Doing Our Share: A Comprehensive Approach to Reducing Greenhouse Gases in Washington State

Recommendations of the Washington Climate Advisory Team

February 1, 2007

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We, the members of the Washington Climate Advisory Team, convened by the Departments of Ecology and Community, Trade and Economic Development at the direction of Governor Gregoire, are pleased to present our final interim report and recommendations.

Our membership, and that of the Technical Working Groups whose contributions to this effort were critical to its success, represent a broad range of Washington organizations and interests. Over the past year, we have come together to develop these recommendations that lead the State towards achievement of its GHG emissions reduction, clean energy job creation and fuel import reduction goals.

The recommendations in this report form the framework for the leadership necessary to drive the innovation and creativity that can enable significant reduction, sequestration, and removal of GHG emissions. By following this path forward, Washington can develop a more robust economy, enhance rural prosperity, provide good jobs, improve our position in the global economy, and build healthier, more sustainable communities.

We have come to a consensus on the need for urgent, responsible, and thoughtful action, now and in the long run. We have collectively developed this framework to build a healthier, more prosperous future in the same spirit of cooperation and intellectual integrity that we hope characterizes how Washington continues to meet the climate challenge going forward.

We appreciate the privilege we have been given to serve on the CAT and participate in charting this path forward. We want to acknowledge and express our appreciation for the support we received in our efforts from the many volunteers who participated as Technical Working Group members and Agencies' staff.

We support the recommendations presented here and, as individuals and as a team, will continue to participate constructively in the further development and implementation of these recommendations. We urge the Governor and the Legislature to continue to provide leadership on this issue, informed and guided by our findings. We urge the citizens of Washington to continue contributing towards climate solutions in their everyday choices, and help build the vision we see for our collective future.

Sincerely,

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List of Acronyms

BAU	Business-as-Usual
CAFE	Corporate Average Fuel Economy
CAT	Climate Advisory Team
CH_4	Methane
CHP	Combined Heat and Power
CIG	Climate Impacts Group (University of Washington)
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CTED	Washington Department of Community, Trade and Economic Development
DSM	Demand Side Management
Ecology	Washington Department of Ecology
EPA	United States Environmental Protection Agency
GHG	Greenhouse Gas
GWP	Global Warming Potential
HFC	Hydrofluorocarbon
IPCC	Intergovernmental Panel on Climate Change
LPG	Liquefied Petroleum Gas
$MMtCO_2e$	Million Metric Tons of CO_2 Equivalent
N_2O	Nitrous Oxide
PAWG	Preparation and Adaptation Working Group
PFC	Perfluorocarbons
PHEV	Plug-in Hybrid Electric Vehicle
PV	Photovoltaic
RCI	Residential, Commercial, and Industrial
SAR	Second Assessment Report
SEPA	State Environmental Policy Act
SF_6	Sulfur Hexafluoride
SSB	Substitute Senate Bill
SWE	Snow Water Equivalent
TCR	The Climate Registry
TWG	Technical Working Group
VMT	Vehicle Miles Traveled
WCI	Western Climate Initiative

Executive Summary

We face a critical challenge, both here in Washington and throughout the world: to stabilize the climate as quickly as possible in order to minimize global warming and reduce its impacts to our environmental, economic, and societal systems. While a daunting challenge, taking action that is significant and meaningful in preventing global warming's most destructive impacts also presents important opportunities. By choosing to grow and expand our Clean Economy in order to embrace and meet the challenge of climate change, Washington can build a healthier and more prosperous future. Our forests, our farms, our fish, our power supply, our marine and terrestrial ecosystems, our heritage and culture, including our tribal cultures, and our communities—indeed, in a most profound way, our entire quality of life—depend on the choices we make today to do so.

The time to act is now. The impacts of climate change, and the costs of these impacts, grow with each year of inaction. As it is very likely that emissions of heat-trapping gases from human activities have caused most of the observed global warming since the mid-20th century, we have the ability to change these choices and behaviors in order to contribute towards solutions. This action must be sustained, responsible and thoughtful. We must deliberately choose alternatives to our current technologies, practices and behaviors, and harness these alternatives to usher in this enormous and unprecedented opportunity.

This interim report of the State of Washington's Climate Advisory Team (CAT) charts the path to transforming our economy and our lifestyles to reduce Washington's contribution to global warming and to seize the economic benefits resulting from innovation, investment, and job creation. In these recommendations, the CAT, a team of business, state and local government, tribal, environmental and religious leaders, describes how Washington can take a comprehensive approach and implement practical solutions that will indeed meet the goals set by Governor Gregoire in February 2007 to significantly reduce and sequester greenhouse gas emissions over time, create clean energy jobs, and reduce expenditures on imported fuels. By pursuing this broad and flexible response to Washington's Climate Change Challenge, we can choose a new way of thinking and acting that will safeguard our environment, increase our prosperity, and secure our future.

The CAT's Recommendations Meet Washington's Environmental and Economic Goals

The suite of options identified by the CAT, together with recent actions already taken in Washington should enable the State to meet the goals set by Governor Gregoire if implemented in a complete and timely manner:

- **Greenhouse gas emission reduction goals**: By 2020, Washington will reduce GHG emissions to 1990 levