[82] and those fueled by natural gas generally use less fuel to provide both heat and power than would be used to provide these two services separately.

CHP is used in many different applications. Small units less than 1 MW in size are often installed in places like nursing homes, schools, and laundries. Larger units ranging in size from 5 to 10 MW usually require host sites that have continuous thermal energy needs. Food processors, large data centers and transportation facilities are examples of applications for CHP projects in this size range. CHP projects in the 10 MW to 60 MW range are found in facilities that operate continuously and are sometimes connected at the transmission level, such as chemical plants or oil refineries. Very large units, which can range in excess of 100 MW, feed substantial amounts of power onto the grid for use by other customers as well as serving the thermal and electric needs of the host site.

While CHP systems use fuel more efficiently than centralized power plants, they have the effect of increasing fuel use on-site. The potential emissions from CHP systems varies significantly depending upon the system size and type of technology used,[83] but the increase in fuel use generally causes increased emissions of $CO_2$ on-site. Potential local adverse effects need to be prevented or mitigated through the existing air permitting process.

California has supported CHP for many years, but market barriers stand in the way of CHP reaching its full market potential. The key difficulty faced by CHP owners is the inability to sell excess electricity to the grid. Sizing CHP systems to operate efficiently often results in the generation of excess electricity. Without a market for this power, many CHP systems may not provide adequate economic return. While this is not the only challenge, it seems to be the most commonly-cited barrier to the development of new CHP systems.

A 2005 draft report prepared for the California Energy Commission by the Electric Power Research Institute (EPRI)[84] examined these barriers and their effects upon the market for CHP. EPRI developed estimates of current CHP capacity in the state, estimated technical and

[82] According to the 2007 IEPR, "Greater use of combined heat and power systems fueled by biomass could also reduce demand for natural gas in process and industrial heat and cooling operations, helping to increase overall energy efficiency and reduce carbon impacts of the state. By 2050, nearly 100 billion cubic feet of biomethane per year could contribute to the state natural gas supplies." CEC 2007 IEPR, p. 176.

[83] Molten carbonate fuel cells, for example, convert chemical energy directly into electricity while producing very little pollution. (Kaarsberg, 2001)

[84] California Energy Commission, Consultant Report, Assessment of California CHP Market and Policy Options for Increased Penetration. Prepared by Electric Power Research Institute. April 2005.

economic market potential, and analyzed the costs and benefits of various incentive options to promote development of the CHP market opportunity. Using different forecasts of technology costs, natural gas and electricity prices, and program design, EPRI predicted a potential market for CHP of between 1,966 MW and 7,300 MW over the period 2002-2020.[85] The 7,300 MW modeled under EPRI's "high deployment scenario" represents an increment of more than 5,000 MW above the base case. EPRI concluded that reaching this level of CHP deployment would require fully addressing the export barriers, utility-provided incentive payments, technological advances, the addition of a T&D (transmission and distribution) support payment, and a $CO_2$ reduction payment. Under their "moderate" scenario, which considered more modest changes in policy and incentives, EPRI predicted a CHP market potential as high as 4,400 MW. It is this estimate that forms the basis for the proposed GHG reduction measure.

### Existing CHP Policy

The Waste Heat and Carbon Emissions Reduction Act[86] requires the CPUC and CEC to evaluate new rules and programs for small CHP systems (up to 20 MW in size). Specifically, the Act directs the CPUC to establish a feed-in tariff – a pre-negotiated price that utilities would pay for excess electricity fed into the grid. Under the Act, the CPUC may require California IOUs to purchase specified amounts of excess electricity from CHP customers that comply with specified sizing, energy efficiency, and air pollution control requirements. The statute also authorizes the state's POUs to purchase excess electricity from CHP systems at a rate determined by their governing boards. The Act requires the CPUC to establish a pay-as-you-save pilot program that would provide up-front financing to nonprofit organizations for the development of CHP systems of 20 MW or smaller. The CPUC may stop the pilot program after the cumulative capacity from the pilot program reaches 100 MW.

Although this Act will provide some support for CHP, it stops short of providing small CHP operators with the guaranteed access to wholesale markets recommended in the CEC's *Integrated Energy Policy Report.*[87]

### Setting New Policies for CHP

ARB anticipates that GHG emissions from many CHP Systems will be regulated under the proposed GHG cap-and-trade program. However, efforts to increase the deployment of CHP systems will require removing market and regulatory barriers and providing adequate utility support to CHP system development. The CEC listed several recommendations in its 2007 IEPR to address the more critical barriers and provide adequate support for CHP system development, including the following:

- The CPUC's self-generation program incentives should be based upon overall efficiency and performance of systems, regardless of fuel type.

- The CPUC should complete a tariff structure to make CHP projects cost and revenue neutral while granting owners' credit for system benefits such as reduced congestion

[86] AB 1613 (Blakeslee, Chapter 713, Statutes of 2007)
[87] California Energy Commission, 2007, *2007 Integrated Energy Policy Report*, CEC-100-2007-008-CMF

- The CPUC and CEC should eliminate all non-bypassable charges for CHP systems regardless of size or interconnection voltage and standby reservation charges.

- The CPUC should refine the Rule 21 interconnection standards, provide third party resolution of interconnection issues and streamline permitting.

- The CPUC should develop a distributed generation (including CHP) portfolio standard regardless of size or interconnection voltage for electric utility procurement plans. Alternatively, the utilities could be required to treat distributed generation and combined heat and power, regardless of size or interconnection voltage, like efficiency programs.

- The CPUC should adopt revenue neutral programs that enable high-efficiency CHP systems to more easily export power to interconnected utilities without additional transmission system charges.[88]

- The CPUC and the Energy Commission should continue to work collaboratively to develop a methodology to estimate distributed generation costs and benefits.

- The state should adopt greenhouse gas measures and regulations that fully reflect the benefits of combined heat and power with separate production of thermal and electric energy[89]

Achieving the proposed 4,000MW goal by 2020 will require that immediate and aggressive steps are taken to address the above recommendations.

The CPUC intends to open a new rulemaking focusing exclusively on CHP this year. During this proceeding, the CPUC is expected to explore regulatory issues that directly affect the development of ultra-clean CHP, and to make decisions regarding how to facilitate the development of efficient and environmentally beneficial CHP. This will require discussions about how CHP generators can participate in a generation market that requires scheduling hour-by-hour exports with the CAISO.

The CPUC and CEC should use this venue to address the IEPR recommendations and remove the most significant CHP market barriers. Once these barriers are addressed, ARB will evaluate the need for additional mandates, efficiency standards or requirements that ensure GHG reduction goals are met. These additional steps may not be needed if market barriers, and utility support for CHP system owners, are appropriately addressed by the state's energy agencies.

### Benefits and Costs

In addition to the energy cost savings and carbon emission reduction benefits, the development and use of well-designed additional CHP systems in California offer other environmental and power generation/distribution benefits. Reliable baseload or load-following CHP can:

- Provide an alternative to new central station fossil-fuel generation and reduces the need for new transmission and distribution infrastructure.

[88] Ibid.
[89] Ibid.

- Improves the efficiency, reliability and security of the State's electricity system and reduces losses during peak hours.
- Provide valuable protection against supply outages and brownouts, especially at oil refineries.
- Provide more efficient fuel use, reduced energy costs and the most efficient and cost-effective form of distributed power generation.
- Effectively reduce transmission and distribution congestion.
- By offsetting more expensive peak electricity, provide potential cost savings to the host site.

For purposes of estimating GHG reductions, ARB staff estimated the electric generation potential from CHP (or the amount of electricity offset from the grid, based on an assumed 85 percent capacity factor), the total amount of fuel consumed onsite, and the amount of waste heat generated for useful thermal purposes (which was then used to calculate the amount of fuel not consumed to produce that amount of thermal energy). Emission gains and reductions were calculated for each of these elements and the net emission reductions are shown in the table below. Capital costs were annualized assuming a 30-year system lifespan and operating costs were estimated based on fuel inputs.

**Appendix C: Electricity and Natural Gas**
**Table 15**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| E-2: Increasing Combined Heat and Power Use by 30,000 GWh | 6.7 | -1,311 | CPUC & CEC | 2009-2020 |

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## *(E-3) Renewables Portfolio Standard*

The CEC estimates that about 12 percent of California's retail electric load is currently met with renewable resources, including wind, solar, geothermal, small hydroelectric, biomass, and biogas[90]. California's Renewables Portfolio Standard (RPS), which was originally established under Senate Bill 1078 (Sher, Chapter 516, Statutes of 2002), requires IOUs, CCAs, and ESPs to increase the percentage of renewable resources in their retail portfolios. While the original legislation gave IOUs until 2017 to meet a 20 percent RPS, Senate Bill 107 (Simitian, Chapter 464, Statutes of 2006) moved up the deadline to 2010.

[90] California Enerrgy Commission, April 2008, 2007 Net System Power Report, Commission Report, CEC-200-2008-002-CMF, http://www.energy.ca.gov/2008publications/CEC-200-2008-002/CEC-200-2008-002-CMF.PDF, p. 4-5.

A more aggressive RPS goal of 33 percent by 2020 has been proposed by Governor Schwarzenegger but is not yet codified into statute. In 2005, The CEC and the CPUC committed in the Energy Action Plan II to "evaluate and develop implementation paths for achieving renewable resource goals beyond 2010, including 33 percent renewables by 2020, in light of cost-benefit and risk analysis, for all load serving entities."[91] Given the importance of renewables to the success of AB 32, an appropriate target for 2020 should be set that is realistic yet pushes California's renewable energy use forward as far as possible. Based on Governor Schwarzenegger's call for a statewide 33 percent RPS, and the strong call for a 33 percent goal made jointly by the CPUC and CEC in their proposed final opinion[92], ARB is including the targeted 33 percent renewable mix as a Recommended Action.

POUs are required to set their own RPS targets.[93]. The governing boards of the state's three largest POUs, the Los Angeles Department of Water and Power (LADWP), the Sacramento Municipal Utility District (SMUD), and the Imperial Irrigation District (IID), have adopted policies to achieve 20 percent renewables by 2010 or 2011. LADWP and IID have established targets of 35 and 30 percent, respectively, by 2020. In the *Interim Decision on Basic Greenhouse Gas Regulatory Framework for Electricity and Natural Gas Sectors*,[94] the CPUC and CEC recommended that ARB *require* the POUs to meet a 20 percent RPS by no later than 2017.

Reaching a target of 33 percent will require that California quickly address challenges such as program complexity, lack of transparency, permitting difficulties, and transmission, distribution and, for intermittent renewables, integration issues. Program complexity and high cost of participating in the IOU's RPS solicitation processes comprise barriers that especially challenge the ability of small renewable projects (less than 20 MW of capacity) to contribute their full potential to State renewable energy goals. Multiple government agencies must continue to work together to overcome these project development barriers. The 2008 IEPR Update proceeding at the Energy Commission is addressing this topic; further analysis is planned for the 2009 IEPR, building upon completed and on-going studies by the Renewable Energy Transmission Initiative (RETI), the CA ISO, and the CPUC.

RETI is an extremely important multi-agency initiative to identify competitive renewable energy zones and streamline approval of transmission infrastructure to access those zones. RETI will identify the transmission projects needed to access renewable power resource areas, facilitate transmission corridor designation and streamline the siting and permitting process. The state

[91] CPUC and CEC, 2005, *Energy Action Plan II*, p. 6
[92] Joint recommendations of the CEC and the CPUC in *Proposed Final Opinion on Greenhouse Gas Regulatory Strategies*, published September 12, 2008 and to be considered for adoption in October, 2008 by the CEC and the CPUC. The document is CEC publication # CEC-100-2008-007-D, available through links at: http://www.energy.ca.gov/ghg_emissions/index.html and is also known as CPUC Proposed Decision of September 12, 2008, CPUC Proceeding R06-04-009 posted at http://docs.cpuc.ca.gov/EFILE/PD/89317.htm. An Executive Summary, Frequently Asked Questions, and other supporting documents are available on both web pages.
[93] California Public Utilities Code Section 387, subparagraph (a) reads as follows: Each governing body of a local publicly owned electric utility, as defined in Section 9604, shall be responsible for implementing and enforcing a renewable portfolio standard that recognizes the intent of the Legislature to encourage renewable resources, while taking into consideration the effect of the standard on rates, reliability, and financial resources and the goal of environmental improvement.
[94] CPUC and CEC Joint Agency Decision, March, 2008, *Interim Decision on Basic Greenhouse Gas Regulatory Framework for Electricity and Natural Gas Sectors*, CEC-100-2008-002-CMF

strongly supports this effort to streamline transmission planning and help bring new renewable projects online. The State will likely need to follow up this effort with work to bring together the parties that can most rapidly build and begin operation of needed renewable resources and transmission additions and improvements. The energy agencies should examine methods and mechanisms used by other states, and by European countries to rapidly bring in both large scale and distributed renewable resources; some of these may be applicable to California's electricity system and markets.

In addition to transmission planning, the state must consider grid reliability and grid integration issues associated with intermittent renewable resources (such as solar and wind). Flexible fossil resources (such as plants that supply power at peak times), dispatchable demand response, and storage will be needed to provide system ramping and regulation for increasing penetrations of intermittent renewable resources. Many of the system modernization needs for renewable integration were analyzed by the CEC's PIER program known as the Intermittency Analysis Project. The resulting final report discussed a specific resource scenario that could achieve 33 percent renewables by 2020, provided needed transmission is built and sufficient grid modernization occurs, but noted that additional, more granular analysis was needed. The CPUC has since begun a staff and stakeholder process to refine a methodology that should help utilities plan long term procurement in a way that is consistent with the 33 percent goal, recently reaffirmed in the joint CEC-CPUC Proposed Opinion published on September 12, 2008. The IOUs and POUs must fully embrace this State goal and move quickly to make necessary system improvements. In procurement planning, it is critical both to maintain reliability while avoiding overinvestment of ratepayer funds in fossil fuel generation that could be come "stranded costs" to be paid by ratepayers in the future.

The California Independent System Operator (CAISO), the agency with primary responsibility for reliability and system planning in the IOU service areas, plans to begin a study later this year on the operating needs and costs of integrating 33 percent renewable energy.[95] Based on its November 2007 study of meeting 20 percent renewable energy, the CAISO has stated that costs could increase as more renewable energy is integrated into the grid. Continued CAISO support and analysis is needed to further understand changes needed to accommodate increasing renewables while maintaining reliability of the electricity and transmission system.

At least 17 European countries and the province of Ontario have adopted feed-in tariffs to speed the transition to renewable energy. The European experience suggests that use of well designed feed-in tariffs that are appropriate for California's energy system could lead to more rapid development of renewables. The CEC is examining feed-in tariffs as part of the 2008 Integrated Energy Policy Report proceeding[96]. In this process, small renewable generation developers (with under 20 MW of generation capacity) have noted the difficulty and high costs they face in the

[95] David Hawkins, July 21, 2008, "CAISO's Plan for Integration of Renewable Resources," California ISO presentation at the CEC 33 Percent Renewables Workshop, http://www.energy.ca.gov/2008_energypolicy/documents/2008-07-21_workshop/presentations/David_Hawkins_CAISO_Plan_for_Integration_of_Renewable_Resources.pdf.

[96] Documents, a June 30 public workshop transcript, and early results of this process are available at: http://www.energy.ca.gov/portfolio/documents/index.html#063008. Investigation of feed-in tariffs will continue to be documented in CEC's 2008 Integrated Energy Policy Report Docket 08-IEP-1/ also RPS Proceeding Docket No. 03-RPS-1078

IOU's RPS solicitation and contract negotiation processes.[97] Because feed in tariffs offer a known price and require limited or negotiation and legal costs for developers, they are one mechanism that can reduce the complexity, uncertainty, cost of financing, and costs of contract negotiation that currently make it difficult for some small renewable developers to participate in the RPS. Furthermore, small distributed renewable facilities often do not face the transmission barriers faced by large "utility-scale" projects, and, according to preliminary results in the Renewable Energy Transmission Initiative, such facilities can likely be brought into the electricity grid more rapidly than large scale projects.

The CEC's 2007 IEPR recommended a feed-in tariff for all RPS-eligible renewable facilities up to 20 megawatts in size. The CEC recommended that the feed-in tariff be set initially at the "market price referent" (MPR) determined each year by the CPUC. The MPR is a proxy price representing the cost of electricity from a modern, efficient combined cycle natural gas generation facility. In Europe, many feed-in tariff programs set technology-differentiated feed-in tariffs, based in part on the costs of different types of renewable generation. Such tariffs can encourage simultaneous development of technologies that are most cost-effective now, and of technologies that are on a path toward greater cost-effectiveness as they increase market share and their components (e.g., solar panels or wind turbines) are manufactured with increasing economies of scale. A tariff set initially at the MPR could immediately benefit small-scale facilities. And although the MPR is not technology-differentiated, it is calculated specifically for each project on a "time-of-delivery" basis, and thus it values peak power more than off peak power. As a result, a feed-in tariff at the MPR would be different for different technologies (e.g., solar and wind) based on generation output profiles, just as the prices paid to projects with different technologies vary in the current IOU RPS procurement process. To allow small renewable generation to reach its full potential share of the RPS, the energy agencies could implement feed-in tariffs or an alternate mechanism that facilitates additional distributed renewable generation up to 20 MW in capacity.

### Benefits and Costs

Expanding the state's RPS goals to 33 percent by 2020will accelerate achievement of longer term (post 2020) GHG reduction goals, enhance fuel diversity, reduce reliance on fossil fuels, and reduce criteria pollutants. An expanded RPS will also further stimulate economic activity by providing opportunities for California companies that develop, produce, install, or operate renewable equipment. Studies have shown that the renewable energy sector generates more jobs than the fossil fuel-based energy sector per unit of energy delivered (i.e., per average megawatt).[98]

Further study is needed to determine which renewable technologies and fuel sources (e.g., solar, biomass, etc.) provide the greatest GHG benefits. This can help inform consideration of the

[97]See CEC draft Consultant Report, *Exploring Feed-In Tariffs for California: Feed-In Tariff Design and Implementation Issues and Options*, CEC publication # CEC-300-2008-003-D, June 20, 2008. A final report, incorporating additional public input, is expected toward the end of 2008. See also WebEx Recording of June 30, 2008 CEC workshop on feed-in tariffs, held as part of the 2008 Integrated Energy Policy Report proceeding. Both the report and the recording are online at: http://www.energy.ca.gov/portfolio/documents/index.html#063008

[98] Renewable and Appropriate Energy Laboratory, 2004, *Putting Renewables to Work: How Many Jobs can the Clean Energy Industry Generate.*

expanded use of feed-in tariffs, which could be designed to stimulate development of renewable resources with large GHG reductions.[99]

**Appendix C: Electricity and Natural Gas**
**Table 16**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| E-3: Renewables Portfolio Standards (33% by 2020 for IOUs & POUs) | 21.3 | 1,782 | CEC/ CPUC | 2020 |

*Note: The cost associated with this measure only reflect the incremental costs to achieve 33% RPS above the existing 20% RPS.

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

[99] For more information on issues and options related to expanding the use of feed-in tariffs for renewable energy in California, see the feed-in tariff documents in the CEC's RPS proceeding, available at http://www.energy.ca.gov/portfolio/documents/index.html.

# 6. WATER

**This section includes the following measures:**

**Recommended Actions**
**(W-1) Water Use Efficiency**
**(W-2) Water Recycling**
**(W-3) Water System Energy Efficiency**
**(W-4) Reuse Urban Runoff**
**(W-5) Increase Renewable Energy Production**
**(W-6) Public Goods Charge for Water**

ARB worked closely with the CAT to develop this Plan. Input from the CAT was compiled, evaluated and analyzed by ARB staff. Many of the measures included in the Recommended Actions are the direct input from the CAT for this sector.

## Overview

For the purpose of this document, the Water sector is comprehensively defined and includes groundwater, surface water, agricultural use, urban use, conveyance, treatment, wastewater, and recycling. This sector plays a critical role in California and cuts across almost all other sectors. Approximately 19 percent of electricity and 30 percent of non-power plant natural gas consumed in California are used by the Water sector to grow crops, supply residential, commercial and industrial development, and produce energy. On top of these many, often competing needs, water is also necessary to maintain a healthy environment. Global warming will likely make it more challenging for California to meet all of these needs. The GHG reduction measures proposed for the Water sector are largely measures to develop additional supply reliability to meet the multiple, growing demands for water in California. Nevertheless, these measures can have many co-benefits including reducing GHG emissions.

Three of the measures (W-1, W-2, W-4) are water supply reliability measures. While efficiency and recycling have many benefits to the sector, the GHG emission reductions from these measures are accounted for in reduced energy requirements. Two of the measures (W-3, W-5) target reducing the amount of non-renewable energy used to convey and treat water and are also counted under the Electricity sector. These two energy efficiency measures apply to all the water projects, systems, and infrastructure in the State, large and small. California has a long and successful history of advancing efficiency and conservation in both the Water and Electricity sectors. Without these ongoing activities, business as usual GHG emissions associated with water use in 2020 would be higher than is currently forecast.

In addition, a mechanism to make allowances available in a cap-and-trade program could be used to provide incentives for local governments, water suppliers and third party providers to bundle water and energy efficiency improvements for small businesses or in targeted communities. This type of allowance set-aside will be evaluated during the rulemaking for the cap-and-trade program.

ARB also recommends a public goods charge for funding investments in the water sector to reduce GHG emissions. As noted by the Economic and Technology Advancement Advisory

Committee, a public goods charge on water can be collected on water bills and then used to fund end-use water efficiency improvements, system-wide efficiency projects and water recycling. DWR, as part of their overall responsibility for managing water resources and reducing GHG emissions, can consider all of these objectives in designing the Public Goods Charge program. Depending on how the fee schedule is developed in a subsequent rulemaking process, a public goods charge could generate $100 million to $500 million annually to invest in efficiency improvements and other projects that reduce GHG emissions. These actions would also have the co-benefit of improving water quality and water supply reliability.

# Recommended Actions

## *W-1: Water Use Efficiency*

Using water more efficiently is one of the key ways to provide water for a growing California. The Governor directed State agencies to develop and implement a plan to achieve a 20 percent reduction in per capita urban water use by 2020. This directive builds on the California Water Plan Update 2005, which identified water use efficiency as a "foundational action" for California water management. California will achieve approximately 1.8 million acre feet (MAF) of urban water use efficiency by 2020 to meet the Governor's call.

To implement this 20 percent by 2020 goal, DWR, CEC, PUC, SWRCB, and the Department of Public Health (DPH) are collaborating to develop and implement various strategies and measures to increase water use efficiency and thereby avoid the need for more energy intensive sources of new supply. This initiative will need to utilize the many Integrated Regional Water Management planning and implementation efforts currently underway throughout California. During 2008, the five-agency group will prepare a statewide water use efficiency measure for the Public Review Draft of the California Water Plan Update 2009 and identify additional opportunities to reduce GHG emissions from the entire water sector.

Measures for achieving the directed water conservation target include:

- Best Management Practices
- Appliance Efficiency Standards
- Landscape Water Standards
- Agricultural Water Use Efficiency
- Analytical Tools
- Regulatory Actions

**Appendix C: Water**
**Table 17**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Water Use Efficiency | 1.4 | TBD | DWR, SWRCB, PUC, CEC | Ongoing |

## W-2: Water Recycling

GHG emission reductions can be achieved when one water supply source is used as an alternative to another, more energy intensive source. Water recycling can reduce energy use and thereby reduce GHG emissions by increasing local water supplies rather than importing water from other regions or reliance on other energy intensive treatment processes. This measure proposes a requirement for development and implementation of water recycling plans by wastewater management agencies working with water supply agencies. This requirement would apply where the recycling of treated effluent is not maximized at wastewater treatment plants located in areas of imported water supply and where water recycling could require less energy than current water sources. Implementation of water recycling plans would be prioritized for those plants that discharge to water bodies from which the wastewater cannot otherwise be easily recovered, such as the ocean and brackish water bodies.

Modern municipal wastewater treatment facilities are capable of producing high quality recycled water that is suitable for a wide range of beneficial uses. The DWR publication Water Recycling 2030: Recommendations of California's Recycled Water Task Force reports that approximately ten percent of municipal wastewater in California is being recycled, but as much as 23 percent of the municipal wastewater flow could be recycled. This measure targets the 23 percent recycling goal by 2030. Finding suitable markets and funding treatment and distribution system costs are challenges to increasing the use of recycled water. The recommended public goods charge could be used to address this market barrier and provide funding for treatment and distribution systems.

Substantial energy savings could be realized if recycled wastewater was used to replace potable water in appropriate applications such as irrigation. The amount of energy required to import or recycle water varies widely throughout the State. The CEC has reported that water supply and conveyance of water from northern to southern California consumes an estimated 3.2 MWh per acre foot (AF). In contrast, the estimated energy needed to recycle wastewater is approximately 0.7 MWh per AF, but this value will vary with the level of treatment required. As a result, the potential energy savings that could be realized through water recycling is estimated as 2.5 MWh per AF in southern California communities that import water.

**Appendix C: Water**
**Table 18**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Water Recycling | 0.3 | TBD | SWRCB, DWR | Ongoing |

## W-3: Water System Energy Efficiency

To meet the needs of Californians, the State's water systems include natural and man-made facilities for the capture, storage, conveyance, treatment, distribution and re-use of water, requiring energy at nearly every step. Consistent with the recommendations of the California Water Plan Update 2005 and the 2005 Integrated Energy Policy Report, this measure seeks to

reduce the magnitude[100] and intensity[101] of energy use in California's water systems through further implementation of energy efficiency measures such as more efficient pumps and wastewater treatment.

Setting a target of a 20 percent reduction from 2006 levels would yield an estimated savings of 4,400 GWh per year. A reduction in electricity consumption would in turn reduce the greenhouse emission associated with this amount of electricity generation. An assessment of actual potential is needed to determine if such target is reasonable.

Two mechanisms are proposed to assess the potential of increasing system (e.g. pumping and treatment) efficiency in the water sector: 1) construct tools and protocols to evaluate, measure, and verify the energy impacts of water system efficiency activities and programs, and 2) conduct research and demonstration projects that explore ways to reduce energy demand and thus the GHG emissions of those water systems. To accurately assess the potential GHG emission reductions that are possible, various tools are needed to evaluate, measure, and verify the amount of energy that could be saved at various stages in the systems. Use of these tools will assist in program implementation and help with evaluation of program effectiveness. These tools can also help water agencies and regional boards determine the most effective measures to implement as part of their water management strategies under existing requirements. These tools will be beneficial to ensuring the cost-effectiveness of projects and governmental accountability. Research is also needed to deploy advanced technologies in water systems to lower energy intensity, examine opportunities to shift loads to energy sources with lower GHG emissions, refine understanding of the interaction of water and energy within the State, and identify new and innovative technologies and measures for mutually achieving energy and water efficiency savings.

**Appendix C: Water**
**Table 19**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Water System Energy Efficiency | 2 | TBD | CEC, PUC, SWRCB, DWR | Ongoing |

## *W-4: Reuse Urban Runoff*

GHG emission reductions can be achieved when any water supply or treatment process is replaced with an alternative supply or process that requires less energy. Capture or infiltration of urban stormwater to increase groundwater and/or stored supplies has the potential to achieve energy and emission reductions by reducing the need to obtain water from more energy intensive sources or processes.

100 Total energy consumed by a particular segment of the water use cycle. Peak demand is usually measured in megawatts and annual consumption in kilowatt-hours or megawatt hours.

101 Total energy consumed per unit of water to perform a water management-related action, such as desalting, conveyance, etc… This demand is usually measured in kilowatt-hours per million gallons.

Development of impervious surfaces and the reliance on traditional storm drain systems have reduced stormwater infiltration in urban areas. Traditional storm drain systems are designed to capture and convey water away from developed areas as swiftly as possible, typically discharging to streams or water bodies. Nontraditional stormwater management strategies emphasize the use of vegetated channels and natural landscapes to intercept runoff, slowing the discharge rate, increasing infiltration, and ultimately reducing discharge volume. Low Impact Development (LID) is probably the most recognized nontraditional approach, but the basic components are shared by other land use and planning techniques. Examples of LID techniques include actions such as adding rain barrels and disconnecting downspouts from storm drains, to more elaborate installation of underground cisterns, constructing surface storage basins, adopting water-saving street designs, and establishing undeveloped areas to infiltrate stormwater.

This measure proposes that LID be required to maximize the infiltration and/or capture of stormwater to increase local water supplies. Where favorable soil and geologic conditions exist, stormwater would be infiltrated to increase groundwater supplies. In locations where potential infiltration is either limited or not recommended, capture and storage would be required to preserve stormwater for nonpotable applications. In addition to LID techniques, this measure promotes development of regional infiltration facilities and neighborhood facilities to augment local water supplies.

A methodology has not been validated by the SWRCB to quantify the volume of water that could be captured and reused, or the energy savings that could be realized. Nevertheless, a pilot methodology is being evaluated to estimate the volume of water that could be obtained through urban stormwater capture, infiltration and/or storage. Applying this preliminary methodology to the urbanized area of southern California yielded estimates of 270,000–333,000 acre-feet of stormwater per year that could be obtained from new and redevelopment residential and commercial projects. Further investigation is warranted to validate these estimates.

**Appendix C: Water-Recommended Actions**
**Table 20**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Reuse Urban Runoff | 0.2 | TBD | SWRCB | TBD |

## *W-5: Increase Renewable Energy Production from Water*

The purpose of this measure is to identify and implement specific projects that take advantage of the State's water system-related opportunities to generate renewable electricity. Examples of renewable energy existing within water and wastewater systems include water moving through conduits, sunlight, wind, and gases emitted during treatment of wastewater at wastewater treatment plants. The CEC's PIER[102] program estimates statewide generation potential from currently undeveloped in-conduit hydroelectric and wastewater treatment renewable energy

[102] California Energy Commission, 2005, *California Small Hydropower and Ocean Wave Energy Resources*: CEC-500-2005-074.
California Energy Commission, 2006, *Statewide Small Hydropower Resource Assessment*: CEC-500-2006-065

resources at a total of 2,100 GWh per year. Further development of renewable generation from solar and wind resources at water system sites would add to this total. Renewable energy generation at water and wastewater facilities will reduce GHG emissions by reducing the need for the facilities to consume electricity derived from fossil fuels. In addition to GHG emission reductions, benefits of projects developed under this measure may also include better management of on-site electricity load at water system sites, mitigation of electricity price volatility, contribution to meeting renewable energy standards, and capture and use of gases from wastewater in an environmentally-preferred manner.

Implementation of this measure will involve several mechanisms. Local agencies are encouraged to develop their own cost-effective projects. The use of existing financial incentives is also encouraged. Another mechanism is to assess economic potential to better target future incentives and research technologies to lower costs and improve performance.

**Appendix C: Water-Recommended Actions**
**Table 21**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Increase Renewable Energy Production | 0.9 | TBD | CEC, PUC | 2020 |

## *W-6: Public Goods Charge for Water*

A public goods charge applied to water will raise funds for reducing GHG emissions resulting from capturing, storing, conveying, treating, using, and disposing of water. These funds would provide a stable and sustained source of revenue. Use of this revenue would further develop water use efficiency, water recycling, pumping and treatment efficiency, reuse of urban runoff, and increase renewable energy production from California's water system. DWR, as part of their overall responsibility for managing water resources and reducing GHG emissions, can consider all of these objectives in designing the Public Goods Charge program. These actions would also have the co-benefit of improving water quality and water supply reliability. Depending on how the fee schedule is developed it could raise approximately $100 million to $500 million per year.

The public goods charge would be applied to each water connection, be collected by each retail water provider in the State, and include all uses of water. This charge could be implemented in several ways. For example, it could be a flat rate per connection i.e. not based on the quantity of water use and therefore not likely to directly reduce water use or the associated emissions. Or, the charge could be per unit or tiered with no charge or a low charge for use at or below some baseline with higher rates charged for higher levels of use. In either case, the funds could be invested in local, regional, and statewide efforts to increase efficiency and renewables, thereby achieving both GHG and criteria pollutant benefits.

**Appendix C: Water-Recommended Actions**
**Table 22**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Public Goods Charge for Water | TBD | 100 - 500 | DWR, SWRCB, PUC, ARB | TBD |

# 7. GREEN BUILDING STRATEGY

**This section includes the following measures:**

**(GB-1) Green Buildings:**
**Greening New and Existing State Buildings**
**Greening Public Schools**
**Greening New Residential and Commercial Construction**
**Greening Existing Homes and Commercial Buildings**

ARB worked closely with the CAT, its Green Building subgroup, and an advisory group to develop this measure. This section has significant overlap with the Energy Efficiency and Conservation measures (E-1 and CR-1) discussed within the Electricity and Natural Gas Sector. Green building design emphasizes synergy among all building systems , including those related to water, waste, electricity and natural gas, and other areas to achieve both GHG and other concomitant environmental benefits that may not be GHG related, such as improved indoor air quality, reduction of waste streams to landfills, and better pedestrian and transit friendly communities. This Plan includes a Green Building Strategy for its GHG benefits to the State.

## Overview

The lifecycle impacts of the built environment have enormous implications for California's carbon footprint. The design, construction, demolition, renovation, maintenance and operation of buildings together account for considerable electricity and natural gas demand, water usage, and waste generation, each of which results in GHG emissions. Building electricity and natural gas use alone accounts for almost one quarter of all California emissions. The mining, harvesting, processing, and transportation of building materials used in construction and products used in the operation of buildings account for further GHG emissions. Finally, the choice of where buildings are sited and how they are integrated within communities also affects transportation patterns and infrastructure needs resulting in potentially significant GHG impacts.

"Green buildings" are designed, built, renovated, operated, and maintained using an integrated approach that creates and ensures a healthy and comfortable environment while maximizing energy and resource efficiency. Factors that are considered when designing a green building include: site selection and development, water and energy use, environmentally preferable products and materials, waste management, and indoor environmental quality. As such, green buildings are a vital tool for meeting the objectives of AB 32 because they provide a mechanism for reducing GHG emissions from multiple sectors – principally energy, water, waste, and transportation; while minimizing other undesirable environmental and community impacts.

Employing a *whole-building or integrated systems* design approach can create synergies that result in multiple benefits at little or no cost, allowing for efficiencies that would never be possible on an incremental basis. Reducing air leakage and employing good passive solar design, for example, can dramatically reduce the building's heating and air conditioning requirements. The cost savings can then offset costs of other green building features, such as sustainable materials, photovoltaics, more-efficient appliances, or gray-water recovery systems for landscape irrigation. This synergistic design leads directly to reduced energy use and an overall lower GHG footprint for the building.

While green building strategies are most easily integrated into new buildings, existing buildings offer the greatest potential for gains in efficiency. California has made impressive strides in improving energy standards for new construction but many buildings were built before energy standards were required for new construction. Even buildings less than ten years old offer a significant opportunity for improved performance with the implementation of technically-feasible and cost-effective technologies and practices. Reducing GHG emissions related to existing buildings is also recognized and discussed as a critical strategy in the Electricity and Natural Gas section.

## GHG Reduction Strategies

California can reduce the carbon footprint of the built environment by adopting comprehensive policies that address energy and water consumption, land use, waste management, and other critical components of designing, constructing, maintaining, operating, and renovating both new and existing buildings. Capturing the full GHG reduction potential from buildings will require a statewide effort, consisting of both mandatory and voluntary actions that are supported by incentives and education.

### *Current Green Building Policies and Programs*

There are several prominent existing state policies that mandate and/or encourage green construction. These include, but are not limited to:

#### 1. Green Building Initiative

The Executive Order (EO) S-20-04, known as the Green Building Initiative, requires that the State commit to aggressive action to reduce State building electricity purchases from the grid by retrofitting, building and operating the most energy and resource efficient buildings, and by taking all cost-effective measures described in the Green Building Action Plan[103] for facilities owned, funded or leased by the State. The EO also encourages cities, counties and schools to do the same. Specifically, it requires state agencies, departments, and other entities under the direct executive authority of the Governor to cooperate in taking measures to reduce grid-based energy purchases for state-owned buildings by 20 percent by 2015, through cost-effective efficiency measures and distributed generation technologies. These measures include:

- Designing, constructing and operating all new and renovated state-owned facilities paid for with state funds such that they can be certified at the "Silver" level or better, under the Leadership in Energy and Environmental Design (LEED) program known as *LEED for New Construction* (LEED-NC)[104];
- Identifying the most appropriate financing and project delivery mechanisms to achieve these goals;
- Seeking out office space leases in buildings with a U.S. EPA Energy Star rating; and
- Purchasing or operating Energy Star electrical equipment whenever cost-effective.

[103] State Green Action Team, *Green Building Action Plan*, available online at: http://www.documents.dgs.ca.gov/green/GreenBuildingActionPlan.pdf

[104] LEED has four levels that can be earned for increasing levels building "greenness." They are: certified, silver, gold and platinum. These levels are available based on points earned through meeting the various green requirements. There are separate systems of these four levels with different requirements for new and existing buildings.

The EO also references the Green Building Action Plan, which commits the State to benchmarking, retro-commissioning, and certifying existing Executive Branch facilities over 50,000 square feet in size so that they meet minimum certification requirements for *LEED for Existing Buildings* (LEED-EB) by 2015. The EO further requires the Division of the State Architect to adopt guidelines to enable and encourage schools built with state funds to be resource and energy efficient. The ARB encourages all state agencies to exceed minimum LEED-EB certification requirements, and to meet the silver, gold or platinum levels of LEED-EB.

**2. California Green Building Standards Code**

In July 2008, the California Building Standards Commission (CBSC) adopted the Green Building Standards Code (GBSC) for all new construction statewide. This initial code will provide a framework and meaningful first step in ongoing development of a statewide green building standards code. It is scheduled to become effective in July of 2009, at which time local jurisdictions may adopt the standards as mandatory if they choose. The code will establish mandatory minimum standards for residential buildings in the 2010 edition of the California Building Standards Code, anticipated to become effective around January 1, 2011. While the current version of the code also includes voluntary standards for commercial buildings and hospitals, GBSC anticipates adopting a mandatory code in 2011. In the future, these standards will be modified, enhanced, and expanded to cover other non-residential occupancies such as schools. The GBSC references energy efficiency building standards contained in the Title 24 Energy Code and sets targets for energy efficiency, water consumption, material conservation and solid waste management, and indoor air quality. ARB plans to work closely with CBSC, the California Housing and Community Development (HCD), the California Energy Commission, and the Division of the State Architect to ensure that the next version of the GBSC includes required provisions for energy, water, and waste reduction practices consistent with the measures identified in, and relied upon for, the Scoping Plan.

It is important that both voluntary and mandatory codes for green building be periodically revised, as are the State's Title 20 and Title 24 energy efficiency codes. Voluntary codes, written in code language, can serve as stretch goals for architects and building systems designers. They can also be adopted easily by local jurisdictions that desire requirements that exceed State minimums.

**3. "Zero Net Energy" Buildings**

The California Public Utilities Commission and the California Energy Commission have established "zero net energy" (ZNE) goals for new construction in California. By 2020, the goal is that all new homes will be ZNE. For commercial buildings, the target date for this goal is 2030.[105] These ZNE goals are discussed in more detail in the Electricity and Natural Gas section of the Scoping Plan.

[105] The *California Long Term Energy Efficiency Plan* covers a robust set of goals and recommended strategic plans for all sectors, including buildings. The plan addresses not only technical standards and technology development, but also recommends supporting implementation strategies needed via marketing, public education, workforce development, and integrated demand side solutions. This 100-page document can be found at: http://www.californiaenergyefficiency.com/index.shtml.

### 4. Funding Programs

The State offers funding programs to facilitate green building practices, such as:

- The Department of General Services (DGS) provides, under Proposition 1-D (2006), additional bond funding for new school construction or major renovation that meets high performance school standards modeled after the CHPS Criteria. However, the Office of Public School Construction (OPSC) recommends that the state support multiple paths to sustainability through CHPS or LEED. The DGS incentive for green school construction provides up to an additional 10 percent of state funding; however, the program is currently limited to a total of $100 million. The program is administered through the State Allocation Board and DGS's Office of Public School Construction.[106]
- The Department of Community Services and Development administers the federal Low Income Weatherization Program, which provides energy efficient retrofits for low-income households in California.[107] Such programs also address indoor pollution problems such as carbon monoxide and lead based paint, and has been shown to be very cost effective in terms of energy efficiency and other environmental and health benefits.[108] In addition, the CPUC regulates ratepayer funding of residential weatherization programs for all housing sectors administered though the investor-owned utilities (IOUs), but the utility programs use different protocols than the State program.
- The CPUC also oversees use of ratepayer funds for residential energy efficiency programs administered by IOUs and targeted at all qualifying low-income households in IOU service areas. Low-income households are estimated to be 30 percent of all households – or about 5.7 million homes throughout the State. These IOU-implemented programs collectively are known as the Low Income Energy Efficiency (LIEE) program. The LIEE spends about $250 million per year, and installs a wide range of efficiency measures, ranging from space and water heaters, and building shell weatherization to efficient refrigerators, air conditioners, lighting, low flow showerheads, and other appliances and measures. The measures are installed by private, non-profit, and local government entities under contracts with the IOUs. The CPUC has adopted a goal to install these measures in all qualifying and willing low-income households by 2020.

### 5. Third-Party Green Building Rating Systems

There are many green building rating systems available to evaluate and compare the energy efficiency and environmental performance of buildings. Most of these systems are voluntary programs that have strong presence within the building design communities. The following are three of the more well-recognized rating systems:

- Leadership in Energy and Environmental Design (LEED) – a nationally accepted green rating system that addresses new construction, existing commercial, residential, and retail buildings as well as schools and neighborhoods.

[106] http://www.green-technology.org/green_technology_magazine/rob_cook.htm.
[107] http://www.csd.ca.gov/Programs/Weatherization%20Assistance%20Program.aspx.
[108] Oakridge National Laboratory, Various reports at http://www.eere.energy.gov/weatherization/ne_benefits.cfm. For example, see the non-energy benefits study by Schweizer and Tonn (2002) and the national evaluation report by Ternes et al. (2007).

- The Collaborative for High Performance Schools (CHPS) – a rating system that offers green building certification geared towards California schools.
- GreenPoint Rated – a rating system that provides green building certification for California homes.

While these rating systems are not equivalent to building codes, they do provide a useful way to encourage the design, construction, and operation of green buildings. As California proceeds in the development of a mature Green Building Standards Code, it will need to address the relevance of the code to these systems. Many of the voluntary stretch goals may continue to be based on the criteria within these green building rating systems, which have been adopted by many local governments. However, strong mandatory and voluntary green building standards in code language should be implemented by the state, and periodically revised, in order to set a minimum "floor" for green buildings and to encourage buildings that beat mandatory standards.

# Recommended Actions

There are additional opportunities for reducing the carbon footprint of California's built environment. Capturing further GHG reductions from California buildings will require strategies that go beyond the requirements of the GBSC and the requirements of the EO, as described in green building measure GB-1.

Many of the green building strategies listed in GB-1 are similar to those listed in the Energy Efficiency and Conservation measure (E-1 and CR-1) of the Electricity and Natural Gas section because energy efficiency and renewable energy are key components of green buildings and have a significant ability to reduce California's greenhouse gas emissions.

## *GB-1: Green Buildings*

All of the following measures reference the Green Building Standards Code. The next iteration of the Green Building Standards Code, which the CBSC has stated will be in effect by 2011, must set stronger minimum mandatory performance standards and voluntary stretch goals for all buildings that go *beyond* current code. The requirements contained within the new GBSC will need to be aligned with and supportive of existing green building standards to achieve any meaningful improvement beyond those already offered by the energy standards. California will place a high priority on ensuring that the new GBSC fully incorporates more aggressive energy, water, and waste reduction requirements.

### Greening New and Existing State Buildings

All state buildings should be required to exceed the current performance requirements outlined in the Governor's Green Building Executive Order S-20-04.

The Green Building CAT subgroup recommends the following green building policies:

1. All new and renovated state buildings larger than 10,000 square feet in size would need to meet the GBSC and be required to meet the following targets:
    - Beginning in 2010, all new buildings would be designed, constructed, and operated to achieve the performance level of LEED-NC 2009 "Gold" or better.

- Beginning in 2025, all new buildings would be ZNE (five years earlier than the statewide mandate for commercial buildings.) Until the ZNE target is reached, state buildings would exceed each new iteration of Title 24 energy code by 30 percent. (Note: reaching ZNE implies a 70-80 percent reduction in energy use compared to the Title 24 2008 Standard (with the balance of energy use addressed via renewable energy solutions.)

2. All single occupancy leases undertaken by the State would be LEED-NC 2009 "Silver" buildings unless compelling market conditions make this impossible. Multiple tenant leases would be in LEED-NC "Certified" buildings where possible
3. All existing state buildings over 25,000 square feet in size would achieve LEED-EB 2009 "Silver" certification by 2020. Smaller buildings would be required to be operated and maintained at a level equivalent to LEED-EB 2009 but certification would not be required.

The State owns and operates over 290 million $ft^2$ of occupied space representing a total of 13,429 existing buildings, with another 17.5 million $ft^2$ of newly constructed state buildings planned for completion by 2020. The green building objectives outlined in EO S-20-04 are mandatory for Executive Branch agencies. Agencies not under direct executive authority of the Governor, including universities, Administrative Office of the Courts, and Legislative branch facilities are encouraged to implement these strategies as well.

In order to meet the proposed requirements for existing buildings, a better funding mechanism is needed for identifying, evaluating, and implementing potential energy and water efficiency improvement projects. This process, which can entail retro-commissioning studies, Investment-Grade Audits, and program administration costs, requires up-front funds that can be difficult to obtain given current State operating procedures. Unless appropriations are provided for these activities, the State will need to find ways to fund them out of existing appropriations. One option would be to pool pro-rated contributions from all State agencies to provide continuing funding. Some portion of building operating cost savings could be paid into this fund to reimburse the front-end funds used to identify and undertake green building projects.

## Greening Public Schools

### *New School Construction*

All new schools would need to meet the GBSC and should be required to be built to CHPS California Criteria 2009 Edition or LEED for Schools and to successive standards as they are updated. By 2020, all new schools should also be required to be "Grid Neutral."[109] Such schools would be highly energy efficient, and would typically produce electricity for remaining needs through renewable generation or efficient combined heat and power systems.

CDE estimates that some 5,843 new classrooms per year are needed to accommodate the rising student population. The Governor's Executive Order S-20-04 encourages school districts to build all schools that receive state funds to be resource and energy efficient, but does not specify a standard. In response, the Division of the State Architect formed a Schools Workgroup that selected the CHPS "Best Practices Manual as the guidelines that would best meet the EO

[109] As discussed in the Collaborative for High Performance Schools, Best Practices Manual, Volume III, Criteria , http://www.chps.net/review/2009Edition/PR_UnMarked_CHPS09Criteria_VIII.pdf

requirements.[110]"

CHPS offers a green building certification program especially designed for K-12 schools in California. A CHPS school is a school that achieves excellence in environmental efficiency and healthy building practices. In addition to greenhouse gas benefits, CHPS schools provide a healthy learning environment for California's children and have been shown to improve learning performance. Schools can self-certify through the free CHPS Designed Program, or seek third-party verification of their high performance school through the CHPS Verified program.

Meanwhile, the Division of State Architect in cooperation with the Office of Public School Construction is creating a "Grid Neutral by Design" schools program to encourage schools built with state funds to produce as much electricity as they use over the course of a year. Achieving this goal would require new innovative funding mechanisms to supplement existing school funding programs.

This green building measure would transform school architecture such that CHPS and grid neutral design become standard practice, thereby ensuring that schools set an example and provide the best possible learning environments for California's children.

### *Existing Schools*

All schools seeking State modernization funds should be required to meet CHPS California Criteria 2009 Edition or successive standards. Schools not going through a major renovation should be required, by 2020, to undergo energy and water testing and benchmarking, and to implement all efficiency measures with up to a ten year payback.

The State has more than 1,000 school districts educating more than six million students. The energy purchased to operate these schools costs California school districts over $1 billion annually and generates more than two million tons of $CO_2$ emissions each year.[111]

Updating existing schools can be accomplished through two mechanisms: major modernizations and minor retrofits. Major modernizations can be funded through the statewide school bond funding program administered by the Office of Public School Construction, which can fund major renovations on portable classrooms that are at least 20 years old and permanent buildings that are at least 25 years old, subject to the availability of bond funds. For school buildings not captured by this mechanism, alternative funding mechanisms will need to be established.

- ARB recommends that funding for school modernization be tied to meeting or exceeding CHPS 2009 standards for existing schools.[112] By changing these funding requirements, all public schools in California would eventually meet CHPS standards. ARB further recommends that by 2020 all schools undergo an environmental performance audit and benchmarking process to identify the best avenues for efficiency improvements. Existing schools should be required to undergo retrofits to improve energy and water efficiency by

[110]Schools Workgroup Implementation Plan
http://www.documents.dgs.ca.gov/dsa/dsaab/implementation_memo2.pdf
[111] Based on information from a study completed in September 2004 for the California Green Building Action Plan
[112] It is anticipated that CHPS will be developing green building standards for existing schools by 2009

25 percent where feasible if they do not meet the minimum environmental performance criteria.

### Greening New Residential and Commercial Construction

All new construction will need to comply with the California Green Building Standards Code. California should work with local jurisdictions to set and meet targets for new homes and commercial buildings to exceed the Green Building Standards Code.

California is expected to experience significant population growth in the coming decades, much of which is expected to take place in the state's hot inland areas. Estimates are that more than two million homes and almost 1.3 billion square feet of commercial space will be constructed between 2010 and 2020. Meeting California's aggressive climate change goals will require that these new buildings be very energy, water, and resource efficient.

Transforming the building industry will require a combination of mandatory and voluntary measures. Adoption of a mandatory GBSC for commercial construction is essential for improving the overall environmental performance of new commercial buildings. As described in the Energy Efficiency measure, it is also important to establish voluntary targets for builders to exceed the future mandatory GBSC. The California Long Term Energy Efficiency Strategic Plan suggests targets for a certain percentage of local governments to adopt "reach" standards for homes and commercial buildings to go beyond the minimum code, as well as for the market and utility incentive programs to work together to deliver target proportions of new homes and commercial buildings designed above code.

In support of their ZNE targets, the CPUC established an interim goal that 50 percent of new homes achieve energy savings that meet the Tier II standards of the Energy Commission's New Solar Homes Program by 2011. The New Solar Homes Partnership Tier II Energy Efficiency Requirements are:

- 35 percent Total Energy Savings Compared to 2005 Title 24
- 40 percent Cooling Energy Savings Compared to 2005 Title 24
- Energy Star for Builder Provided Appliances
- Full Compliance with Title 24 Lighting Requirements

In order to achieve statewide GHG emission reductions, these targets should be expanded to address other aspects of environmental performance. For example, these targets could be re-framed as a carbon footprint reduction goal for a 35 percent reduction in both energy and water consumption. For commercial buildings, a 2011 target should be established such that 25 percent of all new buildings reduce energy and water consumption by at least 25 percent beyond code.

Local governments are key players because they have explicit authority to pass ordinances and green building standards that are more stringent than the GBSC. Many local jurisdictions have begun to lead the way in green building. This Plan encourages local governments to adopt "beyond-code" green building requirements for all buildings, or offer incentives for builders to exceed state minimum codes. To assist this effort, State government must develop and regularly tighten voluntary standards, written in code language for easy adoption by local jurisdictions. As codes and standards push new construction toward a standard of ZNE, efforts for going "beyond

code" will need to focus on non-energy areas of improvement, such as water, embodied energy of building materials, solid waste, and transportation. The state could work with local jurisdictions to set the specifics of these targets, including options for certification,[113] incentives, reporting, and verification. The State can also assist local governments as they adopt ordinances that make mandatory the State's voluntary provisions of the GBSC.

As zero energy mandates are incorporated into the energy standards, some of these targets may need to be adjusted accordingly to account for a dwindling potential for improvements "beyond code." As we approach the 2020 and 2030 targets for zero energy buildings, these "percent above code" targets must shift to "percent of ZNE" targets. Zero energy new and existing buildings can be an overarching and unifying concept for energy efficiency in buildings, as discussed above (building energy efficiency measures E-1 and CR-1).

### Greening Existing Homes and Commercial Buildings

Existing buildings account for the greatest potential for GHG reductions in the building sector. About two-thirds of California's homes and apartments – more than 8 million homes, were built prior to the 1982 energy efficiency standards. Similarly, about 5.25 billion square feet of commercial buildings were built before 1978 when the first commercial building energy efficiency standards took effect. Many of these structures have not undergone major remodels, and may be lacking in very basic energy efficiency features.

California should implement a combination of voluntary and mandatory programs designed to achieve major energy and water efficiency changes in existing buildings. This measure is also listed as a key tool for successfully implementing the Energy Efficiency measure (E-1 and CR-1**).**

California should establish a comprehensive environmental performance rating system for residential and commercial buildings. The purpose of such a system is to inform owners and prospective buyers relatively how well a building "performs" in terms of energy and water efficiency, as well as its overall carbon footprint. Understanding how a building's performance compares to its peers (i.e. "benchmarking") is an important first step to identifying appropriate efficiency improvements.

Specifically, this green building measure would encourage utilities (potentially working with third party providers) to offer environmental performance audits to all homeowners in their service territories, and to provide financing mechanisms for cost-effective energy and water efficiency improvements up to a specified limit (within regulatory guidelines for cost-effective use of ratepayer funds). The CEC and CPUC would be the likely entities to develop the details of this program, including setting aggressive targets for these utility-sponsored retrofits. The State's Low Income Weatherization Program with its established network of service providers and training programs should also be considered in implementing this green building measure. To achieve significant changes to the existing building stock, it may be necessary to establish a mandatory component to this program, for homes of a certain rating.

Similarly, utilities and other third parties are encouraged to offer a similar program for commercial building owners, promoting environmental performance testing and financial

[113] For example, the CEC's Tier II standards, LEED, and/or GreenPoint Rated homes.

incentives for retro-commissioning. The retro-commissioning process includes conducting a diagnostic evaluation of the entire building to identify operational problems, making appropriate repairs, and optimizing controls and sequences to improve overall energy performance and indoor air quality. New legislation[114] already requires energy use benchmarking and disclosure by all commercial building owners to prospective buyers, lessees, or lenders starting January 1, 2010. The next step would be to encourage commercial building owners to implement cost-effective measures and building improvements identified by the environmental performance audits at specified trigger events such as changes in ownership or remodeling[115].

Success with this measure will require lenders, appraisers, and other parties in the real estate industry attribute value to green buildings. Lenders should be encouraged to offer "energy and water efficient mortgages" that allow the buyer to qualify for a larger loan if the home is energy and water efficient. Lenders and appraisers alike must also be encouraged to factor the energy and water saving features of a home into their estimates of the home value and monthly utility bill outlay. In an energy efficient home, the utility bills would be much lower, and these bill reductions can more-than-offset the increase in mortgage payments. This, coupled with environmental performance rating systems such as HERS 2009, GreenPoint Rated for Existing Homes, and Energy IQ, will help consumers to include green building features into their decision making process.

## Implementation Strategies

### *State and Local Governments Programs*

Implementing these strategies will require leadership and strong policies from state and local government. State government plays a role in setting statewide targets, leading by example, and ensuring that model voluntary codes that surpass minimum state requirements are available for adoption as requirements by local governments within their jurisdictions. Local jurisdictions have distinct authority to pass ordinances and green building standards that are more stringent than the GBSC and energy requirements that exceed those of Title 24. If these local standards are based on state models already written in code language, builders will not face a mix of different requirements. Some local governments are already setting green building targets very similar to those recommended in this Scoping Plan, demonstrating their desire to be ahead of the curve in responding to the dual challenges of increasing energy prices and climate change.

### *Funding Mechanisms*

Of particular importance is the need to provide workable funding mechanisms for the upgrade of existing buildings. Many existing buildings were built before more stringent energy codes were adopted and therefore offer proportionally more potential for improvement than newer buildings. With the US national average growth rate (in number of buildings) at approximately 1 to 2 percent per year, major GHG emission reduction efforts must necessarily be focused on existing buildings.[116] Funding mechanisms need to be established that will provide investment capital to upgrade these buildings in ways that account for and monetize extended lifecycle benefits, and that are not hampered by building sale or occupancy turn over. Taken individually, building

[114] AB 1103 (2007)
[115] Existing Title 24 building energy efficiency code applies to existing buildings that are renovated or remodeled in most cases. Implementation of the 2008 code for non-residential buildings is expected to result in a significantly higher portion of energy savings from existing, rather than new, buildings.
[116] American Physical Society, *Energy = Future, Think Efficiency*, Sept 2008, Page 53.

energy efficiency improvements are relatively small and incremental over time, and therefore easy to overlook. But increasing energy efficiency is very cost effective and the cumulative effect of widespread improvements in energy efficiency can amount to very substantial reductions in GHG emissions. However unless mechanisms are developed to encourage and fund such improvements the expected reductions are not likely to occur.

Mechanisms such as on-bill financing or energy efficiency services contracts can enable a building owner to implement improvements without having to provide up front capital. Such mechanisms allow the owner to finance energy or water efficiency projects with loan payments that are offset by utility bill savings over time. Other financial incentives such as grants, tax-exempt financing, direct loans, tax credits, and rebates could be improved to better encourage greater numbers of builders, contractors, owners, buyers and sellers of real property to invest in green buildings. Financing mechanisms are also needed for schools and state buildings. Non-financial incentives for green buildings are also crucial, and could include expedited permitting, priority plan review, green building technical assistance and recognition programs. Architects, builders, and homeowners often lack the time and resources to research green building design options, and applying for incentives can often be burdensome. Creating a "one stop shop" for information, resources, and incentives could make the process easier and faster for architects, builders, and homeowners. Improving access to technical information and implementing recognition programs could encourage market transformation through raising awareness and knowledge of green building practices and benefits.

One promising funding mechanism is local government sponsored loans for energy efficiency and renewable energy that can be paid back by being added to tax assessments. The City of Berkeley pioneered this concept, and has a program now under development. This mechanism means that the costs of improvements, or, for example, solar photovoltaics, can be amortized over a longer period than an ordinary home equity or commercial renovation loan. Furthermore, the low, amortized cost stays with the building, even if the building changes ownership. Berkeley, a charter city, was able to pass an ordinance to establish this mechanism. Legislation recently signed by the Governor now allows any California city to establish this kind of financing program for energy efficiency and building scale renewables[117].

### *GHG Reductions*

Accounting only for potential GHG savings that arise from reductions in energy and water use and from the recycling of C&D waste, preliminary estimates are that green building measures can reduce California GHG emissions by approximately 26 $MMTCO_2E$ in the year 2020.[118] In this plan, most of these emission reductions are accounted for in the electricity, waste, and water sectors. Further research is needed to estimate transportation-related additional GHG emission reductions from green buildings. A complete evaluation of the interaction between the green building measures and other sector measures may reveal GHG reductions from green buildings that are, in fact, "additional" to those accounted for in the electricity and natural gas, recycling and waste, water, and other sectors. Case studies, protocols, carbon calculators, and decision-

[117] AB 811 (Levine), Chapter 159, Statute of 2008

[118] Initial estimates for GHG emission reduction potential for this sector are based on LEED "Certified" buildings, however many of the strategies recommend certification to "LEED Silver" or higher standards. Also, these estimates do not include savings from transportation or green operating procedures such as recycling. As a result, actual emission reductions could be greater than those estimated here.

support tools should be developed to measure and verify GHG emission reductions from green buildings.

**Appendix C: Green Buildings**
**Table 23**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Green Buildings<br>• Greening New and Existing State Buildings<br>• Greening Public Schools<br>• Greening New Residential and Commercial Construction<br>• Greening Existing Homes and Commercial Buildings | 26 | TBD | Various | Various |

# 8. INDUSTRY

**This section includes the following measures:**

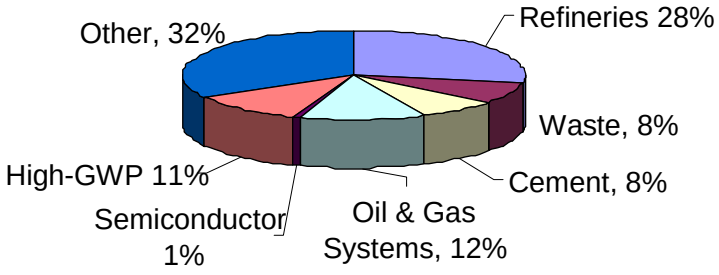
**California Cap-and-Trade Program Linked to the Western Climate Initiative**
**(I-1) Energy Efficiency and Co-Benefits Audits for Large Industrial Sources**
**(I-2) Oil and Gas Extraction GHG Emission Reduction**
**(I-3) GHG Leak Reduction from Oil and Gas Transmission**
**(I-4) Refinery Flare Recovery System Improvement**
**(I-5) Removal of Methane Exemption from Existing Refinery Regulations**

## Overview

The Industry sector in California covers a broad and diverse range of sources. The State, if it were a nation, would have one of the largest economies in the world; maintaining the economic health of California's business and industry while continuing to reduce criteria, toxic, and GHG emissions is vitally important. With over 100 $MMTCO_2E$ in emissions in 2004, the sources in these sectors account for approximately 20 percent of California's GHG emissions. Most emission reductions from the industrial sector will be realized through the Cap and Trade Program which will include large industrial sources. ARB is also proposing to develop two refinery measures and two oil and gas production measures as part of the Scoping Plan. Through the use of innovative technology and ideas to meet the requirements placed on the industrial sector, California can be an industry leader in creating new products and techniques to reduce emissions of GHGs.

**Industrial and Commercial**

**Appendix C Figure 6**



# Recommended Actions

## *Cap-and-Trade Program*

California is working closely with other states and provinces in the Western Climate Initiative (WCI) to design a regional cap-and-trade program that can deliver GHG reductions throughout the region. ARB will develop a cap-and-trade program for California that will link with the programs in the other WCI Partner states and provinces to create this regional market.

The WCI proposes to include emissions from industrial facilities in the cap-and trade program. Both fuel consumption and process emissions are recommended for inclusion. Large emitters would have a direct regulatory obligation under the program based on their facility emissions. Those covered by the program would have flexibility in how best to meet their regulatory obligation to surrender emission allowances to cover their actual emissions in each compliance period. Consistent with the WCI draft recommendations, California's preliminary recommendation is to include all large industrial facilities within the cap-and-trade program, including cement plants, refineries, oil and gas production, and others.

To apply the cap-and-trade program effectively and comply with the requirements of AB 32, the potential for emissions "leakage" must be considered. While important for all sectors, the assessment of the risk of leakage for industrial facilities must particularly consider the potential for production to shift to outside of California or outside of WCI. California and the WCI Partners are examining these risks, and are working to identify approaches for mitigating leakage potential, thereby ensuring that production in California and the WCI Partner jurisdictions remains competitive and real emissions reductions are achieved.

By setting a limit on the quantity of greenhouse gases emitted, a well-designed cap-and-trade program will motivate GHG reduction from industrial facilities that are expected to be the most cost effective options available from these sources.

The WCI program design for the cap-and-trade program includes fugitive methane emissions to the extent that adequate quantification methods exist. During implementation of this measure, ARB will determine whether these emissions will also be covered in California's cap-and-trade program. If the emissions are covered under the cap, ARB will evaluate the need for the measures described here.

## *(I-1) Energy Efficiency and Co-Benefits Audit for Large Industrial Sources*

This measure would apply to major industrial facilities with more than 0.5 $MMTCO_2E$ per year of emissions of greenhouse gases and be implemented through a regulation adopted by ARB. In general, these facilities also have significant emissions of criteria air pollutants, toxic air pollutants, or both. Major facilities that have this level of emissions include larger power plants, refineries, and cement plants. Rulemaking will be initiated in 2010 and the measure will be in effect by 2012, with results potentially available to ARB as early as 2013. This rulemaking will

occur independently of any others, and will not affect rulemakings for criteria pollutants, the cap and trade program, or others.

In California, the 2004 emissions inventory shows that there are 54 major industrial facilities with emissions greater than 0.5 $MMTCO_2E$. The breakdown includes five major oil and gas facilities, two hydrogen plants, one minerals facility, 13 refineries, nine cement plants, 23 power plants, and one natural gas compressor station. The five oil and gas facilities are located in the western Kern County oil fields and are distributed sources but are each treated as a single stationary source; the other facilities are located at single sites throughout California. The emissions range from about 5 $MMTCO_2E$ to just over 0.5 $MMTCO_2E$. The total emissions associated with these facilities are about 77 $MMTCO_2E$, which represents about 80 percent of the total emissions from the industrial sector.

Each facility would be required to conduct a certified, independent, third-party audit of significant individual sources within the facility to determine the potential to reduce greenhouse gases, criteria air pollutants, and toxic air pollutants. The one time audit would include an assessment of the impacts of replacing or upgrading older, less efficient units such as boilers and heaters, or replacing the units with combined heat and power units, and the results submitted to the Board. For example, the audit might identify specific sources within a facility that are old, inefficient, are cost-effective to control directly, and have significant emissions of criteria air pollutants, toxic air pollutants, or both.

The analysis would identify the potential emission reductions, the costs, the cost-effectiveness, the technical feasibility, and the potential to reduce air pollution impacts on local populations. ARB will use the results of the audit to determine if certain emission sources within a facility have cost-effective GHG reduction options that also provide significant reductions in other pollutants. The results of these audits will be useful to the facility in determining where improvements can be made to assist in meeting the requirements of the market system. Also, where the results of the audits indicate that regulatory strategies are warranted, rule requirements, permit conditions, or other mechanisms would be considered to implement the best combination of reductions in GHGs, toxics, and criteria pollutants. The estimated one time cost for the measure is approximately $13.5 million, based on an estimated average audit cost of $250,000 per facility applicable to approximately 54 facilities.

**Appendix C: Industry**

**Table 24**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Energy Efficiency and Co-Benefits Audits for Large Stationary Sources | TBD | TBD | ARB | 2010/2012 |

# A. OIL AND GAS PRODUCTION

California has a large oil and gas industry, which produced approximately 250 million barrels of crude oil and 325 billion cubic feet of natural gas in 2005. This production comes from California's more than 50,000 oil and 1,500 gas wells, including off-shore platforms. The majority of the oil wells are located in southern California, with most of the gas fields located in northern California.

An extensive network of pipelines within the state brings California crude from import terminals and onshore and offshore oil fields to refineries, and distributes finished fuels to more than 70 product terminals throughout the state. Pipelines are also part of the regional petroleum market. California refineries supply Nevada with almost 100 percent of its transportation fuels. Arizona gets more than 60 percent of its fuel from California, while Oregon depends on California's refiners for 25 to 35 percent of its fuel.

The industry is dominated by large, integrated oil companies. While small businesses comprise a large number of individual production wells, their share of total production is modest. There is some evidence that with the current high oil prices, more small producers are entering or reentering the market, resulting in increased emissions.

## *(I-2) Oil and Gas Extraction GHG Emission Reduction*

This measure would address fugitive emissions from the extraction process of California's large oil and gas industry, including on and off-shore sources. Fugitive emissions—mostly in the form of methane—account for approximately five percent of the GHG emissions from this part of the sector and are estimated to be 0.3 $MMTCO_2E$ in 2020. These emissions are from well and process equipment venting: leaks of flanges, valves and other fittings on the wells and equipment; and from separation and storage units such as sumps and storage tanks. This level of emissions follows the historical trend of statewide extraction rates. However, increases in crude oil prices have resulted in increased oil extraction and may increase emissions. If so, this measure would yield greater benefits. This measure may also eventually address combustion sources that are not captured by the Cap and Trade Program.

Controls for the fugitive sources range from applying simple fixes to existing technologies, to deploying new technologies to replace inefficient equipment and detect leaks and would include: improving operating practices to reduce emissions when compressors are taken off-line; installing compressor rod packing systems; substituting high bleed with low bleed pneumatic devices; improving leak detection; installing electronic flare ignition devices; replacing older equipment (flanges, valves, and fittings); and installing vapor recovery devices. These are proven technologies in the U.S. EPA's Natural Gas operations efficiency program, or STAR program, that will pay back investments in a short period of time through saleable gas savings.

The measure described here is expected to reduce fugitive methane emissions by approximately 0.2 $MMTCO_2E$ per year, beginning in 2015 and continuing to 2020 and beyond. Staff estimated the fugitive emission reductions by applying the natural gas savings from the STAR program actions described above to a number of such units in the current emissions inventory. These emission reductions may be underestimated if an industry survey reveals that there are additional sources of emissions.

ARB staff estimates that implementing this measure would result in significant cost savings due to the energy savings. Capital costs are estimated to total $800 thousand with net annualized costs savings of about $3.7 million. There is a potential for further reductions from this measure and these potential reductions will be evaluated as part of the ongoing evaluation of the sector.

## *(I-3) GHG Leak Reduction from Oil and Gas Transmission*

This measure addresses emissions from the transmission and distribution of natural gas throughout California. Statewide, there are approximately 12,000 miles of pipeline for natural gas. Transmission-related emissions come primarily from fugitive sources and secondarily from combustion sources. Approximately ninety-five percent of the emissions from this part of the sector are from methane. These emissions are from venting, accidental releases of GHGs, and leaks of flanges, valves and other fittings along pipelines.

This measure would include improving operating practices to reduce emissions when compressors along the pipeline are taken off-line, as well as installing compressor rod packing systems and replacing older equipment (flanges valves and fittings) along the pipelines. The measure would be based, to a large degree, upon the U.S. EPA's Natural Gas STAR program aimed at cost effective approaches to reducing methane emissions. This measure may also eventually address combustion sources that are not captured by the Cap and Trade Program.

Total fugitive emissions from natural gas transmission are estimated to be 1.7 $MMTCO_2E$ in 2020. The measure described here is expected to reduce fugitive methane emissions by approximately 0.9 $MMTCO_2E$ per year. Staff estimated the fugitive emission reductions by applying the natural gas savings from the U.S. EPA's Natural Gas STAR program actions described above to a number of such units in the current emissions inventory. These emission reductions may be underestimated if an industry survey reveals that there are additional sources of emissions.

ARB staff estimates capital costs to be about $24 thousand, with annualized net savings of about $17 million. Implementation of this measure would impact mainly the natural gas industry and have little or no impact on the price of end products as the annual savings exceeds the capital costs and annual operating and maintenance costs. Because of the cost savings, there is a potential for further reductions from this measure and these potential reductions will be evaluated as part of the ongoing evaluation of the sector.

**Appendix C: Industry**
**Table 25**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Oil and Gas Extraction GHG Emission Reduction | 0.2 | -3.7 | ARB | 2011/2015 |
| GHG Leak Reduction from Oil and Gas Transmission | 0.9 | -17 | ARB | 2010/2015 |

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

## B. REFINERIES

The GHG emissions from refineries in the state are estimated to be 35.2 $MMTCO_2E$ (2004), including emissions from hydrogen production. Increased energy efficiency could produce significant emission reductions in this sector. Establishing leak controls for methane would also result in GHG reductions.

California is the third largest refining state in the nation, with 21 refineries located primarily in the San Francisco and Los Angeles regions. These facilities produce approximately 80 million gallons of refined product per day.[119]

It is unlikely that refinery production will decrease in California over the next 12 years because of GHG reduction requirements. Due to the State's proximity to existing infrastructure (seaports, pipelines, etc.) and the developing Low Carbon Fuel Standard (LCFS)—which will hold both in-state and out-of-state producers to the same low carbon fuel standard—the demand for fuel products from California's refineries will not significantly change in the short term.

### *(I-4) Refinery Flare Recovery System Improvements*

In a refinery, flares are combustion devices, usually elevated, that are designed to safely dispose of flammable gases generated in processing units during emergency conditions or during normal, planned maintenance. A series of piping manifolds directs the gases to the flare.

While the main purpose of the flare system is to protect the refinery and surrounding community from potential catastrophic overpressure in the process units, the combustion of gases in flares results in emissions of nitrogen oxides (NOx), sulfur oxides (SOx), some unburned hydrocarbons, and greenhouse gases (GHG).

A flare gas recovery unit can minimize emissions from the flare by recovering the gases before they are combusted by the flare. The system collects the gas, compresses it, cools it, and then sends it back to a refinery process, where the recovered gas can be used as refinery fuel gas or refinery feedstock. In order to achieve the optimum performance, the flow of waste gases should be less than or equal to the capacity of recovery system.

[119] California Energy Commission, 2008; From Web site: www.energy.ca.gov/oil/refineries.html

Staff proposes to improve the overall flare gas recovery in the flare systems of California's refineries by increasing compressor capacity where practicable. Furthermore, staff will evaluate connecting to the flare system pressure-relief valves that currently release to the atmosphere.

Staff assumed that installing an additional compressor in the flare system, at a cost of $3.75 million apiece, at 19 of the 21 refineries would result in a total estimated capital expenditure of $71.3 million. The additional gas-recovery capacity would then be sufficient to handle sizable flare events that would have exceeded the capacity of the old systems. The recovered gases would be utilized in the refineries, resulting in cost savings. Staff assumes that flare emissions would be halved by this measure.

### *(I-5) Removal of Methane Exemption from Existing Refinery Regulations*

Under this measure, existing fugitive methane exemptions would be removed from the regulations applicable to equipment and sources employed in California's refineries. The local air pollution control authorities oversee and implement regulations which limit and monitor refinery fugitive emissions. Methane is currently exempted from local fugitive emissions regulations because it is not a volatile organic compound (VOC) that contributes to urban ozone levels. Storage tanks, wastewater treatment facilities, and process losses (leaks) are all sources of fugitive emissions which contain methane. Valves, pumps, compressors, pressure relief valves, flanges, connectors and other piping components are especially vulnerable to leakage. To implement this measure, ARB would work with the local air pollution control authorities to:

- Modify existing regulations to include in addition to VOCs, methane detection and leak repair as a regulatory requirement;
- Ensure that components that contain significant amounts of methane are included in fugitive emissions monitoring programs, and increase the fugitive methane monitoring frequency of all identified components; and
- Modify leak detection methodology and equipment requirements to detect methane, and where needed, require the installation of additional leak detection equipment.

The measure described herein is expected to reduce GHGs emissions between 0.01 and 0.05 $MMTCO_2E$ per year in 2020. This measure is expected to eliminate approximately 85 to 90 percent of fugitive methane emissions. Additional analysis is needed to more accurately quantify actual refinery methane emissions.

Based on data provided by the South Coast Air Quality Management District and the Bay Area Air Quality Management District, ARB estimates that the annual costs for implementation of this measure to be about $5,000,000. Staff assumed that, of the estimated 650,000 valves in the 21 California refineries, five percent were not being inspected due to the methane exemption in current local air district rules. Annual inspection costs for these 32,500 valves would be $1.6 million. Assuming one percent of valves and five percent of other devices need to be repaired at $50/repair and 0.5 percent of devices need replacement—at $10,000 per replacement—an additional $1.7 million cost is incurred. When methane leaks are minimized, savings will occur, and the gas captured as a result of this measure will result in an energy savings valued at $2.7 million. Therefore, total annual costs are estimated at $0.6 million. Implementation of these regulations will require close coordination with local air districts, but should not impact entities

beyond the refining industry. This measure should have little or no impact on the price of refined end products.

The benefits and costs of the refinery-based GHG-reduction measures described in this section are summarized in the below.

**Appendix C: Industry-Recommended Actions**
**Table 26**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Refinery Flare Recovery System Improvement | 0.33 | -39 | ARB | 2010/2012 |
| Removal of Methane Exemption from Existing Refinery Regulations | 0.01 | 0.6 | ARB | 2010/2012 |

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

# 9. RECYCLING AND WASTE MANAGEMENT

**This Sector includes the following measures:**

**Recommended Actions**
**(RW-1) Landfill Methane Control Measure (Discrete Early Action)**
**(RW-2) Increasing the Efficiency of Landfill Methane Capture**
**(RW-3) High Recycling/Zero Waste: Commercial Recycling, Composting and Other Organics Products, Anaerobic Digestion, Extended Producer Responsibility, Environmentally Preferable Purchasing**

**Areas of Research/Opportunities for future GHG Emission Reductions:**
**Liquefied Natural Gas (LNG) from Landfill Gas**

ARB worked closely within the Recycling and Waste Management (R&WM) CAT subgroup in developing these measures. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

## Overview

The Recycling and Waste Management sector includes the state's solid waste facilities (such as landfills, material recovery facilities, and transfer stations), composting infrastructure, and recycling industries. When organic materials, construction materials and other municipal solid wastes are discarded, they end up in landfills. In California however, much of the waste is turned into renewable resources and in the process, California realizes significant greenhouse gas (GHG) emission reductions. Increasing waste diversion from landfills beyond the current rate of 54 percent (which exceeds the 50 percent mandate) provides additional recovery of recyclable materials that will directly reduce GHG emissions. Recycled materials can reduce the GHG emissions from multiple phases of product production including extraction of raw materials, preprocessing and manufacturing. Furthermore, use of composted organic materials provides environmental benefits such as carbon storage in soils and reduced use of fertilizers, pesticides, and water, rather than placing these materials into a landfill to decompose into methane and other gases.

The 147 active landfills in the state are owned by private companies, mostly large waste disposal companies, or by municipalities. Closed landfills are scattered throughout the state and once provided service to specific localities. Other types of waste facilities, such as compost facilities, transfer stations, or material recovery facilities, handle diversion of reusable materials (organic materials, traditional recyclables like paper, plastic, glass, metals, and construction materials).

Per the Statewide GHG emissions inventory, the largest emissions from the Recycling and Waste Management sector come from landfills and are in the form of methane, which is produced when materials placed in landfills decompose over time. Often, decades elapse and methane is still produced from this decomposition. Although methane is captured currently at many large landfill sites, there are still active landfill operations and closed landfill sites that continue to emit methane that could be captured. ARB staff worked with the Recycling and Waste Management Subgroup of the Climate Action Team to develop measures to reduce landfill methane emissions.

ARB identified improved capture of landfill methane as a Discrete Early Action Measure. Methane that is currently emitted can be captured and further controlled, and can, in some cases, be used as a fuel to replace conventional fossil fuels. In addition, methane capture can also reduce air quality impacts by capturing and destroying volatile organic compounds and other landfill gases that are emitted during the decomposition process. ARB staff is working closely with the California Integrated Waste Management Board (CIWMB) to develop this measure which ARB will consider in early 2009.

In addition, the sector team identified a series of other measures that are currently non-regulatory, but would aid in the overall reduction of GHG emissions from the sector. Implementation of landfill gas best management practices, increased production and markets for compost and other non-ADC beneficial uses of organic materials, commercial recycling, extended producer responsibility and environmentally preferable purchasing, and deployment of anaerobic digestion for production of fuels/electricity from biomass were all included in the staff recommendation to consider for the Scoping Plan.

The diversion of organic material from landfills can provide a significant reduction in GHG through landfill methane avoidance, alternative energy production and water conservation. The CIWMB is undertaking efforts to increase production and markets for compost and other organics products including development of a complete life cycle assessment of organic diversion alternatives; development of compost-based best management practices, compost specifications for agriculture, and a study examining the effectiveness of using compost as cover material to mitigate methane from landfills. The use of organic waste as an alternative daily cover (ADC) by landfills is another unique issue. ADC used by landfill operators is currently counted toward local waste diversion goals, which can result in competition for this material as feedstock for compost; this policy is under review by CIWMB.

Extended producer responsibility and commercial recycling are additional ways to address GHG reductions. Extended producer responsibility would address the problem that many items are now produced without regard to their end-of-life disposition. Promoting commercial recycling would increase the rate of removing recyclables from the waste stream for efficient reuse. If more products are recyclable and are designed with an eye toward their end-of-life disposal, significant amounts of GHG could be realized. Some of the benefits of extended producer responsibility and most of the benefits of increased commercial recycling would likely accrue outside of California making emissions accounting more challenging. This measure would reduce both co-pollutants and global GHGs and would move towards the CIWMB's goal of a sustainable California where all resources are conserved to the maximum extent feasible. While most of the recycling and manufacturing may occur outside of California, some does occur in the state (e.g. glass, paper, and plastics manufacturing) and it is likely still significant.

CIWMB also identified technologies and outreach that would improve emission reduction through voluntary strategies. One method involves increasing the use of anaerobic digestion, a type of controlled, in-vessel decomposition of the organic fraction of the waste stream that allows for renewable energy production and avoidance of landfill methane emissions. Another method includes increasing outreach efforts on best management practices for efficient landfill operating practices to minimize the release of landfill gases and provide tools for landfill operators to move towards methane capture ahead of any regulatory deadlines. These best management practices could be used at smaller and closed landfills to reduce fugitive methane

releases and would also provide tools and costs to consider in the event that the methane controls could be applied even though their amount of waste-in-place might exempt them from the requirements.

Opportunities for emission reductions as well as diversion benefits also exist through design measures. For example, the Green Buildings section of the Scoping Plan identifies measures designed to reduce construction and demolition waste. This may potentially aid the Recycling and Waste Management sector in the reduction of GHG emissions in addition to further increasing diversion of waste materials.

# Recommended Actions

## A. LANDFILL METHANE CAPTURE

### *(RW-1) Landfill Methane Control Measure (Discrete Early Action)*

Enhanced control of methane emissions from municipal solid waste landfills will require owners and operators to install gas collection and control systems at smaller and other uncontrolled landfills. Additionally, all affected landfills will be required to satisfy enhanced methane monitoring requirements to ensure that their gas collection and control system is operating optimally and that fugitive emissions are minimized.

The Landfill Methane Control Measure is a discrete early action measure and is currently in the regulatory development process. The measure will be fully adopted by January 1, 2010, but will likely have a phase in period to become fully effective. The preliminary one-time estimated cost for adoption is approximately $70 per ton of $CO_2$ reduced. Capital cost was estimated to be approximately $3,440,000 and annual operation cost of approximately $706,400 per landfill. Total industry costs estimates will be discussed in the staff report for the landfill methane control measure.

**Appendix C: Recycling and Waste Management**
**Table 27**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| **RW-1**: Landfill Methane Control Measure (Discrete Early Action) | 1.0 | 52 (approximately 1 per landfill) | ARB | Board Hearing Early-2009 |

## B. ADDITIONAL REDUCTIONS IN LANDFILL METHANE

### *(RW-2) Increasing the Efficiency of Landfill Methane Capture*

To support the landfill methane control measure (RW-1), CIWMB recently published a guidance document titled “Technologies and Management Practices for Reducing Greenhouse Gas

Emissions from Landfills" that can be used as an outreach tool to optimize and increase the efficiency of landfill methane capture. Implementation of the options described in this guidance document may further reduce emissions from landfills and improve gas collection efficiencies beyond the control measure. Emission reductions are site specific and therefore cannot be quantified. ARB and CIWMB will work together to assess the need for regulatory action to mandate any specific options, as appropriate, at California landfills.

**Appendix C: Recycling and Waste Management**
**Table 28**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| **RW-2:** Increasing the Efficiency of Landfill Methane Capture | TBD | TBD | CIWMB | TBD |

## *(RW-3) High Recycling/Zero Waste*

### Mandatory Commercial Recycling

The commercial recycling measure focuses on increased commercial waste diversion. There are about 24,000 commercial businesses in California that generate over half of the statewide solid waste. Reductions in GHG emissions can be realized from solid waste management by recovering traditional recyclable materials from the commercial waste stream with the goal to remanufacture these materials, thus reducing the GHG emissions from multiple phases of product production including extraction of raw materials, preprocessing and manufacturing. Traditional recyclable materials have significant intrinsic energy value that displaces fossil fuel energy requirements when introduced back into the manufacturing cycle.

Not all of the reductions from the commercial recycling measure will occur in California, making accounting more difficult. Benefits from the commercial recycling measure include avoided methane emissions from landfill disposal by recycling any organic materials from the waste stream. Economic studies are planned to investigate the potential for commercial recycling.

### Composting and Other Organics Products

Various activities for increasing the production and markets for compost, mulch, and biofuels/energy and diverting these organic materials from landfills are being pursued as measures in this sector. Diversion of organic materials can provide a significant reduction of GHG through landfill methane avoidance. Additional GHG emission reductions are achieved through reduced water consumption and fertilizer production resulting in energy savings in pumping irrigation water and manufacturing and transporting fertilizer. CIWMB efforts to increase the production and markets for compost and other beneficial uses include an Economic and Life Cycle Assessment of Organic Diversion Alternatives; compost-based best management practices; development of compost specifications for agriculture; and a study examining the effectiveness of using compost as cover material to mitigate methane from landfills. However,

because composting facilities emit Volatile Organic Compounds (VOCs), which are criteria pollutants that contribute to ozone formation these facilities may have some region-specific (e.g.. San Joaquin Valley) air district permitting requirement issues. There is a need for research on emissions and best management practices to fill knowledge gaps and uncertainty regarding emissions from compost facilities.

### Anaerobic Digestion

Anaerobic digestion is a type of conversion technology that diverts organic materials from the waste stream to be utilized as feedstock for a digestion process that produces energy and displaces fuel or energy derived from fossil fuels in a sustainable manner. This measure would seek to increase anaerobic digestion of green waste, food waste and other organic components of the waste stream. Typically the methane gas produced by the anaerobic digestion process is converted into LNG, compressed natural gas (CNG), or electricity for on-site energy needs and export to the energy grid. In addition to GHG reductions, this measure also results in the production of 1.2 million MWh of renewable energy on an annual basis.

This measure will also seek to expedite the deployment of GHG reducing technologies by providing funding that assists developers in demonstrating their technology for commercialization of emerging conversion technologies that maximize the front-end recovery of materials for recycling, meet strict cross-media performance standards to protect public health, safety and the environment and result in a net reduction in GHG emissions.

Benefits from these measures include avoided methane emissions by increasing waste diversion of organic materials from landfills and development of a biomass renewable energy sources. Executive order S-06-06 directs State agencies participating in the Bio-energy Interagency Working Group to enhance the sustainable management and development of biomass resources for electricity generation and production of alternative fuels (bio-fuels).

### Extended Producer Responsibility and Environmentally Preferable Purchasing

Extended producer responsibility is a strategy to place a shared responsibility on the producers, and all entities involved in the life cycle of a product for reducing the health and environmental impacts that result from supply chain, production, use, and end-of-life management of a product. A major component of this measure includes product design changes that minimize a negative impact on public health and the environment at every stage of the product's lifecycle. By implementing extended producer responsibility additional environmental benefits could also be realized such as reductions in air emissions and water pollution along with waste minimization. Environmentally preferable purchasing (EPP) can reduce the quantity of energy consumed through the production and use of products in addition to reducing the quantity and toxicity of waste in California by purchasing recycled, repairable, and durable goods. This concept provides the State an opportunity to lead by example in reducing GHG emissions.

**Appendix C: Recycling and Waste Management**
**Table 29**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions) | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| **RW-3: High Recycling/Zero Waste**[120] | | | | |
| Mandatory Commercial Recycling | 5.0[121] | TBD | CIWMB | TBD |
| Increase Production and Markets for Composting and Other Organics Products (studies underway for data development) | 2.0[122] | TBD | CIWMB | TBD |
| Anaerobic Digestion[123] | 2.0 | TBD | CIWMB | TBD |
| Extended Producer Responsibility | TBD | TBD | CIWMB | TBD |
| Environmentally Preferable Purchasing | TBD | TBD | DGS | TBD |

# C. AREAS OF RESEARCH/OPPORTUNITIES FOR FUTURE GHG EMISSION REDUCTIONS

## *Liquefied Natural Gas (LNG) from Landfill Gas*

This activity implements grant-funded projects at two landfills to demonstrate commercial scale technologies for converting landfill gas to LNG vehicle fuel. Recovery of landfill methane that is combusted through flaring can be captured as a biomass renewable energy source. Executive order S-06-06 directs State agencies participating in the Bio-energy Interagency Working Group to enhance the sustainable management and development of biomass resources for electricity generation and production of alternative fuels (bio-fuels). However, substantial financial and technical barriers exist for in-state production of LNG from landfill gas. The technology transfer

[120] These measures represent the lower bound of the GHG estimates provided by CIWMB.
[121] Some GHG reductions may occur outside of California making accounting more difficult, additional research to quantify emission is needed
[122] Preliminary estimate by CIWMB, based on 50% diversion of compostable organics from landfills. CIWMB is currently developing a GHG tool to refine GHG reduction estimate.
[123] For anaerobic digestion, GHG reductions include only methane avoidance at landfills; however this measure also contributes 1.2 million MWh in renewable energy production. This measure does not include other waste-to-energy technologies.

from these commercial projects, which are expected to conclude in June 2009, could provide significant GHG reduction opportunities.

# 10. FORESTS

**This sector includes the following measures:**

**Recommended Actions**
**(F-1) Sustainable Forest Target**
- **Regulatory and Statutory Capacity**

*Forest Practice Rules Mechanism*
*CEQA Mechanism*

**Opportunities for Additional Reductions**
Forest Conservation
Forest Management
Afforestation/Reforestation
Urban Forestry
Fuels Management

ARB worked closely with the CAT and its sector-specific subgroups in developing the measures included in this Plan. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

## Overview

California's forests play a critical role in the State's carbon balance, with the unique capacity to remove CO2 from the air and store it long-term as carbon. The forest sector is the only sector included in the Scoping Plan that provides a net removal of GHGs.

Under the Sustainable Forest Target (Measure F-1), Board of Forestry and Fire Protection will use its existing authority over sustainable forestry, post-harvest restocking, fire hazard reduction and fire safety, timberland conversion, and existing forest improvement assistance programs to ensure sustainable management practices and, at a minimum, to maintain current carbon sequestration levels. Coordination of these efforts with federal forest land managers is essential to the target of maintaining carbon sequestration levels. Other opportunities exist to not only maintain but enhance the capacity for forests to sequester and store more carbon through measures such as additional voluntary actions, offsets, expanded assistance programs and markets.

Current net forest sector emissions are approximately -5 $MMTCO_2E$ (2002-2004 average). This net number is negative because the gross emission rate from disturbances such as fires, harvesting, land conversion, and decomposition of wood and other forest products is less than the gross atmospheric uptake and sequestration of carbon from forest growth. Forests also provide multiple ecological benefits (for example, habitat, structure, and nutrient cycling), as well as a suite of other human benefits or services on which we depend (for example, water storage, soil stability, air and water quality, wood products, and recreation).

The 33 million acres of forest land in California cover one third of the State. Ownership is split about evenly between the public and private sectors. Fifty-two percent of forest land is managed

by the federal government, 45 percent by private landowners, and 3 percent is managed by the State. Stakeholders in the forest sector consist of private landowners, public land managers, non-profit organizations, agencies, local governments, and community-based groups. Forests can be characterized as tree-dominated landscapes which can support greater than ten percent tree canopy cover and include forestlands, woodlands, urban forests, and rangelands. The forest sector also includes all primary wood products, as well as wood fiber for bio-energy.

# Recommended Actions

## *(F-1) Sustainable Forest Target*

This measure recognizes that the current abundance of forest carbon stock in California is, in part, a result of rigorous forest practice rules that tightly control forest management across the State. The California Forest Practice Rules are the most stringent in the country. The goal of the Sustainable Forest Target is to maintain the current net forest sink of -5 $MMTCO_2E$ through 2020, using the mechanisms provided by the Forest Practice Rules, timberland conversion regulations, fire safety requirements, and forest improvement assistance programs, as well as the California Environmental Quality Act (CEQA) which mandates avoidance or mitigation of forest carbon losses to conversion. Establishing a sequestration target resonates internationally—deforestation is recognized as the single largest contributor to global GHG emissions—while also setting a precedent for the rest of the land base.

### Regulatory and Statutory Capacity

*Forest Practice Rules Mechanism:* Regulatory actions that affect carbon sequestration on private forest lands are enforced through the California Forest Practice Rules by the California Board of Forestry. For example, Forest Practice rule changes implemented in December 2004 will produce an additional annual 2.2 $MMTCO_2E$ reduction in 2020. The Board of Forestry and Fire Protection in conjunction with the Resources Agency, the California Department of Forestry and Fire Protection, and the Air Resources Board will evaluate how current regulations and programs address GHG emissions so that it can ensure achievement of the 5 $MMTCO_2E$ target. This assessment includes updating approaches to estimating the annual forest inventory, developing a statewide forest carbon monitoring and assessment plan, and a re-assessment of the current regulatory framework in the context of carbon benefits.

*CEQA Mechanism:* Private lands are strongly influenced by development pressures. Local Government has the primary land use authority under the CEQA and Government Code. While local government has land-use authority for non-timber lands, the Board of Forestry and Fire Protection has pre-emptive land use authority for timberland where the land use is to be changed to a non forest management use. The Public Resources Code (PRC 4621 et.seq.) requires Timberland Conversion Permits (TLC) where the land use change will occur, and these permits are subject to CEQA. The CEQA process provides further authority for the conversion permit process to require mitigation for these projects. Regulatory changes for the TLC process could help direct conversion away from forest lands that provide net GHG benefits and identify potential mitigations. CEQA guidelines are being revised to ensure evaluation of GHG emissions and climate change impacts which will strengthen the ability to require mitigation for the loss of carbon stocks through the conversion of timberlands.

California forests face the additional threat of the impacts of global warming. Uncertainty about how much the climate will change and how feedbacks will affect forests make it particularly difficult to predict future emissions for this sector. Achieving the goal of 5 $MMTCO_2E$ from the Forest sector by 2020 will require active participation by the private sector and local, state, and federal governments to fully implement. Jurisdiction or authority issues are a function of the land base and the specific actions needed to achieve the GHG benefits. Land-use conversion, and its impact on emissions, links the forest sector to the Land-Use and Local Government sectors under the Scoping Plan.

**Appendix C: Forests**
**Table 30**

| Reduction Strategy | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Sustainable Forest Target | 5 | 50 | Board of Forestry and Fire Protection | Ongoing |

# Opportunities for Additional Reductions

There are additional greenhouse gas reduction opportunities which can enhance the capacity of forests to sequester and store carbon in addition to the sustainable forest target and they include:

1) Forest Conservation
2) Forest Management
3) Afforestation/Reforestation
4) Urban Forestry
5) Fuels Management

The five opportunities for additional reductions above could potentially produce another 2 $MMTCO_2E$ benefits in 2020 over and above the 5 MMT sustainable forest target. Conservation and forest management approaches are already underway, and will provide reductions in 2020 through proposition funds 40, 50, and 84. Investment in afforestation/reforestation in the near-term will lead to significant long-term benefits of more than 23 $MMTCO_2E$ per year by 2050, though site preparation activities may result in emissions in 2020. Offset market opportunities for forest management activities have been identified for about 0.5 $MMTCO_2E$ of the total 2 $MMTCO_2E$ annual benefits in 2020 and up to 13 $MMTCO_2E$ in 2050 from both reforestation and forest management. The adoption of additional forestry protocols for actions under other strategies may enhance GHG benefits from markets. Strengthening the funding base for the California Forest Improvement Program (CFIP) will provide future consistency to support ongoing afforestation/reforestation and potentially emission reducing fuels treatment activities. Increased activity across the State, and the associated GHG reductions, could be maintained if the CFIP program funding were more continuous.

California's forests will play a role in the State's goal of reducing emissions but given the inherent uncertainty in quantifying emissions and sequestration in this sector, especially with

climate change, additional research and the development of pilot projects and quantification tools are necessary. Emissions reductions under this sector will require active participation by private landowners and local, state, and federal governments to fully implement and realize maximum GHG benefits. Strategies in the Forest sector will interact with those in other sectors including land use, waste management, agriculture, water, and electricity. Investing in research and quantification tools will be necessary to improve inventory and modeling accuracy.

## Reduction Opportunity: Forest Conservation

California forests and woodlands continue to be developed and converted to non-forest uses. Cal Fire's Fire and Resources Assessment Program (FRAP) projects a conversion of 312,000 acres of forestland and 258,000 acres of woodlands between 2000 and 2020. In addition to residential and industrial development, forests and woodlands may also be converted for roads, power lines, rail, pipelines, agriculture and rights-of-way.

Tools available to prevent or mitigate conversion include land use planning, conservation easements, and mitigation banking. Agencies or non-governmental organizations may buy or accept donations of forestland (fee title) easements or other interests to preserve and enhance them for forest uses such as habitat, recreation, community forestry, and timber management. When easements or other interests are sold or donated, the landowner can have the property assessed for the purposes of lowering their tax liability. To ensure carbon sequestration over the long term, these forest and woodland land purchases generally require permanent retirement of development rights, preclude uses that would reduce carbon stocks or sequestration capacity, and include management geared toward maintaining or increasing carbon sequestration through conservation management projects. Mitigation banking for land conversion through tree planting is quantified under the Afforestation/Reforestation strategy

The following implementation approaches have already been funded or have a high likelihood of securing funding.

- Proposition 40 and 50 purchases of forest and woodland in 2005 and 2006: This implementation approach protected forests and woodlands from conversion through fee title or easements. These forests will continue to produce GHG benefits in the future as they mature.
- Proposition 84 purchases to conserve forest and oak woodland habitats
- Future funding: This measure assumes funding for forest and woodland conservation projects that is comparable to Proposition 84.

## Reduction Opportunity: Forest Management

There are significant opportunities to increase the carbon storage on managed forest lands over the next few decades by increasing forest growth through healthy and fully stocked stands that utilize site potential for growth while resisting or minimizing emissions from fire, insects and disease. Stands on timberlands statewide are growing at approximately 2.4 percent per year and this represents about 70 to 75 percent of their potential. Many of the timberland owners in California could make voluntary choices to manage their forestlands at a level above the minimums of the Forest Practice Rules.

Implementation approaches include:

- Riparian Zone Extension: The voluntary extension of existing riparian protection zones currently required by the Forest Practice Rules.
- Timber Stand Improvement: These activities include 1)restoring conifer areas to full productivity by reduction of undesirable species and restocking with native species, 2) thinning stands to increase the growth rate for remaining trees, 3) optimizing rotation age from a carbon life cycle perspective, 4) planting additional trees where the existing stocks are not fully utilizing the biological potential of the site. The additional value of the carbon will provide the incentive for the private landowners to make the additional investment in their lands to better utilize the growth potential.

## *Reduction Opportunity: Afforestation/Reforestation*

Forest activities can have both near-term and long-term GHG benefits. Tree planting has very significant long-term benefits. FRAP analysis shows that afforestation/reforestation planting activities over the next decade may reap more than 23 $MMTCO_2E$ annually by 2050. However, the near-term benefits provided by planting seedlings are minimal, since the removal of brush and replanting of trees initially produces a small increase of emissions.

Afforestation is the establishment of a forest in an area where the preceding vegetation was not forest. Reforestation is the establishment of native tree cover on lands that were previously forested, but have had less than ten percent tree canopy cover for a minimum of ten years.

Afforestation/reforestation emission reductions can be implemented through a number of separate approaches that cumulatively increase the acres of land that are forested annually. Implementation approaches include:

- CFIP: The California Forest Improvement Program administered through Cal Fire authorizes the Department to provide technical and other assistance (cost share funding) to private landowners with ownerships 5,000 acres and under. Through additional funding the existing cost share program would be able to increase the amount of afforestation and reforestation that is done on private lands.
- State land reforestation: On state lands, authority exists to implement afforestation/reforestation projects.
- Federal land reforestation: On U.S. Forest Service and other public lands, federal agencies have the authority to implement afforestation/reforestation projects.
- Mitigation: This measure analyzes potential GHG benefits of having CalFire and local government require reforestation mitigation of forest and woodland converted.
- Offset Program: Developing a market for GHG offsets will encourage landowners to reforest areas currently occupied with brush and other vegetative communities and to implement other conservation forest management practices.

## *Reduction Opportunity: Urban Forestry*

Urban forestry can create GHG benefits through planting trees in urban areas by 1) sequestering carbon, 2) reducing energy demand due to shading, and 3) providing biomass for fossil fuel alternatives from urban “green” waste. Urban forests provide many co-benefits, such as reducing stormwater runoff, increasing property values, reducing VOC emissions, providing social benefits, among others. Many cities and organizations are actively involved in tree planting to expand the role of urban forests. In areas where urban development interfaces with

wild lands individual land owners are also engaged in tree planting and various forms of vegetation management affecting fire risk reduction, forest carbon sequestration, and energy savings.

Urban forestry projects are already being implemented through government actions and voluntary planting on private property and potentially could result in the planting of over nine million trees through 2010 using voluntary and incentive programs.

The implementation approaches include:

- Agency planting: The State supports efforts by private and public landowners, non-profit organizations, and local governments in urban areas to keep planting suitable species of trees in strategic locations to provide maximum benefits of shade, minimal long-term care costs, and low capacity to emit smog-forming constituents.
- Voluntary planting: As voluntary actions, homeowners commonly plant trees on their property for a variety of reasons. Education and marketing can help achieve the strategic planting of these trees to maximize survival and benefits and can result in an additional 1.2 million trees planted annually. Through city and community based organizations there are several major initiatives to increase voluntary tree planting in California.

The GHG emission reductions from sequestration are listed in Table 31. Reductions from shading benefits (reduced air conditioner use) and bio-power, roughly 0.8 $MMTCO_2E$, are not included because they will be reported in the energy sector to avoid double counting.

## *Reduction Opportunity: Fuels Management*

Emission reductions from forest fuels management could be achieved through two implementation approaches.

- State and federal fuels treatment: Fuels management strategies have the potential to reduce the risk of catastrophic fires. However, fuels management needs to be evaluated to determine whether, and if so under what circumstances, quantifiable greenhouse gas emission reductions are achieved.
- Forest biomass for use in bio-power and bio-fuel production: Utilization of forest biomass supports the goals of the Bioenergy Action Plan for California (2005) which targets biomass resources to produce transportation fuels, electricity generation, and biogas including enhancement of the supply of biomass through fuel hazard reduction.

**Appendix C: Forests—Opportunities for Additional Reductions Reportable by Forest Sector (Sequestration)††**

**Table 31**

| Opportunities for Additional Reductions | **Potential 2020 Reductions $MMTCO_2E$** | **Net Annualized Cost ($ Millions)** | **Proposed Lead Agency** |
|---|---|---|---|
| ○ Forest Conservation<br>○ Forest Management<br>○ Afforestation/ Reforestation<br>○ Urban Forestry<br>○ Fuels Management | Minimum 2 | TBD | Cal Fire |

†† Over 2 $MMTCO_2E$ in benefits that will accrue in 2020 from Forest Practice Act rules instituted in 2004 are also not included here since they are considered part of the Sustainable Forest Target.

# 11. HIGH GWP

**This sector includes the following measures:**

**Recommended Actions**

**(H-1) Motor Vehicle Air Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing (Discrete Early Action)**

**(H-2) $SF_6$ Limits in Non-Utility and Non-Semiconductor Applications (Discrete Early Action)**

**(H-3) Reduction of Perfluorocarbons in Semiconductor Manufacturing (Discrete Early Action)**

**(H-4) Limit High GWP Use in Consumer Products (Discrete Early Action)**

**(H-5) High GWP Reductions from Mobile Sources**

- Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems
- Air Conditioner Refrigerant Leak Test During Vehicle Smog Check
- Refrigerant Recovery from Decommissioned Refrigerated Shipping Containers
- Enforcement of Federal Ban on Refrigerant Release during Servicing or Dismantling of Motor Vehicle Air Conditioning Systems

**(H-6) High GWP Reductions from Stationary Sources**

- High GWP Stationary Equipment Refrigerant Management Program
  - Refrigerant Tracking/Reporting/Repair/Deposit Program
  - Specifications for Commercial and Industrial Refrigeration
- High GWP Recycling and Deposit Program
- Specifications for Commercial and Industrial Refrigeration
- Foam Recovery and Destruction Program
- SF6 Leak Reduction and Recycling in Electrical Applications
- Alternative Suppressants in Fire Protection Systems
- Residential Refrigeration Early Retirement Program

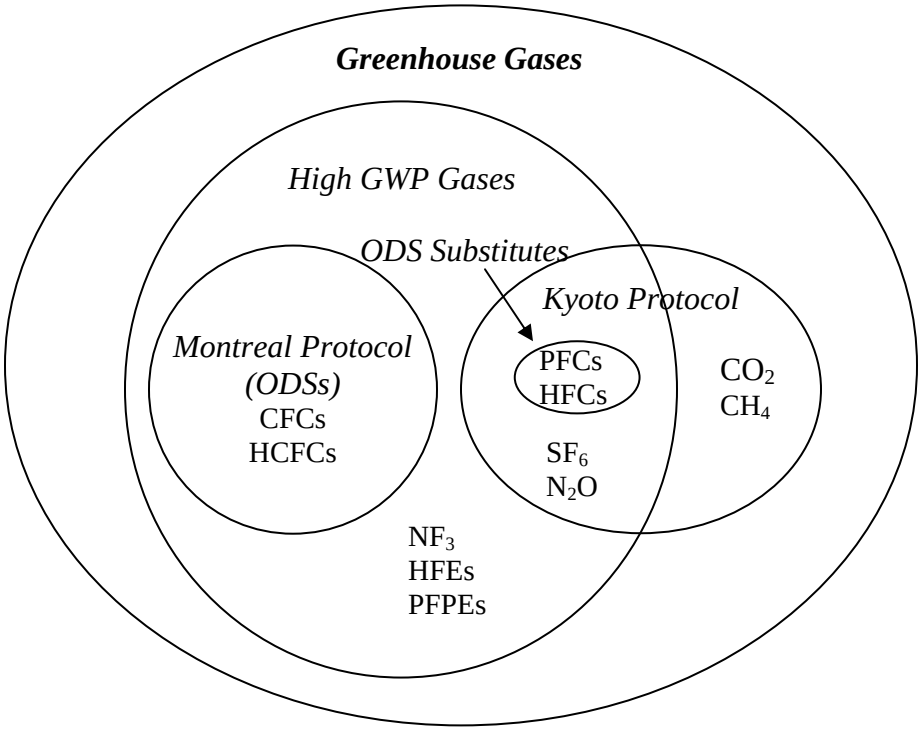
**(H-7) Mitigation Fee on High GWP Gases**

## Overview

While not a discrete sector of the California economy, the High Global Warming Potential (high GWP) sector consists of a broad range of sources that emit gases that have hundreds to thousands of times the climate impact as $CO_2$. High GWP substances are largely used as refrigerants in stationary and mobile source air conditioning and refrigeration. However, high GWP gases are also used as foam-blowing agents, in electrical transmission, as fire suppressants, in consumer products, and in the semiconductor industry.

High GWP GHGs can generally be categorized as Kyoto Protocol gases, Montreal Protocol gases, and several miscellaneous gases not covered under either treaty.

**Appendix C Figure 7**




The first category of high GWP GHGs is ozone-depleting substances (ODS), which include chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). ODS production is controlled under the Montreal Protocol as a result of concerns about stratospheric ozone depletion, but emissions are not controlled. The underlying assumption of the Montreal Protocol is that the gases produced will eventually be emitted. However, for some end uses there can be a considerable time lag between gas production and emission. Because ODSs have been used as blowing agents in foams and are stored as refrigerants in various systems, there is a legacy of gases that will be emitted unless recovered, which are referred to as "banks". Currently, ODS banks total over 600 $MMTCO_2E$ in California, even though most production of CFCs in developed nations stopped in 1996. The Montreal Protocol Technology and Economic Assessment Panel (TEAP) estimates that the majority of the CFCs, currently banked will be released to the atmosphere over the next several years unless preventative measures are taken. HCFCs will be produced in developed countries until 2020, and emissions and banks of these chemicals will continue to build until HCFC-22 phase-out begins in 2010.

As a result of the Montreal Protocol's phase-out of ODSs, the gases have been replaced with hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), which are hence called ODS substitutes. Whereas ODSs have negative impacts for both climate change and stratospheric ozone, ODS substitutes are not ozone-depleting but are generally potent GHGs. Along with sulfur hexafluoride ($SF_6$), HFCs and PFCs are Kyoto Protocol gases and are specifically listed in AB 32.

Other high GWP GHGs include nitrogen trifluoride ($NF_3$), hydrofluoroethers (HFEs), and perfluoropolyethers (PFPEs). Available information is presently insufficient to quantify the emissions and banks of these gases in California, but it is likely that the quantities are small.

Ozone-depleting substances are not included in California's AB 32 1990 GHG inventory that defines the target for 2020. The majority of ODS substitutes are Kyoto gases and are thus included in the inventory. Emissions and banks of Kyoto Protocol gases are building as ODSs are phased out and are replaced by ODS substitutes. In total, the high GWP sector is currently estimated to represent on the order of 3 percent of the GHG inventory. However, the sector is growing rapidly primarily due to the increased use of substitutes for ODS.

A distinguishing trait of high GWP gases is that they are not used by a distinct economic sector, and that the gases are primarily of interest in the contexts of climate change and, for some gases, ozone depletion. Emissions of high GWP gases are of great importance because of the potency of the substances; for example, one pound of $SF_6$ has the same effect on global warming as 11 metric tons of $CO_2$. In addition, banks of high GWP gases and their impending emissions are a unique situation. The combination of non-Kyoto GHGs and Kyoto GHGs leads to intricacies in estimating emission reductions from source categories that are in the inventory for some gases and excluded for others. The Draft Scoping Plan addresses these high GWP gases as a sector, as this is the most convenient method to design an overall emission reduction strategy.

A variety of strategies are being pursued to reduce high GWP GHG emissions at all stages of the life cycle. In the development and production phase, a preferred path to reduce or avoid entirely emissions from high GWP gases is to require and/or promote the use of safe and effective alternatives with either much lower GWP or no global warming impact. Examples of replacement measures include alternative fire suppressants and low GWP refrigerants in new motor vehicle air conditioning (MVAC) systems. For in-use products, measures to limit gas leaks are being pursued such as leak tightness specifications for commercial and industrial refrigeration. At the end of a product's life, measures emphasize recovery of high GWP gases, such as $SF_6$ recovery from electrical transmission and particle accelerators. Existing banks are targeted for destruction to avoid future emissions.

The low cost of many high GWP GHGs, as well as lack of incentives for emission control, has resulted in the common practice of simply re-charging leaky or poorly designed/maintained systems, or using high GWP GHGs in completely emissive processes. Low costs and the lack of enforced regulations limiting releases have also lead to low recovery and reclamation rates for many high GWP GHGs, meaning that venting occurs during maintenance or end of life disposal.

The high-GWP refrigerant management program—a single measure targeting the issues of refrigerant leak, tracking, reporting, and repair; refrigerant use, sale and disposal is proposed as a key mitigation measure. The aim of such a program is to prevent refrigerant leaks, use the economic incentive of a deposit to ensure return of refrigerant cylinders for refrigerant recovery. The ARB is also working with the California Energy Commission to establish specifications for new commercial refrigeration systems to reduce both direct and indirect emissions of GHGs. The specifications are planned to be addressed through amendments to Title 24.

The high GWP sector is also a viable candidate for establishing an up-stream mitigation fee program (proportional to the GWP of the gases) to better promote lower GWP alternatives, lower

overall use and greater product recycling. Such an upstream fee could promote reduced emissions as well as increased end-of-life recovery. In addition, the collected fees could be used to mitigate greenhouse gas emissions. The role of an upstream mitigation fee will be investigated as part of the process for reducing emissions from the high GWP sector.

Emissions from the high GWP sector are expected to triple over the next several years translating into emissions of high GWP Kyoto gases of over 40 $MMTCO_2E$ in 2020. The collection of recommended measures is expected to yield reductions of at least 15 $MMTCO_2E$ of Kyoto gases in 2020 with the potential for further reductions as new low GWP substitutes are developed. The use of fees within this sector could likely yield higher reductions. In addition, measures will also target sources of non-Kyoto high GWP gases, with substantial reductions in 2020 (over 15 $MMTCO_2E$) expected for ODS, particularly from "banks" of materials. Although these reductions in non-Kyoto gases are not counted toward AB 32's reduction requirement, the measures that target ODS will also yield reductions of ODS substitutes.

Following the development of the rules needed to implement the measures in the high GWP sector, staff will assess whether additional measures are necessary and feasible for achieving additional reductions in high GWP GHG emissions.

# Recommended Actions

## *(H-1) Motor Vehicle Air Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing (Discrete Early Action)*

The primary purpose of this measure is to reduce the emissions of the high GWP gas HFC-134a, a potent greenhouse gas (GHG) with a global warming potential (GWP) of 1,300, from activities associated with do-it-yourself (DIY) charging. In the future, this measure will be expanded or a complementary measure will be developed to govern professional servicing and repair of these systems.

Under normal operation, a motor vehicle air conditioning (MVAC) system may slowly lose refrigerant due to "normal" leakage. Larger leaks are generally due to compressor leaks, and malfunctioning hoses and connections. When a vehicle's air conditioning system loses cooling effectiveness due to the loss of HFC-134a refrigerant, the vehicle owner has two choices for recharging. The system can be recharged or "topped off" using small cans of HFC-134a purchased at retail auto parts stores, or it can be serviced by a professional auto shop.

Do-it-yourselfers can save money by performing a MVAC system recharge using small cans of refrigerant instead of having a professional perform the recharge. However, the DIY rarely properly identifies the leak or performs repairs due to a lack of adequate training and/or equipment. It is also likely that DIY recharge of a MVAC system results in the release of more HFC-134a than a recharge performed by professionally trained and industry-certified technicians at a licensed auto repair facility.

The goal of this measure is to reduce or eliminate the emissions associated with nonprofessional servicing of MVACs. Under current procedures, emissions occur from servicing procedures,

unused refrigerant remaining in the used can (can heel), and unrepaired leaking systems when a DIYer recharges his MVAC.

ARB staff considered two options for addressing emissions reduction from nonprofessional servicing of MVACs. One option would restrict the sale and import of the small cans of refrigerant and allow only professional servicing of MVACs. This proposal would eliminate DIY servicing and the associated emissions. MVACs would be serviced and repaired, as needed, by trained certified technicians. Some consumers would likely forgo air conditioning in order to avoid the added cost, and some would take their vehicle to the professional shops. At full implementation, up to about 1.9 million cans would no longer be available for the DIY market. Potential emission reductions for the "small can" sales restriction would amount to approximately 0.41 $MMTCO_2E$. The "can heel" emissions would be reduced because sales of small cans of refrigerant would not be permitted. This option was included in the AB 32 Early Action Plan. However, subsequent research and analysis have led staff to the conclusion that this is not the preferred option due to the potential significant cost impact to the consumer.

The second and recommended mitigation option primarily focuses on reducing the emissions from the can heel. This proposal would require the installation of self-sealing valves on the small cans of refrigerant and enhanced consumer education, as well as an effective can deposit and return program to collect used cans of refrigerant directly from the customer for refrigerant recycling or destruction. The combination of sealed cans and refrigerant recovery would minimize the emissions from can heels. The estimated emission reductions for the self-sealing valve and recycling program are 0.26 $MMTCO_2E$ in 2020. The Board is expected to consider the recommended option for this measure at its January 2009 hearing.

Related measures aim to ensure that professional servicing of MVACs in California is less emissive than current practices. ARB staff will explore the benefit of more stringent technician certification requirements, new requirements for returnable 30 pound refrigerant containers, and other steps to improve professional servicing to gain additional emission reductions.

## *(H-2) $SF_6$ Limits in Non-Utility and Non-Semiconductor Applications (Discrete Early Action)*

$SF_6$ is a versatile gas used in a multitude of industries including utilities and the semiconductor industry. These two uses will be addressed as separate measures. This Discrete Early Action measure focuses on the non-utility/semiconductor-related emissions of $SF_6$. Specifically, the measure will consider a potential ban on the use of $SF_6$ where technologically feasible and cost-effective alternatives are available, as well as a mitigation fee and/or a performance standard for other uses.

The main uses of $SF_6$ in California that are not directly related to utilities or semiconductor manufacturing include: magnesium casting, tracer gas use (including fume hood testing), consumer products, and medical uses (ultrasounds, eye surgery). Alternative gases are being pursued for magnesium die-casting, consumer products, and tracer gas uses. Medical use emissions appear to be very low, and are proposed to be exempt from $SF_6$ bans due to low emissions, high costs, and lower effectiveness of alternatives.

Based on emission estimates for 2004, emission reductions by 2020 range between 0.1 $MMTCO_2E$ and 0.3 $MMTCO_2E$.

The largest expected costs are for the magnesium sector with capital costs of $573,000 for equipment replacement for 2 facilities and a cost of $50,000 per facility for training.[124] If turnover is high, this could be an annual cost. There are two California facilities that are known to be using $SF_6$ and one that may be using $SF_6$. Depending on the alternative used, cost savings could be equivalent to $54,000 annually. The cost savings are only applicable if $SO_2$ is the alternative used. Other alternatives are likely to be close in cost to $SF_6$.

Costs for the other sectors cannot be quantified at this time. However, the capital costs and operating costs are expected to be small or may even come with a savings. Capital costs could occur if new detection equipment is needed. The cost of the alternative gas, which will be an operating cost, is likely to be the largest expense as large infrastructure changes are not needed. Alternatives are likely to be less expensive than $SF_6$ on a per-unit basis, but whether overall cost savings occur depends on the relative amounts of substitute gases needed.

## *(H-3) Reduction of Perfluorocarbons in Semiconductor Manufacturing (Discrete Early Action)*

A specific subset of high GWP gas use is in the semiconductor industry. California semiconductor and related device production facilities employ approximately 9,300 employees, representing approximately 0.06 percent of total statewide employment. While these businesses are located throughout the State, they are concentrated in the Bay Area, primarily in the Silicon Valley.

Six local air quality agencies in the state currently regulate emissions of volatile organic compounds (VOCs) from the semiconductor and related devices industry. Federal law (National Emission Standards for Hazardous Air Pollutants) requires treatment of hazardous substances so that potential public health risks are mitigated. However, emission reductions of high GWP gases (which are not VOCs or toxic compounds) from these facilities have only occurred voluntarily through agreements with the U.S. EPA and a small number of California manufacturers.

An existing national, voluntary GHG reduction agreement with the U.S. EPA will expire in 2010. The Semiconductor Industry Association (SIA) is discussing renewing the agreement. California's proposed regulation could be used as a model for any new national regulatory or voluntary program.

The semiconductor manufacturing industry uses multiple GHGs with a range of global warming potentials from 6,500 to nearly 24,000. The sector has considerable emissions but also has potential to be an important source of GHG reductions. This proposed measure is designed to reduce the emission of these gases by 50 percent from 2006 levels.

[124] Environment Canada. 1998. Powering GHG Reductions through Technology Advancement. Clean Technology Advancement Division, Environment Canada.
U.S. Environmental Protection Agency 2006. Global Mitigation of Non-$CO_2$ Greenhouse Gases. U.S.EPA Report 430-R-06-005. June 2006.

Based on the results of an industry survey conducted by ARB in 2008, the GHG emissions from more than 100 semiconductor and related devices facilities for 2006 (the latest reportable year) are approximately 0.3 $MMTCO_2E$. This is lower than the initial estimate of 0.9 $MMTCO_2E$[125] and reflects the current gas usage and control devices in-place.

The currently proposed regulation would require manufacturers to use process optimization, alternative chemistries, and abatement technologies in combination or separately to reduce emissions. Reductions are expected to be at least 50 percent or 0.15 $MMTCO_2E$. This measure is currently in the regulatory development process and is scheduled for adoption in 2008 with a compliance date in 2012.

Process optimization primarily focuses on reducing gas use in the chemical vapor deposition (CVD) chamber cleaning process. This practice involves the use of detectors and/or process modifications to achieve the optimum gas usage to reduce excess emissions. As part of the voluntary national program, many participating manufacturers have implemented this option at their facilities. However, many California operators do not participate in that program and will realize emissions reductions benefits from process optimization.

The use of other chemicals during the CVD cleaning or circuitry etching processes is referred to as alternative chemistries, or chemical substitution. Alternative chemistries can include the use of high GWP gases that are more efficiently used in CVD chamber cleans or plasma etching, thereby reducing overall GHG emissions. For example, some manufacturers have substituted $NF_3$ for $C_2F_6$ in CVD chamber cleans. Although $NF_3$ has a higher GWP than $C_2F_6$ (17,000 for the former, 9,200 for the latter), much less $NF_3$ is used in the process so that overall emissions are reduced. It is important to note here that the proper use and control of $NF_3$ is accounted for in the emission reduction potential for this rule, it is not accounted for in ARB's GHG inventory because $NF_3$ is a non-Kyoto GHG.

Abatement technologies commonly involve a device that thermally destroys fluorinated gases and can be commercially applied to both etch and CVD chamber clean processes. High temperature and catalytic oxidation and plasma destruction are the most common technologies used to abate emissions. The performance of abatement systems can vary greatly depending on the abatement device and process parameters, such as temperature and gas flow rates. Nonetheless, abatement has proven to be a commercially available and effective method of controlling emissions of GHGs.

These devices can be costly and use large amounts of energy and cooling. If semiconductor manufacturers in California choose abatement as a compliance option, ARB believes that up to 24 systems may be installed Statewide. These systems would not significantly impact sector energy demand. While this technology results in some additional energy use, the destruction of these high GWP gases provides a net benefit in reducing GHGs.

[125] Based on applying a growth factor of 1.35 percent per year to ARB's 2004 inventory estimates

## *(H-4) Limit High GWP Use in Consumer Products (Discrete Early Action)*

Consumer products containing high GWP GHGs include pressurized containers that utilize HFC propellants,[126] as well as other miscellaneous products such as boat horns, dusters, and tire inflators.[127]

The objective of this measure is to reduce the use of compounds with high GWP when alternatives are available. To achieve reductions of GHG emissions, consumer product formulations would need to be changed to reduce or eliminate the use of high GWP compounds. The reduction in use of compounds with high GWP in consumer products is a long-term effort.

This measure was designated as a Discrete Early Action, and a regulation establishing a GWP limit of 150 for Pressurized Gas Dusters was adopted by ARB in June 2008 and will be enforceable by January 2010. Staff will propose GWP limits for additional consumer product categories, where feasible, which would also be enforceable by the deadline for discrete early action items.

Total GHG emissions reduction from consumer products is estimated to be 0.25 $MMTCO_2E$ in 2020. ARB staff estimates emissions reduction of 0.23 $MMTCO_2E$ from the regulation of Pressurized Gas Dusters.

In the case of Pressurized Gas Dusters, manufacturers of non-complying products are expected to reformulate their products by switching from the use of HFC-134a (GWP of 1,300) to HFC-152a (GWP of 140). 18 of 90 products in the Pressurized Gas Duster category currently comply with the GWP limit of 150, representing a market share of 86 percent, based on sales. HFC-152a is less expensive per pound than HFC-134a, so it is anticipated that there would be a raw ingredient cost savings in virtually every case. The total cost of the measure to reduce GHG from Pressurized Gas Duster products is about $450,000 over ten years, or $45,000 per year.

## *(H-5) High GWP Reductions from Mobile Sources*

### Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems

The measure requires low global warming potential (GWP) refrigerants with overall improved lifecycle climate performance for new Motor Vehicle Air Conditioning (MVAC) systems, with initial emphasis on A/C systems used for heavy-duty and off-road vehicle application, followed by a MVAC requirement in light-duty vehicles.

Currently, almost all new passenger vehicles sold in California come equipped with an air conditioning system that utilizes HFC-134a refrigerant, which has a GWP of 1,300. A/C systems typically leak refrigerant over time and their leakage rates increase with vehicle age. In addition, the use of the A/C system requires energy from the vehicle's engine. On an annual basis, this accounts for up to 5 percent of the total vehicle fuel usage. Fuel consumption while

[126] Hair sprays, deodorants, household products, spray paints may contain HFCs propellants, but are considered to be minor sources. Metered dose inhalers also contain HFCs, but due to medical necessity, low-GWP replacements are not currently being pursued in the Early Action Measures or Scoping Plan.

[127] Automotive products such as cans of refrigerant used for do-it-yourself (DIY) MVAC recharging, are covered within the mobile sources sub-sector rather than the consumer products sub-sector.

the A/C is on can increase by over 20 percent. Thus, it is desirable to have lower amounts of refrigerant and/or low GWP refrigerants in tighter A/C systems with improved efficiency. New HFC alternative refrigerants with lower GWP values are expected to become available substitutes for HFC-134a in new MVACs.

The core of the measure would focus on developing new regulations requiring (1) that new MVACs use refrigerants with GWP below a specified threshold (to be determined) in new vehicles not subject to California's adopted vehicle GHG emission standards (AB 1493) and (2) improvements in MVACs system performance for reduced indirect emissions. For vehicles subject to AB 1493, this measure would explore further MVAC improvements when the first phase of the rule is fully implemented. This measure would apply to all MVACs in vehicles certified for sale in California after 2016, impacting about 7 million light-duty vehicles and about 2 million medium and heavy-duty vehicles by the year 2020.

The central premise of the proposed measure is the replacement of high GWP refrigerants used in California's MVACs with lower GWP alternatives that also represent better lifecycle climate performance (LCCP) than the current refrigerant. Indirect emissions from fuel use can be three times the direct emissions from a typical MVAC. Thus, the rules would be designed to promote a shift towards better overall MVAC performance. With low GWP refrigerants there is a corresponding reduction of the impact from MVAC servicing and releases at the vehicle/equipment end of life.

Direct and indirect emissions from air conditioning systems in California's on-road light-duty vehicles (LDVs) are already governed by the regulations resulting from AB 1493 through the 2016 new model year. Accordingly, manufacturers can use low GWP alternative refrigerants as one tool for complying with ARB limits on GHG emissions for the entire vehicle or for generating early compliance emission credits. Air conditioning systems in all other on-road classes and all off-road vehicles are presently unregulated by California. This measure would cover those classes of vehicles not included in the AB 1493 regulation.

Development of this measure will benefit from consideration of a similar regulation calling for the phase out of HFC-134a beginning with new types of vehicles in 2011 adopted recently by the European Union. Staff will explore the potential GHG reductions from a similar phase out of HFC-134a (or other high GWP refrigerants) used in other vehicle classes in the California fleet such as heavy-duty on- and off-road vehicles including new as well as in-use systems. The identification of suitable alternatives would be based on lifecycle climate performance. In all cases, careful attention will be paid to ensure the indirect emissions are also lowered via the deployment of more energy efficient systems.

Anticipated reductions for 2020 are expected to be 0.7 $MMTCO_2E$ for light-duty vehicles and 1.8 $MMTCO_2E$ for heavy-duty vehicles for a total of 2.5 $MMTCO_2E$ for a universal phase out of HFC-134a in new and in-use MVACs in California.

### Air Conditioner Refrigerant Leak Test During Vehicle Smog Check

There are 11 million Smog Checks performed annually as part of California's vehicular inspection and maintenance (I/M) program. As originally proposed, the measure would add a refrigerant leak check to the "pass" criteria for California Smog Checks.

The goal of this measure is to reduce the number of in-use MVACs that are leaking excessively. The reduction would be calculated based on the number of vehicles failing the MVACs Smog Check and subsequently repaired. This measure would prevent the ongoing "leak-recharge-leak" cycle associated with the use of small cans of refrigerant by do-it-yourselfers to systems that need repair but are not fixed.

In order for this measure to be implemented, ARB would work with the Bureau of Automotive Repair (BAR) and the Department of Consumer Affairs (DCA) to develop a new A/C test protocol and incorporate it into Smog Check procedures. The vehicle owner would see a slight increase in the duration and cost of the Smog Check biannual inspection.

The potential emission reductions from this measure are up to about 0.5 $MMTCO_2E$ per year by 2020. Due to the increased time and equipment required for the MVAC system test, the consumer price of a Smog Check is estimated to increase by about $20 per check. However, staff's assessment of this measure has continued to evolve. Given that new MVACs are tighter and require less refrigerant, the relative importance of the measure will continue to decline as it is generally limited to older vehicles. Further, there may be more efficient approaches outside of Smog Check that can facilitate the identification and repair of leaky MVACs. Staff is exploring alternative approaches for mitigating emissions independent of the Smog Check program.

### Refrigerant Recovery from Decommissioned Refrigerated Shipping Containers

As noted by the Environmental Justice Advisory Committee, refrigerated shipping containers accumulate in major ports and the refrigeration systems on these containers may leak high GWP refrigerants. ARB proposes a measure to address the refrigerant remaining in the decommissioned containers' cooling systems, the leakage from these containers, and their disposal as they approach their end-of-life (EOL). Upon reaching EOL, these types of containers may not undergo proper refrigerant recovery.

This measure would improve compliance with a Federal Clean Air Act regulation by the U.S. EPA (40 CFR 82) that prohibits venting of certain types of refrigerant, including HFCs, to the atmosphere when refrigeration equipment is serviced or dismantled. Thus, the intent of this measure is to mitigate any impacts from releases, either intended or accidental, of refrigerant from refrigerated shipping containers. Venting is avoided by recovering refrigerants with specialized equipment. The recovered refrigerant can be re-used by the owner or transferred to re-processors approved by U.S. EPA.

Since there are no firm statistics related to the degree of compliance with the requirements of 40 CFR 82, no quantitative estimate of emission reductions can be proposed yet. The ultimate goal will be to recover the refrigerant remaining in the refrigerated shipping containers at decommissioning and eliminate the greenhouse gas emissions from this source.

Implementation of this measure may be similar to the one enforcing the federal ban on releasing refrigerants to the atmosphere for the servicing or dismantling of Motor Vehicle Air Conditioning (MVAC) systems. After the recovery of refrigerant from a decommissioned container, it may be desirable to disable the refrigeration unit as well, which could require a regulation. The anticipated approach would emphasize enhanced enforcement of existing federal requirements for recovery via audits of activities and documentation. Including oversight,

inspection, recordkeeping, and/or reporting requirements in the implementation of this measure may require additional regulations.

The primary reason for implementing the recovery of refrigerant from decommissioned refrigerated shipping containers is to reduce greenhouse gas emissions. However, any destruction of ozone-depleting substances that were used in older refrigeration systems will also prevent the negative impacts on stratospheric ozone that would have resulted from the ODS emissions. Staff will develop estimated emission reductions as well as mitigation costs to determine the degree to which the measure represents a viable emission reduction option.

#### Enforcement of Federal Ban on Refrigerant Release during Servicing or Dismantling of Motor Vehicle Air Conditioning Systems

The goal of this measure is improved compliance with existing regulations[128] prohibiting the venting of certain types of refrigerant, including HFCs, to the atmosphere when motor vehicle air conditioning (MVAC) equipment is serviced or dismantled. Venting is avoided by recovering refrigerants with specialized equipment before dismantling or servicing. The recovered refrigerant can be re-used or transferred to re-processors approved by U.S. EPA for proper disposal.

ARB, U.S. EPA, the California Department of Motor Vehicles (DMV), and the Bureau of Automotive Repair (BAR) will be involved in the implementation of this measure.

Much of the field work in a cooperative enforcement program could involve the enforcement staff of the local agencies that enforce county and State ordinances regarding disposition of automotive fluids, such as brake fluid, engine oil, coolant, and transmission fluid. These agencies could receive a "leveraging" effect for their programs if ARB and US EPA resources are made available in a cooperative program for enforcing the federal refrigerant-recovery regulation.

The potential reductions from dismantling are on the order of 0.07 to 0.3 $MMTCO_2E$ per year in 2020. Further, it is anticipated that a collaborative arrangement with U.S. EPA has the potential to yield reductions with a modest resource commitment by either entity.

There are no added costs associated with the proposed measure beyond those currently imposed. Any incurred expenses are costs that the dismantler or technician has avoided so far by failure to comply with the existing federal regulation.

### *(H-6) High GWP Reductions from Stationary Sources*

#### High GWP Stationary Equipment Refrigerant Management Program

ARB staff has proposed to create the high-GWP Stationary Equipment Refrigerant Management Program, which integrates two AB 32 early action measures: High GWP Refrigerant Tracking, Reporting, Repair and Deposit for Stationary Refrigeration and Air Conditioning systems and Specifications for New Commercial and Industrial Refrigeration Systems. These two measures, discussed below, target different areas of the refrigerant value chain for stationary equipment.

[128] Existing federal regulation (40 CFR 82.154) bans the release to the atmosphere of high GWP refrigerants at the end-of-life (EOL) or during equipment servicing.

The Stationary Equipment Refrigerant Management Program approaches the challenge of high GWP gases management in a more systematic manner integrating all sectors of the value chain.

Refrigerant Tracking/Reporting/Repair/Deposit Program

This measure would require commercial and public facilities with large stationary air conditioning and refrigeration equipment to minimize emissions of high GWP refrigerants through reporting, leak repair, improved servicing, and end-of-life control.

This program could include several components: 1) leak repair, monitoring, reporting, technician certification, and registration/permitting requirements for refrigeration and air conditioning equipment using high GWP refrigerants; and 2) a deposit program accompanied by restrictions on cylinders and other containers used to store and transport high GWP gases.

The South Coast Air Quality Management District currently requires facilities with refrigeration and/or air conditioning systems containing more than 50 pounds of ozone depleting substances to submit annual reporting of refrigerant usage biennially. The program also requires that facilities repair leaks. ARB staff has extrapolated reported data from SCAQMD to estimate potential statewide reductions. Based on this extrapolation, it is expected that roughly 86,000 facilities in California could be affected by ARB's program; of the 86,000, staff estimate that 10,000 facilities have both air conditioning and refrigeration systems while 76,000 facilities have only air conditioning systems.

Preliminary estimates are that in 2020, emission reductions could total 7.7 $MMTCO_2E$ of ozone depleting substances (ODS) and 6.3 $MMTCO_2E$ of HFC refrigerants. The reductions would occur as a result of improved leak detection and repair, along with installation of new equipment, and ODS phase out.

Estimates for monitoring costs are $2,500 per facility for equipment and $100 in annual operating costs. Repair of air conditioning systems is roughly $2,500 ($2,000 in labor costs and $500 in parts and refrigerant), while system replacement would cost on the order of $20,000. For refrigeration, repair is estimated to cost $11,000 ($3,000 in labor costs and $8,000 in parts and refrigerant), while system replacement would cost on the order of $500,000. Statewide costs are estimated at about $9 million in 2020. Preliminary analysis reveals that the measure is expected to result in a savings in 2020 on the order of $75 million due to the reduced consumption of refrigerant. Additional analyses are underway on potential costs associated with safe disposal of equipment and refrigerant (e.g., a cylinder deposit program) and to refine these preliminary estimates.

Specifications for Commercial and Industrial Refrigeration

This measure proposes new specifications for commercial and industrial refrigeration systems to both reduce emissions of high GWP refrigerant and to increase energy efficiency of the units. The measure would apply to a portion of commercial and industrial refrigeration systems, including large direct expansion (DX) refrigeration systems used in supermarkets, cold storage warehouses, and industrial processes, including food processing. Commercial refrigeration systems also include retail food standalone equipment (open and closed food display cases) and refrigerated vending machines.

Emissions from refrigeration and air conditioning (RAC) systems are categorized as (1) direct refrigerant emissions via leaks during use as well as servicing and end-of-life emissions and (2) indirect emissions ($CO_2$-equivalent emissions resulting from energy use).

Because the piping required for connection of all the cases can be miles long, DX systems may contain very large refrigerant charges, typically several thousand pounds; they are also leaky, with average leak rates in California estimated to be 20 – 30 percent of refrigerant charge annually. Leaks result from vibration and thermal expansion of numerous pipes, threaded joints, fittings, and valves. Oftentimes, refrigerant pipe work is inaccessible, and leaks cannot be found or repaired. Ruptures can result in huge refrigerant losses, with GHG emissions exceeding several thousand metric tons carbon dioxide equivalent.

In terms of potential control strategies, reduction of leaks and charge sizes in direct expansion systems is of primary importance. Reduction of charge size not only reduces the potential for high GWP emissions from system ruptures, but reduces future high GWP refrigerant banks in California. Refrigerant banks are sources of future emissions, and without a recovery/destruction program in place, will eventually be emitted during equipment charging, lifetime, and end-of-life (EOL).

The regulation is expected to establish performance limits for new systems. Options for reducing leaks, charge sizes, and refrigerant GWPs include replacement of DX systems with indirect systems, i.e. secondary loop (SL) systems, and energy efficiency improvements through closed cases, floating head pressure controls, and best available display case components, standalone equipment and vending machines. This performance-based measure is expected to address direct and indirect emissions reductions during the lifetimes of commercial and industrial refrigeration systems.

For new commercial and industrial refrigeration systems, this measure would establish a low leak rate (e.g., 2 percent) as well as a possible limit on the product of charge size and refrigerant GWP less than a specified threshold. Secondary loop systems and advanced $CO_2$ systems are both being explored as potential options for reducing emissions from new commercial and industrial refrigeration applications.

In addition, ARB has initiated discussions with the California Energy Commission (CEC) and other stakeholders to explore integrating specifications into the next version of California Buildings Standards Code (Title 24) that would reduce direct refrigerant emissions from new commercial and industrial refrigeration systems and establish energy efficiency goals for new and existing retail food systems. The CEC supports this approach and has committed to work with ARB. The next version of Title 24 will be released in the 2011 timeframe and therefore the compliance with these performance standards for new large commercial/industrial refrigeration installations would be expected to start by 2012.

As the old DX systems turnover, high GWP GHGs will need recovery, reclamation, and destruction or reuse. Refrigerant recovery and destruction is being addressed as part of other strategies in the high GWP sector.

In total, direct and indirect GHG emission reduction potential from this measure in 2020 is estimated to be at least 4 $MMTCO_2E$. Additional benefits of this measure include stratospheric

ozone protection for the estimated 50 percent of DX systems that currently employ HCFC-22, an ozone-depleting GHG.

Currently, first installation costs for SL systems are higher than existing DX systems, with average costs estimated to be 15-20 percent greater, or around $100,000[129,130]. The incremental costs associated with incorporating energy efficient equipment into new retail food installations is expected to be small relative to overall refrigeration system construction costs. Based on an estimated value of 40 percent lower maintenance and repair costs relative to the annual DX maintenance and repair cost in California (~$64,000[131]), the annual operations cost savings is on the order of $25,000, though considerably more work needs to take better to evaluate the net costs of the various options.

Average capital costs for supermarket refrigerant systems are on the order of $1.7 million, with systems having a 20-year lifetime. Due to increased energy efficiency, the operations savings from reduced electricity use are estimated at $700,000 annually.

The capital costs of upgrading existing systems or installing new systems are expected to be passed along to customers, so in the case of retail food stores and food processors, increased food and beverage costs are possible and will need to be evaluated.

### Foam Recovery and Destruction Program

Waste insulation foam emits high GWP GHGs into the atmosphere when it is shredded during appliance recycling or broken during building construction, renovation, and demolition. The waste foam continues to emit GHGs while it is landfilled.[132] The goal of the measure is to reduce these emissions to as close to zero as possible, by diverting waste foam away from landfills, and destroying the foam at high temperatures; or by capturing the high GWP GHGs within the foam for destruction or reuse.

Plastic insulating foams containing high GWP blowing agents are used in refrigerators, freezers, building insulation, transport refrigerated units, and miscellaneous sources. For insulating foam containing high GWP GHGs, the vast majority are used in building insulation (65 percent of banks and emissions) and appliances (mainly refrigerators and freezers, about 30 percent). After the appliance or insulating material has reached the end of its life, the waste foam is often landfilled, and the high GWP gases within the foam are eventually emitted into the atmosphere.[133] Typically, about one-fourth of the GHGs remaining in foams during their disposal are released to the atmosphere as the foam is processed (e.g., broken or shredded). Of the GHGs that remain within foams that are landfilled about 60 percent are captured and

[129] Van D. Baxter, Oak Ridge National Laboratory, IEA Annex 26: Advanced Supermarket Refrigeration/Heat Recovery Systems, Final Report Volume 1 – Executive Summary, April 2003.
[130] Cynthia Gage (USEPA) ASHRAE presentation: "Experiences with Secondary Systems", 2/05.
[131] Maintenance and repair costs for supermarkets are on the order of $2.35/square foot for California, which, multiplied by the average square footage, 27,000 square feet (from ARMINES), gives $63,450 annually: http://www.whitestoneresearch.com/news/archive/1998/980828.htm
[132] USEPA, U.S. High GWP Emissions 1990-2010: Inventories, Projections and Opportunities for Reductions, EPA 000-F-97-000, June 2001
[133] IPCC/TEAP, IPCC Special Report on Safeguarding the Ozone Layer and the Global Climate System, Issues related to Hydrofluorocarbons and Perfluorocarbons, 2005.

combusted by landfill gas collection systems with the balance eventually being released to the atmosphere.

The program can be implemented using measures that provide regulatory standards or incentives for the recovery and collection of foam. Either approach would necessitate restricting waste foam from landfills or recovering high GWP gases at the point of appliance recycling or building demolition, deconstruction, or renovation prior to landfilling the foam.

This measure will primarily target appliance foam with possible additional emissions reductions from recovery of building foam. If 100 percent of waste foam were diverted from landfills and sent to recovery and destruction facilities by 2020, 6,000 metric tons of waste foam containing HFCs would be recovered in 2020. At this level, annual HFC emissions reduction would be about 0.3 $MMTCO_2E$ from appliance foam, with another 0.7 $MMTCO_2E$ that could be reduced from building insulation foam, for a total of 1.0 $MMTCO_2E$. ODS recovery and destruction will occur simultaneously with HFC reduction, equivalent to an additional 5.5 $MMTCO_2E$ in 2020.[134]

Costs to recover and destroy foam from appliances are about $30/$MTCO_2E$ using an automated system. The annual cost of an appliance foam recovery and destruction program to reduce 0.3 $MMTCO_2E$ would be about $9 million per year, assuming all appliances were recycled using an automated system.

Beyond the scope of the proposed measure, building insulation foam can also be recovered, at an estimated cost of $182/$MTCO_2E$. Reduction of 0.7 $MMTCO_2E$ from building foam would cost $127 million per year.

Costs of the different segment of a foam recovery and destruction program can also be expressed in practical units as follows: [135]

- $13.50 per appliance using an automated recycling system
- $40 per appliance using manual foam recovery
- $6 - $17/square foot of building area (depending upon type of building, single-story versus multiple stories) for building insulation foam recovery [136]

### $SF_6$ Leak Reduction and Recycling in Electrical Applications

Gas-insulated circuit breakers that use $SF_6$ as an insulating gas are the largest source of fugitive $SF_6$ emissions in California electricity systems. In addition, gas-insulated substations (GIS) constitute a smaller source of $SF_6$ emissions. In general, older equipment produces more fugitive emissions than newer equipment. Moreover, particle accelerators utilize and emit $SF_6$ from equipment similar to that found in electrical transmission and distribution equipment. Particle accelerators also use $SF_6$ as a quenching medium.

This measure will reduce emissions of $SF_6$ within the electric utility sector and at particle accelerators by requiring the use of best achievable control technology for the detection and

[134] U.S. EPA, Vintaging Model for ODS and High-GWP GHG Emissions, 2006.
[135] "US EPA. Global Mitigation of Non-$CO_2$ Greenhouse Gases, EPA 430-R-06-005, June 2006"
[136] Caleb Management Services. Foam Recovery and Destruction Cost Estimates from Pilot Programs in Europe and Japan, 2007. Policy Advisory for IPCC Foam Emissions Research. Forwarded to ARB May 21, 2008.

repair of leaks, and the recycling of $SF_6$. Particle accelerator industry representatives are already considering the use of possible substitute mediums.

$SF_6$ is primarily released when equipment is opened for routine servicing. Sometimes, $SF_6$ is vented to the atmosphere during servicing, but increased environmental awareness and large increases in the cost of $SF_6$ during the mid-1990's have significantly reduced this practice.

The estimated emissions annual reduction of 0.07 $MMTCO_2E$ is based on the projected 2020 emissions of 0.22 $MMTCO_2E$ multiplied by the U.S. EPA reduction estimate of 20 percent for leak detection and repair and ten percent for recycling and recovery.

This measure would establish a regulation mandating a performance standard. Utilities and other affected entities would comply by using leak detection and repair (LDAR) abatement equipment to reduce system leakage. The proposed performance standard would mandate and enhance current voluntary federal $SF_6$ recycling standards. Voluntary industry practices have established an 80 percent $SF_6$ recovery rate, based on perceived economic efficiencies of recovery equipment. The proposed standard would increase recovery and recycling to 100 percent of the $SF_6$ contained in electrical and particle accelerator equipment without substantially increasing the industries' costs.

Statewide annual operating costs are estimated to be $300,000 for LDAR and recycling. However, it is assumed that all $SF_6$ saved during leak detection and maintenance activities represents a cost savings, because the facility $SF_6$ purchase and consumption rate will decrease. The cost savings from $SF_6$ is $420,000 annually, yielding a net cost savings of $120,000.

### Alternative Suppressants in Fire Protection Systems

This measure will consider alternative suppressants in total flooding (fixed) and streaming (portable) fire suppression systems. Most fire suppression systems originally used halons, ozone depleting compounds whose production was phased out following the Montreal Protocol, but new systems have moved to halon alternatives. ARB is coordinating its evaluation of potential mitigation measures with several stakeholders including the Office of the State Fire Marshal.

Over 16 percent of total flooding systems have moved to high GWP suppressants.[137] In comparison, streaming systems have moved almost exclusively to non-GWP agents, but there are some high GWP suppressants on the market. This measure will concentrate on total flooding systems but will also determine if there are reduction options for the streaming market.

The emissions of high GWP gases from fire protection systems come from intentional use as a fire suppressant, leakage, and accidental discharges. In total, annual emissions are estimated at 1.5-2 percent of total banks. The U.S. Environmental Protection Agency has developed voluntary guidelines to minimize non-fire emissions of HFCs and PFCs, and the fire protection industry has implemented a data collection effort to better understand emissions.

In addition to emissions, the continued use of high GWP agents in new systems will result in a build-up (or bank) of high GWP gases in fire suppression systems. Banks of high GWP gases are of concern because these gases will eventually be emitted, unless they are collected and

[137] U.S. EPA. Global Mitigation of Non-$CO_2$ Greenhouse Gases. U.S. EPA Report 430-R-06-005. June 2006.

destroyed or recycled. Leak reduction can minimize current emissions and recycling can reduce the bank growth.

The goal of this measure is two-fold: to reduce emissions and banks of high GWP gases from the fire protection sector, and to ensure low end-of-life emissions from halon systems. For high GWP systems, this measure will consider options for existing and new systems for both total flooding and portable applications. Leak reduction, mitigation fees, use of lower GWP agents, and end-of-life agent recycling and destruction are potential options to be examined. Most halon systems will reach their end of life by 2020, so a goal of this measure is to have all halon systems that are decommissioned either recycle or destroy the halon.

As noted above, this measure will have an effect on both emissions and banks. Emissions should be reduced to less that 0.1 $MMTCO_2E$ with an effort to ensure limited growth in high GWP banks between 2012 and 2020. Business-as-usual projections show a doubling of emissions in that time period. Depending on the availability of alternatives it may be possible to prevent growth in the banks altogether. Annual emissions reduction is estimated to be less than 0.1 $MMTCO_2E$ in 2020.

Cost estimates are uncertain at this time given the lack of data on the number and size of systems in California. Assuming installation of low or non-GWP suppressants in systems coming online between 2010 and 2015, statewide one-time costs vary from $10 million to $12 million for 2012-2015 with annual costs ranging from $200,000 to a savings of $200,000, depending on the substitute gas. For systems coming online between 2015 and 2020 the statewide one-time cost is approximately $3 to 4 million with annual costs ranging from $70,000 to a savings of a similar amount.[138] These estimates assume a 20-year equipment lifetime. The resulting costs may seem high per metric ton of $CO_2E$ emitted because the capital costs occur upon installation of the system, but emissions occur slowly (2 percent per year) over 20 years or longer. Costs only account for emissions and not the increasing banks of high GWP agents. Staff is in the very preliminary stages of assessing both the emission reduction potential as well as the costs for this category. As such, the viability of the measure will continue to be assessed as the analysis proceeds.

### Residential Refrigeration Early Retirement Program

This non-regulatory measure involves partnering with existing voluntary programs to retire inefficient residential refrigeration appliances such as refrigerators and freezers. Appliance early retirement includes the recovery of high-GWP refrigerants and blowing agents for reclamation or destruction to avoid GHG emissions. If all waste refrigerant and foam blowing agents are properly reclaimed or destroyed GHG emissions avoidance benefits may be significant. Staff believes that by partnering with organizations such as utilities ARB can increase the role of appliance early retirement programs as an option for reducing GHG emissions. Part of the measure would include providing information to assist with the proper disposal of appliances including the insulating foams that include high-GWP substances as blowing agents.

Based on California law, all appliances are required to be recycled and the refrigerant recovered, but there is no requirement to recover foam blowing agents. A primary benefit of this measure would be the recovery and destruction of foam blowing agents from retired appliances.

[138] Ibid.

Residential appliances targeted for early retirement will begin with pre-1996 refrigerators using refrigerants and foam blowing agents that total about five metric tons carbon dioxide equivalent per appliance. The goal of this measure is to increase early retirement rates of inefficient residential appliances.

This measure will be coordinated with the Foam Recovery/Destruction measure, another early action measure that is expected to require EOL recovery of high-GWP refrigerants and foam blowing agents from appliances. The Residential Refrigeration program will focus on operating refrigerators, while the Foam Recovery/Destruction measure will focus on non-operating refrigerators.

Current tools to encourage early retirement of appliances consist of the U.S. EPA Responsible Appliance Disposal program, a promotional program to support retailers and utilities using best practices in appliance disposal, and utility companies' energy efficiency programs. The primary solution considered under this measure is to support these programs. This support may be provided directly through ARB's existing outreach efforts or potentially through development of mechanisms to increase incentives provided to consumers, businesses, and/or appliance recyclers.

In 2020, there are potential one-year direct GHG emission reductions of 0.1 $MMTCO_2E$, which are primarily from Kyoto gases. Additionally, there are potential one-year indirect GHG emission reductions resulting from energy savings, which are a result of retirement of inefficient residential refrigeration appliances.

### *(H-7) Mitigation Fee on High GWP Gases*

This measure would establish an upstream mitigation fee on sales of high GWP industrial gases. These gases have potent global warming potentials and an upstream fee would ensure that the climate impact of these substances is incorporated into their price, encouraging emission reductions and the development of alternatives. Even with the reductions from other high GWP measures, the sector's emissions would still be over 30 $MMTCO_2E$ in 2020 (and about twice current emissions). This difficulty in reducing absolute emissions is because the high GWP sector is the fastest-growing category in California's GHG inventory due, in part, to the replacement of ODS for which production is being phased-out. The remaining emissions would be difficult to address via traditional regulatory approaches since the gases are used in many small uses in diverse applications and there is potential for new or evolving uses. Additionally, some uses have no current alternative and there is a lack of incentive to either develop alternatives or reduce leakage. The mitigation fee would complement rather than replace many of the downstream high GWP regulations currently being developed. As sources comply with the regulatory measures, affected entities would reduce their emissions and therefore the amount of the fee they would need to pay. The fee would address high GWP gases in a consistent manner, on a carbon dioxide equivalent basis, and serve to change behavior, induce new lower GWP alternative products, and provide revenue that can be used to mitigate GHG emissions elsewhere. Addressing this large source of emissions will provide reductions in 2020 and will also position California for further reductions beyond 2020.

A stakeholder process to evaluate and potentially develop a fee on sales of gases with high-GWPs will begin in early 2009. Emission reductions from the mitigation fee would be a

function of the fee level as well as how revenues are directed. The level of the fee would be set based on economic and technical evaluations. Fees would be administered by the ARB, and would be assessed at a consistent rate per $MTCO_2E$. Depending upon the fee level, the annual revenue generated may range from $300 million to over $1 billion. However, the recommended fee, as well as the structure of the program, would be developed through a stakeholder process before consideration by the Board.

The revenue generated through the mitigation fees could be used to achieve cost-effective reductions of GHGs. Possible uses include greenhouse gas mitigation, investment in efficiency, research and development and deployment of green technologies. It is anticipated that reductions in banks of ODS could also be considered as an option for use of the fee revenue. However, determining the appropriate use and expending any revenues would likely require legislative or budget act authority.

The reductions, fee levels, and structure are preliminary and further analysis and stakeholder input will be necessary. The mitigation fee measure is expected to go to the Board in late 2009/early 2010.

**Appendix C: High GWP**
**Table 32**

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| H-1: Motor Vehicle Air Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing (Discrete Early Action) | 0.26 | 3 | ARB | 2009/2010 |
| H-2: $SF_6$ Limits in Non-Utility and Non-Semiconductor Applications (Discrete Early Action) | 0.3 | 0.08 | ARB | 2009/2010 |
| H-3: Reduction of Perfluorocarbons in Semiconductor Manufacturing (Discrete Early Action) | 0.15 | 2.6 | ARB | 2008/2012 |
| H-4: Limit High GWP Use in Consumer Products (Discrete Early Action) | | 0.06 | | |
| Pressurized Gas Duster GWP Limit of 150 | 0.23 | | ARB | 2008/2012+ |
| Other Consumer Product Categories | 0.02 | | ARB | Ongoing |
| H-5: High GWP Reductions from Mobile Sources | | 20.86 | | |
| Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems | 2.5 | | ARB | 2010/2015 |
| Air Conditioner Refrigerant Leak Test During Vehicle Smog Check | 0.5 | | ARB/ BAR | 2011/2012* |
| Refrigerant Recovery from Decommissioned Refrigerated Shipping Containers | 0.2 | | ARB | 2011/2012 |

| Reduction Measure | Potential 2020 Reductions $MMTCO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Enforcement of Federal Ban on Refrigerant Release during Servicing or Dismantling of Motor Vehicle Air Conditioning Systems | 0.1 | | ARB | 2009/2010* |
| H-6: High GWP Reductions from Stationary Sources | | See Separate Entry Below | | |
| Stationary Equipment Refrigerant Management Program- Refrigerant Tracking/Reporting/ Repair/Deposit Program | 6.3 | -2.58 | ARB | 2009/2010 |
| Stationary Equipment Refrigerant Management Program- Specifications for Commercial and Industrial Refrigeration | 4.0 | 0.58 | ARB/CEC | 2011/2012 |
| Foam Recovery and Destruction Program | 0.3 | 9 | ARB | 2009/2010 |
| $SF_6$ Leak Reduction and Recycling in Electrical Applications | 0.1 | 0 | ARB | 2010/2012 |
| Alternative Suppressants in Fire Protection Systems | 0.1 | 1.76 | ARB/ Cal/Fire | 2010/2011* |
| Residential Refrigeration Early Retirement Program | 0.1 | -5.89 | ARB | 2010/2011* |
| H-7: Mitigation Fee on High GWP Gases | 5[139] | 100 | ARB | 2009/2010 |

*Informational items as they are non-regulatory or the regulations would be adopted by another organization (e.g., fire suppression strategy is expected to be adopted by Cal/Fire via amendments to Title 24).
†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

[139] The 5 $MMTCO_2E$ reduction is an estimate of what might occur with a fee in place. Additional emission reductions from a fee would be expected as resulting revenues are used in mitigation programs. Using the funds to mitigate greenhouse gas emissions could substantially increase the emission reductions from this measure.

# 12. AGRICULTURE

**This sector includes the following measures:**

**Recommended Actions**
**(A-1) Methane Capture at Large Dairies**

**Areas of Research/Opportunities for future GHG Emission Reductions**
**Assessing and Reducing N2O Emissions**
**Efficiency Improvements**

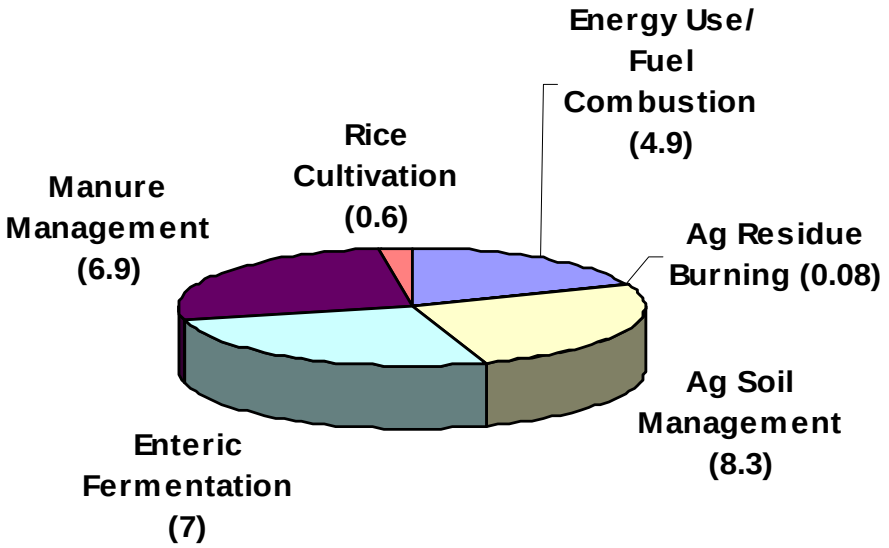
ARB worked closely within the CAT and its sector-specific subgroups, the Economic and Technology Advancement Advisory Committee, and with stakeholders to develop the measures included in this Plan. This input was evaluated and analyzed by ARB and is reflected in the measures included in this sector.

## Overview

For purposes of California's GHG inventory and AB 32 implementation, the Agricultural sector includes on-farm emissions from animals and from crop cultivation and management, but does not include post-farm processing and distribution or manufacture of inputs such as pesticides or fertilizer. On-farm sources include emissions from animal wastes, energy use (including fuel combustion), crop residue burning, enteric fermentation, soil management practices (such as fertilizer and manure applications and soil liming), and anaerobic decomposition of organic matter.

**Appendix C: Agriculture Figure 8**

**2004 Agriculture Sector Emissions ($MMTCO_2E$)**




In 1990, the Agricultural sector emitted an estimated 23.4 $MMTCO_2E$, representing five percent of the statewide total. This figure increased to 27.9 $MMTCO_2E$ in 2004, or six percent of the statewide total. The emissions forecast for the sector shows an increase in emissions to

29.8 $MMTCO_2E$ in 2020; the primary driver behind the projected increase is growth in dairy livestock.

The Agricultural sector presents several opportunities to reduce GHG emissions and help California achieve the reductions necessary to meet the goals of AB 32. GHG reduction strategies for the Agricultural sector include voluntary actions to reduce emissions and research to better quantify emissions and identify further opportunities for reductions. Many of the voluntary strategies presented for the Agricultural sector were identified by the Economic and Technology Advancement Advisory Committee.

As described below, the Scoping Plan includes a recommended voluntary measure for methane capture at dairies though use of manure digester systems. This voluntary approach is designed to encourage investment in technology and improve cost-effectiveness over time. The voluntary approach will be re-assessed at the five-year Scoping Plan update to determine if the program should be made mandatory for large dairies by 2020. This reassessment will include performance, cost-effectiveness, and other actions needed to facilitate implementation, but specific criteria for the evaluation are not yet developed.

The Plan includes a two-phase research effort to better understand $N_2O$ emissions from fertilizer applications. Phase 1 of this effort will address the variables affecting emissions and, based on the findings in Phase 1, Phase 2 will explore opportunities for emission reductions. Also included are potential voluntary measures such as improved water efficiency, improved irrigation pump efficiency, and optimal tire inflation (for fuel savings). These potential strategies may not be appropriate in every situation but provide an opportunity for greenhouse gas reductions and cost savings through reduced fuel use.

In addition to the strategies in the Scoping Plan, there are other opportunities for the Agricultural sector to reduce GHG emissions. One of these areas is the utilization of agricultural biomass for electricity generation and fuel production. Approximately 8 million tons of agricultural biomass is available for use annually; however, only 1.1 million tons is currently utilized largely due to technological impediments. Traditionally, this biomass has been burned on-site, incorporated into the soil, chipped, or sent to a landfill. More productive use of this material will reduce GHG emissions related to its disposal or decomposition, and serve as a renewable energy source displacing demand for fossil fuel use. Utilization of this material would complement regulatory programs requiring farmers to reduce open burning of residues by providing a disposal avenue for biomass that would have otherwise been burned, subjected to anaerobic decomposition, or disposed of in landfills. Development of bioenergy sources, which supports California's renewable energy goals, will be tracked and accounted for in the Energy sector.

Increasing carbon sequestration in plants or soils offers another potential opportunity for the Agricultural sector. Under certain conditions, practices such as conservation tillage, cover cropping, and incorporating soil amendments may increase or retain soil carbon. Sequestration can also be increased on rangelands or in on-farm plantings such as permanent crops, hedgerows, or riparian restoration projects.

Methane emissions from ruminant agriculture may be reduced by utilizing recommended feeding practices, dietary additives or agents that impact digestion efficiency, and/or longer-term breeding and management practices. However, further research is needed to understand and

quantify the impacts of practices to reduce direct methane emissions from livestock digestive processes.

Gaps in scientific knowledge and scientific uncertainty in existing data on many agricultural strategies make the identification of real, permanent, additional, verifiable and enforceable reduction measures difficult to immediately implement. The extent to which these and other voluntary GHG reduction activities occur may depend on the availability of economic incentives such as marketable emission reduction credits, grants, tax incentives, or renewable energy incentives, as well as the development of quantification protocols.

# Recommended Actions

## *(A-1) Methane Capture at Large Dairies*

Digesters are tanks or covered lagoons in which bacteria break down manure in an oxygen-free environment to create biogas, a mix of primarily methane (60 to 70 percent) and carbon dioxide (30 to 40 percent).[140] The biogas is captured in the tank or lagoon, and impurities removed prior to use in a turbine, IC engine, or fuel cell to create electricity, or injected into a utility natural gas pipeline. Regardless of the ultimate fate of the captured biogas, manure digester systems must meet local, state and federal air quality requirements, as well as water quality requirements. GHG reductions occur through operation of these systems because methane, which is 21 times as potent as $CO_2$ as a global warming pollutant, is captured and either utilized or destroyed instead of being directly released to the atmosphere.

Encouraging the capture of methane through use of manure digester systems at dairies will provide early voluntary emission reductions and promote the use of renewable energy. Economic incentives such as marketable emission reduction credits, favorable utility contracts, or renewable energy incentives will be key to early implementation. This voluntary approach in the initial years should encourage investment in the technology and improve cost effectiveness over time, which could help to facilitate a possible transition from a voluntary to a regulatory approach. The voluntary approach will be re-assessed at the five-year Scoping Plan update to determine if the program should be made mandatory for large dairies by 2020.

The manure digester protocol for quantifying GHG reductions approved by the Air Resources Board in September 2008 supports the implementation of this measure. This quantification methodology will ensure that voluntary reductions achieved are real, permanent, verifiable and enforceable. The installation and operation of digesters have potential cross-media impacts that must be assessed by multiple agencies including ARB, local air districts, State and Regional Water Boards and the California Integrated Waste Management Board. Increased regulatory coordination among these agencies is needed. Another issue highlighted by digester operators is that contracts from utilities contain few incentives for selling excess electricity or gas into the utility electrical grid or gas distribution system. ARB will continue to work with stakeholders and other agencies to encourage widespread capture of methane at large dairies.

[140] Managing Manure with Biogas Recovery Systems: Improved Performance at Competitive Costs. U.S. Environmental Protection Agency. http://www.epa.gov/agstar/pdf/manage.pdf

It is estimated that individual digester costs can range from $4-6 million for a dairy with at least 1,000 head. These costs include the digester tank or covered lagoon; electrical production equipment; manure solids separator; flare; biogas clean-up, upgrading, and processing equipment; and utility interconnection equipment. These costs also include annual operation and maintenance costs of about $100,000. Digesters have an estimated useful project life of about 15 years.

**Appendix C: Agriculture**
**Table 33**

| Reduction Measure | Potential 2020 Reductions MMT$CO_2E$ | Net Annualized Cost ($ Millions)† | Proposed Lead Agency | Adoption/ Implementation Timeframe |
|---|---|---|---|---|
| Methane Capture at Large Dairies | 1 | 156 | ARB | 2017-2020 |

†The net cost of this GHG emission reduction strategy may not include the savings associated with emission control requirements necessary to obtain equivalent reductions of criteria pollutants reduced as a co-benefit, or the additional costs to control increased criteria pollutant emissions as a result of this measure. To the extent feasible, the net cost of emissions controls for criteria pollutants will be evaluated further in measure development.

# Areas of Research/Opportunities for future GHG Emission Reductions

## *Assessing and Reducing N2O Emissions*

The application of nitrogen fertilizers leads to emission of nitrous oxide ($N_2O$), a greenhouse gas. ARB is coordinating with the California Energy Commission and the California Department of Food and Agriculture on a research program to better understand the variables affecting emissions (Phase 1) and based on the findings explore opportunities for emission reductions (Phase 2).

$N_2O$ accounts for roughly 15.6 MMT$CO_2E$, or 2.8 percent of California's 2004 Statewide GHG inventory. Current estimates indicate that agricultural soil produces more than 50 percent of overall $N_2O$ emissions in California, contributing an estimated 8.3 MMT$CO_2E$. The $N_2O$ in soil is primarily derived from nitrogen-rich substances such as plant residues, manure amendments, and nitrogen fertilizers. Because $N_2O$ is generated through microbiological processes of nitrification and denitrification in soil as part of the natural nitrogen cycle, its emissions are closely related to the amount of nitrogen compounds in the soil. Continuing to improve the timing and application techniques of nitrogen sources into agricultural ecosystems, coupled with alternative agricultural management practices that affect physical, chemical, and biological properties of the soil environment (and consequently soil microbial activities), may offer opportunities to mitigate $N_2O$ emissions.

The first step in this research effort is the establishment and validation of $N_2O$ emission estimates under California-specific conditions, which will help refine the greenhouse gas emissions inventory. California has a unique opportunity to explore the effects of dynamic changes in soil moisture, due to controlled irrigation, on $N_2O$ emissions. The $N_2O$ inventory

assessment will inform subsequent work to identify strategies that reduce nitrogen losses (which can be up to 50 percent), prolong nitrogen residence time in soil, and benefit crop uptake.

## Efficiency Improvements

Another aspect of the Agricultural sector's strategy is the potential opportunity to reduce GHG emissions through improved operational efficiency. These actions may not be applicable in all situations; to the extent that they are viable and desirable for individual farmers, the practices could be undertaken on a voluntary basis. Among the efficiency measures that could be pursued and developed for the future are continued improvements to water use efficiency and conservation, irrigation pump efficiency improvements, and maintenance of correct tire pressure to reduce fuel use by farm equipment.

Continued advances in agricultural water efficiency and conservation offer the potential for additional GHG reductions, as well as benefits for the State's water resources. The Agricultural sector accounts for approximately 80 percent of California's total water use and approximately 43 percent of California's total water supply.[141,142] Continued investment in water saving measures provides the opportunity to reduce water costs, preserve water resources, and reduce greenhouse gases.

Irrigation pump efficiency could be improved through on-site testing of agricultural water pumps, pump repairs, and the promotion of scientifically-determined irrigation scheduling practices. Such improvements would be expected to reduce either electricity or diesel fuel consumption for farmers, with associated cost savings.

Another opportunity for reducing fuel use is through the maintenance of correct tractor tire pressure when operationally feasible. Proper tire inflation based on the tire load can result in significant fuel savings, increased productivity, and reduced soil compaction during primary tillage operations, based on a UC Davis study.[143] The study found that tractors using correct tire pressure required approximately 20 percent less diesel fuel and increased productivity by 5 to 10 percent. The reduction in fuel consumption reduces both GHG and criteria pollutant emissions, and the reduced soil compaction could potentially reduce $N_2O$ production in soil.

[141] Department of Water Resources. Agricultural Water Use Program. http://www.owue.water.ca.gov/agdev/
[142] In addition to being a potential strategy to reduce GHG emissions, using water more efficiently may help the agricultural sector cope with potential reductions in water availability associated with the ongoing impacts of climate change on the hydrologic cycle.
[143] Lancas, K.P., S.K. Upadhyaya, and M. Sime. 1994. Traction and soil compaction due to low pressure tires. Unpublished report. Agricultural Engineering Department, University of California Davis

# Appendix D: September 23, 2008 Western Climate Initiative Design Recommendations

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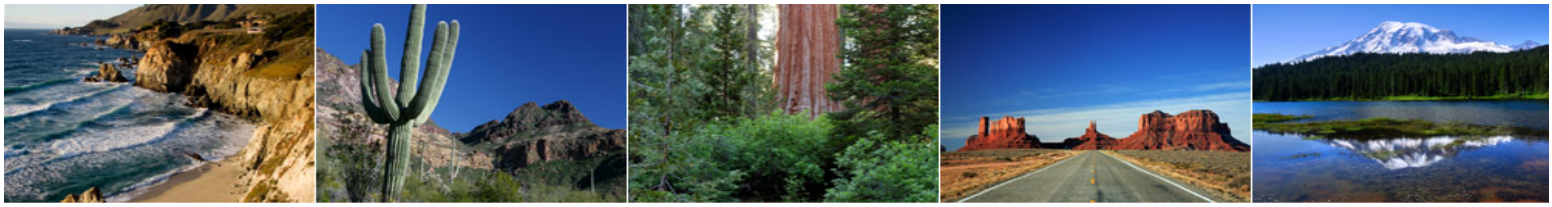


# Western Climate Initiative

## Design Recommendations for the WCI Regional Cap-and-Trade Program

September 23, 2008

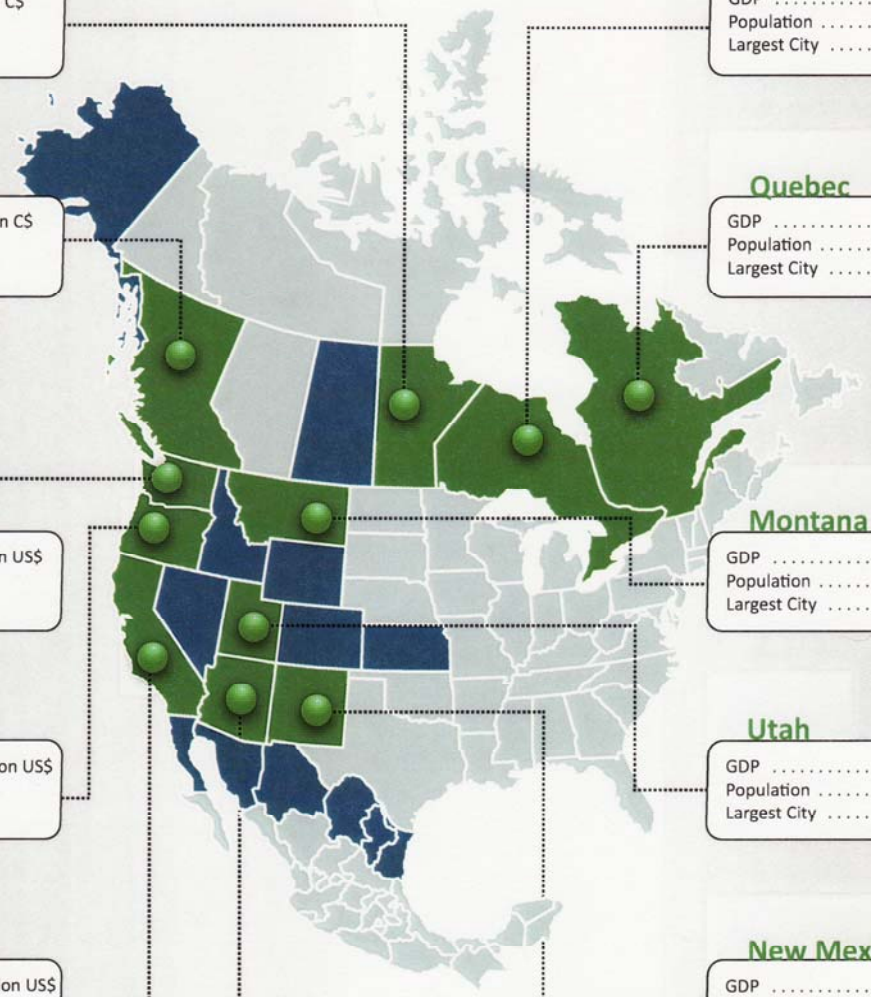
Corrected Version: Issued March 13, 2009

*Arizona* *British Columbia* *California*

*Manitoba* *Montana* *New Mexico* *Ontario*

*Oregon* *Quebec* *Utah* *Washington*

# Western Climate Initiative



## Manitoba

GDP ..... 48,586 Million C$
Population ..... 1,186,700
Largest City..... Winnipeg

## Ontario

GDP ..... 582,019 Million C$
Population ..... 12,803,900
Largest City ..... Toronto

## British Columbia

GDP ..... 190,214 Million C$
Population ..... 4,380,300
Largest City ..... Vancouver

## Quebec

GDP ..... 298,157 Million C$
Population ..... 7,700,800
Largest City ..... Montreal

## Washington

GDP ..... 311,270 Million US$
Population ..... 6,468,424
Largest City ..... Seattle

## Montana

GDP ..... 34,253 Million US$
Population ..... 957,861
Largest City ..... Billings

## Oregon

GDP ..... 158,233 Million US$
Population ..... 3,747,455
Largest City ..... Portland

## Utah

GDP ..... 105,658 Million US$
Population ..... 2,645,330
Largest City ..... Salt Lake City

## California

GDP ..... 1,812,968 Million US$
Population ..... 36,553,215
Largest City ..... Los Angeles

## New Mexico

GDP ..... 76,178 Million US$
Population ..... 1,969,915
Largest City ..... Albuquerque

## Arizona

GDP ..... 247,028 Million US$
Population ..... 6,338,755
Largest City ..... Phoenix

Partners  Observers

## WCI OBSERVERS

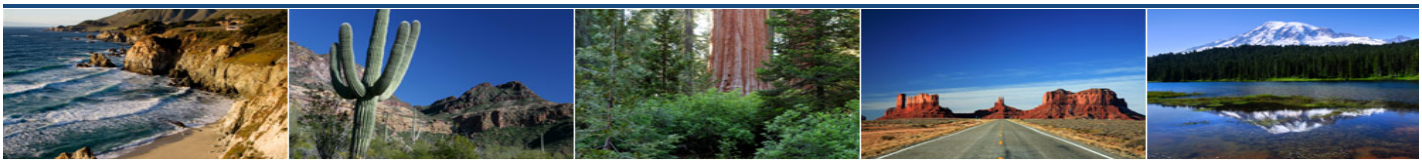
**CANADA**
Saskatchewan

**UNITED STATES**
Alaska
Colorado
Idaho
Kansas
Nevada
Wyoming

**MEXICO**
Baja California
Chihuahua
Coahuila
Nuevo Leon
Sonora
Tamaulipas

*All figures for 2007*
*Source for US data: US Census Bureau and US Bureau of Economic Analysis*
*Source for Canadian data: Statistics Canada*

# Western Climate Initiative



September 23, 2008

To All Interested Parties:

In February 2007, the governors of Arizona, California, New Mexico, Oregon and Washington kicked off this ambitious effort to design a regional, market-based approach for reducing greenhouse gas emissions. Since that time, the governors of Montana and Utah and the premiers of British Columbia, Manitoba, Ontario, and Quebec have joined in this historic effort and today we are pleased to release our "Design Recommendations for the WCI Regional Cap-and-Trade Program."

Each of our states and provinces recognizes the need to take action now to address the threats posed by global climate change. The design recommendations being released today are an important milestone in our collective effort to respond to the leadership role states and provinces have established on this issue.

While we are pleased to reach this milestone, we recognize that much more remains to be done to move from program design to program implementation. Over the next couple of months, we will prepare a detailed work plan to guide the next phase of the Western Climate Initiative. The work plan will identify the priorities for the coming year and will provide information on how all interested parties can continue to engage in our process.

As we developed these recommendations over the last 18 months, we benefited greatly from the input provided by a wide variety of stakeholders representing business, industry, labor, and environmental groups. The dedication of our state and provincial staff and the assistance of our technical and policy advisors were also critical to our success.

On behalf of the governors and premiers of the Western Climate Initiative, we again thank you for your interest in our work and for your many contributions to date. We look forward to working with you as we move into the next phase of this initiative. We know that together we can meet the challenge of climate change while enhancing overall environmental health and economic vitality throughout the region.

Sincerely,

The WCI Partners

## State of Arizona

Lori Faeth
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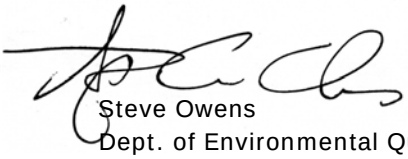

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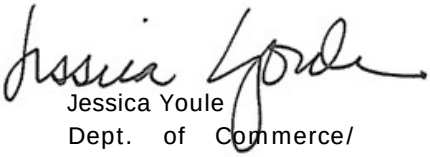

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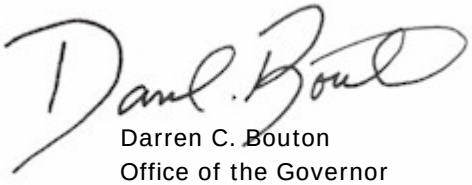

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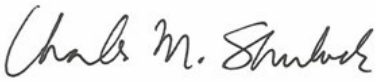

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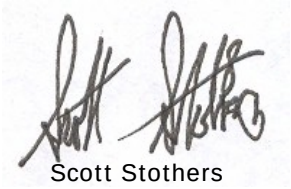

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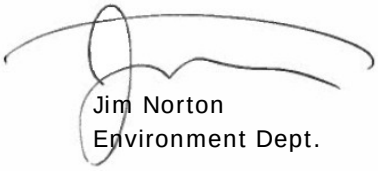

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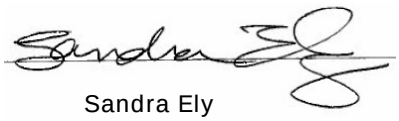

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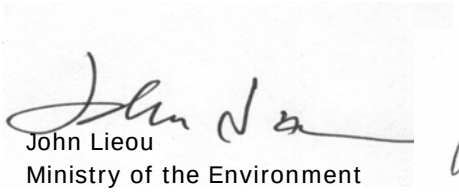

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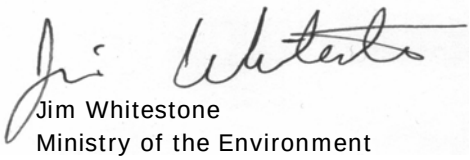

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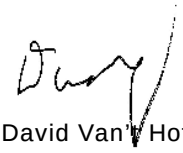

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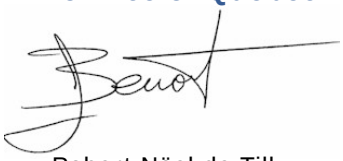

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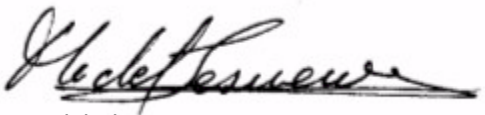

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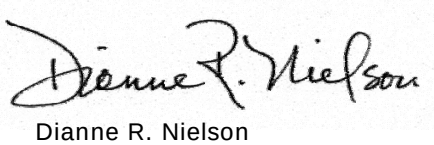

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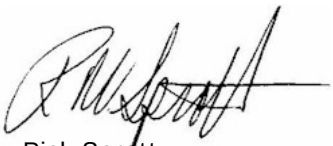

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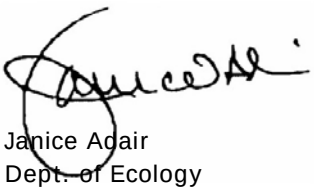

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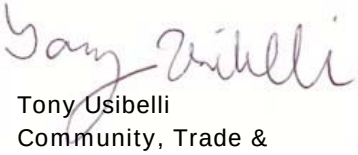

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Community, Trade & Economic Development

# Acknowledgements

Those of us who were honored to represent our states and provinces in designing the WCI cap-and-trade program owe a debt of gratitude to the advisors who helped us throughout the process: Franz Litz, Nicholas Bianco, and Jonathan Pershing of the World Resources Institute, Judi Greenwald, Anna Motschenbacher, Joshua Bushinsky, and Steve Caldwell with the Pew Center on Global Climate Change, Tom Peterson, Jeff Wennberg, Ken Colburn, and June Taylor with the Center for Climate Strategies, and Michael Lazarus with the Stockholm Environment Institute.

Sam Hitz, Tymon Lodder, Jill Gravender and Executive Director Diane Wittenberg from The Climate Registry and Paula Fields with ERG were instrumental in helping develop the essential elements for reporting.

Jill Duggan who heads the United Kingdom's International Emissions Trading office and her colleague, Tim McRae, shared expertise and experiences with the design and implementation of the EU ETS. Similarly, Mr. Litz and Mr. Wennberg worked for New York and Vermont respectively during the design of the Regional Greenhouse Gas Initiative (RGGI) and helped us build upon that experience.

Rob Greenwood and Bill Ross of Ross and Associates provided exceptional facilitation services during the last several negotiating sessions of the WCI, helping us get to success. Lydia Dobrovolny, also with Ross and Associates, provided critical support during the final negotiating sessions.

Karl Hausker, Glen Wood and their colleagues at ICF International and Jeff Amlin at Systematic Solutions, Inc. provided assistance to the WCI Economic Modeling Team as they evaluated a number of important questions related to the costs and benefits of the WCI cap-and-trade program.

Tim Smith with Waggener Edstrom Worldwide developed our communication tools with amazing speed. Deb Kinsley with the Western Governors' Association provided unparalleled service in making all of the arrangements for our Partner meetings and stakeholder workshops. We want to also thank Marcus Schneider and his colleagues at the Energy Foundation who provided the seed money to get this effort underway.

Our biggest thanks go to Pat Cummins with the Western Governors' Association. As our project manager, he kept us on track, on course and within budget. We simply would not have gotten through the process without Pat's assistance and support.

# Table of Contents

# Section 1: Design Recommendations for the WCI Regional Cap-and-Trade Program

The Western Climate Initiative (WCI) jurisdictions are recommending a design for a broad cap-and-trade program as part of a comprehensive regional effort to reduce emissions of global warming pollution to achieve the WCI 2020 regional goal. The recommended design will provide opportunities to obtain low-cost emission reductions through emission trading, allowance banking, and inclusion of an offsets component. The design is also intended to mitigate economic impacts, including impacts on consumers, income, and employment. The design balances all principles adopted by the WCI Partner jurisdictions to maximize total benefits throughout the region, including reducing air pollutants, diversifying energy sources, and advancing economic, environmental, and public health objectives, while also avoiding localized or disproportionate environmental or economic impacts. Finally, the WCI Partner jurisdictions have designed a program that can stand alone, provide a model for, be integrated into, or be implemented in conjunction with programs that might ultimately emerge from the federal governments of the United States and Canada.

## 1. Scope[1]

1.1. Greenhouse gases (GHGs) covered: Carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

1.2. Emissions covered:

1.2.1. Electricity generation, including emissions from electricity generated outside the WCI jurisdictions (or generated by a federal entity or on tribal lands) that is delivered into a WCI Partner jurisdiction for consumption in that WCI Partner jurisdiction;

1.2.2. Combustion at industrial and commercial facilities;

1.2.3. Industrial process emission sources[2], including oil and gas process emissions;

1.2.4. Residential, commercial, and industrial fuel combustion at facilities with emissions below the WCI thresholds3 (as described below in the Point of Regulation section, these emissions will be covered upstream). Coverage of these emissions will begin at the start of the second compliance period;

[1] The *scope* defines the GHG emissions that are included in the cap-and-trade program, including the emission sources and GHG emissions that fall under the cap.

[2] As used here, process emissions include emissions from chemical, biological, and other non-combustion processes. These emissions may be deliberate (e.g., vented), fugitive (e.g., leaked), or accidental.

[3] *Thresholds* are emission levels that determine when a particular entity or facility will have a compliance obligation under the cap-and-trade program.

1.2.5. Transportation fuel combustion (as described below in the Point of Regulation section, these emissions will be covered upstream.) Coverage of these emissions will begin at the start of the second compliance period.

1.2.6. The WCI Partner jurisdictions recommend covering combustion from transportation, residential, commercial, and industrial (including electricity) fuel sources with the expectation that the individual WCI Partner jurisdictions will:

- Mitigate the economic impact on consumers;
- Implement other policies that will reduce GHG emissions from the transportation sector and reduce demand for transportation fuels (such as vehicle standards, smart growth, low carbon fuel standards, transit options, etc.); and
- Address any issues associated with the point of regulation and its implementation.

1.3. For biomass determined by each WCI Partner jurisdiction to be carbon neutral, the carbon dioxide emissions from the combustion of that biomass are not included in the cap-and-trade program, except for purposes of reporting.

1.4. Carbon dioxide emissions from the combustion of pure biofuels, or the proportion of carbon dioxide emissions from the combustion of biofuel in a blended fuel (e.g., B20 or E85), are not included in the cap-and-trade program, except for purposes of reporting.

1.5. Prior to program start, the WCI Partner jurisdictions will assess whether and how to include upstream emissions from biofuel and fossil fuel production, taking into consideration the potential for emissions leakage, the potential role of other policies (such as a low carbon fuel standard), consistent treatment among fuels, and other factors (such as practicality of implementation).

1.6. As described in Section 5, Role of Other Policies, WCI Partner jurisdictions acknowledge that individual jurisdictions may utilize other fiscal measures such as British Columbia's carbon tax, to address transportation fuels and fuel use by residential and commercial sources that contribute to achieving overall comparable GHG emission reductions and internalize the price of carbon as expected through the regional cap-and-trade program.

1.7. Adequate quantification methods will be established for emissions sources prior to including them in the program.

## 2. Point of Regulation[4]

2.1. Industrial sources (both process and combustion) with emissions above the threshold: The point of regulation will be at the point of emission.

2.2. Electricity: The point of regulation is the First Jurisdictional Deliverer (FJD). For sources within WCI jurisdictions, the FJD is the generator. For power that is generated outside the WCI jurisdictions (or generated by a federal entity or on tribal lands) for consumption within a WCI Partner jurisdiction, the FJD is the first entity that delivers that electricity over which the consuming WCI partner jurisdiction has regulatory authority.

2.3. Residential, commercial, and industrial fuel combustion at facilities with emissions below the threshold: The point of regulation will be where the fuels enter commerce in the WCI Partner jurisdictions, generally at a distributor. The precise point is to be determined and may vary by jurisdiction.

2.4. Transportation fuel combustion: The point of regulation will be where the fuels enter commerce in the WCI Partner jurisdictions, which for liquid fuels is generally at the terminal rack, final blender, or distributor. The precise point is to be determined and may vary by jurisdiction.

## 3. Thresholds for Coverage Under the Cap-and-Trade Program

3.1. Emission threshold: 25,000 metric tons of carbon dioxide equivalents ($CO_2e$) annually defines the entities or facilities (e.g., First Jurisdictional Deliverer, fuel distributor, fuel blender) that will have a regulatory compliance obligation under the cap-and-trade program. Mandatory reporting data may be used to adjust this threshold for specific industries where necessary. Additional analyses will be performed to determine if adjustments to the threshold are needed to ensure sufficient coverage or to address competitiveness issues within individual sectors prior to the beginning of the program (e.g., because different WCI Partner jurisdictions may have the same industry but with different sized sources).

3.2. A method will be developed to prevent entities or facilities from avoiding coverage, such as by breaking themselves into separate power deliverers that each deliver electricity with emissions below the threshold.

## 4. Program Expansion

4.1. Future Program Expansion: The scope of the cap-and-trade program is capable of expanding over time (including possibly adjusting applicability thresholds). Prior to each compliance period, the WCI Partner jurisdictions will review whether to bring new sources into the program and, if so, which ones.

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[4] The *point of regulation* is the entity or facility with the compliance obligation, i.e., the requirement to surrender sufficient GHG allowances to cover actual emissions during the compliance period. An *allowance* is the tradable permit to emit one metric ton of GHG emissions in $CO_2e$. The term *entity* is generally used when the point of regulation is upstream of the point of emissions, to describe a company that has an obligation to surrender allowances to cover the carbon content of the fuel the company is moving through commerce, or when the point of regulation is at the First Jurisdictional Deliverer, to describe a company that has an obligation to surrender allowances to cover the emissions attributable to the generation of power the company is importing. When the point of regulation is at the point where the emissions occur, the term *facility* is generally used. The term *source* is used to refer to emissions from either a facility or an entity.

## 5. Role Of Other Policies[5]

5.1. The role of other GHG-reducing policies is to help the WCI Partner jurisdictions achieve their 2020 reduction goal and provide other benefits. Those policies will work in concert with the cap-and-trade program and may apply to any source of GHG emissions.

5.2. Carbon Tax and Other Fiscal Measures:

5.2.1. The WCI Partner jurisdictions agree that individual jurisdictions may use fiscal measures that contribute to achieving overall comparable GHG emission reductions and internalize the price of carbon as expected through the regional cap-and-trade program for transportation and residential/commercial fuels.

5.2.2. British Columbia currently has a carbon tax. By 2012, the WCI Partner jurisdictions will determine the mechanism for integrating the cap-and-trade program with the BC carbon tax.

## 6. Setting the Regional Cap[6]

6.1. The aggregate regional cap for the cap-and-trade program will:

6.1.1. Equal the sum of the WCI Partner jurisdictions allowance budgets (as referenced in Section 7.1).

6.1.2. Include annual caps (with 3-year compliance periods7) from the beginning of the program in 2012 through 2020. The annual caps will be set in advance of the program start in 2012 so that the total number of allowances issued in each 3-year compliance period through 2020 is known.

6.1.3. Decline over time. The regional cap trajectory for covered sectors will be a straight line from the year of initial coverage (2012 for some sources and 2015 for other sources) to 2020.

6.2. 2012: The initial regional cap will be set at the best estimate of expected actual emissions for those sources covered in the initial year of the program (i.e., 2012) as calculated through the Partner allowance budgets as described in 7.2.

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[5] *Other policies* include complementary policies and alternative policies. A *complementary policy* is used in this context to mean policies other than a cap-and-trade program that aid in the goal of achieving emissions reductions for capped or uncapped sources. *An alternative policy* is a policy that is employed in lieu of a cap-and-trade program to achieve emissions reductions for one or more sources.

[6] The *regional cap* is the overall limit on total emissions set for the total emissions included in the cap-and-trade program.

[7] The 3-year compliance periods are 2012-2014, 2015-2017, and 2018-2020.

6.3. 2015: The regional cap in 2015 will be set by adding the best estimate of expected actual emissions in 2015 from transportation fuels and residential, commercial, and industrial fuels (and any other sectors or sources that may be added to the program for the first time in 2015) to the emissions trajectory for the sources first included in the program in 2012.

6.4. 2020: The regional cap for 2020 will be set so that reductions achieved by the cap plus reductions from other GHG reduction policies for uncapped sources will achieve the WCI regional 2020 goal.

6.5. Post-2020 caps: The WCI Partner jurisdictions will set these regional caps not less than three years in advance.

6.6. Once established, the regional cap for each compliance period will not be adjusted except as necessary to account for:

- Changes in WCI membership;
- Changes in scope or thresholds; or
- Data found to be incorrect or inaccurate that was used to determine the cap, which may become apparent, for example, after the start of mandatory reporting.

Any adjustments will be made prior to the beginning of the compliance period.

## 7. Apportionment[8]

7.1. Each WCI Partner jurisdiction will have an annual allowance budget within the declining regional cap from 2012 to 2020. The annual WCI Partner jurisdiction allowance budget for each year through 2020 will be set prior to the start of the program in 2012.

Each WCI Partner jurisdiction's 2020 allowance budget will be derived from its individual WCI Partner jurisdiction goal[9] used for purposes of the program, accounting for other policies described in Section 5.[10]

There are instances in which electricity is generated in one WCI Partner jurisdiction, but consumed in another WCI Partner's jurisdiction, giving rise to the possibility of double-counting emissions. WCI Partner jurisdictions in such situations will agree to an equitable solution in the context of the WCI cap-and-trade program design.

7.2. For 2012, each WCI Partner jurisdiction's allowance budget will be based on the best estimate of expected emissions for sources covered in the cap-and-trade program in the WCI Partner jurisdiction in 2012. The estimate of expected actual emissions in 2012 will be developed using the best available data (including any available mandatory reporting data) and by accounting for expected changes in emissions in 2012. Population growth, economic growth,

[8] *Allowance apportionment* describes the Partners' budget or share of WCI region-wide GHG emission allowances. Allowance budgets must be set for each Partner jurisdiction.

[9] Partner goals are those reduction goals or limits that have been established by each individual WCI Partner jurisdiction.

[10] By the end of 2009, Oregon will determine its cap-and-trade specific Partner goal at a level which is at least as stringent as the WCI regional goal.

voluntary and mandatory emission reductions, and other factors will be considered in making the estimate. Each WCI Partner jurisdiction's allowance budget will be adjusted to account for the production and consumption of electricity megawatt hours within each WCI Partner jurisdiction, population growth, and the share of total WCI Partner jurisdictions emissions in 2001 through 2005. Each WCI Partner jurisdiction will make a one-time contribution of 1% of their 2012 budget to be allocated to make these adjustments.

7.2.1. For 2015, each WCI Partner jurisdiction's allowance budget will be set by adding the best estimate of expected actual emissions in 2015 from transportation fuels and residential, commercial, and industrial fuels (and any other sectors or sources that may be added to the program for the first time in 2015) to the emissions trajectory for the sources first included in the program in 2012. The estimate of expected actual emissions in 2015 will be developed using the best available data (including any available mandatory reporting data) and by accounting for expected changes in emissions in 2015 for the sources added to the cap in 2015. Population growth, economic growth, voluntary and mandatory emissions reductions, and other factors will be considered in making the estimate.

7.2.2. From 2015-2020, the trajectory for each WCI Partner jurisdiction's annual allowance budget for covered sectors will be a straight line from the year of initial coverage (2012 for some sources and 2015 for other sources) to 2020.

7.3. For years post-2020, the WCI Partner jurisdictions will set allowance budgets not less than three years in advance.

7.4. Once established, each WCI Partner jurisdiction's allowance budget will not be adjusted except as necessary to account for:

- Changes in WCI membership;
- Changes in scope or thresholds; or
- Data found to be incorrect or inaccurate that were used to determine the cap or the WCI Partner jurisdiction allowance budgets, which may become apparent, for example, after the start of mandatory reporting.

Such adjustments will take effect at a regionally coordinated and designated time, such as at the beginning of a compliance period.

7.5. WCI Partner jurisdictions will recognize within their own jurisdictions allowances issued by other WCI Partner jurisdictions so that all WCI allowances are of equivalent use and fungible throughout the WCI region, regardless of which WCI Partner jurisdiction issues the allowances.

## 8. Distribution of Allowances[11]

8.1. Distribution of Allowances by WCI Partner jurisdictions: Once the allowance budget has been established for each WCI Partner jurisdiction, allowances will be issued by each WCI Partner within its own jurisdiction. Each allowance will be equal to one metric ton of carbon dioxide equivalent.

8.2. The WCI Partner jurisdictions agree that a portion of the value represented by each WCI Partner jurisdiction's allowance budget (for example, through set-asides of allowances, a distribution of revenues from the auctioning of allowances, or other means) will be dedicated to one or more of the following public purposes which are expected to provide benefits region wide:[12]

- Energy efficiency and renewable energy incentives and achievement;
- Research, development, demonstrations, and deployment (RDD&D) with particular reference to carbon capture & sequestration (CCS); renewable energy generation, transmission and storage; and energy efficiency;
- Promoting emission reductions and sequestration in agriculture, forestry and other uncapped sources; and
- Human and natural community adaptation to climate change impacts.

8.3. The remaining portion of the value represented by each WCI Partner jurisdiction's allowance budgets will be used as that jurisdiction sees fit. WCI Partner jurisdictions may consider objectives such as:

- Reducing consumer impacts, especially for low-income consumers;
- Providing for worker transition and green jobs;
- Achieving emission reductions in communities that experience disproportionate environmental impacts;
- Supporting community-wide efforts funded by local governments to reduce GHG emissions;
- Providing transition assistance to industries;
- Recognizing early actions to reduce emissions; and/or
- Promoting economic efficiency.

8.4. In advance of the first compliance period, and at least one year before the beginning of each relevant compliance period thereafter, each WCI Partner jurisdiction will advise the other WCI Partner jurisdictions how it intends to distribute or retire allowances so that all WCI Partner jurisdictions' plans can be made public in a coordinated fashion.

8.5. If analysis demonstrates that allocations to a particular sector should be treated uniformly by some WCI Partner jurisdictions in order to address competition among like facilities or entities within that sector, and if from that analysis some WCI Partner jurisdictions determine that it is necessary to address those competitiveness issues between the WCI Partner jurisdictions where the facilities or entities operate, those WCI Partner jurisdictions will

[11] *Allowance distribution* is the Partners' initial distribution of GHG emission allowances into the market.

[12] This will recognize pre-existing commitments to action and legislative requirements on use of revenue (e.g., through BC's Climate Action Plan and Carbon Tax).

standardize the distribution of allowances as necessary to address competitive impacts sufficiently, in advance of the first compliance period.

- Potential sectors where analysis to consider similar treatment is appropriate include those with process (non-combustion) emissions where the greatest emission reduction potential is associated with large technology changes and high GHG emission intensity, such as aluminum, steel, cement, lime, pulp and paper, and oil refining.
- Some WCI Partner jurisdictions may also decide that based on analysis of competitive factors in the electricity sector, distribution of allowance value or auction revenues in that sector should be standardized between those WCI Partner jurisdictions where competitive issues are recognized.

8.6. A WCI Partner jurisdiction will allocate or retire all the allowances in its allowance budget by the end of the applicable compliance period. Except as provided in Section 8.10, a WCI Partner jurisdiction will not hold allowances beyond the end of the compliance period.

8.7. Recognizing the WCI Partner jurisdictions objective of standardizing treatment of some sectors, and acknowledging the differences in the appropriate use of auctions by sector:

8.7.1. Consistent with applicable state and provincial law, the WCI Partner jurisdictions will auction a minimum of 10% of the allowance budget in the first compliance period beginning in 2012. This minimum percentage will increase to 25% in 2020. The WCI Partner jurisdictions aspire to a higher auction percentage over time, possibly to 100%.

8.7.2. Each WCI Partner jurisdiction has discretion to auction a greater portion of its allowance budget as it sees fit.

8.7.3. If a WCI Partner jurisdiction cannot auction allowances, that Partner jurisdiction will notify the other WCI Partner jurisdictions at least six months before the beginning of auctions scheduled for each compliance period. The fact that a WCI Partner jurisdiction cannot auction allowances shall not preclude the other Partner jurisdictions from doing so.

8.8. To the extent WCI Partner jurisdictions auction allowances, those jurisdictions will undertake auctions through a coordinated regional auction process by which each participating WCI Partner jurisdiction will auction allowances throughout the WCI region and receive their proceeds from the auction.

8.9. By the end of 2009 the WCI Partner jurisdictions will develop a design for the coordinated regional auction process. The WCI Partner jurisdictions will design the auction process to consider and prevent market manipulation.

8.10. To manage the risk of inadvertently setting the program cap higher than intended relative to emissions covered by the program, a reserve or minimum price will be established for a portion of the auctioned allowances. Consistent with applicable state and provincial law, this portion will equal 5% of allowances issued by any WCI Partner jurisdiction. If any of these allowances

when offered at auction are not purchased at or above the reserve or minimum price, a fraction of the unsold ones will be retired. The unsold allowances that are not retired may be auctioned in later compliance periods or retained by the individual WCI Partner jurisdictions for use as each sees fit in later compliance periods, as determined in advance by the WCI Partner jurisdictions. Any WCI Partner jurisdiction that does not participate fully in the auction with the reserve or minimum price will retire the same proportion of its allowance budget as those retired by the WCI Partner jurisdictions that participated in the auction. The percentage of the allowance budgets, the reserve price, the fraction of unsold allowances that will be retired, and the fraction of unsold allowances that will be retained by the individual WCI Partner jurisdictions will be determined as part of the auction design.

8.11. Early Reduction Allowances. The program will encourage entities and facilities included under the cap to reduce GHG emissions before the start of the first compliance period in 2012.

8.11.1. Each WCI Partner jurisdiction may issue Early Reduction Allowances for certain emissions reductions at covered entities and facilities within its jurisdiction that are achieved after January 1, 2008 and before January 1, 2012.

8.11.2. By the end of 2009, the WCI Partner jurisdictions will jointly establish criteria to determine which early reductions will be eligible for Early Reduction Allowances. The criteria will ensure that the reductions are voluntary, additional, real, verifiable, permanent and enforceable.

8.11.3. Each WCI Partner jurisdiction that issues Early Reduction Allowances will do so in 2012. Any Early Reduction Allowances issued will be in addition to each WCI Partner jurisdiction's 2012 allowance budget.

8.11.4. These allowances shall be treated like other allowances in the cap-and-trade program.

8.12. Other Early Actions and Set-Asides: Each WCI Partner jurisdiction has discretion to recognize early actions other than those under Section 8.11, or otherwise set-aside allowances for distribution. Recognition for early action or set-asides under this subsection will come from within the cap and will come out of the individual WCI Partner jurisdiction's allowance budget.

8.13. Banking: Purchasers and covered entities or facilities, and parties who otherwise obtain allowances, will be allowed to bank allowances without limitation, except to the extent that restrictions on the number of allowances any one party may hold are necessary to prevent market manipulation.

8.14. Borrowing: Borrowing of allowances from future compliance periods will not be allowed.

8.15. Compliance Periods: Each compliance period will be three years long.

## 9. Offsets,[13] and Allowances From Other Systems

9.1. The WCI Partner jurisdictions will include a rigorous offsets system. The primary role of the offsets system is to reduce the compliance costs for the cap-and-trade program, while ensuring the environmental integrity of the cap.

9.2. The WCI Partner jurisdictions will limit the use of all offsets, and allowances from other GHG emission trading systems that are recognized by the WCI Partner jurisdictions, to no more than 49% of the total emission reductions from 2012-2020 in order to ensure that a majority of emission reductions occur at WCI covered entities and facilities. Each WCI Partner jurisdiction will have the discretion to set a lower percentage limit. All offsets and non-WCI allowances must meet the rigorous criteria established by the WCI Partner jurisdictions.

The WCI Partner jurisdictions will establish criteria to ensure that all offset projects used to meet a compliance obligation result in a GHG reduction, removal or avoidance that is real, surplus/additional, verifiable and permanent or that meets a comparably rigorous standard as described in Section 9.7 below. Offset projects must also be enforceable by the individual WCI Partner jurisdiction that is issuing the credit and the credit must be verifiable by the individual WCI Partner jurisdiction that is accepting it. The criteria will ensure that the quantification of the GHG reduction, removal, or avoidance is accurate and not double counted. The standards and processes for approving offset projects will be developed and implemented in an open and transparent manner that will be well-defined in advance of the start of the cap-and-trade program.

9.3. The WCI Partner jurisdictions encourage the development of offset–projects located inside WCI jurisdictions for compliance purposes in the WCI cap-and-trade regulatory program in order to capture collateral benefits associated with some offsets projects, such as health, social, and environmental benefits.

9.4. The WCI Partner jurisdictions have identified the following list of project types as a priority for investigation and development to participate in the offset system. Making these project types a priority means the WCI Partner jurisdictions are interested in understanding if they are suitable for the offset system, if they will meet the criteria for environmental integrity, and if adequate protocols/methodologies for their quantification and monitoring can be adapted or developed. Priority does not mean these project types are guaranteed to be in an offset system. Project types that reduce emissions that would eventually be covered by the cap-and-trade system would only be eligible until that coverage begins. Project types that reduce emissions covered by the cap-and-trade system would not be eligible to create offsets because the result would be a double counting of the emission reduction. The list is in alphabetical order and does not directly or indirectly represent a ranking or order of preference:

[13] *Offsets* are emission reduction projects undertaken to address emissions not included in a cap-and-trade program. An offset mechanism enables covered entities to offset their own emissions by purchasing emission reduction credits generated through projects that address emissions not covered by the cap.

- Agriculture (soil sequestration and manure management);
- Forestry (afforestation/reforestation, forest management, forest preservation/conservation, forest products); and
- Waste management (landfill gas and wastewater management).

9.5. Starting in 2009, the WCI Partner jurisdictions will coordinate to review, develop, and approve, as appropriate, protocols for the project types that meet the necessary criteria for inclusion. The WCI Partner jurisdictions will use offset protocols that are standardized to the extent possible and make use of (or adapt if needed), existing protocols as appropriate. The WCI Partner jurisdictions will also initiate the establishment of a process during 2009 to coordinate the review and approval of other project types and protocols proposed by project developers. The WCI Partner jurisdictions will establish rigorous criteria for inclusion of offsets in the WCI program.

9.6. WCI Partner jurisdictions will recognize offsets meeting the WCI criteria within their own jurisdictions regardless of which WCI Partner jurisdiction issued them, so that all WCI offsets are of equivalent use and fungible throughout the WCI region. Offsets not meeting the WCI criteria will not be accepted for compliance purposes.

9.7. WCI Partner jurisdictions may approve and certify offset projects located throughout the United States, Canada, and Mexico where such projects are subject to comparably rigorous oversight, validation, verification, and enforcement as those located within the WCI jurisdictions. WCI Partner jurisdictions will not approve offset credits for GHG reductions in developed countries (Annex 1 countries in UN Framework Convention on Climate Change) for projects that reduce, remove, or avoid emissions from sources that within WCI Partner jurisdictions are covered by the cap-and-trade program.

9.8. The WCI Partner jurisdictions may accept offset credits from developing countries through the Clean Development Mechanism (CDM) of the Kyoto protocol, and the WCI Partner jurisdictions may establish added criteria to ensure similar rigor to WCI approved/certified offset projects or other requirements, such as international offset standards, as appropriate to enable use of these offset credits in the cap-and-trade program.

9.9. The offset protocols used by the WCI Partner jurisdictions will meet rigorous criteria to preserve the environmental integrity of the overall cap-and-trade program.

9.10. WCI Partner jurisdictions do not intend to regulate or restrict the existing voluntary market in offsets, to restrict the sale of offsets from projects located within a WCI Partner jurisdiction, or to place restrictions on ownership of offsets projects located within WCI Partner jurisdictions.

## 10. Reporting

10.1. Mandatory measurement and monitoring for the six included GHG emissions will commence in January 2010 for all entities and facilities subject to reporting. Reporting of 2010 emissions will begin in early 2011.

10.2. The entities and facilities subject to reporting are those with annual emissions equal to or greater than 10,000 metric tons of $CO_2e$. Where fuel combustion emissions are covered upstream (e.g., emissions from transportation fuel combustion and emissions from fuel combustion at residential, commercial, and industrial facilities with emissions below the threshold) the reporting threshold will apply to entities (e.g., fuel distributors and blenders) based on the expected combustion emissions from the fuels distributed. In some limited instances the threshold may be based on other parameters, such as throughput or capacity, as long as these thresholds represent the equivalent of, or are lower than, the 10,000-metric-ton threshold..

10.3. WCI Partner jurisdictions will require third party verification of reported emissions from entities and facilities that will be included under the cap.

10.4. Prior to the start of the mandatory reporting program, the WCI Partner jurisdictions will establish the essential requirements for reporting by all entities and facilities required to report in each of the WCI Partner jurisdictions.

10.5. As each WCI Partner jurisdiction collects additional emissions data from entities and facilities required to report, data will be made available to all WCI Partner jurisdictions for review and consideration for possible expansion of the cap-and-trade program.

10.6. Nothing in the WCI program design limits the discretion of any WCI Partner jurisdiction to require reporting earlier, at lower thresholds, or for entities and facilities not covered by the cap-and-trade program.

## 11. Start Date for Cap-and-Trade

11.1. The cap-and-trade program will launch January 1, 2012.

## 12. Compliance and Enforcement

12.1. Each WCI Partner jurisdiction will retain and/or enhance its regulatory and enforcement authority and responsibilities to enforce compliance with the cap-and-trade program within its own jurisdiction.

12.2. Each covered entity or facility will demonstrate compliance with the cap-and-trade program by surrendering sufficient allowances by July 1 of the year following the end of each compliance period. To ensure transparency and maintain public confidence, certain data from the emissions reports, allowances, and offsets that are used for compliance will be made public in a timely manner.

12.3. If by the deadline for demonstrating compliance a covered entity or facility does not have sufficient allowances to cover its emissions for the previous compliance period, it shall be required to obtain and surrender three allowances for every metric ton of $CO_2e$ not covered by an allowance at the deadline. This does not preclude other penalties allowed under individual state or provincial laws.

12.4. The WCI Partner jurisdictions recognize that during the first compliance period, both they and the entities and facilities covered by the cap-and-trade program will likely encounter issues that arise in the implementation of any new program. Consequently, the WCI Partner jurisdictions are committed to providing appropriate technical and other compliance assistance to the program participants.

12.5. The WCI Partner jurisdictions will ensure accounting systems are in place to prevent using allowances, tradable units, and offsets more than once for compliance.

## 13. Regional Organization, New WCI Partner Jurisdictions, and Linkage

13.1. To reduce administrative costs and improve program transparency and consistency, a regional administrative organization will be created to:

- Coordinate the regional auction of allowances;
- Track emissions and provide public information on progress towards the WCI regional goal;
- Monitor and report on market activity, including any potential market manipulation;
- Serve as a forum for WCI Partner jurisdictions to update one another on program progress;
- Coordinate review and adoption of protocols for offsets;
- Coordinate review and adoption of updated reporting protocols;
- Coordinate review and issuing of offset credits; and
- Suggest criteria and means to accredit service providers to deliver validation and verification services.

13.2. New WCI Partner jurisdictions will come into the cap-and-trade program at a regionally coordinated and designated time, such as the beginning of the relevant compliance period.

13.3. Before joining, a new WCI Partner jurisdiction must have adopted an economy-wide GHG reduction goal for 2020 that is at least as stringent as the WCI regional goal.

13.4. Determination of allowance budgets for new WCI Partner jurisdictions will take into account the following parameters:

- The WCI regional goal;
- Allowance budgets for existing WCI Partner jurisdictions;
- The share of the new WCI Partner jurisdiction's budget that is already included through the WCI's regional cap-and-trade program provisions covering imported electricity; and
- The new Partner's individual GHG emissions reduction goal.

13.5. The WCI Partner jurisdictions will seek bilateral and multilateral linkages with other government-approved cap-and-trade systems so that those allowances and allowances issued by WCI Partner jurisdictions would be fully fungible. Until such bilateral or multilateral linkages are established, the use of allowances from other cap-and-trade systems will be limited as described in Section 9.2.

## 14. WCI Design and Possible Federal Programs

14.1. The WCI Partner jurisdictions have designed a program that can stand alone, provide a model for, be integrated into, or be implemented in conjunction with programs that might ultimately emerge from the federal governments of the United States and Canada. The WCI Partner jurisdictions intend to promote and influence federal GHG emission reduction programs that are consistent with WCI cap-and-trade design principles, and ensure those programs translate into absolute GHG reductions. In the event WCI issues allowances before a federal program in Canada or the United States, WCI Partner jurisdictions will work to ensure that those allowances are fully recognized and valued in the operation of a federal program.

14.2. The approach taken by the WCI Partner jurisdictions builds upon the experience gained by the WCI Partner jurisdictions in developing and implementing climate change action plans and other market-based programs to address air quality issues, including the regional haze and acid rain programs in the United States. Continued leadership in developing a regional cap-and-trade program allows the WCI Partner jurisdictions to take important action now and promote and protect the interests of early actors in the design and implementation of future national and international programs. Taking action now to achieve emission reductions will position WCI Partner jurisdictions to be leaders in the carbon constrained future.

# Section 2: Background Report on the Design Recommendations for the WCI Regional Cap-and-Trade Program[14]

The Western Climate Initiative (WCI) is a cooperative effort of seven U.S. states and four Canadian provinces (the "Partners") that are collaborating to identify, evaluate, and implement policies to reduce greenhouse gas (GHG) emissions, including the design and implementation of a regional cap-and-trade program.[15] The Initiative began in February 2007 with the governors of Arizona, California, New Mexico, Oregon, and Washington, who have since been joined by the premiers of British Columbia, Manitoba, Ontario, and Quebec, and the governors of Montana and Utah.[16] Participation in the WCI reflects each Partner's strong commitment to identifying, evaluating, and implementing collective and cooperative actions to address climate change. This Background Report accompanies the Design Recommendations for the regional cap-and-trade program.

The WCI cap-and-trade program is the most comprehensive cap-and-trade program designed to date. Nearly 90 percent of the GHG emissions in the states and provinces will be covered by the cap when it is fully implemented in 2015. It will include more sectors and emissions than either the Regional Greenhouse Gas Initiative (RGGI) in the northeastern United States, which covers the electricity sector only, or the European Union's Emissions Trading Scheme (EU ETS), which does not cover transportation or residential and commercial fuel use. Through its broad scope, the WCI program will reduce costs while reducing emissions across the economy. It will also spur growth in new green technologies, help build a strong clean-energy economy, and reduce dependence on foreign oil.

The Partner jurisdictions are motivated by the impacts of climate change already being felt in the region. Observed trends include rising temperatures leading to warmer, earlier springs and more frost-free days; changing precipitation patterns that include both prolonged drought and increased flooding, as well as shifts in springtime precipitation from snow to rain; changes in water availability due to earlier spring snowmelt, changes in available water volume, and increased evaporation from reservoirs; rising sea levels; and a growing number of large wildfires. Additional impacts expected from unabated climate change include more heat waves, shrinking glaciers and reduced snowpack, reduced biodiversity as invasions of non-native species increase and local habitat moves northward and to higher elevations, and reduced air quality due to elevated levels of ozone and

[14] No statement in this document should be taken to contradict the Design Recommendations released concurrently with this Background Report; any perceived conflict should defer to the Design Recommendations.

[15] The complete text of the February 26, 2007 Memorandum of Understanding can be found in Appendix A.

[16] The states of Alaska, Colorado, Idaho, Kansas, Nevada, and Wyoming participate as observers, as do the province of Saskatchewan and the Mexican border states of Baja California, Chihuahua, Coahuila, Nuevo Leon, Sonora, and Tamaulipas.

particulates. These impacts affect a wide range of economic sectors, from electricity generation to public health, from agriculture to tourism. The cost of inaction is enormous.

The analyses conducted on the WCI design suggest that the region can mitigate the costs of reducing emissions and realize a cost savings through increased efficiencies and reduced fuel consumption. These savings come in addition to the benefits the region will accrue from a cleaner environment and the promotion of investment and innovation to accelerate the transition to a green economy. The WCI cap-and-trade program is a winning proposition for Partner jurisdictions.

The initial phase of the WCI cap-and-trade program will be a time of transition during which WCI Partner jurisdictions will manage risks, protect the economy, and see real reductions in greenhouse gas emissions. Action is needed now to reduce greenhouse gas emissions and to adapt to climate change impacts. Working together, the states and provinces in the WCI are leading the way.

## 1. Public Comments and Discussion of WCI Recommendations

The process that led to the recommended design of the regional cap-and-trade program was careful and deliberative. At each step of design development, the WCI Partners sought extensive stakeholder input, as described in part 3.1.3, which yielded a great volume of comments on the range of issues confronted by participating WCI Partner jurisdictions. The comments submitted to the WCI Partner jurisdictions have been posted on the WCI website.[17] The WCI Partners carefully reviewed and considered stakeholder comments in order to formulate the design recommendations for the cap-and-trade program.

This section elaborates on the key program design recommendations. Each design element is defined and the design recommendation is summarized. Stakeholder input on the design element is reviewed briefly. Finally, the WCI Partners' recommendation is discussed in light of stakeholder input, the balancing required between disparate stakeholder positions, lessons learned from other cap-and-trade programs, economic analyses, and expert opinion. The design recommendations also rely on the design principles adopted by the WCI Partner jurisdictions and the overarching program goal of ensuring that greenhouse gas (GHG) emissions are reduced within the WCI Partner jurisdictions.

In conjunction with the cap-and-trade program, individual WCI Partner jurisdictions will:

- Mitigate economic impacts on consumers;
- Implement other policies that will reduce GHG emissions from the transportation sector and reduce demand for transportation fuels (such as vehicle standards, smart growth, low carbon fuel standards, and transit options); and

[17] www.westernclimateinitiative.org.

- Address jurisdiction-specific issues associated with the point of regulation and its implementation.
- If any of the design elements differ between the Design Recommendations and the following explanatory text, the Design Recommendations take precedence.

## 1.1. Scope

### 1.1.1. Definition

The *scope* defines the GHG emissions that are included in the cap-and-trade program, including the sectors, emissions sources, and greenhouse gases that fall under the cap. The cap is the absolute aggregate limit on GHG emissions.

### 1.1.2. Design Recommendation

The WCI Partner jurisdictions recommend a multi-sector greenhouse gas cap-and-trade program covering emissions of the six major GHGs: carbon dioxide, methane, nitrous oxide, perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulfur hexafluoride.[18] In the initial compliance period beginning in 2012, the program will cover emissions from electricity, including imported electricity; industrial combustion at large sources; and industrial process emissions[19] for which adequate quantification methods exist. In the second compliance period, beginning in 2015, the program will expand to cover fuels combusted at industrial, residential, and commercial buildings that are not otherwise covered as emissions sources, as well as transportation fuels. The first compliance period of the program will include about half of the economy-wide emissions in the WCI Partner jurisdictions. Starting with the second compliance period, the program will include about 90 percent of emissions. The program is capable of expanding further over time based on new information.

The carbon dioxide emissions from the combustion of biomass that are determined to be carbon neutral will not be covered by the cap-and-trade program emissions cap. Similarly, the carbon dioxide emissions from the combustion of bio-fuels or the bio-fuel component of blended fuels will not be covered by the program emissions cap. However, carbon dioxide emissions from biomass, bio-fuels, and the bio-fuel component of blended fuels will be subject to the program reporting requirements. The WCI Partner jurisdictions are continuing to assess whether and how to include upstream emissions from bio-fuel and fossil fuel production that do not take place within the WCI Partner jurisdictions.

[18] The Scope Draft Design Recommendations describes the options considered by the scope subcommittee, the evaluation criteria applied to the options, the data and analytical inputs (including data on emissions, numbers of entities, and potential cost impacts), and the decision process for deciding on the recommendations. Available at www.westernclimateinitiative.org/ewebeditpro/items/O104F16031.PDF.

[19] As used here, process emissions include emissions from chemical, biological, and other non-combustion processes. These emissions may be deliberate (e.g., vented), fugitive (e.g., leaked), or accidental.

Individual jurisdictions may utilize comparable fiscal measures, such as British Columbia's carbon tax, to address transportation fuels and fuel use by residential and commercial sources, and industrial fuels not otherwise covered at the emissions source. Adequate quantification methods will be established for emissions sources before they are included in the program.

### 1.1.3. Stakeholder Input

Stakeholder comments expressed strong support for the broadest possible coverage of sources and emissions under the cap-and-trade program. Factors identified by stakeholders supporting a broad scope include:

- To provide greater certainty that economy-wide emission reductions will be achieved;
- To reduce compliance costs by covering a broad set of emissions sources with diverse emission reduction opportunities;
- To create a level playing field for all fuels;
- To ensure that carbon is priced throughout the economy; and
- To create a more robust GHG trading market.

Many stakeholders stressed the importance of having reliable measurement, monitoring, and reporting protocols in place in order to include an emissions source in the program. For example, stakeholders from the waste management industry highlighted their view that the quantification protocols for landfill methane emissions cannot currently calculate methane emissions at individual landfills with adequate precision for a cap-and-trade program.

Considerable input was received on whether to include transportation fuels in the cap-and-trade program. Many stakeholders supported including transportation fuels in the program, emphasizing that these fuels are the largest source of GHG emissions across the WCI Partner jurisdictions and for most of the individual jurisdictions. They argued that these fuels need to be included to ensure that the economy-wide emission reduction goals can be achieved. Some stakeholders pointed out that if transportation fuels were omitted from coverage, then they would enjoy a competitive advantage over electricity as a vehicle fuel, since electricity would be covered by the program. Stakeholders also provided analyses indicating that including transportation fuels will reduce the concentration of the carbon trading market by including significant additional participants. Reduced concentration may help protect against market manipulation and provide for a more robust market.

A small group of stakeholders expressed opposition or hesitation to including transportation fuels citing concerns regarding: economic impacts, particularly on low-income communities; administrative complexity; and the lack of technical options for reducing reliance on fossil-carbon-based fuels. Some stakeholders suggested that the demand for transportation fuels has been shown to be highly inelastic, so that there would be little emission reduction achieved by including the fuels in the program. Other stakeholders cited analyses suggesting that the demand for transportation may be inelastic, but the demand for traditional transportation fuels was or is becoming increasingly elastic.

The timing for including transportation fuels in the program was also the subject of considerable input. Some stakeholders said it was best to include the fuels in the first compliance period, in particular to internalize the price of carbon as soon as possible. Others said that a delay in coverage was warranted to allow the point of regulation to be adequately determined and to enable complementary policies to enhance the availability of options for reducing emissions.

Stakeholders also commented on whether and when residential and commercial fuels should be included in the cap-and-trade program. Some stakeholders expressed concerns regarding economic impacts and administrative complexity. Some commented that direct use of natural gas at a residence or business is a more efficient use of that fuel than using it to generate electricity and, for this reason, should be excluded from coverage in the program. It was also argued that energy efficiency programs would be a more effective method of reducing emissions from these fuels. Others stressed the importance of creating a level playing field across all fuels, indicating that natural gas competes with electricity in residential and commercial applications.

The inclusion of industrial process emissions was also the subject of stakeholder input. Stakeholders pointed out that some process emissions are due to chemical reactions that are fundamental to their production processes. They recommended that these "fixed process emissions" be excluded from the program. Similarly, some stakeholders suggested that the process emissions from geothermal electricity generation should be excluded because geothermal electric generation is a low-emitting process.

Issues were also raised by stakeholders related to incorporating combined heat and power (cogeneration) into the program since it has implications in both the industrial and electricity sectors.

### 1.2. Discussion of WCI Partners' Recommendation

The WCI Partner jurisdictions have weighed all input carefully and have proposed a program scope that best achieves the program objectives and addresses stakeholder concerns. The WCI Partners are persuaded by the multiple benefits of having as broad a scope as possible, including transportation fuels and fuels for residential, commercial, and small industrial users along with electric sector emissions and industrial emissions. Recognizing that transportation fuels are the largest source of GHG emissions in the region, the WCI Partners have concluded that transportation fuels must be included in order to achieve the objective of reducing emissions not only by 2020, but by 2050. Additionally, the WCI Partners believe that it is important to internalize the cost of carbon throughout the economy and to ensure a level playing field across all fuels. Consequently, the WCI Partners have also concluded that there are important benefits from including transportation fuels and fuels for residential, commercial, and small industrial users.

The timing of the coverage of transportation fuels and fuels for residential, commercial, and small industrial users was considered carefully. While there are benefits of including these fuels starting with the first compliance period, multiple factors necessitated covering them starting in the second compliance period. Electric sector emissions and industrial emissions are traditional emissions sources regulated in the context of clean air regulations. In the WCI Partners' judgment, it is practical to cover these sectors from the start of the program in 2012.

Emissions from fuels for residential, commercial, and small industrial users and transportation fuels are different than those typically dealt with by regulatory agencies under either the U.S. or Canadian Clean Air Acts. The WCI Partner jurisdictions concluded that it is important to have time to develop clear requirements for the entities that will have a regulatory obligation for these emissions, including how to calculate or measure their emissions. In addition, the Partner jurisdictions believe it is important for other policies that will reduce overall consumer demand for these fuels (such as the California clean car standards and strategies to reduce vehicle miles traveled, and to increase the use of low carbon or other "cleaner" fuels) be put in place before these fuels are covered by the cap-and-trade program. The WCI Partner jurisdictions recognize the importance of increased emphasis on energy efficiency to reduce fuel combustion in residential, commercial, and small industrial uses. The WCI Partner jurisdictions also believe it is important to develop strategies to address any potential consumer impacts from covering these emission sources in advance of the second compliance period.

All process emissions with adequate quantification methods will be included in the program. The WCI Partner jurisdictions believe that it is important to incorporate the price of carbon throughout the economy, including in products with fixed process emissions. However, the WCI Partners also recognize that the competitive position of some industrial sources could be affected by this decision. Consequently, the WCI Partners are continuing to evaluate the potential competitive impacts on these sources and will address these impacts if they are found to be significant.

Economic analyses support the recommendation for broad coverage in the cap-and-trade program. The analysis conducted for the WCI Partners is consistent with the body of literature supporting a broad scope, including transportation fuels. In particular, the analysis found that compliance costs can be reduced if the program includes a broad scope.

The WCI Partner jurisdictions recognize the importance of combined heat and power (cogeneration) in the program scope and are continuing to evaluate its implications for the program design.

## 1.3. Point of Regulation

### 1.3.1. Definition

The *point of regulation* is the entity or facility with the compliance obligation. The term *entity* is used (a) when the point of regulation is upstream of the point of emissions, to describe a company that has an obligation to surrender allowances to cover the expected emissions from the combustion of the fuel the company is moving through commerce, or (b) when the point of regulation is at the First Jurisdictional Deliverer, to describe a company that has an obligation to surrender allowances to cover the emissions attributable to the generation of power the company is importing. When the point of regulation is at the point where the emissions occur, the term *facility* is generally used. A *compliance obligation* is the requirement to surrender GHG allowances sufficient to cover actual emissions during the compliance period.

### 1.3.2. Design Recommendation

The WCI Partner jurisdictions are recommending the following points of regulation for the cap-and-trade program:

- For industrial process and combustion sources with emissions above the threshold, the point of regulation is at the facility that has the point of emissions.
- For entities generating and/or delivering electricity with attributed emissions above the threshold, the point of regulation is at the First Jurisdictional Deliverer. This means at the facilities generating power within the WCI Partner jurisdictions and at the first entity over which a Partner has regulatory authority that delivers electricity generated outside the WCI into a WCI Partner jurisdiction for consumption in that Partner jurisdiction.
- For residential, commercial, and industrial fuel combustion at facilities with emissions below the threshold, the point of regulation is where the fuels enter commerce in the WCI Partner jurisdictions, generally at a fuel distributor. The precise point will be determined before the fuels are brought into the program in 2015 and may vary by jurisdiction.
- For transportation fuel combustion, the point of regulation is where the fuels enter commerce in the WCI Partner jurisdictions, generally at the terminal rack, final blender, or distributor. The precise point will be determined before these fuels are brought into the program in 2015 and may vary by jurisdiction.

### 1.3.3. Stakeholder Input

Stakeholders provided a broad range of comments regarding the preferred points of regulation for the various emissions included in the program. Some stakeholders supported a point of regulation as close to the point of emissions as is practical in order to provide a

regulatory obligation on the actual emitter. Other stakeholders supported an upstream point of regulation, particularly for transportation and other fuels in order to provide as broad coverage as possible.

The WCI Partner jurisdictions received a great variety of comments on the point of regulation for the electricity sector. A majority of commenters favored some approach to cover emissions associated with electricity from outside the WCI Partner jurisdictions. However, there was a wide variety of opinions on how best to cover emissions from imported electricity. A specific challenge relative to covering all deliverers of electricity is the need to track the emissions from the point of generation to the point of delivery inside the WCI Partner jurisdictions. Some commenters observed that, considering this challenge, the WCI Partners should start with a generator-based only point of regulation for electricity, then expand to include power imported for consumption into the WCI Partner jurisdictions once the tracking issue was resolved. Some stakeholders suggested that the tracking issues are complex enough that additional technical assessment is necessary to ensure an adequate approach can be successfully deployed.

#### 1.3.4. Discussion of WCI Partners' Recommendation

In selecting the point of regulation for the different covered sources, the WCI Partner jurisdictions considered the experience of prior cap-and-trade programs, the administrative requirements for the covered facilities and entities, the number of facilities and entities that would be included, and especially given the regional nature of the program, the potential for leakage. For industrial facilities, the point of regulation will be at the facility with the source of the emissions, putting the regulatory obligation at the point of emission. Because there are a very large number of small combustion sources in the transportation, residential and commercial sectors, and at small industrial facilities, the Partner jurisdictions decided it would be impractical to regulate at the point of emissions for these sectors. Rather, the WCI Partners found that these emissions can best be covered upstream at the point of entry of the fuel into the region's economy. By starting the inclusion of these fuels in the second compliance period, the Partners have allowed sufficient time to address issues related to defining the precise upstream point of regulation for these sources.

For electricity, the point of regulation will be at the First Jurisdictional Deliverer. The First Jurisdictional Deliverer is the generator of electricity in a WCI jurisdiction, or the first deliverer of electricity that is generated outside the region to be consumed within a WCI Partner jurisdiction. Emissions associated with power that is wheeled through the WCI Partner jurisdictions but not consumed in any of them is not covered by the program. The Partners recognize that there will be challenges to tracking emissions from the source where electricity is generated to the jurisdiction where it will be consumed. However, the WCI Partners also recognize that a significant amount of electricity consumed in the WCI Partner jurisdictions is generated by federal entities, on tribal land, or in non-WCI jurisdictions. Due to the interconnected nature of the electric grid, leakage of electricity emissions to jurisdictions or entities that are not part of the WCI is a significant concern that the First Jurisdictional Deliverer point of regulation is intended to address. Additionally, the Partners

determined that this point of regulation can best address leakage while maintaining compatibility with wholesale electricity markets.

The recommendation to put the electricity point of regulation at the First Jurisdictional Deliverer represents a WCI innovation to eliminate emissions leakage. Previous programs—such as the Regional Greenhouse Gas Initiative, which follows a pure generator-based approach—have generally failed to address the leakage potential at all. As a new approach, First Jurisdictional Deliverer will pose some new challenges to implement. Given these challenges, work will continue on the First Jurisdictional Deliverer approach, including additional opportunities for stakeholder input during five stakeholder technical working sessions scheduled through the fall and winter of 2008/09. These meetings will provide the WCI Partners, technical experts, and other stakeholders additional opportunities to work together on key issues associated with the implementation of the First Jurisdictional Deliverer approach.

## 1.4. Thresholds Triggering a Compliance Obligation under the Cap-and-Trade Program

### 1.4.1. Definition

*Thresholds* are annual emission levels that are used to determine whether a particular entity or facility will have a compliance obligation under the cap-and-trade program.

### 1.4.2. Design Recommendation

The cap-and-trade program will apply an emissions threshold of 25,000 metric tons of $CO_2e$ annually to determine the facilities or entities that will have a regulatory compliance obligation under the program.[20] Additional analyses, including data from mandatory reporting, will be performed to determine if adjustments to the threshold are needed to ensure sufficient coverage or to address competitiveness issues within individual sectors prior to the beginning of the program (i.e., because different Partner jurisdictions have the same industry but with different-sized sources). The WCI Partner jurisdictions will develop a method to prevent entities or facilities from avoiding coverage by breaking themselves into smaller units that individually have emission levels that are below the threshold.

### 1.4.3. Stakeholder Input

Stakeholders provided a broad range of comments regarding how best to apply emission thresholds. The comments were broadly consistent with the goal of covering the vast majority of emissions while reducing administrative burden by minimizing the number of entities and facilities with a direct compliance obligation. Stakeholders differed in their

[20] The Scope Draft Design Recommendations address the question of thresholds and include a section (Section 4.3) on considerations for setting emissions thresholds. Available at http://www.westernclimateinitiative.org/ewebeditpro/items/O104F16031.PDF.

balancing of these objectives, with some recommending lower thresholds, such as 10,000 metric tons of $CO_2e$ annually, and at least one stakeholder recommending 100,000 metric tons annually. Sector-specific thresholds were also discussed, including thresholds defined in terms of production capacity (such as megawatt (MW) capacity for electric power generation) and other units.

Stakeholders also emphasized the importance of defining how the threshold would be applied, including the definition of "facility" or "entity" that would be used. The definition of facility was discussed particularly with reference to oil and gas production fields that may contain equipment dispersed over large areas. Some stakeholders inquired whether the threshold would be applied prospectively (i.e., prior to the start of the compliance period), annually during a compliance period, or after the end of the compliance period.

### 1.4.4. Discussion of WCI Partners' Recommendation

The WCI Partner considered a broad range of thresholds for the program, with the objective of covering a large portion of emissions (e.g., 90 percent of the emissions in the covered sectors) with as few facilities and entities as possible. The WCI Partner jurisdictions agree with the objective of minimizing the number of facilities and entities with a direct regulatory obligation to minimize the program's administrative burden for both the complying industries and the program administrators. The WCI Partners reviewed available data from several jurisdictions to assess how many facilities and entities would be expected to have compliance obligations and the portion of total emissions covered for a range of threshold values.[21] Based on this review, the WCI Partners concluded that current data support setting an emission threshold of 25,000 metric tons of $CO_2e$ per year and that this threshold would cover more than 90 percent of emissions.

The WCI Partners recognize that additional data will be valuable for assessing the appropriateness of the threshold level. The comprehensive mandatory emissions reporting will provide more complete data, which will be examined to ensure that the threshold is set to achieve the level of program coverage desired. Of note is that by including residential, commercial, and small industrial fuels in the program at an upstream point of regulation, the threshold becomes less important for ensuring coverage of emissions from these fuels: the emissions at facilities below the threshold are covered upstream. Additionally, as discussed above, the WCI Partners will assess whether the threshold creates competitiveness impacts within industries.

[21] For example, The California Air Resources Board found that in California, a threshold of 25,000 metric tons of CO2 covered about 94 percent of emissions from stationary sources. A threshold of 10,000 metric tons of CO2 increased coverage to only 96 percent of emissions, but nearly doubled the number of regulated sources. See the Staff Report: Initial Statement of Reasons for Rulemaking, available online at http://www.arb.ca.gov/regact/2007/ghg2007/isor.pdf.

## 1.5. Program Expansion

### 1.5.1. Definition

*Program expansion* allows the cap-and-trade program to incorporate additional sectors, greenhouse gases, or facilities or entities under the cap, or to include a new Partner in the cap-and-trade-program.

### 1.5.2. Design Recommendation

The WCI Partner jurisdictions have designed a cap-and-trade program that is capable of expanding over time (including possibly adjusting applicability thresholds over time). Prior to each compliance period, the WCI Partner jurisdictions will review whether to bring new sources into the program, and if so, which ones.

### 1.5.3. Stakeholder Input

The great majority of stakeholders commenting suggested broad coverage to the extent practicable. Some also expressed a desire to bring all of the states and provinces that are part of the western interconnected electrical grid into the program.

### 1.5.4. Discussion of WCI Partners' Recommendation

A provision that allows for expansion over time is responsive to public comments calling for broad coverage of the cap-and-trade program. The scope of the program will expand from its initial coverage of industrial combustion and process sources and electricity sources in the first compliance period. In the second compliance period, transportation fuels will be included, along with residential, commercial, and industrial fuels serving facilities not covered by the program in the first compliance period. In addition, the program emissions threshold has been set initially at 25,000 metric tons of $CO_2e$ annually, but will be revisited based on the mandatory emissions data to be reported by emissions sources region-wide, and additional facilities or entities may be brought into the program. Finally, the WCI Partner jurisdictions would like any states, provinces or tribes that have committed to making GHG emission reductions comparable to the WCI regional reduction goal to become Partners in the WCI.

## 1.6. Role of Other Policies

### 1.6.1. Definition

*Other policies* include complementary policies and alternative policies. A *complementary policy* is used in this context to mean policies other than a cap-and-trade program that aid in the goal of achieving emission reductions inside or outside the capped sectors. *An*

*alternative policy* is a policy that is employed in lieu of a cap-and-trade program for one or more sectors.

### 1.6.2. Design Recommendation

The role of other GHG-reducing policies is to help the WCI Partner jurisdictions achieve their 2020 reduction goal and provide other benefits. Those policies will work in concert with the cap-and-trade program and may apply to any source of GHG emissions.

In addition, the WCI Partner jurisdictions have agreed that individual jurisdictions may use fiscal measures that contribute to achieving overall comparable GHG emission reductions and internalize the price of carbon as expected through the regional cap-and-trade program for transportation and residential/commercial/small industrial fuel users. British Columbia currently has a carbon tax on these fuels. By 2012, the WCI Partner jurisdictions will determine the mechanism for integrating the cap-and-trade program with British Columbia's carbon tax.

### 1.6.3. Stakeholder Input

Many stakeholders emphasized the importance of complementary measures, especially for the residential, commercial, and transportation sectors. Others expressed concern that complementary measures would not provide the same level of certainty in emissions reductions from these sectors as would coverage under the cap.

### 1.6.4. Discussion of WCI Partners' Recommendation

The WCI Partner jurisdictions recognize that it will take numerous policies working in concert with cap-and-trade to achieve the regional reduction goal. The WCI economic analysis supports this point. It also makes sense: for example, codes that require energy efficient buildings complement the inclusion of electricity and residential, commercial, and small industrial fuel use under the cap.

In addition to aiding in the achievement of reductions at sources covered by the cap, complementary policies are needed for reductions at sources not covered by the cap-and-trade program. For example, during the first compliance period, the WCI Partners are recommending that complementary policies be instituted to reduce fuel demand in the transportation residential, and commercial sector, and by small industrial fuel users. This will help ensure consumers have real choices about the cars they drive, the fuels they use, and energy efficient appliances and buildings when these fuels are included in the cap-and-trade program in 2015.

The WCI Partner jurisdictions also agree that other policies, such as British Columbia's carbon tax, can be used as an alternative to cap-and-trade if designed to achieve comparable emission reductions and to internalize the cost of carbon for transportation fuel

and fuel use by residential, commercial, and small industrial sources, as expected through the cap-and-trade program.

## 1.7. Setting the Regional Cap for the Cap-and-Trade Program

### 1.7.1. Definition

The *regional cap* is the overall GHG emissions limit set for the facilities and entities covered by the cap-and-trade program. The cap declines over time to the desired reduction limit in 2020. For the WCI Partner jurisdictions, the program is designed to achieve their 2020 emissions goal.

### 1.7.2. Design Recommendation

The WCI Partner jurisdictions are recommending the following with respect to the aggregate regional emissions cap:

- The aggregate regional cap for the cap-and-trade program will (a) represent the sum of the WCI Partner jurisdictions allowance budgets; (b) include annual caps with three-year compliance periods, and (c) decline over time to reach the 2020 cap level.
- The initial 2012 regional cap will be set based on the best estimate of expected actual emissions. Among the factors that will be considered in making these estimates are population growth, economic growth, voluntary and mandatory emission reductions, and other factors including reporting data that is available when the cap is set. Of particular importance is that the voluntary emission reductions recognized through the issuance of Early Reduction Allowances be reflected in the estimates for the 2012 allowance budgets for each WCI Partner, and consequently the region as a whole (see Part 1.10 for a discussion of the Early Reduction Allowances). A mechanism will be developed that reconciles the 2012 allowance budgets for each Partner with the Early Reduction Allowances issued by each Partner.
- The 2015 regional cap will be set by adding the best estimate of actual emissions in 2015 from transportation fuels and residential, commercial, and industrial fuels (and any other sectors or sources that may be added to the program in 2015) to the emissions cap trajectory for the sources first included in the program in 2012.
- The 2020 regional cap will be set so that reductions achieved by the cap plus reductions from other GHG reduction policies will achieve the WCI 2020 regional emissions goal.
- Annual regional caps for calendar years 2012 through 2020 will be established before the start of the program in 2012 so that the total number of allowances issued in each three-year compliance period through 2020 will be known.
- The annual regional caps will only be adjusted for changes in WCI membership, changes in program scope or applicability thresholds, or to correct for data discovered

to be incorrect or inaccurate. Any adjustments will be made before the beginning of a compliance period.

#### 1.7.3. Stakeholder Input

A number of stakeholders cautioned against beginning the cap-and-trade program with a cap that over-allocates emissions allowances, with some recommending use of actual, historic emissions as opposed to estimates of future emissions that rely on best available data. Many stakeholders expressed concern that setting the regional cap at the level of emissions expected in 2012 will encourage emitters to increase their emissions prior to the setting of the regional cap in order to increase the allowances in the system. Some stakeholders expressed support for setting the initial cap far ahead of the 2012 program start, so that the program reduces emissions in the first year and does not penalize early actions or create a "perverse incentive" for higher emissions before the program starts. Stakeholders were not unanimous on whether the cap should decline in a uniform straight line from the start of the program, or begin without a reduction and decline at an accelerating rate over time. Many stakeholders stressed the importance of having good emissions data for setting the cap to avoid over-allocation and to ensure more robust reductions from the program.

#### 1.7.4. Discussion of WCI Partners' Recommendation

Recognizing that good emissions data will not be available before it is time to set the 2012 cap, the WCI Partner jurisdictions have accounted for the need to project actual emissions in the first year of the program. This projection will take into account population growth, economic growth, voluntary and mandatory emissions reductions, and other factors. Some WCI Partner jurisdictions will have limited emissions reporting in place prior to the recommended start of the WCI reporting in 2010; this reporting data will also be considered. The 2015 cap will bring in additional sectors under the cap, and the initial cap for these sectors will be established in a similar manner, with the reporting data playing a larger role.

The recommended approach for setting the 2012 emissions cap does not provide an incentive to increase emissions through 2012. The estimate for 2012 will be completed at the latest in 2010. Consequently, there is no opportunity to increase emissions prior to 2012 to influence the estimate of the 2012 emissions cap. Also, to provide an incentive to reduce emissions before the start of the program in 2012, the WCI Partner jurisdictions are recommending Early Reduction Allowances, which will provide allowances for certain voluntary reductions made during a specific period prior to 2012.

To guard against over-allocation, the WCI Partner jurisdictions have also recommended that the first five percent of the auctioned allowances have a minimum reserve price. If allowances are not purchased at or above the minimum reserve price, a portion will be retired, auctioned in a subsequent period, or distributed in a subsequent period. This

mechanism will serve to remove "extra" allowances from the market. This auction provision is detailed below in Part 1.9.

The WCI Partner jurisdictions are recommending that the annual regional caps from 2012 to 2020 follow a straight-line declining trajectory, recognizing that the total amount of allowances will increase in 2015 when transportation and other fuels are added to the program. It should be noted that the end point for 2020 will not change when those fuels are added. All caps will be established in advance of the start of the program in 2012 so that the reductions accomplished from the program will be known well in advance. Setting the caps in advance will also allow the WCI Partner jurisdictions to ensure the 2020 reduction goal will be met.

The economic modeling analysis suggests that the cap-and-trade program can achieve reductions from capped sectors consistent with the regional reduction goal with modest economic benefits. The cost per metric ton of allowances is expected to remain below $25 through 2020 with complementary policies, banking, and offsets. WCI's economic modeling found that the savings from reduced fuel expenditures under a cap-and-trade program with complementary policies could exceed the cost of additional investments in energy efficiency. The overall effect on the economy (e.g., the effect of the WCI program on state GDP, employment, and income) remains to be analyzed via additional macroeconomic modeling; however, prior modeling studies of other proposed cap-and-trade programs found that the economy can continue to grow robustly under well-designed climate policies.

## 1.8. Allowance Apportionment to WCI Partners

### 1.8.1. Definition

*Allowance apportionment* describes the individual Partner share of the overall "budget" of GHG emission allowances under a regional cap. An allowance budget must be set for each Partner jurisdiction.

### 1.8.2. Design Recommendation

The WCI Partner jurisdictions are recommending the following concerning the establishment of individual WCI Partner allowance budgets:[22]

- Each WCI Partner will have an annual allowance budget within the regional cap. All annual allowance budgets through 2020 will be established before the start of the program in 2012. The sum of the individual Partner's allowance budgets will equal the regional cap.

[22] The Allocation Options paper describes the advantages and disadvantages of different allocation options and the relevant design principles. Available at http://www.westernclimateinitiative.org/ewebeditpro/items/O104F14628.pdf.

- Each WCI Partner's 2012 allowance budget will be based on the best estimate of expected emissions for sources covered in the cap-and-trade program in the WCI Partner's jurisdiction in 2012, developed using the best available data and by accounting for expected changes in emissions in 2012. Population growth, economic growth, voluntary and mandatory emissions reductions, and other factors will be considered. Of particular importance is that the voluntary emission reductions recognized through the issuance of Early Reduction Allowances be reflected in the estimates for the 2012 allowance budgets. A mechanism is needed, and will be developed, that reconciles the 2012 allowance budgets for each Partner with the Early Reduction Allowances issued by each Partner.
- There will be a one-time adjustment in 2012 to each WCI Partner jurisdiction's allowance budget to account for the production and consumption of electricity megawatt hours within each WCI Partner jurisdiction, population growth, and the share of total WCI Partner jurisdictions emissions in 2001 through 2005. Each WCI Partner jurisdiction will make a one-time contribution of one percent of its 2012 budget to make these adjustments.
- For 2015, each WCI Partner jurisdiction's allowance budget will be set by adding the best estimate of expected actual emissions in 2015 from transportation, residential, and commercial fuels, and small industrial fuel users (and any other sectors or sources that may be added to the program for the first time in 2015) to the emissions trajectory for the sources first included in the program in 2012. The estimate of expected actual emissions in 2015 will be developed using the best available data (including available mandatory reporting data) and by accounting for expected changes in emissions in 2015 for the sources added to the cap at that time. Population growth, economic growth, voluntary and mandatory emissions reductions, and other factors will be considered in making the estimate.
- Each WCI Partner jurisdiction's 2020 allowance budget will be derived from its individual WCI Partner jurisdiction goal used for purposes of the program.[23] Reductions from other greenhouse gas reduction policies will also be considered.
- In order to avoid the double counting of emissions associated with electricity that is generated in one WCI Partner jurisdiction but consumed in another Partner jurisdiction, the affected WCI Partner jurisdictions will negotiate an equitable solution for apportioning those allowances.
- For years post-2020, the WCI Partner jurisdictions will set allowance budgets not less than three years in advance, based on future reduction limits or goals and using at least three years of reporting data for covered sectors.
- Individual WCI Partner jurisdiction allowance budgets will be established before the start of the program in 2012 and will only be adjusted for changes in WCI membership, changes in program scope or applicability thresholds, or to correct for errors discovered in the data.

[23] Partner goals are those reduction goals or limits that have been established by each individual WCI Partner jurisdiction for the cap-and-trade program.

#### 1.8.3. Stakeholder Input

Stakeholders provided a wide diversity of comments on potential ways to apportion allowances among Partners, with little consensus on key issues particularly for the electricity sector. Many argued for emissions to be apportioned based on load while others were equally passionate that emissions be apportioned based on historical emission levels. The comments reflected the stakeholders' view of how the apportionment method selected might affect their potential to receive free allocation.

Several stakeholders called for WCI to recognize the voluntary market for Renewable Energy Credits (RECs) via a set-aside of allowances to reward or incentivize renewable investment at the regional or state and provincial level.

#### 1.8.4. Discussion of the WCI Partners' Recommendation

The WCI Partners' recommendation for the establishment of individual WCI Partner jurisdiction allowance budgets reflects the special or unique circumstances in each state and province, including the mix of industries; the production and consumption of electricity and the source of that electricity; and expected growth in the economy and population. The WCI Partner jurisdictions agreed to make a one-time adjustment to take these factors into account. The formula for determining how to distribute the allowances associated with this adjustment will be part of the work plan for 2009 and beyond for the WCI Partner jurisdictions.

Nothing in this design precludes any individual WCI Partner jurisdiction from setting aside some amount of allowances to reward or incentive renewable energy. See Part 1.10 for the discussion on set-asides.

### 1.9. Allowance Distribution by Partners

#### 1.9.1. Definition

*Allowance distribution* is the Partners' initial issuance of GHG emission allowances.

#### 1.9.2. Design Recommendation

The WCI Partner jurisdictions are proposing the following approach to allowance distribution by the WCI Partners:[24]

[24] The Allocation Options paper describes the advantages and disadvantages of different allocation options and the relevant design principles. Available at http://www.westernclimateinitiative.org/ewebeditpro/items/O104F14628.pdf.

- Generally, allowance distribution will be done independently by each WCI Partner jurisdiction.
- In some cases, the WCI Partner jurisdictions have agreed to consider standardizing allowance distribution across specific sectors if analysis demonstrates uniform treatment is necessary to address competitiveness issues. This uniform treatment, if deemed necessary, will be implemented prior to the first compliance period.
- The WCI Partner jurisdictions have agreed that a portion of the *value* represented by each Partner's allowance budget (for example, through set-asides of allowances, a distribution of revenues from the auctioning of allowances, or other means) be dedicated to specific purposes that will benefit all of the WCI Partner jurisdictions. Those purposes are: energy efficiency; research, development, demonstrations, and deployment (RDD&D); agricultural and forestry sequestration; and adaptation to climate change impacts.
- The WCI Partner jurisdictions are recommending a number of other potential uses for the remaining allowance value. They are: reducing consumer impacts, especially for low-income consumers; providing for worker transition and green jobs; achieving emission reductions in communities that experience disproportionate environmental impacts; supporting community-wide efforts funded by local governments to reduce GHG emissions; providing transition assistance to industries; recognizing early actions to reduce emissions; and/or promoting economic efficiency.
- For the first compliance period, the WCI Partner jurisdictions will auction a *minimum* of 10 percent of the allowance budget, and to increase the minimum percentage to reach 25 percent in 2020. WCI aspires to reach higher auction percentages over time, possibly to 100 percent.
- Each WCI Partner jurisdiction may auction a greater percentage of its allowance budget at its discretion.
- Some jurisdictions may not have the legal authority to auction allowances and that will not prevent the other Partner jurisdictions with authority from doing so.
- Each WCI Partner will advise the other WCI Partners of its allocation methods before the program start, and at least one year in advance of the start of each subsequent compliance period.
- The WCI Partner jurisdictions have recommended that auctioning be coordinated through a regional auction platform. The design of the auction will be completed before the cap-and-trade program begins in 2012 and will consider how to prevent market manipulation under the auctions.
- To counter any potential oversupply of allowances in the emissions trading market, the WCI Partner jurisdictions recommend that the first five percent of the allowances auctioned during the first and second compliance period have a reserve price. Should some of the allowances not sell at the reserve price, the Partners may retire a fraction of the allowances or retain them to be auctioned in later compliance periods, as agreed to by the WCI Partners in advance.

### 1.9.3. Stakeholder Input

There were widely differing opinions about how the Partners should distribute allowances. Some commenters called for 100 percent free allocation to covered facilities and entities, while others favored a 100 percent auction of all allowances. Still others favored a hybrid with some distribution for free, such as to retail providers of electricity with the rest auctioned. Most stakeholders who advocated for 100 percent auction pointed to the Regional Greenhouse Gas Initiative (RGGI), which ultimately decided to auction nearly 100 percent of the allowances in that system. They expressed concern over the creation of windfall profits from the distribution of free allowances to covered facilities and entities. Some stakeholders asked that the approach for distributing allowances take into account competitiveness issues that may arise between similar industries and between industrial sectors under the cap-and-trade program. No common ground was found in the widely varying stakeholder views. A number of stakeholders commented on the use of auction revenue. A variety of uses and purposes were suggested.

### 1.9.4. Discussion of the WCI Partners' Recommendation

In making their recommendation on allowance distribution, the WCI Partners considered the following:

- Auctions are an efficient methodology to distribute allowances and some level of auction is necessary for price discovery, which may help to minimize price volatility, especially in the beginning of the program.
- The WCI Partner jurisdictions aspire to eventually achieve a nearly 100 percent level of auction.
- Unlike RGGI, which covers just the electricity sector in the Northeast and is a deregulated market, within the WCI most of the electric sector is vertically integrated and rate regulated. Auctions are not needed to address potential windfalls under these conditions, and the allowances that are provided will be used for public purposes.
- Like RGGI, the WCI Partners believe that the decision on the maximum amount of auctioned allowances is best left to that states and provinces. The RGGI states agreed to use a percentage of the value of the allowances for consumer benefit and strategic energy purposes. The decision to auction allowances was made by each participating state after consultation with stakeholders and legislators in part as the method to assure those uses were realized. The WCI Partner jurisdictions have recommended that the allowance value be used for purposes similar to RGGI. The allowance value could be from auction revenues, direct allocation of allowances for specific uses, through set-asides, or other means as determined by the individual states and provinces.

- In addition to electricity, the first compliance period covers industrial emission sources. Many industrial facilities face domestic and international competition from facilities that are not covered by climate policies. For those facilities that are unable to pass along compliance costs in the face of this competition, there is a substantial risk of emissions leakage: the emissions would shift to outside of the WCI Partner jurisdictions without reducing emissions overall. The related issue of job leakage or outsourcing, even to other parts of the United States or Canada, is a legitimate concern that needs to be considered by each state and province. As a regional program, the primary mechanism for addressing this leakage risk is through the judicious distribution of allowances to facilities to ensure that they have an incentive to reduce emissions, but are not disadvantaged competitively.
- If the WCI Partner jurisdictions had designed a federal program for either the US or Canada, the auction percentage would have been much higher because of the guaranteed national scope of the program and the additional policy levers available at the federal level, including the ability to address international competition.
- There is uncertainty regarding the status of future international climate agreements and which countries might be signatories to them, particularly China and India. Depending on the outcome, the portion auctioned in a federal program could be higher as the leakage issues are addressed through those international agreements.
- The WCI economic modeling found that combining cap-and-trade with a portfolio of complementary policies will make the program more cost-effective. Using some portion of allowance value for the uses recommended in the WCI design will help realize that cost-effectiveness.[25]

## 1.10. Early Reduction Allowances and Other Early Actions or Set-Asides

### 1.10.1. Definition

*Early Reduction Allowances* refers to rewarding certain greenhouse gas reductions that occur at facilities or entities covered by the cap-and-trade program prior to the start of the program and after a set starting date. *Early actions* refer more generally to activity that reduces emissions that may not qualify for Early Reduction Allowances. *Set-asides* are allowances that are allocated for specific purposes by individual WCI Partner jurisdictions.

### 1.10.2. Design Recommendation

The program will encourage entities and facilities included under the cap to reduce greenhouse gas emissions after January 1, 2008 and before the start of the first compliance period in 2012 through the issuance of Early Reduction Allowances. These allowances will be in addition to the WCI Partner jurisdictions' 2012 allowance budgets. By the end of

[25] This will recognize pre-existing commitments to action and legislative requirements on use of revenue (e.g., through BC's Climate Action Plan and Carbon Tax).

2009, the WCI Partner jurisdictions will jointly establish criteria to determine which early reductions will be eligible for these allowances. The criteria will ensure that the reductions are voluntary, additional/surplus, real, verifiable, permanent, and enforceable. Each WCI Partner jurisdiction that issues Early Reduction Allowances will do so in 2012. These Early Reduction Allowances will be treated like other allowances in the cap-and-trade program.

For all other early actions and all types of set-asides, each WCI Partner jurisdiction will have the discretion to determine which early actions it will recognize or whether and for what purposes allowances will be set-aside. Recognition for early action and other set-asides will come from within the cap and out of the individual WCI Partner jurisdiction's allowance budget.

### 1.10.3. Stakeholder Input

There was a general level of support for granting recognition for early actions through the award of allowances. Some commenters favored awarding those allowances through set-asides coming out of individual WCI Partner allowance budgets. However, most commenters preferred that allowances be issued in addition to each WCI Partner's allowance budget as the only meaningful way to recognize GHG emission reductions that are taken prior to program launch.

### 1.10.4. Discussion of WCI Partners' Recommendation

The recommendation allows for the award of Early Reduction Allowances to facilities and entities that will be covered by the program that reduce their emissions on or after January 1, 2008 and before January 1, 2012. The WCI Partner jurisdictions will develop the additional criteria for determining which reduction activities will be eligible for Early Reduction Allowances. All Early Reduction Allowances will be allocated to the facilities and entities that have made reductions that are eligible for these allowances in 2012 only. Entities that will be covered by the program in 2015 may be eligible for these allowances and will also receive them in 2012.

The WCI Partner jurisdictions believe that the granting of Early Reduction Allowances provides an additional incentive for facilities and entities that will be covered by the cap-and-trade program to reduce emissions prior to the program start. Awarding these allowances will not result in an over-allocation of allowances because the Early Reduction Allowances will apply to reductions of emissions that would have otherwise been included in each Partner's 2012 allowance budget. This design recommendation is consistent with the Northeast $NO_x$ Budget Cap-and-Trade Program, as well as the subsequent U.S. Environmental Protection Agency (EPA) $NO_x$ SIP-Call Program.

The WCI Partner jurisdictions also recognize that there are specific purposes for which allowance set-asides may be warranted. For example, a WCI Partner jurisdiction with hydro power may want to set-aside allowances for use during low water years. Alternatively, a WCI Partner jurisdiction may want to recognize early reduction activities that do not qualify

for Early Reduction Allowances. Each Partner will have the discretion to create set-asides for specific purposes; any allowances used for these purposes will come from the Partner's allowance budget.

## 1.11. Banking, Borrowing and Compliance Periods

### 1.11.1. Definitions

*Banking* of emissions allowances and offset credits means that holders of the allowance or offset credit may use the allowance or credit that is received or purchased in one compliance period for sale or use in a subsequent compliance period. *Borrowing* means using allowances from a future compliance period to cover a compliance obligation in a current compliance period.

### 1.11.2. Design Recommendation

Emission allowances will not expire. Parties who own emission allowances will be allowed to hold, or "bank," the allowances without limitation, except to the extent that restrictions on the number of allowances any one party may hold are necessary to prevent market manipulation.

Borrowing of allowances will not be permitted.

Each compliance period will cover three specific years: 2012–2014 is the first compliance period; 2015–2017 is the second compliance period, and 2018–2020 is the third compliance period. The compliance periods will not be rolling periods. Each will start on January 1 of the first year of the compliance period.

### 1.11.3. Stakeholder Input

Stakeholders who commented on these issues generally favored allowing unlimited banking of allowances. Some commenters expressed concern that extensive banking could lead to manipulation of the market. Borrowing attracted some favorable comments, but also a number of negative comments. Nearly all commenters favored a multi-year compliance period.

### 1.11.4. Discussion of WCI Partners' Recommendation

Banking of allowances can encourage early compliance. Banking of allowances can reduce volatility over time by providing liquidity in the market. It can also give facilities and entities a stake in the continued operation of the program in that banked allowances are a financial asset. In the economic analysis conducted for the WCI program design, banking moderated allowance prices more than any other program design element, including offsets, thereby reducing the costs of the program. Banking has been used in the U.S. Acid Rain

cap-and-trade program, as well as the $NO_x$ budget trading program in the Eastern United States.

The WCI Partner jurisdictions have recommended that banking of allowances be allowed without limit, except to the extent that limits on banking prove necessary to prevent market manipulation. This is an issue that the WCI Partner jurisdictions will analyze prior to the start of the program.

Borrowing of allowances will not be allowed in the WCI cap-and-trade program. Borrowing creates a risk of undermining the program because the practice creates a debt, and could result in facilities and entities with a large debt asking for relief. Such relief may result in an over-allocation of allowances, a breaking of the emissions cap or exemptions from the program's coverage. No U.S. cap-and-trade system to date has allowed borrowing.

The three-year compliance period will allow covered facilities and entities to manage planned or emergency changes in operations over the short term, as well as low water years that might affect the generation of hydro electricity.

## 1.12. Offsets and Allowances from Other Cap-and-Trade Systems

### 1.12.1. Definition

*Offsets* are GHG emission reductions, GHG emissions avoided, or GHG removals from the atmosphere, measured in metric tons of $CO_2e$. Offsets are achieved by *offset projects*. *Offset credits* (also measured in metric tons of $CO_2e$) are issued for offsets that are achieved by offset projects that meet certain criteria. Offset credits can be traded, and can be used for compliance purposes, or as part of voluntary actions. When used within a cap-and-trade program, offset credits used for compliance purposes come from emission sources or sinks not covered by the cap.

Emission allowances from other cap-and-trade systems are regulatory instruments used to limit GHG emissions. These emission allowances are issued by appropriate government regulatory authorities and are used for compliance purposes.

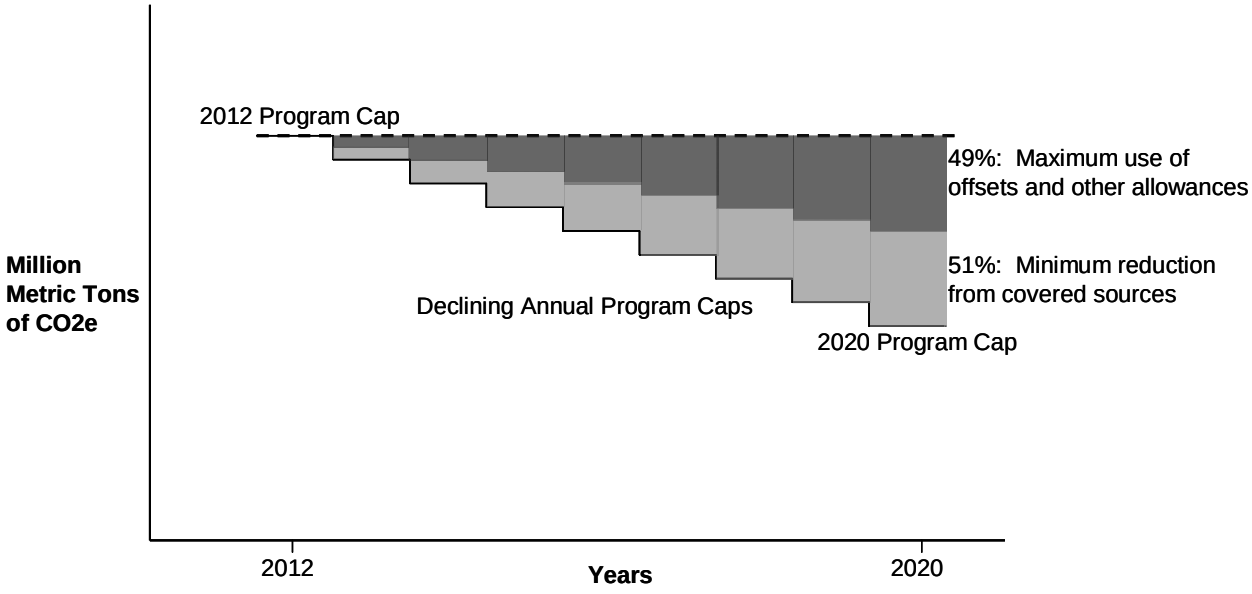
### 1.12.2. Design Recommendation

The WCI Partners are recommending a rigorous offset program. The purpose of the offset program is to reduce compliance costs while encouraging emission reductions, innovation, and technology development for sources and sinks not covered by the cap-and-trade program. In order to achieve these goals, the WCI Partners recommend the following offset program design features:[26]

[26] The Offsets Options Paper describes how, in developing its recommendation, the Offsets subcommittee defined a range of options, including whether to have offsets, and whether to limit their quantity, location, and type. Available at http://www.westernclimateinitiative.org/ewebeditpro/items/O104F14585.PDF . WCI

- The WCI Partner jurisdictions will establish standards and processes for issuing offset credits, accepting offset credits from the Clean Development Mechanism (CDM), and recognizing emission allowances from other GHG trading systems. The offset credits issued or recognized by the WCI Partner jurisdictions and emission allowances from other GHG trading systems recognized by the WCI Partner jurisdictions can be used for compliance purposes in the WCI Partner jurisdictions cap-and-trade program. The standards and processes will be developed and implemented in an open and transparent manner that will be well-defined in advance of the start of the cap-and-trade program.
- The WCI Partner jurisdiction will limit the use of all offsets and allowances from other GHG emission trading systems that are recognized by the WCI Partner jurisdictions to no more than 49 percent of the total emission reductions from 2012-2020. This limit will ensure that a majority of emission reductions occur at WCI covered entities and facilities. The 49 percent limit is conceptually illustrated in Figure A.

**Figure A: Illustration of the 49 Percent Offsets Limit**




This illustration shows how the limit on the use of all offsets and allowances from other systems is limited to 49 percent of total emission reductions starting from the 2012 program emissions cap. For simplicity, this illustration does not show the expansion of the program scope in 2015.

held an Offsets Public Workshop to help inform its recommendation. Workshop materials are available at http://www.westernclimateinitiative.org/WCI_Meetings_Events.cfm . The Offsets subcommittee defined criteria and objectives for the offsets program. See the Offsets Draft Design Recommendations for details. Available at http://www.westernclimateinitiative.org/ewebeditpro/items/O104F16589.PDF

- Each WCI Partner jurisdiction will have the discretion to set a lower limit on the use of offsets and allowances from other trading systems.
- The WCI Partner jurisdictions will jointly establish criteria to ensure that all offset projects used to meet a compliance obligation result in a GHG reduction, removal or avoidance that is real, surplus/additional, verifiable and permanent. The criteria will be used to ensure that the quantification of the GHG reduction, removal, or avoidance is accurate and not double counted.
- In addition, offset projects must be enforceable by the individual WCI Partner jurisdiction that is issuing the credit and the credit must be verifiable by the individual WCI Partner jurisdiction that is accepting it.
- The standards and processes for approving offset projects will be developed and implemented in an open and transparent manner that will be well-defined in advance of the start of the cap-and-trade program.
- Offset credits will not be approved for projects that reduce, remove or avoid emissions from sources covered by the WCI cap-and-trade program.
- The WCI Partner jurisdictions have identified the following list of project types as a priority for investigation and potential participation in the offset program:
    - Agriculture (soil sequestration and manure management);
    - Forestry (afforestation/reforestation, forest management, forest preservation/conservation, forest products); and
    - Waste management (landfill gas and wastewater management).
- Starting in 2009, the WCI Partner jurisdictions will jointly coordinate to review, develop and approve protocols for the project types that meet the necessary criteria for inclusion. At the same time, WCI Partner jurisdictions will initiate the establishment of a process to coordinate the review and approval of other project types and protocols proposed by project developers.
- WCI Partner jurisdictions will recognize offsets meeting the WCI criteria within their own jurisdictions regardless of which WCI Partner jurisdiction issued them. Offsets not meeting the WCI criteria will not be accepted for compliance purposes.
- The WCI Partner jurisdictions are recommending the following geographical parameters for offsets:
    - WCI Partner jurisdictions may approve, certify, and issue offset credits for projects located throughout the United States, Canada, and Mexico where such projects are subject to comparably rigorous oversight, validation, verification and enforcement as those located within the WCI jurisdictions.
    - WCI Partner jurisdictions will not accept offset credits for GHG reductions in developed countries (Annex 1 countries in the UN Framework Convention on Climate Change) for projects that reduce, remove, or avoid emissions from sources that within WCI Partner jurisdictions are covered by the cap-and-trade program.

- The WCI Partner jurisdictions may accept offset credits from developing countries through, for example, the Clean Development Mechanism (CDM) mechanism of the Kyoto Protocol, and the WCI Partner jurisdictions may establish added criteria to ensure similar rigor to WCI approved/certified offset projects or other requirements appropriate to enable use of these offset credits in the cap-and-trade program.
- The WCI Partner jurisdictions encourage the development of offset projects located inside WCI Partner jurisdictions for compliance purposes in the WCI cap-and-trade regulatory program in order to capture collateral benefits associated with some offsets projects, such as health, social, and environmental benefits.

### 1.12.3. Stakeholder Input

Stakeholders generally supported a rigorous offset program. Underlying the support for an offset program is the recognition that all offsets used for compliance purposes must be of the highest quality. Stakeholders referenced issues that have arisen in previous offset programs, including the CDM, to highlight the importance of developing and applying project protocols that ensure that reductions are real, surplus/additional, verifiable, permanent, and enforceable.

Stakeholders were divided on whether the use of offsets for compliance purposes should be limited either in quantity or location. Some stakeholders suggested that there is no need to limit the use of high quality offsets because they reflect real emission reductions. Some stakeholders objected to the use of any offsets, pointing out the existing disproportionate environmental impacts experienced in some communities. Many stakeholders expressed a strong preference for a limitation on the use of offsets to ensure that a majority of reductions are made at covered facilities or entities. Many others favored no limitation provided the offsets meet rigorous criteria.

Many stakeholders expressed support for specific types of offsets. Many stakeholders also commented that the offset limitation should be applied to the reductions that are required, not to the compliance obligation of a facility or entity. Finally, some stakeholders recommended that the location of offset projects be limited to within WCI partner jurisdictions in order to assure enforcement and verification or so that the environmental co-benefits of the projects would be realized within the WCI jurisdictions. Others argued that any reduction in greenhouse gases in the world is important to combat climate change and thus the location of the project should not matter.

### 1.12.4. Discussion of WCI Partners' Recommendation

The WCI Partners believe that the program as designed will result in a rigorous offset program. The Partners recognize that issues have been raised regarding the quality of offsets from previous programs and the Partners propose to learn from past efforts, to build

on their strengths and avoid their weaknesses. Toward this end, the Partners will develop and implement the offset program in an open and transparent manner that incorporates stakeholder input and involvement.

In making the recommendations in the program design, the WCI Partner jurisdictions considered the following:

- Offsets are an important tool to manage the risks of unexpectedly high compliance costs. Multiple analyses, including the economic analysis conducted for the WCI Partner jurisdictions, highlight the role that offsets can play in reducing the risks of high compliance costs.
- The quality of the offset project matters. It must be real, additional/surplus, permanent, verifiable, and enforceable.
- The criteria and protocols for offsets are critically important and will be developed by the WCI partner jurisdictions jointly.
- The manner in which greenhouse gases, especially carbon dioxide, mix in the atmosphere means that a reduction in any location is important to address global climate change.
- The wording of the Initiative signed by the Governors and Premiers calls for a design of a market program that will reduce greenhouse gases in the WCI Partner jurisdictions collectively "and to achieve related co-benefits."
- Co-benefits include the innovation that comes from moving toward a low carbon economy, which the cap incentivizes.
- The majority of emission reductions - at least 51 percent - will come from facilities and entities covered by the WCI program. This will help initiate the transformation to a low- carbon future within the WCI jurisdictions.
- Any WCI Partner jurisdiction that sets a limit lower than 49 percent will reduce the use of offsets and allowances from other systems from its portion of the total.
- Offset projects in developed countries (including Canada and the United States) that reduce emissions from sources that would be covered by the cap-and-trade program were they in the WCI Partner jurisdictions are not eligible to create offset credits. The WCI Partners have excluded offset credits from these projects in developed countries to avoid providing an incentive to delay the adoption of policies to reduce GHG emissions.
- Offset projects located outside the WCI jurisdictions that are subject to comparably rigorous oversight, validation, verification, and enforcement as those located within the WCI jurisdictions should help reduce compliance costs.
- The WCI Partner jurisdictions recognize that flexibility to use the limited amount of offsets and allowances from other systems any time throughout the period of 2012-2020 may help contain compliance costs. Therefore, the offset program may

incorporate flexibility to use offsets and non-WCI allowances across the three compliance periods, which each WCI Partner jurisdiction could use at its discretion.

- The WCI economic modeling analysis found that offsets contribute to managing the risk of high compliance costs in combination with banking and complementary policies. However, the analysis indicated that limiting the use of offsets and allowances from other programs to 49 percent of the reductions achieved by the program should provide adequate cost moderation.

The WCI Partner jurisdictions will establish eligible WCI offset project types, as well as requirements, methodologies and measurement and verification protocols, in advance of the program start. This approach will help ensure that project developers clearly understand the requirements for achieving acceptable reductions before the project begins. The WCI Partner jurisdictions will also develop a process by which offset project developers can propose additional offset project types for approval.

The WCI Partners did not include a recommendation to limit offset projects to WCI Partner jurisdictions in order to provide opportunities for additional low-cost reductions within the system, to support emission reductions on a global scale, and because of concerns that such a limitation may not withstand legal challenges.

## 1.13. Cost Containment

### 1.13.1. Definition

*Cost containment* is keeping the costs of program as low as possible, consistent with program objectives. There are a variety of cost containment mechanisms that can help manage the cost of compliance for covered entities in a cap-and-trade program. The cap-and-trade program is itself a form of cost containment, since emission trading minimizes costs. Offsets, described above, are a cost containment mechanism. Temporal flexibility, including banking, borrowing, and the length of the compliance period, is another.

### 1.13.2. Design Recommendation

The WCI Partner jurisdictions are recommending a broad scope and the inclusion of offsets as described above. They also recommend that purchasers and covered entities be allowed to bank allowances, without restrictions on the amount of allowances that may be banked or on how long they may be banked. WCI Partner jurisdictions recommend that borrowing of allowances from future compliance periods not be allowed. The WCI Partners recommend the compliance periods be three years long.

#### 1.13.3. Stakeholder Input

Stakeholder input generally favored the inclusion of the cost-containment features of a broad cap-and-trade program, some offsets component, and unlimited banking. Stakeholder comment generally did not favor borrowing. In addition, some stakeholders called for an emergency clause, allowance price cap, or exit ramp in the event of a significant economic crisis attributable to the cap-and-trade program.

#### 1.13.4. Discussion of WCI Partners' Recommendation

The WCI Partner jurisdictions have made a number of design decisions that will contain costs.

- The broad scope affords numerous opportunities to contain costs through emission trading.
- Temporal flexibility allows firms greater flexibility in compliance. Such flexibility can reduce allowance price volatility.
- Unlimited banking will help address price volatility.
- Complementary programs will also contain costs, and the program encourages their use.
- Offsets will also help contain costs.

The WCI Partner jurisdictions did not include borrowing for the reasons noted in Part 1.11. An allowance price cap was also not included because of the potential to exceed the cap and not meet the emission goal in 2020. The WCI Partners hope to link this program to other similarly rigorous programs, possibly including the EU ETS. It is the understanding of the WCI Partner jurisdictions that the EU will not link to a system with a price cap. Finally, the WCI Partner jurisdictions did not include an escape clause because each WCI Partner jurisdiction has its own laws on emergency action that must be considered in the development of any such recommendation.

### 1.14. Reporting

#### 1.14.1. Definition

*Reporting* describes the required monitoring and measurement of GHG emissions by facilities and entities, and how these emissions will be reported.

#### 1.14.2. Design Recommendation

The WCI Partner jurisdictions recommend that mandatory measurement and monitoring for the six included GHGs commence January 2010 with reporting of the 2010 calendar year emissions beginning in early 2011. The entities and facilities subject to reporting are those with annual emissions equal to or greater than 10,000 metric tons of $CO_2e$. Where fuel

combustion emissions are covered upstream (e.g., emissions from transportation fuel combustion and emissions from fuel combustion at residential, commercial, and industrial facilities with emissions below the threshold) the reporting threshold will apply to entities (e.g., fuel distributors and blenders) based on the expected combustion emissions from the fuels distributed. However, in some limited instances the threshold may be based on other parameters, such as throughput or capacity, as long as these thresholds represent the equivalent of, or are lower than, the 10,000-metric-ton threshold.

WCI Partner jurisdictions will require third-party verification of reported emissions from entities and facilities that will be included under the cap.

Prior to the start of the mandatory reporting program, the WCI Partner jurisdictions will establish the essential requirements for reporting by all entities and facilities required to report in each of the WCI Partner jurisdictions. Essential requirements will include specifics regarding:

- Applicability and Boundaries
- Definitions
- Timing
- Report Content and Submittal
- Pollutants and Equivalence Factors
- Compliance
- Verification/Audit/Quality Assurance
- Emissions Quantification and Monitoring

As each WCI Partner jurisdiction collects additional emissions data from entities and facilities required to report, certain data will be made available to all WCI Partner jurisdictions for review and consideration for possible expansion of the cap-and-trade program.

Each WCI Partner jurisdiction will maintain discretion to require reporting at lower thresholds or from entities and facilities outside of the cap-and-trade program.

### 1.14.3. Stakeholder Input

Stakeholders said they want a reporting system that is fair, easy to manage, and not costly for reporters or WCI Partner jurisdictions. Stakeholders generally supported a transparent and robust accounting system for consistent and accurate reporting of emissions across sectors and jurisdictions. There was substantial support for the WCI Partner jurisdictions' efforts to harmonize WCI reporting and future federal greenhouse gas reporting, and there was concern regarding the burdens of having to report differently to multiple programs. Stakeholders overwhelmingly supported beginning reporting before cap-and-trade commences, in order to have accurately measured emissions as a basis for allocating allowances. Stakeholders were generally split on the topic of third-party verification.

Additional opportunities for stakeholder input will be available during the fall of 2008 as the essential requirements for reporting continue to be developed and the final draft is released in December of 2008.

### 1.14.4. Discussion of WCI Partners' Recommendations

Comprehensive mandatory and accurate reporting is especially important to a cap-and-trade program because of its focus on actual emissions performance and emission allowance trading. The WCI Partner jurisdictions' recommendations are consistent with the overwhelming stakeholder support for beginning reporting before cap-and-trade commences, and with the general support for the development of uniform WCI-wide reporting rules to maximize administrative simplicity and cost effectiveness.

The WCI Partners recognize the burdens that would be created by multiple widely divergent reporting programs, and will seek to harmonize reporting across WCI Partner jurisdictions. The WCI Partner jurisdictions will encourage federal reporting program development to consider the need for flexibility and accommodation of the needs of regional cap-and-trade programs already far along in their development.

The WCI Partner jurisdictions recommend a reporting threshold lower than the threshold for inclusion in the cap-and-trade program for several reasons. First, reporting must be at a lower level to ensure that accurate, verified emissions data support the exclusion of a sub-threshold entity or facility from the obligation to hold allowances. Second, reporting down to a threshold of 10,000 metric tons of $CO_2e$ is needed to determine whether the threshold for inclusion in the cap-and-trade program is set at the appropriate level to include a high proportion of emissions. Third the lower reporting threshold is required to monitor potential leakage to facilities or entities below the threshold of the cap-and-trade program. Finally, a threshold of 10,000 metric tons of $CO_2e$ is being considered in potential legislation for a U.S. federal cap-and-trade program.

The WCI Partner jurisdictions have considered the advantages and disadvantages of third-party verification and jurisdictional audit and quality assurance. The WCI Partner jurisdictions note that in a cap-and-trade program, every metric ton of emissions translates into a financial obligation or benefit, whereas in existing air pollutant reporting and compliance, errors in emissions data can be inconsequential if they do not affect whether a compliance limit has been exceeded. For those facilities and entities with compliance obligations, there are no inconsequential emissions totals. A high degree of accuracy and reliability for this emissions data is needed for market transparency and credibility, as well as for potential linkage to other emissions trading programs.

## 1.15. Enforcement

### 1.15.1. Definition

*Enforcement* is the means of assuring covered entities' compliance with the cap-and-trade program.

### 1.15.2. Design Recommendation

The WCI Partner jurisdictions recommend that if a covered entity or facility does not have sufficient allowances at the end of a compliance period, the entity or facility shall be required to surrender three allowances for every excess metric ton of CO2e to the jurisdiction to which they have the compliance obligation within three months of the end of each compliance period. This does not preclude other penalties allowed under individual state or provincial laws. Each WCI Partner jurisdiction will retain its existing regulatory and enforcement authority and responsibilities.

### 1.15.3. Stakeholder Input

Stakeholders generally recognized the importance of having an enforcement mechanism. A number of stakeholders noted a preference for financial penalties or a combined policy that calls for a violator to surrender required allowances and pay a fine. Additionally, some stakeholders requested greater flexibility during the first compliance period while regulated sources become familiar with the program. Stakeholders also highlighted the importance of transparency in the enforcement process, specifically recommending that information be made public regarding the use and origin of offset credits for compliance.

### 1.15.4. Discussion of WCI Partners' Recommendation

In any cap-and-trade program, participants must be accountable for their emissions and must comply with requirements for monitoring, reporting, and holding adequate emissions allowances. The enforcing jurisdiction must provide certainty through well-recognized and automatic penalties for non-compliance. Previous well-designed cap-and-trade programs have had compliance rates over 99 percent. [27]

The enforcement mechanism recommended by the WCI Partner jurisdictions is the same as the $NO_x$ Budget Program in the northeastern United States. The Partners did not recommend a financial penalty because the price of allowances will be set by the market. It will be impossible to assure a set penalty amount will be higher than the cost of allowances.

[27] Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California, available online at http://climatechange.ca.gov/publications/market_advisory_committee/2007-06-29_MAC_FINAL_REPORT.PDF.

However, each WCI Partner jurisdiction may establish additional penalties, including civil and criminal penalties for intentional violations of program requirements. Such penalties provide an additional level of deterrence to ensure that the financial incentives associated with the cap-and-trade program are not abused and to increase confidence in the integrity of the market and the value of an allowance.

The WCI Partner jurisdictions also recommend that certain data from the emissions reports, allowances, and offsets that are used for compliance be made public in a timely manner to ensure transparency and maintain public confidence.

## 1.16. Regional Organization

### 1.16.1. Definition

A *regional organization* centralizes the execution of administrative tasks for the WCI Partner jurisdictions. It has no authority beyond that of the individual WCI Partner jurisdictions.

### 1.16.2. Design Recommendation

The WCI Partner jurisdictions will create a regional administrative organization to:

- Coordinate the regional auction of allowances;
- Track emissions and provide public information on progress towards the WCI regional goal;
- Monitor and report on market activity, including any potential market manipulation;
- Serve as a forum for WCI Partners to update one another on program progress;
- Coordinate review and adoption of protocols for offsets;
- Coordinate review and adoption of updated reporting requirements and emissions measurement methods;
- Coordinate review and issuance of offset credits; and
- Suggest criteria and means to accredit service providers to deliver validation and verification services.

### 1.16.3. Stakeholder Input

Stakeholders generally emphasized the need for coordination across the region to ensure consistency in the program.

### 1.16.4. Discussion of WCI Partners' Recommendation

The regional organization recommendation is designed to help the WCI Partner jurisdictions achieve the necessary coordination. Each jurisdiction will retain its regulatory authority and enforcement responsibilities. By centralizing administrative tasks and coordinating WCI Partner activities, the regional organization will help reduce administrative costs and

improve program transparency and consistency. RGGI has such an organization and it has thus far been successful in facilitating consistent implementation of RGGI's cap-and-trade program across the RGGI states.

### 1.17. Other Issues Raised by Stakeholders

A few stakeholders have also raised issues around market manipulation. The WCI Partners will continue to examine this issue and are committed to taking steps as the program is further designed to minimize the potential for manipulation. Evidence from existing and past allowance systems has not revealed compelling evidence that market manipulation through collusion or other market gaming situations has occurred. Price distortions did occur where there was not full price disclosure or when trading was thin, causing price volatility.

## 2. Overview of Cap-and-Trade

A cap-and-trade program sets a clear, mandatory, enforceable limit on GHG emissions and then allows the market to identify the least-cost ways to achieve the limit. The state or provincial government sets an absolute aggregate limit (or "cap") on GHG emissions from a sector or multiple sectors. Tradable emissions "allowances," or limited authorizations to emit,[28] are then distributed in an amount that equals the total emissions permitted by the cap, which may decline over time. These allowances can be distributed by auction, free allocation, or a combination of the two. The government specifies which entities or facilities must surrender allowances to cover their emissions at the end of a pre-determined period of time, which is called the "compliance period."

After allowances are issued by governments, they can be bought and sold ("traded"). The limit on the total number of allowances, combined with the requirement to surrender allowances to cover emissions, makes allowances valuable and scarce. Allowance trading occurs because participants face different costs for reducing emissions. Trading allowances reveals a market price for them. The price is an incentive to facilities and entities with emissions to either invest in reductions that will let them sell allowances or avoid the cost of buying them. For some participants, implementing new, low-emitting technologies may be relatively inexpensive. Those participants will buy fewer allowances or sell surplus allowances to participants that face higher emission control costs. A participant will choose to buy more allowances when the cost of an allowance is lower than the cost of reducing its emissions. By giving participants a financial incentive to control emissions and the flexibility to determine how and when emissions will be reduced, the capped level of emissions is achieved in a manner that minimizes the cost of emissions reductions.

[28] Emission allowances are not considered property rights but are a limited authorization to emit.

Emissions trading programs have been successfully implemented in the United States and other countries to control other types of emissions, such as acid rain pollutants like sulfur dioxide ($SO_2$), in an environmentally sound, cost-effective manner.[29]

When designed properly, cap-and-trade programs provide certainty on the level of emissions reductions achieved and help ensure these reductions are attained at the lowest cost. The cap creates a firm limit on GHG emissions. By letting individual sources choose when and how to reduce emissions, cap-and-trade minimizes the cost of emission reduction. It also stimulates the development of new technological solutions that can enable lower-cost reductions now and in the future.

Cap-and-trade programs may also cost governments less to implement than command-and-control programs in which governments specify various performance, operational, or emission requirements based upon technology.[30] The state or province needs only (1) to ensure that covered sources accurately report their emissions and, at the end of each compliance period, surrender a number of allowances equal to their emissions; and (2) to provide some market oversight to ensure fair competition.

When designed properly, cap-and-trade programs can be particularly useful in the effort to address climate change and can aid more traditional policies in achieving emissions reductions. Greenhouse gas emissions come from many different kinds of sources with widely varying options for achieving emission reductions, affording numerous opportunities for mutually advantageous trading. Also, the location of a given emissions reduction does not matter with respect to climate change. A GHG cap-and-trade program is environmentally effective because a ton of carbon dioxide ($CO_2$) or other greenhouse gas emitted from one source has the same global warming effect as a ton emitted from any other.[31]

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[29] Estimated savings for Phases I and II of the Acid Rain Program were more than $1 billion in 1995 dollars. The cost savings estimated in comparison to command-and-control approaches were estimated to be about 44-55 percent of the total compliance costs. *See for example* Carlson, C. P., D. Burtraw, M. Cropper, and K. L. Palmer. 2000. Sulfur dioxide control by electric utilities. *Journal of Political Economy* 108 (6):1292-1326. Ellerman, A. D., P. L. Joskow, R. Schmalensee, J. Montero, E. M. Bailey. 2000. *Markets for Clean Air: The US Acid Rain Program*. Cambridge: Cambridge University Press.

[30] For example, the U.S. acid rain program requires a staff of approximately 50 people to track all emissions data, allowance transfers, and compliance for over 4000 sources, including auditing of all hourly emissions data, tracking several thousand allowance transfers per year, annual compliance determination, and annual program assessment. See *Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California*. Recommendations of the Market Advisory Committee to the California Air Resources Board, June 2007, p. 73 and 99. Available online at www.pewclimate.org/docUploads/2007-06-29_MAC_FINAL_REPORT.pdf

[31] From a climate change perspective, because GHGs are chemically stable and persist in the atmosphere for a decade or longer and become well mixed throughout the atmosphere, the location of the reduction does not matter. Still, there may be other important policy reasons to consider the location of GHG reductions.

## 2.1. The Reasons for a Regional Cap-and-Trade Program

The reasons for coordinating regionally to design and implement a cap-and-trade program are compelling. A vast body of literature makes the case for a GHG cap-and-trade system that maximizes coverage of emissions and minimizes the costs of achieving a given GHG emissions level. Cap-and-trade has been applied successfully in the United States and Canada and in other regions to reduce other pollutants, and a number of countries have implemented such a system for GHGs under the Kyoto Protocol of the UN Framework Convention on Climate Change. In the absence of U.S. and Canadian federal engagement in these efforts, many U.S. states and Canadian provinces are moving ahead on their own and/or in cooperation with neighboring states and provinces to reduce GHG emissions.[32]

Because of their broader coverage, regional cap-and-trade programs perform better than individual state or provincial programs can in terms of realizing cost savings from trade, maintaining competitiveness and avoiding emissions leakage. Emissions leakage occurs when economic activity and associated emissions shift out of the jurisdiction covered by the policy in order to avoid the costs of compliance. The regional program levels the competitive playing field across the participating jurisdictions, thereby reducing the risk of emissions leakage.

Regional cap-and-trade programs can be more efficient and effective than state-by-state and province-by-province efforts because they cover more emissions sources and provide greater opportunities for mutually beneficial transactions. Administrative and technical support functions can also be shared among the participating jurisdictions, lowering the overall costs of implementation. Regional cap-and-trade programs can also help move the United States and Canada toward federal-level policies by acting as laboratories for program design and implementation. RGGI, for example, has advanced the debate in the United States around a number of cap-and-trade design issues, including allowance auctioning and offsets. WCI jurisdictions hope that their own analyses, deliberations, decisions, and implementation experiences will help to accelerate the development of U.S., Canadian, and global GHG markets.

## 2.2. Lessons from the European Union

The European Union (EU) developed a cap-and-trade program to meet its GHG reduction obligation under the Kyoto Protocol. The EU Emissions Trading Scheme (ETS) covers carbon dioxide emissions from certain sectors, including power generation, certain industrial process sources, and all large industrial combustion facilities. Proposed in 2001, the EU ETS began its three-year "learning phase" in 2005. The goal of the learning phase was to

[32] In addition to the states and provinces participating in the WCI, ten Northeast states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont) have joined to form Regional Greenhouse Gas Initiative (www.rggi.org), which is a cap-and-trade program for $CO_2$ from electrical utilities, and six Mid-Western States (Iowa, Illinois, Kansas, Michigan, Minnesota, and Wisconsin) and one Canadian Province (Manitoba) have signed on to the Mid-Western Greenhouse Gas Reduction Accord (www.midwesternaccord.org) to design a cap-and-trade program for their region.

develop the infrastructure and experience to successfully implement a cap-and-trade program during the second trading period, which started in 2008, and not to achieve significant reductions in GHG emissions, per se.[33]

A number of lessons can be drawn from the EU ETS. In particular, the EU ETS learning phase demonstrated:

- The importance of accurate emissions data to create an effective trading system that results in sufficient emissions reductions and to ensure that the appropriate number of allowances is distributed;
- That cost containment measures such as banking and multi-year compliance periods tend to reduce market volatility;
- Suppliers quickly factor the price of emissions allowances into their business decisions under a cap-and-trade program;
- The relationship between allowance allocation, allowance markets, and electricity regulation must be understood and addressed to avoid unintended consequences; and
- The linkage of 28 separate trading programs in the EU ETS provides a valuable prototype for a globally linked carbon market.

## 2.3. Lessons from Other Emission Trading Programs[34]

The United States has implemented six emissions trading programs since the late 1970s: the early U.S. EPA emissions trading programs,[35] the federal Lead-in-Gasoline, Acid Rain, and Mobile Source trading programs; the northeast regional NOx Budget Trading Program, and the Los Angeles Air Basin RECLAIM program. From an examination of the literature and experiences with these programs, there are important lessons and recommendations that emerge:

[33] For a full examination of the EU ETS, see Ellerman, D. A. and P. Jaskow. 2008. *The European Union's Emissions Trading System in Perspective.* Pew Center on Global Climate Change. Available online at: www.pewclimate.org/docUploads/EU-ETS-In-Perspective-Report.pdf

[34] *See for example* www.epa.gov/airmarkets.usca; Aulisi, A., A. E. Farrell, J. Pershing, and S. Vandeveer. 2005. *Greenhouse Gas Emissions Trading in U.S. States. WRI White Paper.* Available online at http://pdf.wri.org/nox_ghg.pdf. Ellerman, A. D., P. L. Joskow, and D. Harrison, Jr. 2003. *Emissions Trading in the U.S*. Pew Center on Global Climate Change. Available online at www.pewclimate.org/global-warming-in-depth/all_reports/emissions_trading. *Climate Change 101: Cap and Trade*. Pew Center on Global Climate Change and Pew Center on States. Available online at www.pewclimate.org/docUploads/Cap&Trade.pdf.

[35] The early EPA programs included four programs—collectively referred to as EPA Emissions Trading or EPA ET—are related by the common objective of providing sources with flexibility to comply with traditional source-specific command-and-control standards while maintaining environmental objectives focused primarily on local air quality. They included netting, offsets, bubbles, and banking. *See* Ellerman, A. D., P. L. Joskow, and D. Harrison, Jr. 2003. *Emissions Trading in the U.S*. Pew Center on Global Climate Change.

- Emission trading has successfully reduced emissions and the costs of achieving those reductions without compromising environmental goals.[36]
- The inclusion of a broad and diverse set of emission sources under the cap will lower costs, achieve the environmental objective, and accelerate innovation, making cap-and-trade particularly applicable for reducing greenhouse gas emissions.
- A common set of rules and guidelines are required for monitoring and reporting emissions to ensure market transparency and compliance.
- Rigorous monitoring of emissions is critical to making the probability of detecting non-compliance high. Penalties for non-compliance must be strict and sure.
- There are some elements of a multi-jurisdictional cap-and-trade program that must be the same between implementing jurisdictions; these include certain elements of measurement and reporting of emissions, the schedule for distributing allowances to covered entities or facilities, compliance and reconciliation periods, the use of banking and/or borrowing, the acceptance of offsets and allowances from other trading programs, and compliance and enforcement.
- Other elements of a multi-jurisdictional cap-and-trade program do not need to be the same across implementing jurisdictions: it is not critical that the states and provinces allocate allowances within their jurisdictions in the same manner and jurisdictions may include varying levels of auction in their allowance distribution.

## 2.4. WCI Design Principles

To attain the Western Climate Initiative's regional GHG reduction goal, the WCI Partner jurisdictions committed to designing a cap-and-trade system that:

- Is equitable, administratively simple for government and private participants, minimizes administrative costs, and has a clear compliance path;
- Maximizes total benefits in jurisdictions throughout the region, including reducing air pollutants, diversifying energy sources, and advancing economic, environmental, and public health objectives, while also avoiding localized or disproportionate environmental or economic impacts;
- Requires all reductions to be real, verifiable, enforceable, and permanent, and surplus/additional;
- Stimulates investment, especially in low carbon technologies, and rewards innovations that will lead to long-term, permanent greenhouse gas reductions;
- Covers as many sources as is practical, while encouraging pollution reductions beyond the capped sources and sectors;

[36] When compared to a policy that would have forced scrubbing to achieve the same level of emissions (required for acid rain mitigation), cost savings of the Acid Rain Program were estimated to be $1.6 billion per year in 1995 dollars. *See* Carlson, C. P., D. Burtraw, M. Cropper, and K. L. Palmer. 2000. Sulfur dioxide control by electric utilities. *Journal of Political Economy* 108 (6):1292-1326.

- Provides appropriate recognition and incentives for early emissions reductions;
- Assures a transparent and robust accounting system that will measure and report emissions rigorously and consistently across all sectors and throughout the region;
- Minimizes the potential for leakage; and
- Facilitates linkage to similarly rigorous regional and international greenhouse gases reduction markets and encourages other states, provinces, and countries to join the market.

### 2.5. Statement on the Overall Policy Design

The WCI Partners are proposing the most expansive cap-and-trade program in U.S. history, covering more sectors than the EU ETS in a broad, multi-sector greenhouse gas cap-and-trade program. As designed, the program will cover approximately 90 percent of the region's GHG emissions. Recognizing that federal mandatory GHG reduction programs might emerge in the United States and/or Canada, the WCI Partner jurisdictions have designed a program that can stand alone, provide a model for, be integrated into, or be implemented in conjunction with future federal programs. The WCI Partner jurisdictions intend to promote and influence federal GHG emission reduction programs that are consistent with the WCI cap-and-trade design principles and to ensure those programs translate into absolute GHG reductions. In the event WCI issues allowances before a federal program in Canada or the United States, the WCI Partner jurisdictions will work to ensure, but cannot guarantee, that those allowances are fully recognized and valued in the operation of a federal program.

## 3. Process to Date and Continued Work

### 3.1. Setting the Regional Goal

The WCI Partner jurisdictions issued their regional GHG reduction goal on August 22, 2007 to achieve an aggregate reduction of 15 percent below 2005 levels by 2020.[37] The WCI regional goal is consistent with the state and provincial goals of the WCI Partner jurisdictions and does not replace the existing goals of the individual WCI Partner jurisdictions. Several metrics were used to establish this goal, including:

- The aggregation of GHG emissions and emissions goals of the WCI Partner jurisdictions;
- Currently available state and provincial emissions inventories, including gross emissions estimates, across all sectors, for the six GHGs reported to the United Nations Framework Convention on Climate Change by the U.S. Environmental Protection Agency in the US Greenhouse Gas Inventory and by Environment Canada in the Canada National Inventory Report: carbon dioxide ($CO_2$), methane ($CH_4$), nitrous

[37] *See* Western Climate Initiative Statement of Regional Goal. Available online at www.westernclimateinitiative.org/ewebeditpro/items/O104F13006.pdf.

oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride ($SF_6$); and[38]

- Where available, consumption-based (or "load-based") emissions estimates for the electricity sector, reflecting the emissions associated with generating the electricity delivered to consumers in each state or province regardless of whether the electricity was generated in state/province or out of state/province.

The WCI Partner jurisdictions also committed to doing their share to reduce regional GHG emissions sufficiently over the long term to significantly lower the risk of dangerous threats to the climate. Current science suggests that this will require worldwide reductions in carbon dioxide emissions of 50 to 85 percent below 2000 levels by 2050.[39]

### 3.2. The Work of the Subcommittees

Five WCI subcommittees were formed to work toward a cap-and-trade program design that all WCI Partner jurisdictions can embrace and recommend for implementation in their jurisdiction. The five subcommittees and their purposes were:

- Reporting. Recommend the GHG emissions reporting system needed to support the WCI cap-and-trade program.
- Electricity. Recommend the point of regulation for the electricity sector.
- Scope. Recommend what other sectors and sources to include in the cap-and-trade program in addition to the electricity sector and the appropriate point of regulation for each sector.
- Allocations. Recommend how to apportion emissions allowances among the WCI Partner jurisdictions and how WCI Partner jurisdictions should distribute allowances to achieve jurisdictional and regional goals.
- Offsets. Recommend whether and how emissions offsets should be included.

Each subcommittee was chaired by a representative of one of the WCI Partner jurisdictions, composed of staff from WCI Partner and observer jurisdictions, and had support from various consultants and advisors working under contract to the Western Governors' Association. During the development of the draft program design, the subcommittees met regularly by conference call and at times held face-to-face meetings. All subcommittees incorporated stakeholder involvement and feedback to help design the program.

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[38] *See* EPA. 2008. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006*. Available online at: www.epa.gov/climatechange/emissions/usinventoryreport.html. Environment Canada. 2008. *National Inventory Report 1990-2006: Greenhouse Gas Sources and Sinks in Canada – The Canadian Government's Submission to the UN Framework Convention on Climate Change*. Available at: www.ec.gc.ca/pdb/ghg/inventory_e.cfm.

[39] IPCC. 2007. *Climate Change 2007: Synthesis Report; Summary for Policymakers.* Available online at: www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

In addition to these five subcommittees, an Economic Modeling Team (EMT) was established to prepare the work plan for, select, and oversee the work of a contractor to evaluate the potential economic impact of the cap-and-trade program. This effort is on-going and includes outreach to stakeholders to receive advice and data to bolster the assumptions and inputs that underlie the modeling exercise.

### 3.3. Stakeholder Process for the Design Recommendations

Throughout the WCI cap-and-trade design process, there have been many opportunities and methods for stakeholder input on a regional level. These opportunities supplemented and did not replace extensive stakeholder consultations at the state and provincial level. In addition, states and provinces have and are continuing to conduct extensive stakeholder consultations. The decisions reached throughout the design process have benefited greatly from stakeholder input.

The regional stakeholder process for the Design Recommendations included a number of important avenues for the sharing of information and input. Among them:

- Stakeholder Workshops. Five regional stakeholder workshops were held to allow face-to-face interaction between stakeholders and WCI Partner jurisdictions and staff. Three of these workshops were comprehensive and included subcommittee-specific sessions to explore the subject areas within each subcommittee's purview. The other two addressed offsets and electricity point-of-regulation specifically. The workshops are noted in the table below.
- Stakeholder Conference Calls. Over the course of the design effort, the WCI Partner jurisdictions held regional stakeholder conference calls to update stakeholders on progress toward a cap-and-trade design and to answer stakeholder questions.
- Review and Comment in Writing. At regular intervals throughout the process, the WCI Partner jurisdictions and the subcommittees released written work for review and comment by stakeholders.
- The Website.[40] The WCI website served as a repository for information on the design effort. The website included information on upcoming stakeholder calls and workshops, and also provided a way to submit comments to the WCI Partner jurisdictions.

The table below details the various stakeholder events along with the work products released by WCI leading up to the release of the Design Recommendations accompanying this document. As noted above, the activities outlined in the table are in addition to the individual outreach to stakeholders conducted by each individual WCI Partner jurisdiction.

[40] The Western Climate Initiative website can be accessed at www.westernclimateinitiative.org.

Part 1, Cap-and-Trade Program Design, summarizes stakeholder input on the cap-and-trade program design elements.

**Table 1: The WCI Stakeholder Input Process Through September 2008**

| Activity | Date |
|---|---|
| Periodic Stakeholder Conference Calls | Summer-Fall 2007 |
| Subcommittee Options Papers released for public review and comment[41] | Early January 2008 |
| Stakeholder Workshop, Portland, OR[42] | January 10, 2008 |
| Initial Draft Scope Recommendations and Electricity Point of Regulation Recommendations released for public review and comment | February 3, 2008 |
| Stakeholder Conference Calls with Scope and Electricity Subcommittees | February 11, 2008 |
| Scope of Work for Economic Analysis[43] released for public review and comment | March 3, 2008 |
| Initial Draft Design Recommendations released[44] for public review and comment<br>• Scope and Electricity<br>• Offsets, Allocations, and Reporting | <br><br>March 5, 2008<br>April 3, 2008 |
| Stakeholder Conference Calls with Subcommittees | Week of March 11, 2008 |
| Offsets Workshop in Vancouver, BC[45] | March 26, 2008 |
| Stakeholder Conference Call with Economic Modeling Team[46] | March 28, 2008 |
| Stakeholder Conference Call with Economic Modeling Team | April 14, 2008 |
| Stakeholder Conference Call with Economic Modeling Team | May 12, 2008 |
| Consolidated WCI Draft Recommendations released[47] for public review and comment | May 16, 2008 |
| Stakeholder Workshop in Salt Lake City, UT to discuss draft subcommittee recommendations[48] | May 21, 2008 |

[41] Allocation, Electricity, Offsets, Reporting, and Scope Options Papers are available online at www.westernclimateinitiative.org/WCI_Documents.cfm.

[42] Public workshop presentations are available online at www.westernclimateinitiative.org/WCI_Meetings_Events.cfm.

[43] Stakeholder involvement opportunities for the economic modeling effort are available online at www.westernclimateinitiative.org/Economic_Analysis.cfm.

[44] Draft Design Recommendations are available online at www.westernclimateinitiative.org/WCI_Documents.cfm.

[45] Offsets workshop materials are available online at www.westernclimateinitiative.org/WCI_Meetings_Events.cfm.

[46] Materials from the Economic Modeling Team's conference calls are available online at www.westernclimateinitiative.org/Economic_Analysis.cfm

[47] The Consolidated Draft Recommendations are available online at www.westernclimateinitiative.org/ewebeditpro/items/O104F17390.PDF.

| Activity | Date |
|---|---|
| Stakeholder Conference Call with Economic Modeling Team | June 9, 2008 |
| Electricity Subcommittee Meeting on Technical Issues Related to First Jurisdictional Deliverer in Portland, OR | July 17, 2008 |
| Stakeholder Conference Call with Economic Modeling Team | July 21, 2008 |
| Draft Program Design Recommendations[49] released for public review and comment | July 23, 2008 |
| Stakeholder Workshop in San Diego, CA to Discuss Draft Design Recommendations | July 29, 2008 |
| Final Design Recommendations to be Delivered to Governors and Premiers | September 23, 2008 |

### 3.4. Continued Work

The Design Recommendations released along with this document represent the final high-level design elements for the cap-and-trade program. Many of the design aspects will require further development. The WCI Partner jurisdictions' next task will be to develop a work plan that identifies and prioritizes those items and develop a schedule for their completion. The work plan will be shared with stakeholders once it is complete. The work plan will include opportunities for stakeholders to advise, comment, and participate in the further development of the cap-and-trade program.

## 4. Economic Analysis

### 4.1. Insights from Prior Analyses of Climate Policies

The potential economic impacts of climate protection policies have been the subject of considerable analysis and debate for more than a decade. Recognizing that significant reductions in GHG emissions are required globally to prevent the most serious climate change impacts, studies have examined how to design climate policies to minimize economic impacts. One of the important recommendations from the recent work has been that market-based policies, such as cap-and-trade programs, can reduce emissions at a lower cost than can be achieved through traditional regulation. This conclusion is grounded in economic theory as well as empirical evidence from past cap-and-trade program experience. Specifically, comprehensive carbon pricing through a cap-and-trade program takes advantage of the diverse opportunities to reduce emissions throughout the economy and provides incentives for continued innovation.

Recent efforts, therefore, move past the basic question of whether to use market-based policies, such as a cap-and-trade program, and onto the question of how to best design a

[48] Meeting agenda and presentations are available online at www.westernclimateinitiative.org/WCI_Meetings_Events.cfm.

[49] The Draft Design Recommendations are available online at www.westernclimateinitiative.org/ewebeditpro/items/O104F18808.PDF.

cap-and-trade program. To inform the design of this program, the WCI Partner jurisdictions examined program guidance,[50] U.S. analyses of the Lieberman-Warner Climate Security Act and California AB32, and Canadian analyses by Environment Canada and British Columbia. These analyses consistently demonstrated that several program design features can have an important impact on compliance costs:

- Flexibility in the timing of GHG reductions reduces the overall costs of cumulative GHG abatement. Multiple-year compliance periods and allowance banking have been identified as effective approaches for providing flexibility.
- Allowing offset credits to be used for program compliance can lower the compliance cost of meeting emission reduction targets.
- A broad scope that covers more sectors in a cap-and-trade program can lower compliance costs by providing maximum opportunities to pursue low-cost emission reductions.

Studies have also shown that innovation in advanced, low-carbon technologies (such as carbon capture and storage for electric power generation) can have a substantial impact on compliance costs, particularly after 2020. Consequently, providing incentives for technology development and demonstration is important for minimizing costs.

Complementary policies have also been examined as a means for addressing market barriers that would otherwise hinder the exploitation of low-cost GHG emission reduction opportunities (e.g., via improved energy efficiency). Thus, complementary policies can lower the overall cost of reducing GHG emissions. Analysts differ in their treatment of complementary policies, however. Some analysts allow for cost savings to be realized from complementary policies such as building codes, appliance standards, vehicle standards, and energy efficiency programs. A recent McKinsey analysis of GHG abatement costs in the United States provides one view of the potential for gains from complementary policies.[51] McKinsey found significant opportunities to reduce GHG emissions while also saving money through investments in energy efficiency. The existence of opportunities to reduce GHG emissions at "negative cost" even in the absence of a cap-and-trade program suggests that complementary policies, such as energy efficiency standards and programs, can lead households and businesses to exploit such opportunities.

Other analysts start with the presumption that markets function efficiently, so that there is little or no opportunity for these complementary policies to lead to overall savings.[52] Under these assumptions, any climate policies must impose economic costs. This divergence of views on the potential to realize savings from complementary policies is one of the primary

[50] See, for example, U.S. Environmental Protection Agency, *A Guide to Designing a Cap and Trade Program for Pollution Control*, Office of Air and Radiation, Washington, D.C., EPA430-B-03-002, June 2003, available online at: www.epa.gov/airmarkt/resource/cap-trade-resource.html.

[51] Creyts, J., et al. (McKinsey). 2007.

[52] See generally Stavins, Robert et al. 2007. "Too Good to Be True? An Examination of Three Economic Assessments of California Climate Change Policy." AEI-Brookings Joint Center Working Paper No. 07-01.

factors that causes some studies to show a small net savings to the economy from climate policies, while others show a small net cost. What is important to recognize is that in virtually all analyses, well defined cap-and-trade programs with the cost-saving features listed above have been found to be consistent with continued robust economic growth in the U.S. and Canada. By coupling a cap-and-trade program with complementary policies, the WCI Partners expect to use the market to capture cost-effective reduction opportunities and drive innovation, while targeted complementary policies address barriers that might otherwise limit the adoption of least-cost emission reductions.

### 4.2. WCI Economic Analysis

In order to examine the economic impacts of WCI program design options, WCI Partner jurisdictions contracted with ICF International and Systematic Solutions, Inc. (SSI) to perform economic analyses using ENERGY 2020,[53] a multi-region, multi-sector energy model. The workings of the model and the inputs to the model were the subject of multiple stakeholder conference calls and were discussed at two WCI stakeholder workshops. Appendix B presents the results of the analysis.

To help inform the program design process, the analysis examined the implications of key design decisions, including: program scope, allowance banking, and the use of offsets. Due to time and resource constraints, the modeling was limited to the eight WCI Partner jurisdictions in the Western Electric Coordinating Council (WECC) area, thereby excluding from the analysis three Canadian provinces, Manitoba, Quebec, and Ontario. Future analyses are planned that will integrate these provinces so that a full assessment of the WCI Partner jurisdictions can be performed.

The results of the analysis provided the following insights into the program design:[54]

- Complementary Policies: The analysis demonstrated that energy efficiency programs, vehicle emissions standards, and programs to reduce vehicle miles traveled (VMT) are important for achieving emission reductions. The manner in which these policies are represented in ENERGY 2020 results in overall savings being realized from these policies. Resources from the cap-and-trade program (e.g., from the auctioning of emission allowances) can fund these complementary programs.
- Banking: The analysis demonstrated that the ability to bank allowances is critical for reducing compliance costs. Throughout all the cases examined, emission allowances

[53] More about the ENERGY 2020 model can be found online at www.energy2020.com/energy.htm.

[54] Like all analyses of climate policies, this analysis relies on a model to explore alternative policy choices and provide insights about how the economy might respond to different types and forms of regulation. The insights derived from the studies do not depend on perfectly accurate projections of the future or precise estimates of economic variables. Rather, modeling studies assess the relative impacts of policy alternatives, to estimate the likely economic effects of policies and to identify preferred policy choices. For a review of how economic models can be used in policymaking, see: Peace, Janet and John Weyant. 2008. "Insights Not Numbers: The Appropriate Use of Economic Models." White Paper prepared for the Pew Center on Global Climate Change, available at http://www.pewclimate.org/white-paper/economic-models-are-insights-not-numbers

were estimated to be banked in early years when allowance prices were below $10/metric ton, and used when allowance prices rose in later years.

- Offsets: The analysis demonstrated that under certain circumstances, offsets provide an effective mechanism for limiting compliance costs. In the analysis performed to date, offsets were assumed to be available at $20/metric ton. As allowance prices were estimated to rise to this level, offsets were estimated to be used in combination with allowance banking to reduce compliance costs.

Overall, the analysis found that the WCI Partner jurisdictions can meet the regional goal of reducing emissions to 15 percent below 2005 levels by 2020 with a small overall savings due to reduced energy expenditures exceeding the direct costs of GHG emission reductions.[55] The savings are focused primarily in the residential and commercial sectors, where energy efficiency programs and vehicle standards are expected to have the most significant impacts. Energy-intensive industrial sectors are estimated to have small net costs overall (less than 0.5 percent of output). When offsets are included in the analysis, allowance prices are estimated to increase from $6/metric ton in 2015 to about $24/metric ton in 2020. If offsets are not included, or if they cost substantially more than $20/metric ton, then the allowance price is estimated to be higher. To date the analysis has included a simplified representation of the potential supply of offsets. Additional work is being considered to develop a better estimate of the supply of offsets under various offset program policies.

The analysis examined the sensitivity of the results to various assumptions. The analysis suggests a net savings whether future energy prices are higher or lower than in the Reference Case. It also suggests a net savings with higher electricity power generation costs. If the program scope were narrowed to exclude transportation fuels and residential and commercial fuels, the overall impacts would be similar, but allowance prices may be expected to be higher because the program is focused on a smaller group of sources. If the program causes a substantial increase in natural gas prices, then the overall impact is estimated to be a small net cost to the economy. However, the program is not expected to lead to increases in natural gas prices. As discussed with stakeholders during the WCI economic analysis conference calls, it is worthwhile to explore many additional sensitivities to better understand the implications of various analytical assumptions and inputs. However, time and resources did not allow additional sensitivities to be examined for this report.

These WCI modeling results are generally consistent with the findings of prior modeling studies of both U.S. and Canadian programs. Offsets and allowance banking provide compliance flexibility that reduces allowance prices. The analysis suggests that offsets are particularly important during the years approaching 2020, but may play a minor role in the early years of the program when allowance prices are expected to be less than $10/metric ton. The overall net savings that are found are consistent with studies that assume that complementary policies, such as energy efficiency programs and vehicle standards, can

[55] Reduced energy expenditures are caused by improved energy efficiency.

result in economic savings. While the overall costs and savings from emission reductions and reduced fuel expenditures are small, potential impacts on specific energy-intensive industrial sectors warrant additional examination. In particular, the results reinforce the need to consider strategies for mitigating economic impacts on industries facing competition from facilities that are not included in climate policies.

In considering the results of the WCI analysis, it is worth highlighting several important assumptions:

- It is assumed that no new nuclear power or hydropower generation capacity will be built prior to 2020. Therefore, the analysis does not include any increase in this power as a result of the cap-and-trade program.
- It is assumed that no carbon capture and storage for electric power generation will be built prior to 2020. Consequently, the analysis does not include the benefits of this carbon-sequestering technology.
- It is assumed that no new coal-fired power plants are built in the WECC states and provinces through 2020 beyond those that are already planned.
- It is assumed that plug-in hybrid electric vehicles will not be produced in any significant quantity prior to 2020. Thus, the model does not include an increase in this low carbon transportation alternative as a result of the cap-and-trade program.
- For the U.S. states, the requirements of the Energy Independence and Security Act (EISA) are assumed to be part of the Reference Case against which the cap-and-trade program is evaluated. For the Canadian provinces, lighting, equipment, and appliance standards as set out by the Canadian Standards Association as well as the federal "ecoENERGY" Renewable Fuels Strategy are included in the Reference Case.

Finally, the analysis does not examine the potential macroeconomic impacts of the costs and savings estimated with ENERGY 2020. The WCI Partner jurisdictions are planning to continue the analysis so that macroeconomic impacts, such as income, employment, and output, can be assessed. Once completed, the macroeconomic impacts can be compared to previous studies of cap-and-trade programs considered in the United State and Canada.

### 4.3. Benefits of Cap-and-Trade Not Fully Represented in Economic Models

Economic models are by necessity simplified representations of the real-world economy, including the characteristics of and relationships among the households and firms that constitute the economy. The simplified nature of these models means that they may not fully capture all of the advantages of market-based climate policies, such as cap-and-trade programs, compared to prescriptive standards (i.e. command-and-control or direction regulation). The aspects of the real-world economy that are imperfectly represented in models are described below along with the implications for how well modeling studies capture the true advantages of market-based climate policies.

Heterogeneity: In direct regulation, all facilities in an industry are required to achieve a given level of performance or emission reduction. Modeling tools typically represent the industry as a single "model facility" or as a sector with demand and supply elasticities. In reality, industry is actually heterogeneous with different facilities facing different costs for reducing emissions. An important benefit of cap-and-trade is that it allows the low cost facilities to do more than the high cost facilities—i.e. the market directs the least-cost emissions reductions. The existing modeling tools may not fully capture this benefit of cap-and-trade, thus underestimating the relative cost-effectiveness of cap-and-trade compared to other policies.

Diffuse Behavioral Change: The price signal from a market program such as cap-and-trade will create consumer behavior change throughout the economy that is diffuse and not necessarily captured by existing modeling tools. These behavior changes are responses to persistent price signals that are not reflected in elasticities and are not part of "model facility" engineering cost studies. For example, bottom-up energy models may show that efficient lighting will be installed at a given allowance price, but it may not show that the consumer will also use the lights more efficiently. Existing modeling tools may not fully reflect these effects.

Induced Innovation: The price signal from a market program such as cap-and-trade will induce technological innovation in a way that is not adequately included in models.

Errors in Direct Regulation Cost Estimates: When direct regulations are promulgated, the costs of complying with the regulations will likely be estimated incorrectly, either too high or too low. When a portfolio of direct regulations is being developed, the mix and stringency of the regulations will be incorrectly estimated as a result. If the cost estimates are too high for a regulation, that regulation will not be strict enough. If the cost estimate is too low, that regulation may be too strict. Market programs such as cap-and-trade do not suffer from this problem, as the market sorts out who should do what to achieve the total emission reduction needed. Existing modeling tools presume that the costs of control are known in advance and are correct. Consequently, the benefit of avoiding these cost estimating errors is not captured by the models, thereby under-estimating the benefits of using market programs.

# Appendix A: Western Regional Climate Action Initiative Agreement

*Note: This agreement was subsequently signed by: Premier Gordon Campbell, British Columbia, Premier Gary Doer, Manitoba, Governor Jon Huntsman, Utah, Governor, Brian Schweitzer, Montana, Premier Jean Charest, Quebec, and Premier Dalton McGuinty, Ontario*

**Christine O. Gregoire** **Theodore R. Kulongoski** **Arnold Schwarzenegger**

**Janet Napolitano** **Bill Richardson**

## WESTERN REGIONAL CLIMATE ACTION INITIATIVE

**WHEREAS**, western states are experiencing the effects of a hotter, drier climate, including prolonged droughts, excessive heat waves, reduced snow packs, increased snowmelts, decreased spring runoffs, altered precipitation patterns, more severe forest and rangeland fires, widespread forest diseases, and other serious impacts; and

**WHEREAS**, scientific consensus has developed that increasing emissions of human-caused greenhouse cases (GHGs), including carbon dioxide, methane and other GHGs, that are released into the atmosphere are affecting the Earth's climate; and

**WHEREAS**, the Western Governors Association (WGA) has declared that climate change could have severe economic and environmental impacts on the Western States in coming decades; and

**WHEREAS**, the WGA also has declared that action is needed to reduce GHG emissions and that many of these actions can have significant economic and environmental benefits for the Western States, including increased energy efficiency, increased renewable energy generation, improved air quality, cost savings, job growth, increased state revenues, and reduced water pollution; and

**WHEREAS**, we support the development of national, regional, tribal, state and local programs to reduce GHG emissions; and

**WHEREAS**, we support national, regional, tribal, state and local level policies on global climate change that are consistent with efforts to develop cost-effective alternative energy sources and more efficient use of energy; and

**WHEREAS**, we recognize the need for collaboration among states to develop climate change policies that provide consistent approaches to recognize and give credit for actions to reduce GHG emissions; and

**WHEREAS**, we have already adopted or committed to adopt clean tailpipe standards for passenger vehicles that will result in major reductions in GHG emissions and other pollutants; and

**WHEREAS**, we support market-based policies to reduce GHG emissions in the most cost-effective manner; and

**WHEREAS**, we have set goals to significantly reduce GHG emissions from our respective states; and

**WHEREAS**, we welcome expanding the partners to this initiative to other states, tribes, Canadian provinces and Mexican states and offer monitoring status to any state, tribe or province interested in observing the initiative;

**NOW, THEREFORE**, we, the undersigned Governors, jointly establish the Western Regional Climate Action Initiative and agree to collaborate in identifying, evaluating and implementing ways to reduce GHG emissions in our states collectively and to achieve related co-benefits. This collaboration shall include, but is not limited to:

- Setting an overall regional goal, within six months of the effective date of this initiative, to reduce emissions from our states collectively, consistent with state-by-state goals;
- Developing, within eighteen months of the effective date of this agreement, a design for a regional market-based multi-sector mechanism, such as a load-based cap and trade program, to achieve the regional GHG reduction goal; and
- Participating in a multi-state GHG registry to enable tracking, management, and crediting for entities that reduce GHG emissions, consistent with state GHG reporting mechanisms and requirements.

In addition, we commit to continue our independent and collaborative efforts to reduce GHG emissions through:

- Promoting the development and use of clean and renewable energy within the region;
- Increasing the efficiency of energy use within our jurisdictions;
- Advocating regional and national climate policies that reflect the needs and interests of western states, tribes and provinces; and
- Identifying measures in our states, tribes and provinces to adapt to the impacts of climate change.

We will direct our staffs and the appropriate state agencies to meet as soon as is practicable to develop a work plan to move forward with this initiative.

**DONE**, in five (5) duplicate originals, this 26th day of February, 2007, in Washington, D.C.

Governor Christine O. Gregoire
State of Washington

Governor Theodore R. Kulongoski
State of Oregon

Governor Janet Napolitano
State of Arizona

Governor Bill Richardson
State of New Mexico

Governor Arnold Schwarzenegger
State of California

# Appendix B: Economic Modeling Results

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# Appendix B: Economic Modeling Results

## Introduction

This appendix presents data from the economic modeling performed for WCI, including the model inputs and outputs for the cases examined. The focus here is on the data and assumptions used as model inputs and the model outputs. The main body of the Background Document discusses the policy implications of the model results.

This appendix is organized as follows:

- Cases Analyzed: describes the cases presented in this appendix.
- ENERGY 2020: provides a brief technical discussion of the model used.
- Assumptions: lists the primary assumptions used in the model.
- Outputs: defines the model outputs that are presented for the cases.
- Summary Results: provides a brief table of key model outputs.
- Reference Case: presents the results of the Reference Case.
- Cap-and-Trade Policy Cases: presents the results of the cap-and-trade policy cases.
- Sensitivity Cases: presents the results of three sensitivity cases.

As discussed below, additional detail on the ENERGY 2020 model and the model inputs and assumptions used in this analysis are presented in the *Assumptions Book for ENERGY 2020* posted on the WCI website.[1]

## Cases Analyzed

This appendix presents three groups of cases. The first group is the Reference Case which reflects expectations in the absence of the WCI policies to reduce greenhouse gas emissions.

The second group is the Cap-and-Trade Policy Cases. These cases examine the primary alternatives for the cap-and-trade program, including whether to allow the use of offsets and whether to have a narrow or broad scope. The narrow scope includes stationary sources (including process emissions) and the electric sector. The broad scope also includes transportation fuels and residential/commercial fuels. The cases presented are:

- broad scope without offsets;
- broad scope with offsets; and
- narrow scope with offsets.

For all three Cap-and-Trade Policy cases, complementary policies are included along with the cap-and-trade program, including clean car standards, programs to reduce vehicle miles traveled, and energy efficiency programs. These complementary policies are defined below.

The third group of cases is the Sensitivity Cases. The purpose of the sensitivity cases is to assess the impacts of various assumptions and inputs on the model results. These assumptions can affect both the Reference Case and the Policy Cases. While a large number of

[1] The WCI website is: www.westernclimateinitiative.org.

assumptions and sensitivities are of interest, this analysis focuses on three sensitivities that were identified as most important by WCI partner jurisdictions and stakeholders.

- High Energy Prices and High Generation Costs: This sensitivity includes both higher energy prices and higher power generation costs as a set of conditions that could occur together in the future. This sensitivity was performed for both the Reference Case and the Policy Case with the broad scope and offsets.
- Low Energy Prices: This sensitivity uses energy prices that are lower than those used in the Reference Case. This sensitivity was performed for both the Reference Case and the Policy Case with the broad scope and offsets.
- High Natural Gas Prices: This sensitivity was designed to examine the impact of higher natural gas prices that may be induced by policies that are undertaken to reduce greenhouse gas emissions. Consequently, this sensitivity was applied to the Policy Case with broad scope and offsets. The results of this Policy Case are compared to the Reference Case with the standard natural gas price assumptions because the presumption is that policies are inducing the natural gas prices to increase.

Additional sensitivity analyses are warranted, and many important and worthwhile issues were identified by stakeholders during the conference calls and workshops that covered this work. However, due to time and resource constraints, additional sensitivities are not included at this time. Future work is anticipated that will enable additional sensitivity analyses to be performed.

## ENERGY 2020

ENERGY 2020 was used to perform this analysis. A description of ENERGY 2020 is in the *Assumptions Book for Energy 2020* posted on the WCI website.[2] Additional documentation is available on the California Air Resources Board (ARB) website.[3] The following is a brief summary.

ENERGY 2020 is an integrated multi-region energy model that provides all-fuel demand and supply sector simulations. ENERGY 2020 can be linked to a detailed macroeconomic model to determine the economic impacts of energy/environmental policy and the energy and environmental impacts of national economic policy. However, the macroeconomic analysis was not performed for this study.

The model simulates demand by three residential categories (single family, multi-family, and agriculture/rural), over 40 NAICS commercial and industrial categories,[4] and three transportation services (passenger, freight, and off-road). There are approximately six end-uses per category and six technology/mode families per end-use.[5] The technology families

[2] The WCI website is: www.westernclimateinitiative.org.

[3] The posting on the ARB website is at: http://www.arb.ca.gov/cc/scopingplan/economics-sp/models/models.htm.

[4] NAICS is the North America Industrial Classification System which was developed jointly by the U.S., Canada, and Mexico to provide new comparability in statistics about business activity across North America.

[5] End-uses include Process Heat, Space Heating, Water Heating, Other Substitutable, Refrigeration, Lighting, Air Conditioning, Motors, and Other Non-Substitutable (Miscellaneous). Detailed modes include: small auto, large

correspond to six fuels groups (oil, gas, coal, electric, solar and biomass) and 30 detailed fuel products. The transportation sector contains 45 modes including various type of automobile, truck, off-road, bus, train, plane, marine and alternative-fuel vehicles. More end-uses, technologies, and modes can be added as data allow. For all end-uses and fuels, the model is parameterized based on historical, locale-specific data. The load duration curves for electricity demand are dynamically built up from the individual end-uses to capture changing conditions under consumer choice and combined gas/electric programs.

Each energy demand sector includes cogeneration, self-generation, and distributed generation simulation, including mobile-generation, micro-turbines, and fuel-cells. Fuel-switching responses are rigorously determined. The technology families (which can be split, as an option, to portray specific technology dynamics) are aggregates that, within the model, change building shell, economic-process and device efficiency and capital costs as price or other information that the decision makers see, change. ENERGY 2020 utilizes the historical and forecast data developed for each technology family to parameterize and disaggregate the model.

The supply portion of the model includes endogenous detailed electric supply simulation of capacity expansion/construction, rates/prices, load shape variation due to weather, and changes in regulation.[6] The model dispatches plants according to the specified rules whether they are optimal or heuristic and simulates transmission constraints when determining dispatch. A dispatch routine selects critical hours along seasonal load duration curves as a way to determine system generation. Peak and base hydro usage is explicitly modeled to capture hydro-plant impacts on the electric system.

ENERGY 2020 supply sectors include electricity, oil, natural gas, refined petroleum products, ethanol, land-fill gas, and coal supply. Energy used in primary production and emissions associated with primary production and its distribution is included in the model. The supply sectors included in a particular implementation of ENERGY 2020 will depend on the characteristics of the area being simulated and the problem being addressed. If the full supply sector is not needed, then a simplified simulation determines delivered-product prices.

ENERGY 2020 includes pollution accounting for both combustion (by fuel, end-use, and sector) and non-combustion, and non-energy (by economic activity) for $SO_2$, $NO_2$, $N_2O$, CO, $CO_2$, $CH_4$, PMT, $PM_{2.5}$, $PM_5$, $PM_{10}$, VOC, $CF_4$, $C_2F_6$, $SF_6$, and HFC at the state and provincial level by economic sector.

## Assumptions

This section presents an overview of the major assumptions used in the modeling analysis. The *Assumptions Book for ENERGY 2020* presents a detailed list of the model inputs, including links to the data sources used to assemble the input data.

auto, light truck, medium-weight truck, heavy-weight truck, bus, freight train, commuter train, airplane, and marine. Each mode type can be characterized by gasoline, diesel, electric, ethanol, NG, propane, fuel-cell, or hybrid vehicles.

[6] ENERGY 2020 includes a complete, but aggregate representation of the electric transmission system.

- Geographic Coverage: This phase of the analysis covers the area of the Western Electricity Coordinating Council (WECC), which includes eight WCI partners: British Columbia, Washington, Oregon, California, Arizona, New Mexico, Utah, and Montana. By covering the entire WECC, the impacts of the WCI programs and policies on electricity generation in the non-WCI WECC states and provinces can be examined. Future analyses are planned that will incorporate the WCI partners that are not in the WECC, including Manitoba, Ontario, and Quebec.
- Sectors and Sources: This phase of the analysis includes energy use in all sectors, as well as most industrial process emissions. Landfill methane emissions and non-energy agriculture emissions are included in the total emissions estimates, but emission reductions are not estimated for these sources.[7] The analysis is based on gross emissions, so that forestry emissions and sinks are excluded.
- WCI Population and GDP Forecast: The model is driven by forecasts provided as input that include population growth and economic growth by detailed sector. Table B-1 shows the population growth forecast and Table B-2 shows the economic growth forecast.

**Table B-1: Population Forecast for Eight WCI Partners, Selected Years (Millions)**

| Jurisdiction | 2006 | 2010 | 2015 | 2020 | Annual Growth |
|---|---|---|---|---|---|
| Arizona | 6.2 | 7.0 | 7.9 | 8.8 | 2.5% |
| British Columbia | 4.3 | 4.5 | 4.7 | 4.9 | 0.9% |
| California | 37.4 | 39.1 | 41.5 | 44.1 | 1.2% |
| Montana | 0.9 | 1.0 | 1.1 | 1.2 | 1.6% |
| New Mexico | 2.0 | 2.2 | 2.3 | 2.5 | 1.8% |
| Oregon | 3.7 | 3.9 | 4.1 | 4.3 | 1.1% |
| Utah | 2.6 | 2.7 | 3.0 | 3.2 | 1.6% |
| Washington | 6.4 | 6.8 | 7.3 | 7.7 | 1.4% |
| **WCI** | **63.5** | **67.2** | **71.9** | **76.7** | **1.4%** |
| Source: Assumptions Book for ENERGY 2020 | | | | | |

[7] Examples of non-energy agriculture emissions are methane emissions from livestock, carbon and $N_2O$ emissions from agricultural soils, and methane emissions from livestock manure management.

**Table B-2: Regional Gross Product Forecast for Eight WCI Partners, Selected Years (Billions of 2007 US dollars)**

| Jurisdiction | 2006 | 2010 | 2015 | 2020 | Annual Growth |
|---|---|---|---|---|---|
| Arizona | 237 | 271 | 322 | 363 | 3.1% |
| British Columbia | 266 | 294 | 326 | 358 | 2.1% |
| California | 1,800 | 2,066 | 2,458 | 2,782 | 3.2% |
| Montana | 33 | 37 | 42 | 47 | 2.5% |
| New Mexico | 77 | 87 | 103 | 117 | 3.0% |
| Oregon | 159 | 186 | 227 | 259 | 3.6% |
| Utah | 98 | 111 | 129 | 146 | 2.9% |
| Washington | 302 | 345 | 410 | 462 | 3.1% |
| **WCI** | **2,972** | **3,396** | **4,018** | **4,534** | **3.1%** |
| Source: Assumptions Book for ENERGY 2020 | | | | | |

- Emission Reduction Options: The model simulates decisions by energy users for each end use, including: fuel choice; investment in end use efficiency (e.g., by purchasing devices that are more efficient than the minimum required by standards); and end use utilization (how much the device is used). End-use specific choices are simulated as needed, such as mode choice for freight movement and passenger transportation. Choices are simulated based on costs (increased capital costs versus the value of fuel saved) as well as non-price attributes (convenience, acceptance of the technology). Past purchasing behavior is used to calibrate the non-price choice parameters for each end use.
- Energy Independence and Security Act of 2007 (EISA): The Reference Case, Policy Cases, and Sensitivity Cases include the requirements in the EISA, including the CAFÉ standards, appliance and lighting energy efficiency standards, and the renewable fuels standard (RFS). These requirements are assumed to be implemented fully in the WCI partner jurisdictions in the United States. For British Columbia and other Canadian provinces, lighting, equipment and appliance standards as set out by the Canadian Standards Association[8] as well as federal "ecoENERGY" Renewable Fuels Strategy[9] are incorporated.
- Renewable Portfolio Standards: All cases incorporate the individual Partner's already-adopted Renewable Portfolio Standards (RPS). See Appendix I of the *Assumptions Book for ENERGY 2020* for details.

[8] http://www.oee.nrcan.gc.ca/regulations/home_page.cfm

[9] This strategy requires 5% average renewable content based on the gasoline pool that is produced or imported, starting in 2010, and 2% average renewable content in diesel fuel and heating oil (distillate) by 2012. The Canada Gazette indicates that the 2% renewable content in diesel fuel and heating oil is equivalent to 5% renewable content in on-road diesel use. (See http://canadagazette.gc.ca/partI/2006/20061230/html/notice-e.html#i3)

- WCI Fuel Prices: The model is also driven by forecasts of fuel prices (oil, coal, natural gas). The model calculates electricity prices internally. Table B-3 shows the fuel price forecast used in the Reference Case. This forecast is taken from the Energy Information Agency's Annual Energy Outlook 2008 high price series. State- and province-specific prices are derived in the model from the prices shown in this table.

**Table B-3: Fuel Price Forecast**

| | 2006 | 2010 | 2015 | 2020 |
|---|---|---|---|---|
| World Oil Price (2007 US$/barrel) | 64.32 | 76.22 | 86.92 | 97.90 |
| Natural Gas Wellhead Price (2007 US$/mmBtu) | 6.93 | 7.50 | 7.13 | 7.29 |
| Coal Prices (2007 US$/ton) | 25.33 | 26.91 | 24.78 | 24.29 |
| Source: EIA Annual Energy Outlook 2008 high price series. | | | | |

- First Jurisdictional Deliverer: All cases incorporate a proxy to represent First Jurisdictional Deliverer. Consequently, emissions from electricity imported into the WCI partner jurisdictions from outside the WCI partner jurisdictions are included in the analysis.
- Allowance Banking: The model enables allowances to be banked when allowance prices are low, and for allowances to be used from the bank when allowance prices are high. Attachment 1 discusses the parameters used to model allowance banking.
- Coal Plants: The cases allow no new coal plants to be built by 2020 in the WECC beyond those already planned and committed. See Appendix F of the *Assumptions Book for ENERGY 2020* for the list of coal plants that are assumed to be planned and committed.
- Nuclear Plants: The cases assume no new nuclear plants to be built by 2020 in the WECC.
- Carbon capture and storage: Carbon capture and storage is assumed not feasible for electric power generation through 2020.
- Hydropower: The cases assume no new hydropower capacity built in the WECC by 2020.
- Plug-in hybrids: The cases assume that plug-in hybrid and electric vehicles are not available in significant numbers through 2020.
- Electrical Generation Costs: The modeling effort relies on estimates of power generation capital costs, operating costs, and heat rates developed for a recent study for the California Public utilities Commission (see Table B-4).
- Macroeconomic estimates: This phase of the analysis does not include macroeconomic analysis.

**Table B-4: Summary of Power Generation Cost Inputs**

| Technology | Total Capital Costs $/kW | Fixed O&M ($/kW-yr) | Variable O&M ($/MWh) | Capacity Factor | Nominal Heat Rate |
|---|---|---|---|---|---|
| Biogas | $2,623 | 107.5 | 0.01 | 85% | 11,566 |
| Biomass | $3,836 | 50.18 | 2.96 | 85% | 15,509 |
| Geothermal | $3,575 | 154.92 | - | 90% | - |
| Hydro - Small | $2,530 | 13.14 | 3.3 | 50% | - |
| Solar - Thermal | $2,840 | 49.63 | - | 40% | - |
| Wind | $1,983 | 28.51 | - | 37% | - |
| Coal ST | $2,671 | 25.91 | 4.32 | 85% | 8,844 |
| Coal IGCC | $3,087 | 36.36 | 2.75 | 85% | 8,309 |
| Coal IGCC with CCS | $5,127 | 42.82 | 4.18 | 85% | 9,713 |
| Gas CCCT | $878 | 11.04 | 2.4 | 90% | 6,917 |
| Gas CT | $794 | 11.4 | 3.36 | 5% | 10,807 |
| Hydro - Large | $2,530 | 13.14 | 3.3 | 50% | - |
| Nuclear | $4,999 | 63.88 | 0.47 | 85% | 10,400 |
| <5MW CHP | $1,952 | 11.04 | 2.4 | 40.5% | 9,700 |
| >5MW CHP | $1,259 | 11.04 | 2.4 | 85% | 9,220 |

Cost Basis Year = 2005. All estimates are 2008 U.S. dollars.
Source: E3 GHG Calculator v2b, tab "Gen Cost". Available at:
http://www.ethree.com/GHG/GHG%20Calculator%20v2b.zip

## Outputs

The model results include estimates of energy use, GHG emissions, electricity generation, fuel prices, and costs. The following are brief explanations of the model results that are shown for the cases analyzed.

- Greenhouse Gas (GHG) Emissions: GHG emissions are presented in millions of metric tons of carbon dioxide equivalent ($MMTCO_2e$). Emissions for the eight WCI partner jurisdictions included in the analysis are presented by major sector.
- Compliance Summary: The Compliance Summary shows how GHG emissions are reduced to achieve the WCI partners' regional emissions goal of a 15% reduction from 2005 levels by 2020. The Compliance Summary shows a Compliance Total, which is the calculated emissions minus offsets used and adjusted for any allowances that are banked or that are used from the bank. The running total of emission allowances banked is also reported. The Compliance Total also considers changes in emissions in the non-WCI WECC power sector. The WCI cap-and-trade policies and complementary policies will affect GHG emissions from power generated in the non-WCI WECC states and provinces.

The change in these emissions are also included in the Compliance Total. To make this calculation, emissions associated with power imported into the WCI jurisdictions are estimated at 70 million tons per year. This estimate is preliminary, and is based on an assessment of recent power flows and emissions factors. Given the uncertainty in the estimate of these emissions, as well as the imperfect manner in which the First Jurisdictional Deliverer (FJD) policy is represented in the model, the reduction in emissions from the non-WCI WECC power sector counted toward the Compliance Total is limited to no more than 45 million tons in any year. Using this limit, the potential emission reduction from the non-WCI WECC power sector may be underestimated, thereby making the model evaluate a more stringent program than may be required in some cases. The Compliance Total is compared to 2006 emissions calculated in the model to estimate the emission reduction. In all the cases presented below, the compliance total shows approximately a 15% reduction in total economy wide emissions in 2020 relative to 2006. As discussed above, the estimates include only the eight WCI partner jurisdictions in the WECC.

- Total Energy Use: Total energy use is reported by fuel type and by major sector in units of TBtu/year.
- Electric Sector: Outputs for the electric sector include:
    - Generation Capacity in units of megaWatts (MW) by generation type. Note that estimated generation capacity grows due to capacity additions, but capacity retirement is not calculated. Consequently, generation capacity does not decline in the model outputs.
    - Generation Output in units of gigaWatt-hours per year (GWh/year) by generation type. The generation output is for the eight WCI partner jurisdictions in the WECC.
    - Electricity Sales in units of GWh/year, including electricity imports into the eight WCI partner jurisdictions in the WECC.
- Transportation Sector: Outputs for the transportation sector include vehicle miles traveled for passenger and freight vehicles, as well as miles traveled per passenger. The fleet average efficiency is reported for four vehicle types in miles per gallon.
- Fuel Prices: Fuel prices are reported for electricity, natural gas, coal, fuel oil, LPG, gasoline, and diesel in 2007 dollars per million Btu (2007 $/mmBtu). The prices include the forecasted energy prices (presented in Table B-3 above for the reference case and other tables below for the sensitivity cases) as well as the costs of delivering the fuels to market. The prices reported for the cap-and-trade policy cases also include the calculated allowance price, reflecting the appropriate carbon content of the fuel.
- Costs and Savings: Costs and savings are reported in millions of 2007 dollars per year ($M/Yr). Fuel Expenditures are reported by major sector, showing changes in expenditures from the Reference Case. These estimates of fuels expenditures do not include the value of the calculated allowance price, so a separate table of total allowance value is presented (equal to emissions times the allowance price). The allowance values reported by sector do not consider that the full allowance value may not be passed

through to consumers. Consequently, the allowance value by sector is reported as "potential" allowance value, recognizing that a portion of the allowance value may be borne by producers and not passed through to consumers. Total Costs are also reported by major sector, which are the sum of changes in fuel expenditures and changes in investment costs. Investment costs increase as more efficient devices, buildings, and processes are purchased in response to the limit on GHG emissions. The investment costs are annualized using a 5% real discount rate over the life of the equipment. The annualize costs are counted each year over the life of the equipment. The estimates of Total Costs include both the change in fuel expenditures and the change in investment costs. As shown in the tables below, the fuel expenditure savings typically offset most or all of the increased investment costs.

Results are shown only for the total of the eight WCI partners included in the analysis. State and province specific results are not included.

## Reference Case

This section presents the results of the Reference Case. This case represents the future through 2020 in the absence of the WCI cap-and-trade program and related complementary GHG emission reduction policies. Table B-5 through Table B-10 show model outputs for:

- GHG emissions;
- energy use;
- electric sector results;
- transport sector results;
- fuel prices; and
- fuel expenditures.

Each table shows total results for the eight WCI Partners in the WECC. The three Canadian provinces not included in this analysis (Manitoba, Quebec, and Ontario) will be included in future modeling efforts.

Each table shows results for 2006 (the first year simulated by ENERGY 2020), 2010, 2015, and 2020. The growth rate reported for 2006-2020 is the average annual rate of exponential growth between the 2006 level and the 2020 level.

**Table B-5: Reference Case Greenhouse Gas Emissions: Eight WCI Partners**

| **GHG Emissions** *(MMTCO2E)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
|---|---|---|---|---|---|
| Residential | 49.7 | 53.7 | 58.4 | 63.1 | 1.7% |
| Commercial | 29.3 | 30.5 | 30.7 | 31.8 | 0.6% |
| Energy Intensive Industry | 176.8 | 174.5 | 181.5 | 191.0 | 0.6% |
| Other Industry | 29.8 | 30.3 | 30.5 | 31.0 | 0.3% |
| Passenger Transport | 290.8 | 299.4 | 303.9 | 294.0 | 0.1% |
| Freight Transport | 93.0 | 89.6 | 89.9 | 91.7 | -0.1% |
| Power Sector | 176.6 | 166.8 | 160.0 | 176.9 | 0.0% |
| Waste & Wastewater | 25.6 | 29.1 | 34.2 | 38.4 | 2.9% |
| Agriculture (non-energy) | 59.9 | 62.1 | 67.5 | 74.9 | 1.6% |
| **Total** | **931.6** | **936.1** | **956.6** | **992.8** | **0.5%** |

**Table B-6: Reference Case Energy Use: Eight WCI Partners**

| **Total Energy Use** *(TBtu/year)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
|---|---|---|---|---|---|
| Aviation Fuel | 609 | 637 | 683 | 725 | 1.3% |
| Biomass | 443 | 429 | 453 | 493 | 0.8% |
| Coal | 1,185 | 1,215 | 1,204 | 1,259 | 0.4% |
| Diesel | 1,091 | 1,051 | 1,032 | 1,025 | -0.4% |
| Ethanol | 85 | 173 | 335 | 480 | 13.2% |
| Landfill Gas | 29 | 29 | 29 | 29 | 0.2% |
| LPG | 231 | 240 | 256 | 282 | 1.4% |
| Gasoline | 3,303 | 3,313 | 3,256 | 3,053 | -0.6% |
| Natural Gas | 3,947 | 3,779 | 3,733 | 4,018 | 0.1% |
| Nuclear | 658 | 658 | 658 | 658 | 0.0% |
| Oil, Unspecified | 695 | 688 | 692 | 714 | 0.2% |
| Other | 2,902 | 2,949 | 3,092 | 3,349 | 1.0% |
| **Total** | **15,178** | **15,161** | **15,422** | **16,086** | **0.4%** |

| **Total Energy Use** *(TBtu/year)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
|---|---|---|---|---|---|
| Residential | 1,638 | 1,772 | 1,938 | 2,119 | 1.9% |
| Commercial | 1,357 | 1,388 | 1,425 | 1,521 | 0.8% |
| Energy Intensive Industry | 2,508 | 2,383 | 2,324 | 2,332 | -0.5% |
| Other Industry | 1,015 | 1,033 | 1,064 | 1,107 | 0.6% |
| Agriculture | 140 | 127 | 114 | 104 | -2.1% |
| Passenger Transportation | 3,998 | 4,131 | 4,252 | 4,201 | 0.4% |
| Freight Transportation | 1,219 | 1,183 | 1,208 | 1,251 | 0.2% |
| Waste & Wastewater | - | - | - | - | #N/A |
| Power Sector | 3,302 | 3,143 | 3,097 | 3,450 | 0.3% |
| **Total** | **15,178** | **15,161** | **15,422** | **16,086** | **0.4%** |

**Table B-7: Reference Case Electric Sector Results: Eight WCI Partners**

| **Generation Capacity** *(MW)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
|---|---|---|---|---|---|
| Gas/Oil | 62,973 | 72,139 | 78,999 | 88,519 | 2.5% |
| Coal | 14,972 | 15,372 | 15,372 | 15,372 | 0.2% |
| Nuclear | 9,330 | 9,330 | 9,330 | 9,330 | 0.0% |
| Hydro | 61,721 | 63,374 | 63,428 | 63,508 | 0.2% |
| Landfill Gas/EFW | 338 | 347 | 347 | 347 | 0.2% |
| Wind | 4,083 | 6,827 | 18,575 | 24,513 | 13.7% |
| Other | 4,358 | 4,537 | 5,572 | 6,582 | 3.0% |
| **Total** | **157,776** | **171,925** | **191,623** | **208,172** | **2.0%** |
| **Generation Output** *(GWh/year)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Gas/Oil | 143,907 | 130,579 | 128,042 | 164,782 | 1.0% |
| Coal | 99,280 | 100,482 | 98,019 | 101,454 | 0.2% |
| Nuclear | 65,072 | 65,072 | 65,072 | 65,072 | 0.0% |
| Hydro | 256,243 | 267,713 | 268,095 | 268,661 | 0.3% |
| Landfill Gas/EFW | 2,036 | 2,088 | 2,088 | 2,088 | 0.2% |
| Wind | 8,733 | 16,245 | 48,811 | 65,273 | 15.5% |
| Other | 23,554 | 24,607 | 30,770 | 36,219 | 3.1% |
| **Total** | **598,824** | **606,784** | **640,897** | **703,548** | **1.2%** |

| **Sales** (GWh/year) | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
|---|---|---|---|---|---|
| Residential | 202,826 | 218,623 | 240,918 | 267,908 | 2.0% |
| Commercial | 231,140 | 234,126 | 245,573 | 270,164 | 1.1% |
| Industrial | 163,747 | 161,434 | 167,796 | 187,146 | 1.0% |
| Transportation | 4,864 | 6,728 | 7,908 | 8,461 | 4.0% |
| Street Lights/Misc. | 16,447 | 16,447 | 16,447 | 16,447 | 0.0% |
| Resale | - | - | - | - | #N/A |
| **Total Sales** | **619,023** | **637,357** | **678,642** | **750,126** | **1.4%** |

**Table B-8: Reference Case Transportation Sector Results: Eight WCI Partners**

| **Distance Travelled (millions of vehicle miles travelled)** | | | | | |
|---|---|---|---|---|---|
| | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Passenger | 556,055 | 589,783 | 635,948 | 678,750 | 1.4% |
| Freight | 72,562 | 73,248 | 77,423 | 82,189 | 0.9% |
| Passenger: Miles/person | 8,755 | 8,781 | 8,847 | 8,844 | 0.1% |
| **Vehicle Efficiency (miles/gallon)** | | | | | |
| | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Light Gas Vehicles | 23.2 | 24.1 | 25.5 | 28.5 | 1.5% |
| Medium Gas Vehicles | 23.2 | 24.1 | 25.5 | 28.4 | 1.5% |
| Heavy Gas Vehicles | 16.9 | 17.3 | 18.5 | 20.4 | 1.4% |
| Heavy Diesel Vehicles | 16.9 | 17.3 | 18.4 | 20.3 | 1.3% |
| Vehicle efficiency represents a fleet-wide average, not the average for new vehicles. | | | | | |

**Table B-9: Reference Case Fuel Prices: Eight WCI Partners**

| **Prices** (2007 $/mmBtu) | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
|---|---|---|---|---|---|
| **Residential** | | | | | |
| Res Electricity Prices | 29.4 | 30.9 | 29.8 | 30.1 | 0.2% |
| Res Natural Gas Prices | 11.5 | 13.5 | 13.9 | 14.5 | 1.7% |
| Res Oil Prices | 21.0 | 23.3 | 24.0 | 25.5 | 1.4% |
| Res LPG Prices | 22.7 | 24.2 | 21.7 | 21.6 | -0.3% |
| **Commercial** | | | | | |
| Com Electricity Prices | 26.4 | 27.8 | 26.7 | 27.3 | 0.2% |
| Com Natural Gas Prices | 8.8 | 10.0 | 9.8 | 10.1 | 1.0% |
| Com Oil Prices | 23.1 | 25.0 | 24.0 | 24.6 | 0.4% |
| Com LPG Prices | 22.5 | 24.3 | 21.7 | 21.4 | -0.4% |
| **Industrial** | | | | | |
| Ind Electricity Prices | 16.3 | 17.1 | 15.5 | 15.4 | -0.4% |
| Ind Natural Gas Prices | 6.7 | 7.3 | 6.4 | 6.3 | -0.5% |
| Ind Coal Prices | 2.2 | 2.2 | 2.1 | 2.1 | -0.1% |
| Ind Oil Prices | 16.4 | 18.4 | 19.2 | 20.7 | 1.7% |
| Ind LPG Prices | 23.9 | 25.5 | 23.1 | 23.1 | -0.2% |
| **Transportation** | | | | | |
| Gasoline Prices | 21.9 | 24.1 | 26.0 | 28.0 | 1.8% |
| Diesel Prices | 21.8 | 24.0 | 25.8 | 27.7 | 1.7% |

**Table B-10: Reference Case Fuel Expenditures: Eight WCI Partners**

| **Annual Fuel Expenditures (Million$/Yr)** | | | | | |
|---|---|---|---|---|---|
| **Sector** | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Residential | 31,763 | 37,523 | 40,670 | 45,609 | 2.6% |
| Commercial | 28,452 | 31,306 | 31,632 | 35,373 | 1.6% |
| Energy Intensive Industry | 28,969 | 31,248 | 30,889 | 32,725 | 0.9% |
| Other Industry | 14,567 | 16,511 | 16,988 | 18,496 | 1.7% |
| Passenger Transportation | 82,031 | 93,848 | 103,830 | 110,035 | 2.1% |
| Freight Transportation | 28,315 | 30,055 | 32,280 | 35,567 | 1.6% |
| Agriculture | 3,140 | 3,142 | 2,819 | 2,848 | -0.7% |
| **Total** | **217,237** | **243,632** | **259,107** | **280,654** | **1.8%** |

## Cap-and-Trade Policy Cases

This section presents the results of three Cap-and-Trade Policy Cases:

- Broad Scope, with complementary policies and without offsets
- Broad Scope, with complementary policies and with offsets
- Narrow Scope, with complementary policies and with offsets

The narrow scope includes of the following:

- Electricity generation, including emissions from electricity imported into WCI jurisdictions from non-WCI jurisdictions
- Combustion at industrial and commercial facilities
- Industrial process emission sources, including oil and gas process emissions

The broad scope includes the emissions in the narrow scope plus the following:[10]

- Residential, commercial, and industrial fuel combustion at facilities with emissions below the WCI thresholds
- Transportation fuel combustion from gasoline and diesel

The banking of allowances is included in all three Policy Cases to simulate how allowances issued or auctioned in one year may be used in a later period. When allowance prices are low, allowances would likely be saved for use in a later year – which is referred to as being banked. When prices are high, allowances would be used from previous year, which is referred to as withdrawn from the bank. Attachment 1 explains how the model simulates banking and withdrawing of allowances.

Offsets are limited to 5% of the compliance obligation. The supply of offsets is modeled using an S-shaped curve that defines the portion of the offset limit that would be used as a function of allowance price. The analyses presented here limit the use of offsets to 5% of the annual compliance obligation, with an expected price of $20 per MTCO2e. Figure B-1 shows how the model simulates the use of offsets. At an allowance price of $20 per MTCO2e, approximately 58% of the offset limit is estimated to be used.

The Offsets Subcommittee is defining a process to develop offset supply curve data reflecting the availability and price of offsets under various offset policy assumptions. When available, those data would enable a more precise assessment to be conducted of the implications of policies that include offsets as a design feature.

The complementary policies have a substantial impact on the estimated emissions and costs. This analysis incorporates three broad sets of policies across all eight WCI partner jurisdictions in the analysis:

- Clean Car Standards, equivalent to California's Pavley I and II. These standards reduce emissions by about 30 MMTCO2E in 2020 compared to the Reference Case.

[10] For purposes of modeling the broad scope of the cap-and-trade program, the eight WCI partner jurisdictions included in the analysis are modeled with the broad scope starting in 2012. Note that British Columbia plans to use its carbon tax as an alternative policy for covering transportation fuels and residential/commercial fuels. This modeling effort, however, treats British Columbia the same as the other seven WCI partner jurisdictions included in the analysis.

- Programs that reduce total Vehicle Miles Traveled (VMT) by 2% from the forecast reference case by 2020. These programs reduce emissions by about 4 MMTCO2E when considered in addition to the Clean Car Standards.
- Aggressive energy efficiency programs that achieve a 1% reduction in the annual rate of electricity and natural gas demand growth. These programs reduce emissions by about 74 MMTCO2E in 2020 across all sectors.

We recognize that the WCI partner jurisdictions have climate action plans that reflect the specific opportunities and needs of the individual jurisdictions. In particular, they typically include policies that extend beyond the three included in this analysis. Based on the available time and resources for this study, as well as the focus on overall results for the WCI partner jurisdictions as a whole, the analysis is limited to reflecting these broad policies at this time.

By themselves the three complementary policies included in the analysis accomplish about 108 MMTCO2E of GHG reductions in 2020, which is about half of the reductions required from the Reference Case estimates in this analysis. Table B-11 shows the estimates for the transportation policies.

The complementary policies are modeled in conjunction with the cap-and-trade policies under the expectation that the cap-and-trade program can provide resources needed for supporting the VMT programs and the energy efficiency programs. In particular, the value of emission allowances (whether auctioned or provided for free) can be directed to support these programs.

**Figure B-1: Assumed Offset Supply Curve**

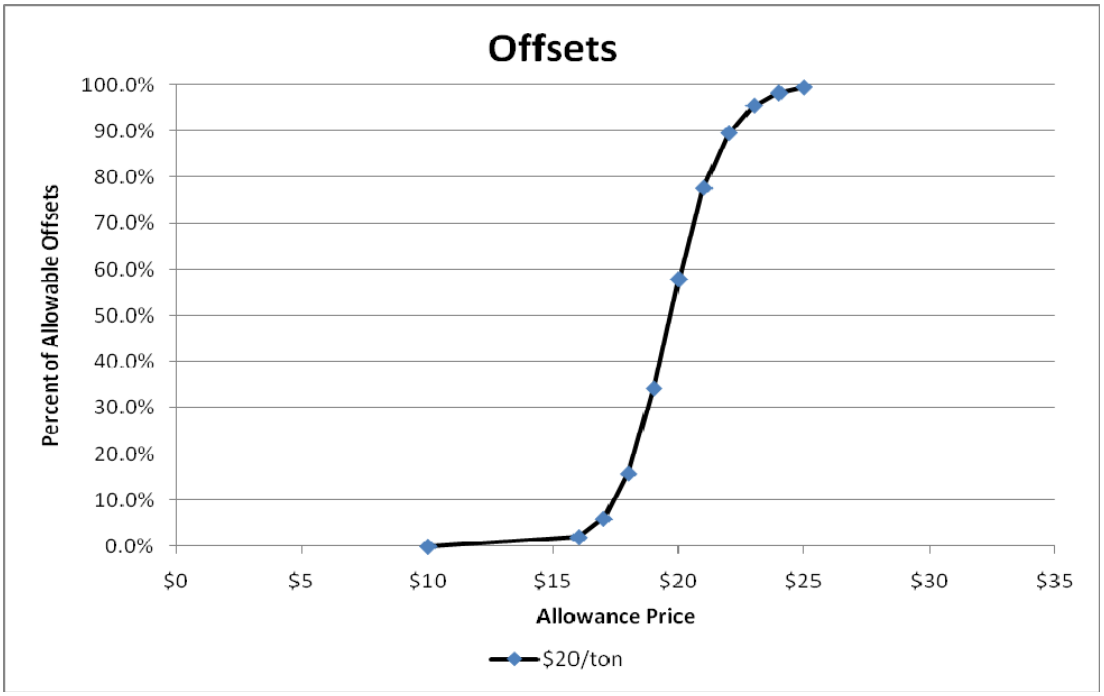


**Table B-11: Impact of Transportation Complementary Policies in 2020 Compared to the Reference Case: Eight WCI Partners**

| | Clean Car Standards | Clean Car Standards and VMT Reduction |
|---|---|---|
| Change in GHG Emissions (million tons) | -30.1 | -34.2 |
| Change in Annual Vehicle Miles Traveled/Person | 112 | -65 |
| Change in Annual Fuel Expenditures (million 2007$) | ($11,943) | ($13,549) |
| Change in Vehicle Capital Expenditures (million 2007$) | $10,325 | ($5,549) |
| Net Cost (Savings) (million 2007$) | ($1,618) | ($19,098) |
| Net cost does not include the cost of VMT Reduction programs. | | |

Table B-12 through Table B-19 show model outputs for these quantities:

- GHG emissions and compliance summary;
- energy use;
- electric sector results;
- transport sector results;
- fuel prices;
- fuel expenditures;
- potential allowance value; and
- costs.

Each table shows results for 2020 for eight WCI Partners, i.e., the seven states and British Columbia. As discussed above, the other three Canadian provinces will be included in future modeling efforts. For each policy case, the three columns indicate the Cap-and-Trade value for the quantity described in the left-most column, the difference between the Cap-and-Trade value and the Reference Case value, and the percentage difference between the two values.

Table B-16 shows fuel prices as a percent difference from Reference Case prices. Table B-19 shows the cost estimates, which only meaningful as incremental differences between the Cap-and-Trade value and the Reference Case value.

**Table B-12: Cap-and-Trade Cases Greenhouse Gas Emissions and Compliance Summary: Eight WCI Partners**

| **GHG Emissions in 2020** *(MMTCO2E)* | **Reference Case** | **Broad, Comp Policies No Offsets** | | | **Broad, Comp Policies With Offsets** | | | **Narrow, Comp Policies With Offsets** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Value | Diff from Reference | Percent Diff | Value | Diff from Reference | Percent Diff | Value | Diff from Reference | Percent Diff |
| Residential | 63.1 | 55.0 | -8.1 | -12.8% | 55.2 | -7.9 | -12.5% | 55.9 | -7.2 | -11.4% |
| Commercial | 31.8 | 26.2 | -5.6 | -17.5% | 26.4 | -5.4 | -17.1% | 27.0 | -4.8 | -15.0% |
| Energy Intensive Industry | 191.0 | 174.5 | -16.6 | -8.7% | 175.0 | -16.0 | -8.4% | 172.6 | -18.5 | -9.7% |
| Other Industry | 31.0 | 26.9 | -4.2 | -13.5% | 27.0 | -4.0 | -12.9% | 26.3 | -4.8 | -15.3% |
| Passenger Transport | 294.0 | 258.7 | -35.2 | -12.0% | 259.0 | -34.9 | -11.9% | 259.9 | -34.1 | -11.6% |
| Freight Transport | 91.7 | 89.9 | -1.7 | -1.9% | 90.4 | -1.3 | -1.4% | 91.7 | 0.0 | 0.0% |
| Power Sector | 176.9 | 114.6 | -62.2 | -35.2% | 131.5 | -45.3 | -25.6% | 104.8 | -72.1 | -40.7% |
| Waste & Wastewater | 38.4 | 38.4 | 0.0 | 0.0% | 38.4 | 0.0 | 0.0% | 38.4 | 0.0 | 0.0% |
| Agriculture (non-energy) | 74.9 | 74.9 | 0.0 | 0.0% | 74.9 | 0.0 | 0.0% | 71.1 | -3.7 | -5.0% |
| **WCI Sub-Total** | **992.8** | **859.2** | **-133.6** | **-13.5%** | **877.9** | **-114.9** | **-11.6%** | **847.8** | **-145.0** | **-14.6%** |
| Non-WCI Power Sector | 70.0 | 70.0 | | | 70.0 | | | 70.0 | | |
| Non-WCI Power Sector Reductions | | -45.0 | | | -37.0 | | | -45.0 | | |
| Offsets | | 0.0 | | | -31.8 | | | -18.2 | | |
| Bank Flow | | -31.1 | | | -31.8 | | | -0.2 | | |
| **Compliance Total** | | **853.1** | | | **847.2** | | | **854.3** | | |
| Percent of 2006 Emissions | | 85.2% | | | 84.6% | | | 85.3% | | |
| Bank Inventory | | 72.6 | | | 74.4 | | | 0.5 | | |
| **Allowance Price** (2007 $/MT) | | **$63** | | | **$24** | | | **$71** | | |
| All emissions in millions of metric tons. | | | | | | | | | | |

**Table B-13: Cap-and-Trade Cases Energy Use: Eight WCI Partners**

| | Reference Case | Broad, Comp Policies No Offsets | | | Broad, Comp Policies With Offsets | | | Narrow, Comp Policies With Offsets | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Value | Diff from Reference | Percent Diff | Value | Diff from Reference | Percent Diff | Value | Diff from Reference | Percent Diff |
| **Total Energy Use in 2020** *(TBtu/year)* | | | | | | | | | | |
| Aviation Fuel | 725 | 717.9 | (7.4) | -1.0% | 720 | (5) | -0.7% | 725 | - | 0.0% |
| Biomass | 493 | 449 | (44) | -8.9% | 448 | (45) | -9.1% | 452 | (41) | -8.3% |
| Coal | 1,259 | 758 | (502) | -39.8% | 1,043 | (217) | -17.2% | 618 | (642) | -50.9% |
| Diesel | 1,025 | 995 | (30) | -2.9% | 1,001 | (25) | -2.4% | 1,014 | (11) | -1.1% |
| Ethanol | 480 | 421 | (59) | -12.2% | 420 | (59) | -12.4% | 419 | (61) | -12.7% |
| Landfill Gas | 29 | 29 | (0) | 0.0% | 29 | 0 | 0.0% | 29 | (0) | 0.0% |
| LPG | 282 | 248 | (33) | -11.8% | 249 | (32) | -11.5% | 250 | (32) | -11.3% |
| Gasoline | 3,053 | 2,625 | (429) | -14.0% | 2,628 | (426) | -13.9% | 2,635 | (418) | -13.7% |
| Natural Gas | 4,018 | 3,245 | (774) | -19.3% | 3,075 | (944) | -23.5% | 3,296 | (722) | -18.0% |
| Nuclear | 658 | 658 | - | 0.0% | 658 | - | 0.0% | 658 | - | 0.0% |
| Oil, Unspecified | 714 | 686 | (27) | -3.8% | 688 | (26) | -3.6% | 687 | (27) | -3.8% |
| Other | 3,349 | 2,956 | (393) | -11.7% | 2,952 | (397) | -11.9% | 2,934 | (415) | -12.4% |
| **Total** | **16,086** | **13,788** | **(2,298)** | **-14.3%** | **13,911** | **(2,176)** | **-13.5%** | **13,718** | **(2,369)** | **-14.7%** |
| **Total Energy Use in 2020** (Tbtu/year) | | | | | | | | | | |
| Residential | 2,119 | 1,853 | (266) | -12.6% | 1,856 | (264) | -12.5% | 1,863 | (257) | -12.1% |
| Commercial | 1,521 | 1,259 | (262) | -17.2% | 1,260 | (261) | -17.2% | 1,265 | (256) | -16.8% |
| Energy Intensive Industry | 2,332 | 2,029 | (303) | -13.0% | 2,035 | (297) | -12.7% | 2,005 | (328) | -14.0% |
| Other Industry | 1,107 | 1,001 | (106) | -9.6% | 1,003 | (104) | -9.4% | 991 | (116) | -10.5% |
| Agriculture | 104 | 93 | (11) | -10.2% | 94 | (10) | -10.1% | 92 | (12) | -11.4% |
| Passenger Transportation | 4,201 | 3,698 | (503) | -12.0% | 3,702 | (499) | -11.9% | 3,712 | (489) | -11.6% |
| Freight Transportation | 1,251 | 1,229 | (22) | -1.8% | 1,235 | (16) | -1.3% | 1,251 | - | 0.0% |
| Waste & Wastewater | - | - | | | - | | | - | | |
| Power Sector | 3,450 | 2,626 | (824) | -23.9% | 2,727 | (724) | -21.0% | 2,539 | (912) | -26.4% |
| **Total** | **16,086** | **13,788** | **(2,298)** | **-14.3%** | **13,911** | **(2,176)** | **-13.5%** | **13,718** | **(2,369)** | **-14.7%** |

**Table B-14: Cap-and-Trade Cases Electric Sector Results: Eight WCI Partners**

| | Reference Case | Broad, Comp Policies No Offsets | | | Broad, Comp Policies With Offsets | | | Narrow, Comp Policies With Offsets | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Value | Diff from Reference | Percent Diff | Value | Diff from Reference | Percent Diff | Value | Diff from Reference | Percent Diff |
| **Generation Capacity in 2020** *(MW)* | | | | | | | | | | |
| Gas/Oil | 88,519 | 109,759 | 21,240 | 24.0% | 109,919 | 21,400 | 24.2% | 109,879 | 21,360 | 24.1% |
| Coal | 15,372 | 15,372 | - | 0.0% | 15,372 | - | 0.0% | 15,372 | - | 0.0% |
| Nuclear | 9,330 | 9,330 | - | 0.0% | 9,330 | - | 0.0% | 9,330 | - | 0.0% |
| Hydro | 63,508 | 63,471 | (37) | -0.1% | 63,471 | (37) | -0.1% | 63,462 | (46) | -0.1% |
| Landfill Gas/EFW | 347 | 347 | - | 0.0% | 347 | - | 0.0% | 347 | - | 0.0% |
| Wind | 24,513 | 22,943 | (1,570) | -6.4% | 22,945 | (1,569) | -6.4% | 22,721 | (1,792) | -7.3% |
| Other | 6,582 | 6,354 | (228) | -3.5% | 6,354 | (228) | -3.5% | 6,344 | (238) | -3.6% |
| **Total** | **208,172** | **227,576** | **19,405** | **9.3%** | **227,738** | **19,566** | **9.4%** | **227,456** | **19,284** | **9.3%** |
| **Generation Output 2020** (*GWh/year)* | | | | | | | | | | |
| Gas/Oil | 164,782 | 127,711 | (37,072) | -22.5% | 101,382 | (63,400) | -38.5% | 134,044 | (30,738) | -18.7% |
| Coal | 101,454 | 58,979 | (42,474) | -41.9% | 85,318 | (16,136) | -15.9% | 46,848 | (54,606) | -53.8% |
| Nuclear | 65,072 | 65,072 | - | 0.0% | 65,072 | - | 0.0% | 65,072 | - | 0.0% |
| Hydro | 268,661 | 268,398 | (263) | -0.1% | 268,398 | (263) | -0.1% | 268,337 | (324) | -0.1% |
| Landfill Gas/EFW | 2,088 | 2,088 | (0) | 0.0% | 2,088 | 0 | 0.0% | 2,088 | (0) | 0.0% |
| Wind | 65,273 | 60,920 | (4,353) | -6.7% | 60,925 | (4,348) | -6.7% | 60,305 | (4,968) | -7.6% |
| Other | 36,219 | 34,579 | (1,640) | -4.5% | 34,579 | (1,640) | -4.5% | 34,558 | (1,661) | -4.6% |
| **Total** | **703,548** | **617,746** | **(85,803)** | **-12.2%** | **617,761** | **(85,788)** | **-12.2%** | **611,251** | **(92,297)** | **-13.1%** |
| **Sales in 2020***(GWh/year)* | | | | | | | | | | |
| Residential | 267,908 | 232,745 | (35,163) | -13.1% | 232,447 | (35,462) | -13.2% | 230,725 | (37,183) | -13.9% |
| Commercial | 270,164 | 223,406 | (46,758) | -17.3% | 222,998 | (47,166) | -17.5% | 221,170 | (48,994) | -18.1% |
| Industrial | 187,146 | 162,812 | (24,333) | -13.0% | 162,071 | (25,075) | -13.4% | 162,118 | (25,027) | -13.4% |
| Transportation | 8,461 | 8,268 | (193) | -2.3% | 8,229 | (232) | -2.7% | 7,923 | (538) | -6.4% |
| Street Lights/Misc. | 16,447 | 16,447 | - | 0.0% | 16,447 | - | 0.0% | 16,447 | - | 0.0% |
| **Total Sales** | **750,126** | **643,678** | **(106,447)** | **-14.2%** | **642,191** | **(107,935)** | **-14.4%** | **638,383** | **(111,743)** | **-14.9%** |

**Table B-15: Cap-and-Trade Cases Transportation Sector Results: Eight WCI Partners**

| | Reference Case | Broad, Comp Policies No Offsets | | | Broad, Comp Policies With Offsets | | | Narrow, Comp Policies With Offsets | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Value | Diff from Reference | Percent Diff | Value | Diff from Reference | Percent Diff | Value | Diff from Reference | Percent Diff |
| **Distance Travelled in 2020** *(millions of vehicle miles travelled)* | | | | | | | | | | |
| Passenger | 678,750 | 672,238 | (6,512) | -1.0% | 672,665 | (6,085) | -0.9% | 673,720 | (5,031) | -0.7% |
| Freight | 82,189 | 81,516 | (673) | -0.8% | 81,715 | (474) | -0.6% | 82,189 | - | 0.0% |
| Passenger: Miles/person | 8,844 | 8,759 | (85) | -1.0% | 8,765 | (79) | -0.9% | 8,778 | (66) | -0.7% |
| **Vehicle Efficiency in 2020** *(miles/gallon)* | | | | | | | | | | |
| Light Gas Vehicles | 28.5 | 33 | 4 | 15.3% | 33 | 4 | 15.4% | 33 | 4 | 15.3% |
| Medium Gas Vehicles | 28.4 | 33 | 4 | 15.3% | 33 | 4 | 15.3% | 33 | 4 | 15.3% |
| Heavy Gas Vehicles | 20.4 | 24 | 4 | 17.4% | 24 | 4 | 17.5% | 24 | 4 | 17.5% |
| Heavy Diesel Vehicles | 20.3 | 24 | 4 | 17.5% | 24 | 4 | 17.5% | 24 | 4 | 17.5% |
| Vehicle efficiency represents a fleet-wide average, not the average for new vehicles. | | | | | | | | | | |

**Table B-16: Cap-and-Trade Cases Fuel Price Results: Eight WCI Partners**

| **Prices in 2020** (2007 $/mmBtu) | **Reference Case** | **Broad, Comp Policies No Offsets** | **Broad, Comp Policies With Offsets** | **Narrow, Comp Policies With Offsets** |
|---|---|---|---|---|
| | Price | Percent Diff | Percent Diff | Percent Diff |
| **Residential** | | | | |
| Res Electricity Prices | 30.1 | -0.3% | 1.0% | 12.7% |
| Res Natural Gas Prices | 14.5 | 31.4% | 12.2% | 1.0% |
| Res Oil Prices | 25.5 | 20.4% | 7.7% | -0.1% |
| Res LPG Prices | 21.6 | 14.6% | 5.6% | 0.0% |
| **Commercial** | | | | |
| Com Electricity Prices | 27.3 | -2.4% | -0.2% | 14.3% |
| Com Natural Gas Prices | 10.1 | 23.7% | 7.9% | -1.0% |
| Com Oil Prices | 24.6 | 4.9% | 2.1% | 0.4% |
| Com LPG Prices | 21.4 | 9.2% | 4.4% | 1.3% |
| **Industrial** | | | | |
| Ind Electricity Prices | 15.4 | 4.7% | 6.6% | 35.6% |
| Ind Natural Gas Prices | 6.3 | 19.2% | 7.1% | 20.2% |
| Ind Coal Prices | 2.1 | 167.4% | 64.3% | 182.4% |
| Ind Oil Prices | 20.7 | 17.2% | 6.5% | 19.4% |
| Ind LPG Prices | 23.1 | 6.2% | 2.9% | 7.0% |
| **Transportation** | | | | |
| Gasoline Prices | 28.0 | 17.4% | 6.6% | 0.0% |
| Diesel Prices | 27.7 | 16.8% | 6.4% | 0.0% |

**Table B-17: Cap-and-Trade Cases Fuel Expenditure Results: Eight WCI Partners**

| Annual Fuel Expenditures in 2020 (M$/Yr) | Reference Case | Broad, Comp Policies No Offsets | | | Broad, Comp Policies With Offsets | | | Narrow, Comp Policies With Offsets | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Value | Diff from Reference | Percent Diff | Value | Diff from Reference | Percent Diff | Value | Diff from Reference | Percent Diff |
| **Sector** | | | | | | | | | | |
| Residential | 45,609 | 39,918 | (5,691) | -12.5% | 40,244 | (5,365) | -11.8% | 43,138 | (2,471) | -5.4% |
| Commercial | 35,373 | 28,861 | (6,512) | -18.4% | 29,356 | (6,017) | -17.0% | 32,098 | (3,275) | -9.3% |
| Energy Intensive Industry | 32,725 | 29,018 | (3,707) | -11.3% | 29,119 | (3,606) | -11.0% | 29,831 | (2,894) | -8.8% |
| Other Industry | 18,496 | 17,001 | (1,495) | -8.1% | 17,062 | (1,434) | -7.8% | 17,977 | (519) | -2.8% |
| Passenger Transportation | 110,035 | 96,146 | (13,889) | -12.6% | 96,251 | (13,784) | -12.5% | 96,577 | (13,458) | -12.2% |
| Freight Transportation | 35,567 | 34,932 | (636) | -1.8% | 35,111 | (457) | -1.3% | 35,568 | 0 | 0.0% |
| Agriculture | 2,848 | 2,482 | (366) | -12.8% | 2,499 | (349) | -12.2% | 2,669 | (178) | -6.3% |
| **Total** | **280,654** | **248,358** | **(32,296)** | **-11.5%** | **249,641** | **(31,012)** | **-11.0%** | **257,859** | **(22,794)** | **-8.1%** |

**Table B-18: Cap-and-Trade Program Potential Allowance Value: Eight WCI Partners**

| Allowance Value in 2020 (M$) | Broad, Comp Policies No Offsets | Broad, Comp Policies With Offsets | Narrow, Comp Policies With Offsets |
|---|---|---|---|
| | Diff from Reference | Diff from Reference | Diff from Reference |
| **Sector** | | | |
| Residential | $3,445 | $1,321 | $0 |
| Commercial | $1,641 | $631 | $1,925 |
| Energy Intensive Industry | $10,922 | $4,188 | $12,293 |
| Other Industry | $1,681 | $647 | $1,873 |
| Passenger Transportation | $16,197 | $6,199 | $0 |
| Freight Transportation | $5,630 | $2,164 | $0 |
| Agriculture | $0 | $0 | $0 |
| **Total** | **39,516** | **15,150** | **16,092** |

Potential allowance value is calculated as the allowance price times the emissions in the sector. The full allowance value may not be incurred in each sector depending on the manner in which allowances are distributed and the ability to pass allowance costs to customers.

**Table B-19: Cap-and-Trade Cases Cost Results: Eight WCI Partners**

| Annualized Costs in 2020 (M$/Yr) | Broad, Comp Policies No Offsets | Broad, Comp Policies With Offsets | Narrow, Comp Policies With Offsets |
|---|---|---|---|
| | Diff from Reference | Diff from Reference | Diff from Reference |
| **Sector** | | | |
| Residential | (6,443) | (6,158) | (3,327) |
| Commercial | (7,845) | (7,369) | (4,760) |
| Energy Intensive Industry | 10,935 | 10,908 | 12,674 |
| Other Industry | 1,979 | 1,996 | 3,250 |
| Passenger Transportation | (20,988) | (20,511) | (19,005) |
| Freight Transportation | (722) | (522) | 0 |
| Agriculture | (442) | (425) | (254) |
| **Total** | **(23,525)** | **(22,080)** | **(11,422)** |

These costs do not include costs of VMT Reduction programs, Energy Efficiency programs, nor Potential Allowance Value.

## Sensitivity Cases

This section presents the results of three sensitivity cases. These cases consider alternatives to the energy prices and generation costs assumed in the Reference Case. The cases discussed here are:

- High Energy Prices and High Generation Costs
- Low Energy Price Case
- High Natural Gas Price Case

Other cases are also of interest, but time did not allow for development of input data for them to be modeled in a meaningful way.

For the first two of these sensitivity cases, it was necessary to produce a new Reference Case as well as a policy case. In these cases the policy is compared to its appropriate sensitivity Reference Case.

For all the sensitivity cases, the WCI policy case is for the broad scope with offsets. The sensitivities are variations of the assumptions embedded in the Reference Case, not variations of cap-and-trade policy design.

### High Energy Prices and High Generation Costs

The purpose of this sensitivity is to examine the implications of energy prices being higher than assumed in the Reference Case. There has been considerable stakeholder comment that the energy prices in the Reference Case may be too low. Additionally, some stakeholders have commented that the power generation cost assumptions maybe too low, indicating that the recent increases in commodity prices have had an impact on these costs.

This sensitivity includes both increased energy prices and increased power generation costs as a set of conditions that could occur together in the future. The high energy cost case assumes that energy prices start at current 2008 prices and increase in real terms by 50% by 2020, as shown in Table B-20. The high power generation cost case assumes that capital and operation and maintenance (O&M) costs are 30% higher than in the Reference Case.

**Table B-20: Fuel Price Forecast:**
**High Energy Prices and High Generation Costs Sensitivity Case**

| | 2006 | 2010 | 2015 | 2020 |
|---|---|---|---|---|
| World Oil Price (2007 US$/barrel) | 64.21 | 120.37 | 143.52 | 166.67 |
| Natural Gas Wellhead Price (2007 US$/mmBtu) | 5.97 | 11.12 | 13.26 | 15.40 |
| Coal Prices (2007 US$/ton) | 28.98 | 41.47 | 48.52 | 55.90 |

### Low Energy Price Case

The purpose of this sensitivity is to examine the implications of energy prices being lower than assumed in the Reference Case. While there has not been stakeholder comment suggesting that energy prices may be lower, it is prudent to examine the implications of

lower prices. The low energy price case uses the mid-price case from the Annual Energy Outlook 2008 (Table B-21).

**Table B-21: Fuel Price Forecast: Low Energy Price Sensitivity Case**

| | 2006 | 2010 | 2015 | 2020 |
|---|---|---|---|---|
| World Oil Price (2007 US$/barrel) | $64.21 | $71.60 | $57.88 | $57.74 |
| Natural Gas Wellhead Price (2007 US$/mmBtu) | $5.97 | $7.11 | $6.09 | $6.25 |
| Coal Prices (2007 US$/ton) | $25.37 | $26.66 | $23.53 | $22.33 |
| Source: EIA Annual Energy Outlook 2008 mid-price series. | | | | |

### High Natural Gas Price Case

The purpose of this sensitivity is to examine the implications of natural gas prices being higher than assumed in the Reference Case. There has been considerable stakeholder comment that efforts to reduce GHG emissions may increase the demand for natural gas. Consequently, the price of natural gas may increase as a result of the policies that are implemented to reduce emissions.

In the cases examined above, the demand for natural gas declines overall as a result of the complementary policies and the cap-and-trade program. Consequently, the policies examined in this analysis would not be expected to lead to an increase in natural gas prices. Nevertheless, this sensitivity was performed to examined the implications of higher natural gas prices.

To perform this sensitivity, the high natural gas price shown in Table B-20 was used with the cap-and-trade policy. The results were compared to the original Reference Case with the Reference Case natural gas prices. So, the natural gas prices are higher in the cap-and-trade case than in the Reference Case.

### Results

Table B-22 through Table B-29 show model outputs for 2020: Each table shows results for eight WCI Partners, i.e., the seven states and British Columbia. The other three provinces will be included in future modeling efforts.

For each policy case, the three columns indicate the relevant Reference Case value (because each policy case has a different Reference Case), Cap-and-Trade value for the quantity described in the left-most column, and the difference between the Cap-and-Trade value and its Reference value.

Table B-26 shows fuel prices as a percent difference from Reference prices. Table B-29 shows the costs, which are only meaningful as incremental differences between the Cap-and-Trade value and the appropriate Reference Case.

**Table B-22: Sensitivity Cases Greenhouse Gas Emissions and Compliance Summary: Eight WCI Partners**

| **GHG Emissions in 2020** *(MMTCO2E)* | **Original Reference Case** | **High Energy Prices & Generation Costs** | | | **Low Energy Prices** | | | **High Natural Gas Prices** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ref Case | Cap-Trade Case | Diff | Ref Case | Cap-Trade Case | Diff | Ref Case | Cap-Trade Case | Diff |
| Residential | 63.1 | 58.5 | 52.2 | -6.3 | 63.9 | 55.1 | -8.7 | 63.1 | 51.9 | -11.2 |
| Commercial | 31.8 | 28.0 | 23.9 | -4.1 | 32.1 | 26.2 | -5.9 | 31.8 | 23.7 | -8.1 |
| Energy Intensive Industry | 191.0 | 182.4 | 170.0 | -12.4 | 193.4 | 174.6 | -18.8 | 191.0 | 174.5 | -16.6 |
| Other Industry | 31.0 | 28.0 | 25.0 | -3.0 | 31.9 | 27.0 | -4.9 | 31.0 | 25.7 | -5.4 |
| Passenger Transport | 294.0 | 276.0 | 244.1 | -31.9 | 299.6 | 262.4 | -37.2 | 294.0 | 259.1 | -34.9 |
| Freight Transport | 91.7 | 79.0 | 78.5 | -0.5 | 100.2 | 95.9 | -4.3 | 91.7 | 90.7 | -1.0 |
| Power Sector | 176.9 | 166.5 | 126.2 | -40.3 | 177.1 | 102.4 | -74.7 | 176.9 | 126.6 | -50.2 |
| Waste & Wastewater | 38.4 | 38.4 | 38.4 | 0.0 | 38.4 | 38.4 | 0.0 | 38.4 | 38.4 | 0.0 |
| Agriculture (non-energy) | 74.9 | 74.9 | 74.9 | 0.0 | 74.9 | 74.9 | 0.0 | 74.9 | 74.9 | 0.0 |
| **WCI Sub-Total** | **992.8** | **931.8** | **833.3** | **-98.6** | **1011.4** | **857.0** | **-154.5** | **992.8** | **865.4** | **-127.4** |
| Non-WCI Power Sector | 70.0 | 70.0 | 70.0 | - | 70.0 | 70.0 | - | 70.0 | 70.0 | - |
| Non-WCI Power Sector Reductions | | | (42.4) | | | (45.0) | | | (45.0) | |
| Offsets | | | (12.7) | | | (34.1) | | | (26.6) | |
| Bank Flow | | | -0.2 | | | -0.1 | | | -11.7 | |
| **Compliance Total** | | | **847.9** | | | **847.8** | | | **852.1** | |
| Percent of 2006 Emissions | | | *84.7%* | | | *84.6%* | | | *85.1%* | |
| Bank Inventory | | | 30.8 | | | 0.1 | | | 168.4 | |
| **Allowance Price** (2007 $/MT) | | | **$18** | | | **$56** | | | **$20** | |
| All emissions in millions of metric tons. | | | | | | | | | | |

**Table B-23: Sensitivity Cases Energy Use Results: Eight WCI Partners**

| | Original Reference Case | High Energy Prices & Generation Costs | | | Low Energy Prices | | | High Natural Gas Prices | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ref Case | Cap-Trade Case | Diff | Ref Case | Cap-Trade Case | Diff | Ref Case | Cap-Trade Case | Diff |
| **Total Energy Use in 2020** (TBtu/year) | | | | | | | | | | |
| Aviation Fuel | 725 | 680 | 678 | (2) | 753 | 738 | (15) | 725 | 721 | (4) |
| Biomass | 493 | 528 | 469 | (59) | 495 | 448 | (47) | 493 | 456 | (37) |
| Coal | 1,259 | 1,223 | 1,055 | (168) | 1,252 | 609 | (642) | 1,259 | 1,100 | (160) |
| Diesel | 1,025 | 876 | 861 | (15) | 1,126 | 1,067 | (59) | 1,025 | 1,004 | (21) |
| Ethanol | 480 | 509 | 445 | (64) | 466 | 412 | (55) | 480 | 420 | (60) |
| Landfill Gas | 29 | 29 | 29 | 0 | 29 | 29 | (0) | 29 | 29 | (0) |
| LPG | 282 | 332 | 285 | (47) | 271 | 243 | (28) | 282 | 273 | (9) |
| Gasoline | 3,053 | 2,824 | 2,439 | (385) | 3,120 | 2,666 | (454) | 3,053 | 2,631 | (423) |
| Natural Gas | 4,018 | 3,478 | 2,687 | (791) | 4,065 | 3,252 | (813) | 4,018 | 2,641 | (1,378) |
| Nuclear | 658 | 658 | 658 | - | 658 | 658 | - | 658 | 658 | - |
| Oil, Unspecified | 714 | 681 | 662 | (19) | 757 | 714 | (43) | 714 | 706 | (7) |
| Other | 3,349 | 3,347 | 2,987 | (360) | 3,347 | 2,943 | (404) | 3,349 | 3,017 | (332) |
| **Total** | **16,086** | **15,164** | **13,255** | **(1,909)** | **16,340** | **13,780** | **(2,560)** | **16,086** | **13,656** | **(2,431)** |
| **Total Energy Use in 2020** (TBtu/year) | | | | | | | | | | |
| Residential | 2,119 | 2,028 | 1,802 | (226) | 2,135 | 1,854 | (281) | 2,119 | 1,803 | (316) |
| Commercial | 1,521 | 1,453 | 1,231 | (222) | 1,530 | 1,261 | (269) | 1,521 | 1,233 | (288) |
| Energy Intensive Industry | 2,332 | 2,205 | 1,963 | (242) | 2,361 | 2,029 | (332) | 2,332 | 2,004 | (328) |
| Other Industry | 1,107 | 1,050 | 968 | (82) | 1,118 | 1,000 | (118) | 1,107 | 976 | (131) |
| Agriculture | 104 | 95 | 88 | (8) | 108 | 95 | (13) | 104 | 91 | (13) |
| Passenger Transportation | 4,201 | 3,960 | 3,500 | (460) | 4,274 | 3,745 | (530) | 4,201 | 3,699 | (502) |
| Freight Transportation | 1,251 | 1,092 | 1,085 | (6) | 1,360 | 1,305 | (55) | 1,251 | 1,238 | (13) |
| Waste & Wastewater | - | - | - | - | - | - | - | - | - | - |
| Power Sector | 3,450 | 3,281 | 2,618 | (664) | 3,454 | 2,492 | (962) | 3,450 | 2,610 | (840) |
| **Total** | **16,086** | **15,164** | **13,255** | **(1,909)** | **16,340** | **13,780** | **(2,560)** | **16,086** | **13,656** | **(2,431)** |

**Table B-24: Sensitivity Cases Electric Sector Results: Eight WCI Partners**

| | Original Reference Case | High Energy Prices & Generation Costs | | | Low Energy Prices | | | High Natural Gas Prices | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ref Case | Cap-Trade Case | Diff | Ref Case | Cap-Trade Case | Diff | Ref Case | Cap-Trade Case | Diff |
| **Generation Capacity in 2020** *(MW)* | | | | | | | | | | |
| Gas/Oil | 88,519 | 89,519 | 106,599 | 17,080 | 86,239 | 108,759 | 22,520 | 88,519 | 136,359 | 47,840 |
| Coal | 15,372 | 15,372 | 15,372 | - | 15,372 | 15,372 | - | 15,372 | 15,372 | - |
| Nuclear | 9,330 | 9,330 | 9,330 | - | 9,330 | 9,330 | - | 9,330 | 9,330 | - |
| Hydro | 63,508 | 63,914 | 63,426 | (488) | 63,507 | 63,464 | (43) | 63,508 | 63,397 | (111) |
| Landfill Gas/EFW | 347 | 347 | 347 | - | 347 | 347 | - | 347 | 347 | - |
| Wind | 24,513 | 22,766 | 21,533 | (1,233) | 24,290 | 22,829 | (1,461) | 24,513 | 23,967 | (546) |
| Other | 6,582 | 6,695 | 6,330 | (365) | 6,646 | 6,384 | (262) | 6,582 | 6,343 | (239) |
| **Total** | **208,172** | **207,943** | **222,938** | **14,995** | **205,731** | **226,485** | **20,754** | **208,172** | **255,115** | **46,943** |
| **Generation Output 2020** (*GWh/year*) | | | | | | | | | | |
| Gas/Oil | 164,782 | 145,539 | 81,131 | (64,407) | 162,219 | 128,052 | (34,167) | 164,782 | 84,935 | (79,847) |
| Coal | 101,454 | 101,513 | 88,202 | (13,312) | 101,389 | 46,101 | (55,288) | 101,454 | 88,847 | (12,606) |
| Nuclear | 65,072 | 65,072 | 65,072 | - | 65,072 | 65,072 | - | 65,072 | 65,072 | - |
| Hydro | 268,661 | 271,519 | 268,082 | (3,437) | 268,649 | 268,349 | (300) | 268,661 | 267,877 | (784) |
| Landfill Gas/EFW | 2,088 | 2,088 | 2,088 | 0 | 2,088 | 2,088 | (0) | 2,088 | 2,088 | (0) |
| Wind | 65,273 | 60,428 | 57,011 | (3,417) | 64,654 | 60,603 | (4,051) | 65,273 | 63,758 | (1,515) |
| Other | 36,219 | 36,501 | 34,019 | (2,482) | 36,886 | 34,499 | (2,387) | 36,219 | 32,919 | (3,299) |
| **Total** | **703,548** | **682,659** | **595,605** | **(87,055)** | **700,956** | **604,763** | **(96,193)** | **703,548** | **605,496** | **(98,052)** |
| **Sales in 2020***(GWh/year)* | | | | | | | | | | |
| Residential | 267,908 | 267,531 | 233,815 | (33,717) | 267,625 | 232,186 | (35,439) | 267,908 | 235,623 | (32,286) |
| Commercial | 270,164 | 272,103 | 227,845 | (44,257) | 268,841 | 222,860 | (45,980) | 270,164 | 228,621 | (41,542) |
| Industrial | 187,146 | 186,028 | 163,446 | (22,582) | 185,238 | 160,256 | (24,983) | 187,146 | 164,351 | (22,795) |
| Transportation | 8,461 | 7,533 | 7,413 | (120) | 8,537 | 8,071 | (465) | 8,461 | 7,458 | (1,003) |
| Street Lights/Misc. | 16,447 | 16,447 | 16,447 | - | 16,447 | 16,447 | - | 16,447 | 16,447 | - |
| **Total Sales** | **750,126** | **749,642** | **648,966** | **(100,676)** | **746,687** | **639,820** | **(106,867)** | **750,126** | **652,500** | **(97,625)** |

**Table B-25: Sensitivity Cases Transportation Sector Results: Eight WCI Partners**

| | Original Reference Case | High Energy Prices & Generation Costs | | | Low Energy Prices | | | High Natural Gas Prices | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ref Case | Cap-Trade Case | Diff | Ref Case | Cap-Trade Case | Diff | Ref Case | Cap-Trade Case | Diff |
| **Distance Travelled in 2020** *(millions of vehicle miles travelled)* | | | | | | | | | | |
| Passenger | 678,750 | 663,044 | 659,404 | (3,640) | 686,691 | 677,633 | (9,058) | 678,750 | 672,895 | (5,855) |
| Freight | 82,189 | 77,505 | 77,301 | (205) | 85,286 | 83,768 | (1,518) | 82,189 | 81,805 | (384) |
| Passenger: Miles/person | 8,844 | 8,639 | 8,592 | (47) | 8,948 | 8,829 | (118) | 8,844 | 8,768 | (76) |
| **Vehicle Efficiency in 2020** *(miles/gallon)* | | | | | | | | | | |
| Light Gas Vehicles | 28.5 | 30.2 | 34.9 | 4.7 | 28.4 | 32.8 | 4.3 | 28.5 | 32.8 | 4.4 |
| Medium Gas Vehicles | 28.4 | 30.2 | 34.9 | 4.7 | 28.4 | 32.7 | 4.3 | 28.4 | 32.8 | 4.4 |
| Heavy Gas Vehicles | 20.4 | 20.6 | 24.2 | 3.6 | 20.5 | 24.0 | 3.6 | 20.4 | 24.0 | 3.6 |
| Heavy Diesel Vehicles | 20.3 | 20.4 | 24.0 | 3.6 | 20.3 | 23.9 | 3.6 | 20.3 | 23.9 | 3.5 |
| Vehicle efficiency represents a fleet-wide average, not the average for new vehicles. | | | | | | | | | | |

**Table B-26: Sensitivity Cases Fuel Price Results: Eight WCI Partners**

| Prices in 2020 (2007 $/mmBtu) | High Energy Prices & Generation Costs | | Low Energy Prices | | High Natural Gas Prices | |
|---|---|---|---|---|---|---|
| | Ref Price | Percent Diff | Ref Price | Percent Diff | Ref Price | Percent Diff |
| **Residential** | | | | | | |
| Res Electricity Prices | 37.5 | -4% | 29.0 | 10% | 30.1 | 12% |
| Res Natural Gas Prices | 22.8 | 6% | 13.4 | 31% | 14.5 | 68% |
| Res Oil Prices | 40.0 | 4% | 19.9 | 23% | 25.5 | 6% |
| Res LPG Prices | 21.7 | 4% | 21.6 | 13% | 21.6 | 5% |
| Commercial | | | | | | |
| Com Electricity Prices | 34.8 | -4% | 26.2 | 11% | 27.3 | 11% |
| Com Natural Gas Prices | 19.0 | 4% | 9.4 | 23% | 10.1 | 96% |
| Com Oil Prices | 43.3 | 1% | 22.5 | 7% | 24.6 | 2% |
| Com LPG Prices | 22.2 | 3% | 21.6 | 8% | 21.4 | 7% |
| **Industrial** | | | | | | |
| Ind Electricity Prices | 22.9 | -2% | 14.6 | 28% | 15.4 | 28% |
| Ind Natural Gas Prices | 16.4 | 2% | 5.9 | 17% | 6.3 | 169% |
| Ind Coal Prices | 5.1 | 20% | 2.1 | 148% | 2.1 | 52% |
| Ind Oil Prices | 35.0 | 3% | 15.0 | 21% | 20.7 | 4% |
| Ind LPG Prices | 23.5 | 2% | 23.2 | 6% | 23.1 | 4% |
| Transportation | | | | | | |
| Gasoline Prices | 40.7 | 3% | 20.7 | 21% | 28.0 | 6% |
| Diesel Prices | 40.6 | 3% | 20.6 | 20% | 27.7 | 5% |

**Table B-27: Sensitivity Cases Fuel Expenditure Results: Eight WCI Partners**

| **Annual Fuel Expenditures in 2020** (M$/Yr) | **Original Reference Case** | **High Energy Prices & Generation Costs** | | | **Low Energy Prices** | | | **High Natural Gas Prices** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ref Case | Cap-Trade Case | Diff | Ref Case | Cap-Trade Case | Diff | Ref Case | Cap-Trade Case | Diff |
| **Sector** | | | | | | | | | | |
| Residential | 45,609 | 59,685 | 51,704 | (7,981) | 43,546 | 40,351 | (3,195) | 45,609 | 49,857 | 4,247 |
| Commercial | 35,373 | 46,310 | 37,665 | (8,646) | 33,624 | 29,954 | (3,670) | 35,373 | 35,121 | (252) |
| Energy Intensive Industry | 32,725 | 45,447 | 40,833 | (4,614) | 28,528 | 25,567 | (2,961) | 32,725 | 34,487 | 1,762 |
| Other Industry | 18,496 | 26,917 | 24,680 | (2,237) | 15,624 | 14,919 | (705) | 18,496 | 19,811 | 1,315 |
| Passenger Transportation | 110,035 | 153,023 | 134,505 | (18,518) | 82,147 | 71,469 | (10,677) | 110,035 | 96,875 | (13,160) |
| Freight Transportation | 35,567 | 45,436 | 45,174 | (262) | 29,929 | 28,755 | (1,174) | 35,567 | 35,199 | (369) |
| Agriculture | 2,848 | 3,807 | 3,328 | (478) | 2,564 | 2,349 | (216) | 2,848 | 2,779 | (69) |
| **Total** | **280,654** | 380,625 | 337,889 | (42,736) | 235,962 | 213,364 | (22,598) | 280,654 | 274,129 | (6,525) |

**Table B-28: Sensitivity Cases Potential Allowance Value: Eight WCI Partners**

| Allowance Value in 2020 (M$) | High Energy Prices & Generation Costs | Low Energy Prices | High Natural Gas Prices |
|---|---|---|---|
| | Diff from Reference | Diff from Reference | Diff from Reference |
| **Sector** | | | |
| Residential | $925 | $3,064 | $1,031 |
| Commercial | $424 | $1,456 | $471 |
| Energy Intensive Industry | $3,013 | $9,705 | $3,468 |
| Other Industry | $443 | $1,502 | $510 |
| Passenger Transportation | $4,325 | $14,584 | $5,150 |
| Freight Transportation | $1,391 | $5,332 | $1,802 |
| Agriculture | $0 | $0 | $0 |
| **Total** | **10,521** | **35,642** | **12,434** |

Potential allowance value is calculated as the allowance price times the emissions in the sector. The full allowance value may not be incurred in each sector depending on the manner in which allowances are distributed and the ability to pass allowance costs to customers.

**Table B-29: Sensitivity Cases Cost Results: Eight WCI Partners**

| Annualized Costs in 2020 (M$/Yr) | High Energy Prices & Generation Costs | Low Energy Prices | High Natural Gas Prices |
|---|---|---|---|
| | Diff from Reference | Diff from Reference | Diff from Reference |
| **Sector** | | | |
| Residential | ($9,724) | ($3,749) | $4,833 |
| Commercial | ($12,158) | ($4,120) | ($1,394) |
| Energy Intensive Industry | $12,294 | $11,335 | $18,778 |
| Other Industry | $1,917 | $2,782 | $5,806 |
| Passenger Transportation | ($21,999) | ($20,845) | ($19,589) |
| Freight Transportation | ($298) | ($1,362) | ($423) |
| Agriculture | ($546) | ($287) | ($131) |
| **Total** | **($30,514)** | **($16,245)** | **$7,880** |

These costs do not include costs of VMT Reduction programs, Energy Efficiency programs, nor Potential Allowance Value.

## Summary Results

Table B-30 presents summary results for the cases presented above. The GHG emissions are reported for the eight WCI partner jurisdictions included in the analysis. Fuel Expenditures and Total Costs (Savings) are relative to the appropriate Reference Case. The potential value of allowances is shown assuming that the full allowance value is passed through to consumers. Total Costs (Savings) include Fuel Expenditures and annualized investment costs. All emissions are in MMTCO2E and all costs are in 2007 dollars.

**Table B-30: Summary Results for 2020: Eight WCI Partners**

| Case | GHG Emission (MMTCO2E) | Offsets Used (MMTCO2E) | Allowance Price (2007 $) | Change in Fuel Expenditures ($M/Yr) | Potential Allowance Value ($M/Yr) | Total Costs (Savings) ($M/Yr) |
|---|---|---|---|---|---|---|
| Reference Case | 992.8 | -- | -- | -- | -- | -- |
| **Cap-and-Trade Policy Cases** | | | | | | |
| Broad Scope, No Offsets | 859.2 | -- | $63 | (32,296) | 39,516 | (23,525) |
| Broad Scope, With Offsets | 877.9 | 31.8 | $24 | (31,012) | 15,150 | (22,080) |
| Narrow Scope, With Offsets | 847.8 | 18.2 | $71 | (22,794) | 16,092 | (11,422) |
| **Sensitivity Cases** | | | | | | |
| High Price | 833.3 | 12.7 | $18 | (42,736) | 10,521 | ($30,514) |
| Low Price | 857.0 | 34.1 | $56 | (22,598) | 35,642 | ($16,245) |
| High Natural Gas Price | 865.4 | 26.6 | $20 | (6,525) | 12,434 | $7,880 |

Fuel Expenditures and Total Costs (Savings) are changes from Reference Case values.

Potential Allowance Value calculated as emissions times allowance price.

Total Costs (Savings) do not include costs of VMT Reduction programs, Energy Efficiency programs, nor Potential Allowance Value.

## Attachment 1: Banking

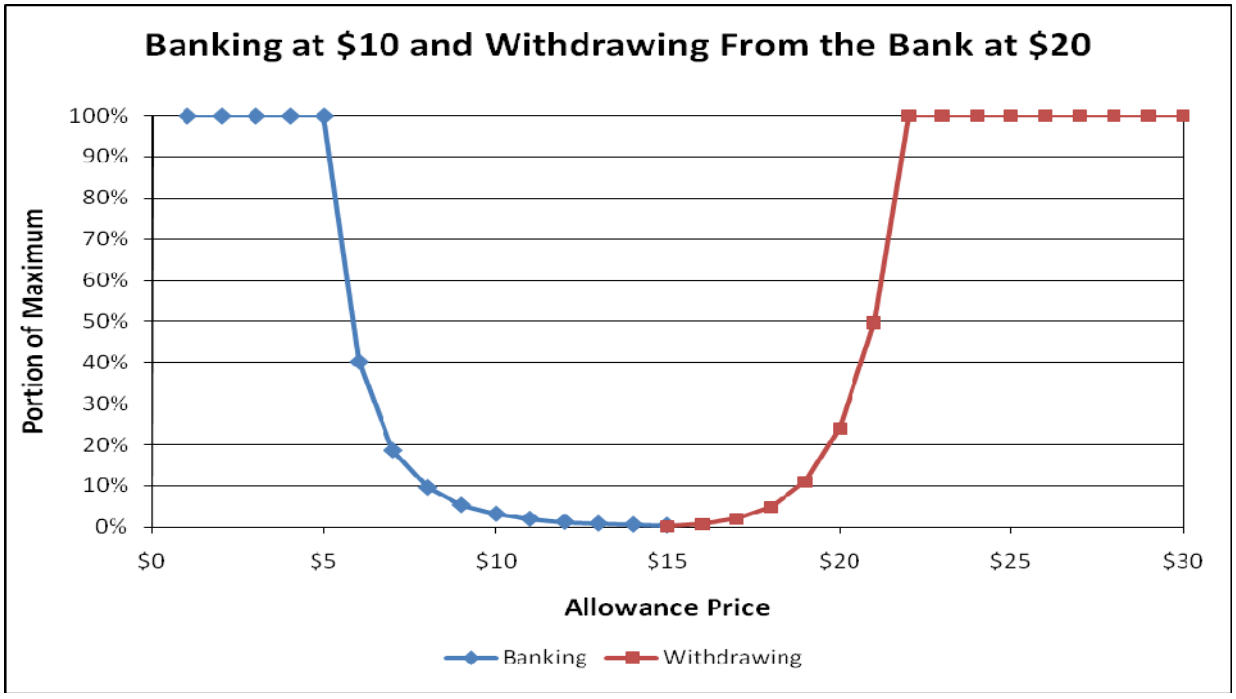
The purpose of banking is to enable allowances issued or auctioned in one year to be used in a later period. When allowance prices are low, allowances would likely be banked. When prices are high, allowances would be withdrawn from the bank. The model does not have the ability to optimize the banking behaviour in the market. Rather, banking is simulated using the following model input parameters:

- The price below which allowances are put into the bank.
- The maximum portion of emission allowances in a given year that can be banked.
- The price above which allowances are withdrawn from the bank.
- The maximum portion of the allowances in the bank in a given year that can be withdrawn.

Figure A-2 shows the banking and withdrawing curves used the cases presented here. The curves shown in the figure set the price below which allowances are banked at $10/ton. The price above which allowances are withdrawn from the bank is set at $20/ton.

The curves in the figure indicate the portion of the allowable banking and redeeming amounts that are simulated to be used. The recommended program design sets no limits on the amounts that can be banked. However, bounds are set in the model to better simulate behavior, particularly in the early years of the program when allowances prices are simulated to be low. The maximum amount put into the bank in a single year is limited to 10% of total allowances available in that year. The maximum amount withdrawn from the bank in a single year is limited to 30% of the allowances in the bank.

**Figure B-2: Banking Curves**



# Attachment 2: Detailed Cap-and-Trade Policy Results

This attachment shows the detailed results for two of the cap-and-trade program model runs:

- Broad Scope, with complementary policies and with offsets; and
- Narrow Scope, with complementary policies and with offsets.

### Cap-and-Trade Program: Broad Scope with Complementary Policies and Offsets

**Table B-31: Cap-and-Trade Program Greenhouse Gas Emissions and Compliance Summary: Eight WCI Partners Broad Scope with Complementary Policies and Offsets**

| | 2006 | 2010 | 2015 | 2020 | Growth Rate 2006-2020 |
|---|---|---|---|---|---|
| **GHG Emissions** *(MMTCO2E)* | | | | | |
| Residential | 49.7 | 53.6 | 54.7 | 55.2 | 0.8% |
| Commercial | 29.3 | 30.4 | 28.0 | 26.4 | -0.8% |
| Energy Intensive Industry | 176.8 | 174.0 | 172.2 | 175.0 | -0.1% |
| Other Industry | 29.8 | 30.2 | 28.5 | 27.0 | -0.7% |
| Passenger Transport | 290.8 | 291.7 | 276.5 | 259.0 | -0.8% |
| Freight Transport | 93.0 | 89.6 | 89.6 | 90.4 | -0.2% |
| Power Sector | 176.6 | 166.4 | 133.0 | 131.5 | -2.1% |
| Waste & Wastewater | 25.6 | 29.1 | 34.2 | 38.4 | 2.9% |
| Agriculture (non-energy) | 59.9 | 62.1 | 67.5 | 74.9 | 1.6% |
| **WCI Sub-Total** | **931.6** | **927.1** | **884.1** | **877.9** | **-0.4%** |
| **Compliance Summary** | | | | | |
| Non-WCI Power Sector | 70.0 | 70.0 | 70.0 | 70.0 | |
| Non-WCI Power Sector Reductions | - | (0.1) | (20.3) | (37.0) | |
| Offsets | - | - | - | (31.8) | |
| Bank Flow | 0.0 | 0.0 | 21.2 | -31.8 | |
| **Compliance Total** | **1,001.6** | **997.0** | **955.0** | **847.2** | |
| *Percent of 2006 Emissions* | *100.0%* | *99.5%* | *95.3%* | *84.6%* | |
| Bank Inventory | 0.0 | 0.0 | 107.4 | 74.4 | |
| **Allowance Price (2007 $/MT)** | **$0** | **$0** | **$6** | **$24** | |
| Percentage of Offsets Allowed | 5% | 5% | 5% | 5% | |
| **Percent Allowable Offsets Used** | | | **0%** | **100%** | |
| All emissions in million metric tons. | | | | | |

**Table B-32: Cap-and-Trade Program Energy Use: Eight WCI Partners**
**Broad Scope with Complementary Policies and Offsets**

| **Total Energy Use** *(TBtu/year)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
|---|---|---|---|---|---|
| Aviation Fuel | 609 | 637 | 682 | 720 | 1.2% |
| Biomass | 443 | 427 | 440 | 448 | 0.1% |
| Coal | 1,185 | 1,212 | 1,063 | 1,043 | -0.9% |
| Diesel | 1,091 | 1,048 | 1,021 | 1,001 | -0.6% |
| Ethanol | 85 | 165 | 298 | 420 | 12.1% |
| Landfill Gas | 29 | 29 | 29 | 29 | 0.2% |
| LPG | 231 | 239 | 242 | 249 | 0.5% |
| Gasoline | 3,303 | 3,219 | 2,920 | 2,628 | -1.6% |
| Natural Gas | 3,947 | 3,764 | 3,217 | 3,075 | -1.8% |
| Nuclear | 658 | 658 | 658 | 658 | 0.0% |
| Oil, Unspecified | 695 | 687 | 679 | 688 | -0.1% |
| Other | 2,902 | 2,944 | 2,892 | 2,952 | 0.1% |
| **Total** | **15,178** | **15,031** | **14,139** | **13,911** | **-0.6%** |
| **Total Energy Use** *(TBtu/year)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Residential | 1,638 | 1,769 | 1,813 | 1,856 | 0.9% |
| Commercial | 1,357 | 1,385 | 1,291 | 1,260 | -0.5% |
| Energy Intensive Industry | 2,508 | 2,374 | 2,151 | 2,035 | -1.5% |
| Other Industry | 1,015 | 1,031 | 1,011 | 1,003 | -0.1% |
| Agriculture | 140 | 127 | 107 | 94 | -2.8% |
| Passenger Transportation | 3,998 | 4,025 | 3,870 | 3,702 | -0.5% |
| Freight Transportation | 1,219 | 1,183 | 1,204 | 1,235 | 0.1% |
| Waste & Wastewater | - | - | - | - | #N/A |
| Power Sector | 3,302 | 3,137 | 2,693 | 2,727 | -1.4% |
| **Total** | **15,178** | **15,031** | **14,139** | **13,911** | **-0.6%** |

**Table B-33: Cap-and-Trade Program Electric Sector Results: Eight WCI Partners Broad Scope with Complementary Policies and Offsets**

| **Generation Capacity** *(MW)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
|---|---|---|---|---|---|
| Gas/Oil | 62,973 | 72,139 | 96,879 | 109,919 | 4.1% |
| Coal | 14,972 | 15,372 | 15,372 | 15,372 | 0.2% |
| Nuclear | 9,330 | 9,330 | 9,330 | 9,330 | 0.0% |
| Hydro | 61,721 | 63,374 | 63,444 | 63,471 | 0.2% |
| Landfill Gas/EFW | 338 | 347 | 347 | 347 | 0.2% |
| Wind | 4,083 | 6,827 | 17,979 | 22,945 | 13.1% |
| Other | 4,358 | 4,537 | 5,618 | 6,354 | 2.7% |
| **Total** | **157,776** | **171,925** | **208,969** | **227,738** | **2.7%** |
| **Generation Output** *(GWh/year)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Gas/Oil | 143,907 | 130,007 | 97,216 | 101,382 | -2.5% |
| Coal | 99,280 | 100,365 | 86,458 | 85,318 | -1.1% |
| Nuclear | 65,072 | 65,072 | 65,072 | 65,072 | 0.0% |
| Hydro | 256,243 | 267,713 | 268,207 | 268,398 | 0.3% |
| Landfill Gas/EFW | 2,036 | 2,088 | 2,088 | 2,088 | 0.2% |
| Wind | 8,733 | 16,245 | 47,160 | 60,925 | 14.9% |
| Other | 23,554 | 24,606 | 30,894 | 34,579 | 2.8% |
| **Total** | **598,824** | **606,095** | **597,095** | **617,761** | **0.2%** |
| **Sales** (GWh/year) | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Residential | 202,826 | 218,393 | 223,899 | 232,447 | 1.0% |
| Commercial | 231,140 | 233,974 | 220,827 | 222,998 | -0.3% |
| Industrial | 163,747 | 161,191 | 155,272 | 162,071 | -0.1% |
| Transportation | 4,864 | 6,663 | 7,729 | 8,229 | 3.8% |
| Street Lights/Misc. | 16,447 | 16,447 | 16,447 | 16,447 | 0.0% |
| Resale | - | - | - | - | #N/A |
| **Total Sales** | **619,023** | **636,669** | **624,174** | **642,191** | **0.3%** |

**Table B-34: Cap-and-Trade Program Transportation Sector Results: Eight WCI Partners Broad Scope with Complementary Policies and Offsets**

| **Distance Travelled** (millions of vehicle miles travelled) | | | | | |
|---|---|---|---|---|---|
| | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Passenger | 556,055 | 585,955 | 631,048 | 672,665 | 1.4% |
| Freight | 72,562 | 73,248 | 77,307 | 81,715 | 0.9% |
| Passenger: Miles/person | 8,755 | 8,724 | 8,779 | 8,765 | 0.0% |
| **Vehicle Efficiency** (miles/gallon) | | | | | |
| | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Light Gas Vehicles | 23.2 | 24.6 | 28.3 | 32.8 | 2.5% |
| Medium Gas Vehicles | 23.2 | 24.6 | 28.2 | 32.8 | 2.5% |
| Heavy Gas Vehicles | 16.9 | 17.8 | 20.8 | 24.0 | 2.5% |
| Heavy Diesel Vehicles | 16.9 | 17.8 | 20.8 | 23.9 | 2.5% |
| Vehicle efficiency represents a fleet-wide average, not the average for new vehicles. | | | | | |

**Table B-35: Cap-and-Trade Program Fuel Prices: Eight WCI Partners Broad Scope with Complementary Policies and Offsets**

| **Prices** (2007 $/mmBtu) | **2006** | **2010** | **2015** | **2020** |
|---|---|---|---|---|
| **Residential** | | | | |
| Res Electricity Prices | 29.4 | 30.9 | 29.7 | 30.4 |
| Res Natural Gas Prices | 11.5 | 13.5 | 14.4 | 16.3 |
| Res Oil Prices | 21.0 | 23.3 | 24.5 | 27.5 |
| Res LPG Prices | 22.7 | 24.2 | 22.0 | 22.8 |
| **Commercial** | | | | |
| Com Electricity Prices | 26.4 | 27.8 | 26.5 | 27.2 |
| Com Natural Gas Prices | 8.8 | 10.0 | 10.0 | 10.9 |
| Com Oil Prices | 23.1 | 25.0 | 24.2 | 25.1 |
| Com LPG Prices | 22.5 | 24.3 | 22.0 | 22.3 |
| **Industrial** | | | | |
| Ind Electricity Prices | 16.3 | 17.1 | 15.6 | 16.4 |
| Ind Natural Gas Prices | 6.7 | 7.4 | 6.6 | 6.7 |
| Ind Coal Prices | 2.2 | 2.2 | 2.5 | 3.5 |
| Ind Oil Prices | 16.4 | 18.4 | 19.6 | 22.0 |
| Ind LPG Prices | 23.9 | 25.5 | 23.3 | 23.8 |
| **Transportation** | | | | |
| Gasoline Prices | 21.9 | 24.1 | 26.5 | 29.8 |
| Diesel Prices | 21.8 | 24.0 | 26.3 | 29.5 |

**Table B-36: Cap-and-Trade Program Fuel Expenditures: Eight WCI Partners Broad Scope with Complementary Policies and Offsets**

| **Annual Fuel Expenditures** (M$/Yr) | | | | | |
|---|---|---|---|---|---|
| **Sector** | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Residential | 31,763 | 37,464 | 38,001 | 40,244 | 1.7% |
| Commercial | 28,452 | 31,263 | 28,475 | 29,356 | 0.2% |
| Energy Intensive Industry | 28,969 | 31,127 | 28,693 | 29,119 | 0.0% |
| Other Industry | 14,567 | 16,483 | 16,156 | 17,062 | 1.1% |
| Passenger Transportation | 82,031 | 91,324 | 93,969 | 96,251 | 1.1% |
| Freight Transportation | 28,315 | 30,055 | 32,173 | 35,111 | 1.5% |
| Agriculture | 3,140 | 3,140 | 2,625 | 2,499 | -1.6% |
| **Total** | **217,237** | **240,856** | **240,093** | **249,641** | **1.0%** |

**Table B-37: Cap-and-Trade Program Potential Allowance Value: Eight WCI Partners Broad Scope with Complementary Policies and Offsets**

| **Allowance Value** (M$) | | | | |
|---|---|---|---|---|
| **Sector** | **2006** | **2010** | **2015** | **2020** |
| Residential | $0 | $0 | $355 | $1,321 |
| Commercial | $0 | $0 | $182 | $631 |
| Energy Intensive Industry | $0 | $0 | $1,118 | $4,188 |
| Other Industry | $0 | $0 | $185 | $647 |
| Passenger Transportation | $0 | $0 | $1,794 | $6,199 |
| Freight Transportation | $0 | $0 | $581 | $2,164 |
| Agriculture | $0 | $0 | $0 | $0 |
| **Total** | **$0** | **$0** | **$4,215** | **$15,150** |

Potential allowance value is calculated as the allowance price times the emissions in the sector. The full allowance value may not be incurred in each sector depending on the manner in which allowances are distributed and the ability to pass allowance costs to customers.

**Table B-38: Cap-and-Trade Program Annualized Costs (Savings): Eight WCI Partners Broad Scope with Complementary Policies and Offsets**

| Annualized Cost (M$/Yr) (Change from Reference Case) | | | | |
|---|---|---|---|---|
| **Sector** | **2006** | **2010** | **2015** | **2020** |
| Residential | $0 | $331 | ($2,279) | ($6,158) |
| Commercial | $0 | ($37) | ($3,632) | ($7,369) |
| Energy Intensive Industry | $0 | $1,109 | $4,981 | $10,908 |
| Other Industry | $0 | $258 | $858 | $1,996 |
| Passenger Transportation | $0 | ($5,326) | ($15,388) | ($20,511) |
| Freight Transportation | $0 | ($0) | ($119) | ($522) |
| Agriculture | $0 | ($3) | ($231) | ($425) |
| **Total** | **$0** | **($3,668)** | **($15,810)** | **($22,080)** |
| These costs do not include costs of VMT Reduction programs, Energy Efficiency programs, nor Potential Allowance Value. | | | | |

## Cap-and-Trade Program: Narrow Scope with Complementary Policies and Offsets

**Table B-39: Cap-and-Trade Program Greenhouse Gas Emissions and Compliance Summary: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets**

| **GHG Emissions** *(MMTCO2E)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
|---|---|---|---|---|---|
| Residential | 49.7 | 53.6 | 54.8 | 55.9 | 0.9% |
| Commercial | 29.3 | 30.4 | 28.1 | 27.0 | -0.6% |
| Energy Intensive Industry | 176.8 | 174.0 | 171.4 | 172.6 | -0.2% |
| Other Industry | 29.8 | 30.2 | 28.3 | 26.3 | -0.9% |
| Passenger Transport | 290.8 | 291.7 | 276.8 | 259.9 | -0.8% |
| Freight Transport | 93.0 | 89.6 | 89.9 | 91.7 | -0.1% |
| Power Sector | 176.6 | 166.4 | 132.4 | 104.8 | -3.7% |
| Waste & Wastewater | 25.6 | 29.1 | 34.2 | 38.4 | 2.9% |
| Agriculture (non-energy) | 59.9 | 62.1 | 64.5 | 71.1 | 1.2% |
| **WCI Sub-Total** | **931.6** | **927.1** | **880.4** | **847.8** | **-0.7%** |
| **Compliance Summary** | | | | | |
| Non-WCI Power Sector Reductions | - | - | (21.3) | (45.0) | |
| Offsets | - | - | (11.7) | (18.2) | |
| Bank Flow | 0.0 | 0.0 | 0.0 | -0.2 | |
| **Compliance Total** | **1,001.6** | **997.1** | **917.4** | **854.3** | |
| *Percent of 2006 Emissions* | *100.0%* | *99.5%* | *91.6%* | *85.3%* | |
| Bank Inventory | 0.0 | 0.0 | 2.7 | 0.5 | |
| **Allowance Price (2007 $/MT)** | **$0** | **$0** | **$19** | **$71** | |
| Percentage of Offsets Allowed | 5% | 5% | 5% | 5% | |
| **Percent of Allowable Offsets Used** | | | **57%** | **100%** | |

**Table B-40: Cap-and-Trade Program Energy Use: Eight WCI Partners**
**Narrow Scope with Complementary Policies and Offsets**

| **Total Energy Use** *(TBtu/year)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
|---|---|---|---|---|---|
| Aviation Fuel | 609 | 637 | 683 | 725 | 1.3% |
| Biomass | 443 | 427 | 441 | 452 | 0.1% |
| Coal | 1,185 | 1,212 | 1,054 | 618 | -4.5% |
| Diesel | 1,091 | 1,048 | 1,024 | 1,014 | -0.5% |
| Ethanol | 85 | 165 | 298 | 419 | 12.1% |
| Landfill Gas | 29 | 29 | 29 | 29 | 0.2% |
| LPG | 231 | 239 | 242 | 250 | 0.5% |
| Gasoline | 3,303 | 3,219 | 2,923 | 2,635 | -1.6% |
| Natural Gas | 3,947 | 3,764 | 3,210 | 3,296 | -1.3% |
| Nuclear | 658 | 658 | 658 | 658 | 0.0% |
| Oil, Unspecified | 695 | 687 | 678 | 687 | -0.1% |
| Other | 2,902 | 2,944 | 2,889 | 2,934 | 0.1% |
| **Total** | **15,178** | **15,031** | **14,129** | **13,718** | **-0.7%** |
| **Total Energy Use** *(TBtu/year)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Residential | 1,638 | 1,769 | 1,815 | 1,863 | 0.9% |
| Commercial | 1,357 | 1,385 | 1,292 | 1,265 | -0.5% |
| Energy Intensive Industry | 2,508 | 2,374 | 2,141 | 2,005 | -1.6% |
| Other Industry | 1,015 | 1,031 | 1,008 | 991 | -0.2% |
| Agriculture | 140 | 127 | 107 | 92 | -2.9% |
| Passenger Transportation | 3,998 | 4,025 | 3,873 | 3,712 | -0.5% |
| Freight Transportation | 1,219 | 1,183 | 1,208 | 1,251 | 0.2% |
| Waste & Wastewater | - | - | - | - | #N/A |
| Power Sector | 3,302 | 3,137 | 2,685 | 2,539 | -1.9% |
| **Total** | **15,178** | **15,031** | **14,129** | **13,718** | **-0.7%** |

**Table B-41: Cap-and-Trade Program Electric Sector Results: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets**

| **Generation Capacity** *(MW)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
|---|---|---|---|---|---|
| Gas/Oil | 62,973 | 72,139 | 96,879 | 109,879 | 4.1% |
| Coal | 14,972 | 15,372 | 15,372 | 15,372 | 0.2% |
| Nuclear | 9,330 | 9,330 | 9,330 | 9,330 | 0.0% |
| Hydro | 61,721 | 63,374 | 63,444 | 63,462 | 0.2% |
| Landfill Gas/EFW | 338 | 347 | 347 | 347 | 0.2% |
| Wind | 4,083 | 6,827 | 17,979 | 22,721 | 13.0% |
| Other | 4,358 | 4,537 | 5,618 | 6,344 | 2.7% |
| **Total** | **157,776** | **171,925** | **208,969** | **227,456** | **2.6%** |
| **Generation Output** *(GWh/year)* | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Gas/Oil | 143,907 | 130,007 | 97,031 | 134,044 | -0.5% |
| Coal | 99,280 | 100,365 | 86,172 | 46,848 | -5.2% |
| Nuclear | 65,072 | 65,072 | 65,072 | 65,072 | 0.0% |
| Hydro | 256,243 | 267,713 | 268,207 | 268,337 | 0.3% |
| Landfill Gas/EFW | 2,036 | 2,088 | 2,088 | 2,088 | 0.2% |
| Wind | 8,733 | 16,245 | 47,160 | 60,305 | 14.8% |
| Other | 23,554 | 24,606 | 30,926 | 34,558 | 2.8% |
| **Total** | **598,824** | **606,095** | **596,656** | **611,251** | **0.1%** |
| **Sales** (GWh/year) | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Residential | 202,826 | 218,393 | 223,631 | 230,725 | 0.9% |
| Commercial | 231,140 | 233,974 | 220,504 | 221,170 | -0.3% |
| Industrial | 163,747 | 161,191 | 155,498 | 162,118 | -0.1% |
| Transportation | 4,864 | 6,663 | 7,691 | 7,923 | 3.5% |
| Street Lights/Misc. | 16,447 | 16,447 | 16,447 | 16,447 | 0.0% |
| Resale | - | - | - | - | #N/A |
| **Total Sales** | **619,023** | **636,669** | **623,771** | **638,383** | **0.2%** |

**Table B-42: Cap-and-Trade Program Transportation Sector Results: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets**

| **Distance Travelled** *(millions of vehicle miles travelled)* | | | | | |
|---|---|---|---|---|---|
| | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Passenger | 556,055 | 585,955 | 631,324 | 673,720 | 1.4% |
| Freight | 72,562 | 73,248 | 77,423 | 82,189 | 0.9% |
| Passenger: Miles/person | 8,755 | 8,724 | 8,782 | 8,778 | 0.0% |
| **Vehicle Efficiency** *(miles/gallon)* | | | | | |
| | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Light Gas Vehicles | 23.2 | 24.6 | 28.2 | 32.8 | 2.5% |
| Medium Gas Vehicles | 23.2 | 24.6 | 28.2 | 32.8 | 2.5% |
| Heavy Gas Vehicles | 16.9 | 17.8 | 20.8 | 24.0 | 2.5% |
| Heavy Diesel Vehicles | 16.9 | 17.8 | 20.8 | 23.9 | 2.5% |
| Vehicle efficiency represents a fleet-wide average, not the average for new vehicles. | | | | | |

**Table B-43: Cap-and-Trade Program Fuel Prices: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets**

| **Prices** (2007 $/mmBtu) | **2006** | **2010** | **2015** | **2020** |
|---|---|---|---|---|
| **Residential** | | | | |
| Res Electricity Prices | 29.4 | 30.9 | 30.4 | 33.9 |
| Res Natural Gas Prices | 11.5 | 13.5 | 14.0 | 14.6 |
| Res Oil Prices | 21.0 | 23.3 | 24.0 | 25.5 |
| Res LPG Prices | 22.7 | 24.2 | 21.7 | 21.6 |
| **Commercial** | | | | |
| Com Electricity Prices | 26.4 | 27.8 | 27.2 | 31.2 |
| Com Natural Gas Prices | 8.8 | 10.0 | 9.8 | 10.0 |
| Com Oil Prices | 23.1 | 25.0 | 24.0 | 24.7 |
| Com LPG Prices | 22.5 | 24.3 | 21.8 | 21.7 |
| **Industrial** | | | | |
| Ind Electricity Prices | 16.3 | 17.1 | 16.3 | 20.8 |
| Ind Natural Gas Prices | 6.7 | 7.4 | 6.8 | 7.5 |
| Ind Coal Prices | 2.2 | 2.2 | 3.3 | 6.0 |
| Ind Oil Prices | 16.4 | 18.4 | 20.3 | 24.7 |
| Ind LPG Prices | 23.9 | 25.5 | 23.6 | 24.7 |
| Transportation | | | | |
| Gasoline Prices | 21.9 | 24.1 | 26.0 | 28.0 |
| Diesel Prices | 21.8 | 24.0 | 25.8 | 27.7 |

**Table B-44: Cap-and-Trade Program Fuel Expenditures: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets**

| **Annual Fuel Expenditures** (M$/Yr) | | | | | |
|---|---|---|---|---|---|
| **Sector** | **2006** | **2010** | **2015** | **2020** | **Growth Rate 2006-2020** |
| Residential | 31,763 | 37,464 | 38,520 | 43,138 | 2.2% |
| Commercial | 28,452 | 31,263 | 28,989 | 32,098 | 0.9% |
| Energy Intensive Industry | 28,969 | 31,127 | 28,806 | 29,831 | 0.2% |
| Other Industry | 14,567 | 16,483 | 16,327 | 17,977 | 1.5% |
| Passenger Transportation | 82,031 | 91,324 | 94,072 | 96,577 | 1.2% |
| Freight Transportation | 28,315 | 30,055 | 32,280 | 35,568 | 1.6% |
| Agriculture | 3,140 | 3,140 | 2,661 | 2,669 | -1.2% |
| Total | 217,237 | 240,856 | 241,656 | 257,859 | 1.2% |

**Table B-45: Cap-and-Trade Program Potential Allowance Value: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets**

| **Allowance Value** (M$) | | | | |
|---|---|---|---|---|
| **Sector** | **2006** | **2010** | **2015** | **2020** |
| Residential | $0 | $0 | $0 | $0 |
| Commercial | $0 | $0 | $521 | $1,925 |
| Energy Intensive Industry | $0 | $0 | $3,176 | $12,293 |
| Other Industry | $0 | $0 | $524 | $1,873 |
| Passenger Transportation | $0 | $0 | $0 | $0 |
| Freight Transportation | $0 | $0 | $0 | $0 |
| Agriculture | $0 | $0 | $0 | $0 |
| **Total** | **$0** | **$0** | **$4,221** | **16,092** |

Potential allowance value is calculated as the allowance price times the emissions in the sector. The full allowance value may not be incurred in each sector depending on the manner in which allowances are distributed and the ability to pass allowance costs to customers.

**Table B-46: Cap-and-Trade Program Annualized Costs (Savings): Eight WCI Partners Narrow Scope with Complementary Policies and Offsets**

| **Annualized Cost** (M$/Yr) (Change from Reference Case) | | | | |
|---|---|---|---|---|
| **Sector** | **2006** | **2010** | **2015** | **2020** |
| Residential | $0 | $331 | ($1,771) | ($3,327) |
| Commercial | $0 | ($37) | ($3,144) | ($4,760) |
| Energy Intensive Industry | $0 | $1,109 | $5,237 | $12,674 |
| Other Industry | $0 | $258 | $1,085 | $3,250 |
| Passenger Transportation | $0 | ($5,326) | ($15,073) | ($19,005) |
| Freight Transportation | $0 | ($0) | $0 | $0 |
| Agriculture | $0 | ($3) | ($194) | ($254) |
| **Total** | **$0** | **($3,668)** | **($13,859)** | **($11,422)** |
| These costs do not include costs of VMT Reduction programs, Energy Efficiency programs, nor Potential Allowance Value. | | | | |

# Appendix C: General Q & A

## Western Climate Initiative

**Q: What is the Western Climate Initiative announcing today?**

The Western Climate Initiative (WCI) Partners today announced their proposed design of a regional market-based cap-and-trade program. This program is an important component of a comprehensive regional effort to reduce the pollution that causes global warming to 15 percent below 2005 levels by 2020.

**Q: What are the market design elements being released by the WCI?**

The WCI partners are recommending a multi-sector cap-and-trade program to reduce the pollution that causes global warming to 15% below 2005 levels by 2020. This program includes the following design parameters:

- A limit on the emissions from all major sources of global warming pollutants;
- Include under the cap all electricity-related emissions, including those associated with electricity imported from outside the WCI partner jurisdictions;
- Ensure that all regulated entities use a consistent reporting methodology; and
- Mitigate economic impacts on consumers and regulated entities by allowing flexibility in how and when the reductions are made (e.g., banking of allowances and the limited use of offsets).

**Q: How was the WCI market design developed?**

The release of the WCI design recommendations is the culmination of 18 months of extensive analysis, stakeholder consultation and deliberation by the WCI Partners. We will continue to consult with and seek input from the broad range of stakeholders who contributed to this process.

**Q: What are the next steps?**

The release of this market design program marks the culmination of 18 months of extensive analysis, stakeholder consultation and deliberation by the WCI Partners. This proposal will now be further developed by each WCI Partner with the objective of taking the steps necessary to implement the program.

The timeline agreed to by the WCI Partners is that each will begin reporting emissions in 2011 for emissions that occur in 2010. The first phase of the cap-and-trade program will begin on January 1, 2012, with a three-year compliance period. The second phase will begin in 2015, when the program is expanded to include transportation fuels and residential, commercial and industrial fuels.

**Q: What emissions sources are subject to the cap under the WCI agreement?**

The WCI cap-and-trade program covers the largest emitters from each state and province, including energy (electricity generation, natural gas and heating fuels), industrial emissions and transportation emissions.

**Q: How will emissions allowances be distributed under the WCI agreement?**

Each WCI Partner jurisdiction will have an emission allowance budget under the cap-and-trade program that is consistent with its jurisdiction-specific emissions goal for 2020. Each Partner has the flexibility to decide how best to allocate its allowance budget within its jurisdiction.

For instance, a Partner could "give" allowances to the emitters operating within its jurisdiction, "auction" the allowances to willing buyers, or provide for some combination of the two. The WCI design calls for a minimum auction level of 10% at the start of the program, increasing to at least 25% by 2020. Each jurisdiction may auction a higher percentage if it so chooses. In addition, the WCI Partners have agreed to use a portion of the allowance value for purposes with region-wide benefits, such as energy efficiency and low-carbon technology development.

**Q: How will compliance be determined under the WCI agreement?**

The bedrock of a cap-and-trade system is a rigorous emissions reporting requirement. The regulated sources are required to ensure the data are accurate and complete. Each WCI partner will require third party validation of reported emissions from entities and facilities that will be included under the cap.

The WCI agreement is consistent with previous well-designed cap-and-trade programs that have had compliance rates of over 99 percent. At the end of each compliance period, facilities and entities with emissions are required to submit the same number of emission allowances to the government as the emissions they had during that compliance period. If the facility or entity does not have sufficient emission allowances to cover its emissions, a "penalty" of three allowances will be assessed for each one they are short.

**Q: What are offsets? How are they handled under the WCI agreement?**

Offsets are reductions in greenhouse gas emissions from outside of the capped sectors, such as forestry and agriculture. Offset credits may be used, provided they meet rigorous criteria to ensure that emission reductions are real, verifiable, surplus/additional, permanent and enforceable. Offset credits may be traded. The WCI program limits the use of offsets for compliance purposes to ensure that a majority of the required emission reductions is achieved in the sources covered by the cap-and-trade program.

# Appendix E: List of Measures

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List of Measures

The following tables include only the Recommended Actions contained in the Scoping Plan. It is provided as a reference. For complete details of the measures, please see the applicable sector in Appendix C.

## Appendix E—List of Recommended Actions by Tons

**Table 1**

| Measure No. | Measure Description | GHG Reductions (MMTCO2E) |
|---|---|---|
| T-1 | Pavley I and II – Light-Duty Vehicle Greenhouse Gas Standards | 31.7 |
| GB-1 | Green Buildings | 26† |
| E-3 | Renewables Portfolio Standard (33% by 2020) | 21.3 |
| E-1 | Energy Efficiency (32,000 GWh of Reduced Demand)<br>• Increased Utility Energy Efficiency Programs<br>• More Stringent Building & Appliance Standards<br>Additional Efficiency and Conservation Programs | 15.2 |
| T-2 | Low Carbon Fuel Standard (Discrete Early Action) | 15 |
| H-6 | High GWP Reductions from Stationary Sources<br>• High GWP Stationary Equipment Refrigerant Management Program:<br>o Refrigerant Tracking/Reporting/ Repair Deposit Program<br>o Specifications for Commercial and Industrial Refrigeration Systems<br>• Foam Recovery and Destruction Program<br>• $SF_6$ Leak Reduction and Recycling in Electrical Applications<br>• Alternative Suppressants in Fire Protection Systems<br>• Residential Refrigeration Early Retirement Program | 10.9 |

List of Measures

| Measure No. | Measure Description | GHG Reductions (MMTCO2E) |
|---|---|---|
| RW-3 | High Recycling/Zero Waste<br>• Commercial Recycling<br>• Increase Production and Markets for Compost<br>• Anaerobic Digestion<br>• Extended Producer Responsibility<br>• Environmentally Preferable Purchasing | 9† |
| E-2 | Increase Combined Heat and Power Use by 30,000 GWh (Net reductions include avoided transmission line loss) | 6.7 |
| H-7 | Mitigation Fee on High GWP Gases | 5 |
| F-1 | Sustainable Forest Target | 5 |
| T-3[1] | Regional Transportation-Related Greenhouse Gas Targets | 5 |
| T-4 | Vehicle Efficiency Measures | 4.5 |
| CR-1 | Energy Efficiency (800 Million Therms Reduced Consumption)<br>• Utility Energy Efficiency Programs<br>• Building and Appliance Standards<br>• Additional Efficiency and Conservation Programs | 4.3 |
| T-6 | Goods Movement Efficiency Measures<br>• Ship Electrification at Ports<br>• System-Wide Efficiency Improvements | 3.5 |
| H-5 | High GWP Reductions from Mobile Sources<br>• Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems<br>• Air Conditioner Refrigerant Leak Test During Vehicle Smog Check<br>• Refrigerant Recovery from Decommissioned Refrigerated Shipping Containers<br>• Enforcement of Federal Ban on Refrigerant Release during Servicing or Dismantling of Motor Vehicle Air Conditioning Systems | 3.3 |

[1] This is not the SB 375 regional target. ARB will establish regional targets for each MPO region following the input of the regional targets advisory committee and a consultation process with MPO's and other stakeholders per SB 375.

| Measure No. | Measure Description | GHG Reductions (MMTCO2E) |
|---|---|---|
| E-4 | Million Solar Roofs (including California Solar Initiative, New Solar Homes Partnership and solar programs of publicly owned utilities)<br>• Target of 3000 MW Total Installation by 2020 | 2.1 |
| W-3 | Water System Energy Efficiency | 2.0† |
| W-1 | Water Use Efficiency | 1.4† |
| RW-1 | Landfill Methane Control (Discrete Early Action) | 1 |
| T-9 | High Speed Rail | 1 |
| A-1 | Methane Capture at Large Dairies | 1.0† |
| T-7 | Heavy-Duty Vehicle Greenhouse Gas Emission Reduction Measure - Aerodynamic Efficiency (Discrete Early Action) | 0.93 |
| I-3 | GHG Leak Reduction from Oil and Gas Transmission | 0.9 |
| W-5 | Increase Renewable Energy Production | 0.9† |
| T-8 | Medium- and Heavy-Duty Vehicle Hybridization | 0.5 |
| I-4 | Refinery Flare Recovery Process Improvements | 0.33 |
| H-2 | $SF_6$ Limits in Non-Utility and Non-Semiconductor Applications (Discrete Early Action) | 0.3 |
| W-2 | Water Recycling | 0.3† |
| H-1 | Motor Vehicle Air Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing (Discrete Early Action) | 0.26 |
| H-4 | Limit High GWP Use in Consumer Products Discrete Early Action (Adopted June 2008) | 0.25 |
| I-2 | Oil and Gas Extraction GHG Emission Reduction | 0.2 |
| W-4 | Reuse Urban Runoff | 0.2† |
| T-4 | Ship Electrification at Ports (Discrete Early Action) | 0.2 |
| H-3 | Reduction of Perfluorocarbons in Semiconductor Manufacturing (Discrete Early Action) | 0.15 |
| CR-2 | Solar Water Heating (AB 1470 goal) | 0.1 |
| I-5 | Removal of Methane Exemption from Existing Refinery Regulations | 0.01 |

List of Measures

| Measure No. | Measure Description | GHG Reductions (MMTCO2E) |
|---|---|---|
| RW-2 | Additional Reductions in Landfill Methane<br>• Increase the Efficiency of Landfill Methane Capture | TBD† |
| W-6 | Public Goods Charge (Water) | TBD† |
| I-1 | Energy Efficiency and Co-Benefits Audits for Large Industrial Sources | TBD |

†GHG emission reduction estimates are not included in calculating the total reductions needed to meet the 2020 target

**Appendix E—List of Recommended Actions by Sector**

**Table 2**

| ` | Measure Description | GHG Reductions (MMTCO2E) |
|---|---|---|
| **Transportation** | | |
| T-1 | Pavley I and II – Light-Duty Vehicle Greenhouse Gas Standards | 31.7 |
| T-2 | Low Carbon Fuel Standard (Discrete Early Action) | 15 |
| T-3[1] | Regional Transportation-Related Greenhouse Gas Targets | 5 |
| T-4 | Vehicle Efficiency Measures | 4.5 |
| T-5 | Ship Electrification at Ports (Discrete Early Action) | 0.2 |
| T-6 | Goods Movement Efficiency Measures<br>• Ship Electrification at Ports<br>• System-Wide Efficiency Improvements | 3.5 |
| T-7 | Heavy-Duty Vehicle Greenhouse Gas Emission Reduction Measure - Aerodynamic Efficiency (Discrete Early Action) | 0.93 |
| T-8 | Medium- and Heavy-Duty Vehicle Hybridization | 0.5 |
| T-9 | High Speed Rail | 1 |
| **Electricity and Natural Gas** | | |
| E-1 | Energy Efficiency (32,000 GWh of Reduced Demand)<br>• Increased Utility Energy Efficiency Programs<br>• More Stringent Building & Appliance Standards<br>Additional Efficiency and Conservation Programs | 15.2 |
| E-2 | Increase Combined Heat and Power Use by 30,000 GWh (Net reductions include avoided transmission line loss) | 6.7 |
| E-3 | Renewables Portfolio Standard (33% by 2020) | 21.3 |

| | | |
|---|---|---|
| E-4 | Million Solar Roofs (including California Solar Initiative, New Solar Homes Partnership and solar programs of publicly owned utilities)<br>• Target of 3000 MW Total Installation by 2020 | 2.1 |
| CR-1 | Energy Efficiency (800 Million Therms Reduced Consumption)<br>• Utility Energy Efficiency Programs<br>• Building and Appliance Standards<br>• Additional Efficiency and Conservation Programs | 4.3 |
| CR-2 | Solar Water Heating (AB 1470 goal) | 0.1 |
| **Green Buildings** | | |
| GB-1 | Green Buildings | 26† |
| **Water** | | |
| W-1 | Water Use Efficiency | 1.4† |
| W-2 | Water Recycling | 0.3† |
| W-3 | Water System Energy Efficiency | 2.0† |
| W-4 | Reuse Urban Runoff | 0.2† |
| W-5 | Increase Renewable Energy Production | 0.9† |
| W-6 | Public Goods Charge (Water) | TBD† |
| **Industry** | | |
| I-1 | Energy Efficiency and Co-Benefits Audits for Large Industrial Sources | TBD |
| I-2 | Oil and Gas Extraction GHG Emission Reduction | 0.2 |
| I-3 | GHG Leak Reduction from Oil and Gas Transmission | 0.9 |
| I-4 | Refinery Flare Recovery Process Improvements | 0.3 |
| I-5 | Removal of Methane Exemption from Existing Refinery Regulations | 0.01 |
| **Recycling and Waste Management** | | |
| RW-1 | Landfill Methane Control (Discrete Early Action) | 1 |
| RW-2 | Additional Reductions in Landfill Methane<br>• Increase the Efficiency of Landfill Methane Capture | TBD† |

| | | |
|---|---|---|
| RW-3 | High Recycling/Zero Waste<br>• Commercial Recycling<br>• Increase Production and Markets for Compost<br>• Anaerobic Digestion<br>• Extended Producer Responsibility<br>• Environmentally Preferable Purchasing | 9† |
| **Forests** | | |
| F-1 | Sustainable Forest Target | 5 |

| | | |
|---|---|---|
| **High Global Warming Potential (GWP) Gases** | | |
| H-1 | Motor Vehicle Air Conditioning Systems: Reduction of Refrigerant Emissions from Non-Professional Servicing (Discrete Early Action) | 0.26 |
| H-2 | $SF_6$ Limits in Non-Utility and Non-Semiconductor Applications (Discrete Early Action) | 0.3 |
| H-3 | Reduction of Perfluorocarbons in Semiconductor Manufacturing (Discrete Early Action) | 0.15 |
| H-4 | Limit High GWP Use in Consumer Products<br>Discrete Early Action (Adopted June 2008) | 0.25 |
| H-5 | High GWP Reductions from Mobile Sources<br>• Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems<br>• Air Conditioner Refrigerant Leak Test During Vehicle Smog Check<br>• Refrigerant Recovery from Decommissioned Refrigerated Shipping Containers<br>• Enforcement of Federal Ban on Refrigerant Release during Servicing or Dismantling of Motor Vehicle Air Conditioning Systems | 3.3 |

| | | |
|---|---|---|
| H-6 | High GWP Reductions from Stationary Sources<br>• High GWP Stationary Equipment Refrigerant Management Program:<br>o Refrigerant Tracking/Reporting/Repair Deposit Program<br>o Specifications for Commercial and Industrial Refrigeration Systems<br>• Foam Recovery and Destruction Program<br>• $SF_6$ Leak Reduction and Recycling in Electrical Applications<br>• Alternative Suppressants in Fire Protection Systems<br>• Residential Refrigeration Early Retirement Program | 10.9 |
| H-7 | Mitigation Fee on High GWP Gases | 5 |
| **Agriculture** | | |
| A-1 | Methane Capture at Large Dairies | 1.0† |

†GHG emission reduction estimates are not included in calculating the total reductions needed to meet the 2020 target

# Appendix F: California's Greenhouse Gas Emissions Inventory

The inventories presented here are summaries of 1990, 2004, and 2020 projected BAU as discussed in the Scoping Plan. For detailed 1990 and 2004 inventories please see:
http://www.arb.ca.gov/cc/inventory/inventory.htm
More detailed information about the 2020 inventory will be released in July at the above web address. Comments on this forecast can be submitted at:
http://www.arb.ca.gov/cc/scopingplan/spcomment.htm

## Greenhouse Gas Emission Inventory and Forecasting

ARB is responsible for developing the California Greenhouse Gas Emission Inventory. The Inventory accounts for all greenhouse gas (GHG) emissions within the state of California and supports the AB 32 Climate Change Program. The Inventory also serves as the basis for developing future year GHG emission forecasts necessary to support measure development and Scoping Plan recommendations. ARB staff has developed a year 2020 "business-as-usual" (BAU) forecast of GHG emissions for use in developing the Scoping Plan.

### Greenhouse Gas Emission Inventory

ARB's current GHG emission inventory is based on statewide fuel use, process, and activity data to estimate emissions. These estimates use the actual amount of all fuels combusted in the state, which accounts for over 85 percent of the greenhouse gas emissions within California.

This approach to inventory development is referred to as "top-down" because data are collected in the aggregate for the entire state, not at the level of the individual facility or emission-point. In contrast, a "bottom-up" inventory uses data from individual sources to determine emissions and sums those emissions to form a statewide total. Once ARB's mandatory reporting regulation is implemented, facility-specific data will become available and will be used to further improve the inventory. Current GHG emissions data can be found on ARB's website at: http://www.arb.ca.gov/cc/inventory/inventory.htm

### Business-as-Usual 2020 Emissions

ARB staff estimated 2020 business-as-usual GHG emissions, which represent the emissions that would be expected to occur in the absence of any GHG reductions actions. ARB staff estimates the statewide 2020 business-as-usual greenhouse gas emissions will be 596 $MMTCO_2E$. Emission reductions from the recommended measures in the Scoping Plan total 169 $MMTCO_2E$, allowing California to attain the 2020 emissions limit of 427 $MMTCO_2E$.

The 2020 BAU emissions estimate was derived by projecting emissions from a past baseline year using growth factors specific to each of the different economic sectors. For the purposes of the Scoping Plan, ARB used three-year average emissions, by sector, for 2002-2004 to forecast emissions to 2020. At the time the Scoping Plan process was initiated, 2004 was the most recent year for which actual data were available.

This 3-year average of known emissions will dampen unusual variations in any given year that would make the baseline year unrepresentative for forecasting. For example, an unusually hot, dry year might cause much higher power consumption and less hydroelectric power generation, and therefore increased emissions associated with power generation than would have otherwise been expected.

### Forecasting Method

Growth factors are sector-specific and are derived from several sources, including the energy demand models generated by California Energy Commission (CEC) for their 2007 Integrated Energy Policy Report (IEPR), business economic growth data developed for ARB's criteria pollutant forecast system (CEFS), population growth data from the California Department of Finance, and projections of vehicle miles traveled from ARB's on-road mobile source emissions

model, EMFAC2007. For the electricity and other energy sectors, ARB consulted with CEC to select the most appropriate growth factor.

ARB's forecasting method is similar to other GHG forecasting approaches, including the method used in the Climate Action Team 2006 Report. Where appropriate, ARB used updated and improved growth factors for estimating 2020 emissions sector-by-sector. These future emissions are projected in the absence of any policies or actions that would reduce emissions. The resulting BAU estimates are compared to the 2020 target set by the Board in December 2007 to determine the total statewide GHG reductions needed.

**Sector Forecasts**

Descriptions of the 2020 BAU forecasts for the major sectors of the inventory are given below with key assumptions staff used to estimate these future emissions.

**Electricity**

The 2020 business-as-usual emissions forecast for the electric power sector is 139.2 $MMTCO_2E$. These emissions are the result of in-state power generation plus specified and unspecified imported power. BAU forecasted emissions assume that all growth in electricity demand by 2020 will be met by in-state natural gas-fired power plants. Expected growth in renewable power to meet the current and proposed Renewables Portfolio Standard (RPS) is not included in the BAU. This allows the Scoping Plan reductions from increasing renewable power generation to be additive with the BAU forecasted 2020 emissions.

The 2020 BAU forecast for emissions from specified sources of imported electricity (i.e., power received from specific out-of-state power plants) is assumed to decrease resulting from the closure of one coal-fired power plant (i.e., Mojave) previously supplying imported electricity. The demand previously served by the closed plant is now replaced by in-state natural-gas generation.

Based on outputs from the CEC's electricity demand models, in-state electricity generation and specified imports will not meet the State's full electricity demand in 2020. The remaining demand is assumed to be met by unspecified imported electricity (i.e., power received from a mix of power generating sources outside the State).

**Transportation**

GHG emissions in 2020 from the transportation sector as a whole are expected to increase from current levels to 225.4 $MMTCO_2E$. This forecasted increase is dominated by increases in emissions from on-road transportation, i.e., passenger cars and heavy-duty trucks. To forecast on-road transportation emissions, ARB staff used 2007 fuel sales data obtained from the California Board of Equalization and estimated 2020 emissions based on the growth in projected vehicle miles traveled (VMT) derived from EMFAC2007. This BAU forecast assumes no change in vehicle fleet mix over time.

**Industrial**

The industrial sector consists of large stationary sources of GHG emissions and includes oil and gas production and refining, cement plants, and large manufacturing facilities. Emissions for this

sector are forecasted to grow to 100.5 $MMTCO_2E$ by 2020, an increase of approximately five percent from the average emissions level of 2002-2004.

Business-as-usual forecasted emissions for this sector are variable, but overall are not expected to grow substantially. Most of the growth from this sector comes from the fuel use and process emissions of two industries: Cement Plants and Refineries.

Emissions from the combustion of natural gas are expected to grow for some industries (e.g., cement plants) and decline for others (e.g., food processors). These assumptions of growth and decline in natural gas demand are based on outputs from energy demand modeling conducted by CEC staff for the 2007 IEPR.

**Landfills**

Forecasted BAU emissions in 2020 for landfills are 7.7 $MMTCO_2E$. This forecast uses a recognized landfill gas emissions model developed by the Intergovernmental Panel on Climate Change (IPCC) and data from the California Integrated Waste Management Board (CIWMB).

The forecast reflects assumptions regarding the continued decay of existing waste in landfills and estimates on the amount and character of new waste deposited in landfills through 2020.

**Commercial & Residential**

The Commercial and Residential sector is expected to contribute 46.7 $MMTCO_2E$ or about eight percent of the total statewide GHG emissions in 2020. Forecasted BAU emissions from the Commercial sector include combustion emissions from natural gas and other fuels (i.e., diesel) used by office buildings and small businesses. Residential emissions result primarily from natural gas combustion used for space heating and for hot water heaters.

Growth in emissions from the Commercial and Residential sector is due primarily to the expected increase in population and assumed increase use of natural gas. Emissions from the use of other fuels, such as diesel fuel, are assumed to remain relatively constant over time.

**High Global Warming Potential Gases**

The forecasted BAU 2020 emissions of High Global Warming Potential (High-GWP) gases are 46.9 $MMTCO_2E$. High-GWP gases, including sulfur hexafluoride (SF6) from electric utility applications, substitutes for ozone depleting substances (ODS) (primarily HFCs and PFCs), and other High-GWP gases used in semiconductor manufacturing and other industrial processes are combined under one sector for purposes of the Scoping Plan. Assumptions used to forecast business-as-usual emissions of High-GWP gases vary by GHG.

SF6 emissions occur primarily from leaks in electrical transmission system equipment in which SF6 is used as an electrical insulator. SF6 leaks are constant from a given piece of electrical equipment and are not related to the use of the equipment. The probable expansion of the electrical transmission system infrastructure is assumed to result in more SF6 emissions from leaks. However, at the same time, technical improvements to the transmission system equipment result in fewer leaks, reducing SF6 emissions. ARB assumes that the effect of an expansion of the electrical transmission system infrastructure, combined with the technical improvements to the equipment in the system, will result in no net change in emissions in 2020.

Emissions of HFCs and PFCs as ODS substitutes occur from their use in refrigeration and air conditioning systems, among other commercial and industrial applications. The high business-as-usual forecasted emissions in 2020 comes about as ODSs are rapidly replaced by ODS substitutes, as more ODSs are phased out.

**Agriculture**

BAU emissions from the agriculture sector are forecasted to increase about seven percent from current levels to 29.8 $MMTCO_2E$ in 2020, due exclusively to the assumed increase in livestock population. The agriculture sector includes emissions from livestock, i.e., digestive processes and manure management; combustion of liquid and gaseous fuels used for irrigation and crop production; emissions from fertilizer use and application of other soil additives; and emissions from agricultural residue burning.

Agricultural residue burning and livestock emissions were forecasted using ARB's criteria pollutant forecasting approach. Forecasted emissions from the combustion of natural gas were estimated using outputs from the 2007 IEPR developed by CEC. Other agriculture-rated emissions were either held constant or extrapolated using historical trends to obtain a 2020 BAU estimate.

**Forestry**

The forest sector is unique in the inventory because it combines GHG emissions to the atmosphere from wildfires, land conversion, wood combustion, wood decomposition, and other emission sources with removal of CO2 from the atmosphere due to forest growth. Positive emissions and negative removals are combined into a single net value. Therefore, a negative value indicates that the forest sector is sequestering carbon or a sink i.e. more CO2 is removed from the atmosphere than is emitted.

Appendix F Table 3

**California GHG Inventory by Category as Defined in the Scoping Plan**
**(millions of metric tons of $CO_2$ equivalent)**

| Inventory Summary for Scoping Plan (June 26, 2008) | Emissions (MMTCO2E) 2002-2004 Average | 2020 Forecast |
|---|---|---|
| **Transportation** | **179.3** | **225.4** |
| ***On Road*** | ***168.7*** | ***209.1*** |
| Passenger Vehicles | 133.9 | 160.8 |
| Heavy Duty Trucks | 34.7 | 48.3 |
| ***Ships & Commercial Boats*** | ***3.3*** | ***6.3*** |
| ***Aviation (Intrastate)*** | ***3.2*** | ***4.8*** |
| ***Rail*** | ***3.0*** | ***3.8*** |
| ***Unspecified*** | ***1.2*** | ***1.4*** |
| **Electric Power** | **109.0** | **139.2** |
| ***In-State Generation*** | ***52.5*** | ***87.2*** |
| Natural Gas | 44.2 | 78.8 |
| Other Fuels | 8.4 | 8.4 |
| ***Imported Electricity*** | ***56.5*** | ***52.0*** |
| Unspecified Imports | 24.3 | 26.1 |
| Specified Imports | 32.2 | 25.9 |
| **Commercial and Residential** | **41.0** | **46.7** |
| ***Residential Fuel Use*** | ***28.5*** | ***32.1*** |
| Natural Gas | 26.9 | 30.6 |
| Other Fuels | 1.6 | 1.5 |
| ***Commercial Fuel Use*** | ***11.9*** | ***14.0*** |
| Natural Gas | 10.5 | 12.3 |
| Other Fuels | 1.4 | 1.6 |
| ***Commercial Cogeneration Heat Output*** | ***0.6*** | ***0.7*** |
| **Industrial** | **95.9** | **100.5** |
| ***Refineries*** | ***35.0*** | ***36.7*** |
| ***General Fuel Use*** | ***21.3*** | ***19.8*** |
| Natural Gas | 14.0 | 11.7 |
| Other Fuels | 7.3 | 8.1 |
| ***Oil & Gas Extraction*** | ***14.2*** | ***14.2*** |
| Fuel Use | 13.4 | 13.4 |
| Fugitive Emissions | 0.8 | 0.7 |
| ***Cement Plants*** | ***9.7*** | ***12.6*** |
| Clinker Production | 5.7 | 7.6 |
| Fuel Use | 4.1 | 5.0 |
| ***Cogeneration Heat Output*** | ***9.2*** | ***9.3*** |
| ***Other Process Emissions*** | ***6.4*** | ***7.9*** |

| Inventory Summary for Scoping Plan (June 26, 2008) | Emissions (MMTCO2E) 2002-2004 Average | 2020 Forecast |
|---|---|---|
| **Recycling and Waste** | **5.6** | **7.7** |
| ***Landfills***[1] | ***5.6*** | ***7.7*** |
| **High GWP** | **14.7** | **46.9** |
| ***Ozone Depleting Substance Substitutes*** | ***12.9*** | ***45.0*** |
| ***Electricity Grid SF6 Losses***[2] | ***1.0*** | ***1.0*** |
| ***Semiconductor Manufacturing***[1] | ***0.8*** | ***0.8*** |
| **Agriculture** | **27.7** | **29.8** |
| ***Livestock*** | ***13.9*** | ***16.2*** |
| Enteric Fermentation (Digestive Process) | 7.0 | 8.2 |
| Manure Management | 6.9 | 8.0 |
| ***Crop Growing & Harvesting*** | ***9.2*** | ***9.2*** |
| Fertilizers | 7.1 | 7.1 |
| Soil Preparation and Disturbances | 2.0 | 2.0 |
| Crop Residue Burning | 0.1 | 0.1 |
| ***General Fuel Use*** | ***4.6*** | ***4.5*** |
| Diesel | 3.3 | 3.3 |
| Natural Gas | 0.7 | 0.5 |
| Gasoline | 0.4 | 0.4 |
| Other Fuels | 0.2 | 0.2 |
| **Forestry** | **0.2** | **0.2** |
| ***Wildfire (CH4 & $N_2O$ Emissions)*** | ***0.2*** | ***0.2*** |
| **TOTAL GROSS EMISSIONS** | **473.5** | **596.4** |
| ***Forestry Net Emissions*** | ***(-4.7)*** | ***0.0*** |
| **TOTAL NET EMISSIONS** | **468.8** | **596.4** |

[1] These categories are under the Industrial Sector in ARB's GHG Emission Inventory

[2] This category is under the Electric Power Sector in ARB's GHG Emission Inventory

Appendix F Table 4

**California GHG Inventory by Sector (millions of tonnes of CO2 equivalent)**

*(CO2 equivalence based upon IPCC Second Assessment Report's Global Warming Potentials)*

| ***Categories Included in the Inventory.*** | ***1990*** | ***02-04*** | ***2020*** |
|---|---|---|---|
| **Agriculture & Forestry** | **23.62** | **27.91** | **30.01** |
| *Ag Energy Use* | *4.50* | *4.63* | *4.47* |
| *Ag Residue Burning* | *0.12* | *0.08* | *0.08* |
| *Ag Soil Management* | *6.54* | *8.40* | *8.40* |
| *Enteric Fermentation* | *6.67* | *7.03* | *8.17* |
| *Forest and Range Management* | *0.19* | *0.19* | *0.19* |
| *Histosol Cultivation* | *0.18* | *0.14* | *0.14* |
| *Manure Management* | *5.00* | *6.88* | *7.99* |
| *Rice Cultivation* | *0.41* | *0.56* | *0.56* |
| **Commercial** | **14.43** | **12.45** | **14.63** |
| *CHP: Commercial (UTO)* | *0.40* | *0.56* | *0.66* |
| *Communication* | *0.07* | *0.09* | *0.11* |
| *Domestic Utilities* | *0.34* | *0.50* | *0.58* |
| *Education* | *1.42* | *1.04* | *1.22* |
| *Food Services* | *1.89* | *2.44* | *2.87* |
| *Health Care* | *1.32* | *1.23* | *1.44* |
| *Hotels* | *0.67* | *0.64* | *0.76* |
| *National Security* | *0.56* | *0.18* | *0.21* |
| *Not Specified* | *5.58* | *3.26* | *3.83* |
| *Offices* | *1.46* | *1.85* | *2.17* |
| *Retail & Wholesale* | *0.68* | *0.60* | *0.70* |
| *Transportation Services* | *0.03* | *0.05* | *0.06* |
| **Electricity Generation (Imports)** | **61.58** | **56.82** | **52.36** |
| *Specified Imports* | *29.61* | *32.17* | *25.89* |
| *Unspecified Imports* | *30.96* | *24.30* | *26.13* |
| *Transmission and Distribution ($SF_6$)* | *1.02* | *0.34* | *0.34* |
| **Electricity Generation (In State)** | **49.05** | **53.22** | **87.88** |
| *CHP: Commercial* | *0.70* | *0.80* | *1.46* |
| *CHP: Industrial* | *14.54* | *20.27* | *31.38* |
| *Merchant Owned* | *2.33* | *26.01* | *44.60* |
| *Utility Owned* | *29.92* | *5.45* | *9.75* |
| *Transmission and Distribution ($SF_6$)* | *1.56* | *0.69* | *0.69* |
| **Industrial** | **103.03** | **99.02** | **105.84** |
| *CHP: Industrial (UTO)* | *9.70* | *9.20* | *9.27* |
| *Flaring* | *0.15* | *0.11* | *0.11* |
| *Landfills* | *6.26* | *5.64* | *7.66* |
| *Manufacturing* | *31.98* | *27.27* | *28.93* |
| *Mining* | *0.03* | *0.25* | *0.19* |
| *Not Specified* | *2.63* | *2.10* | *2.27* |
| *Oil & Gas Extraction* | *14.65* | *14.19* | *14.19* |
| *Petroleum Marketing* | *0.02* | *0.00* | *0.00* |
| *Petroleum Refining* | *32.82* | *35.03* | *36.72* |
| *Pipelines* | *1.63* | *1.45* | *1.79* |
| *Waste Water Treatment* | *3.17* | *3.78* | *4.72* |
| **Residential** | **29.66** | **28.52** | **32.10** |
| *Household Use* | *29.66* | *28.52* | *32.10* |
| **Transportation** | **150.67** | **179.31** | **225.40** |
| *Aviation (intrastate)* | *5.13* | *3.18* | *4.84* |
| *Not Specified* | *3.01* | *1.21* | *1.35* |
| *On Road* | *137.99* | *168.66* | *209.10* |
| *Rail* | *2.33* | *3.00* | *3.76* |
| *Water-borne (within 24 nautical miles from California coast)* | *2.21* | *3.26* | *6.35* |

| **Not Specified (across all sectors)** | **1.27** | **16.21** | **48.19** |
|---|---|---|---|
| *Unspecified fuel combustion* | *1.23* | *3.34* | *3.20* |
| *Use of substitutes for ozone depleting substances* | *0.04* | *12.87* | *44.99* |

| **Summary of Categories Included in the Inventory.** | **1990** | **02-04** | **2020** |
|---|---|---|---|
| **Gross California Emissions** | **433.29** | **473.45** | **596.41** |
| **Sinks from Forests and Rangelands** | **-6.69** | **-4.67** | **0.00** |
| **Net California Emissions** | **426.60** | **468.78** | **596.41** |

| ***Categories Excluded from the Inventory.*** | ***1990*** | ***02-04*** | ***2020*** |
|---|---|---|---|
| **Transportation** | **59.02** | **46.01** | **84.30** |
| *Aviation (interstate and international)* | *33.95* | *34.06* | *53.02* |
| *Water-borne (interstate and international)* | *25.06* | *11.94* | *31.28* |

| **Summary of Categories Excluded from the Inventory.** | **1990** | **02-04** | **2020** |
|---|---|---|---|
| **Total Excluded Emissions** | **59.02** | **46.01** | **84.30** |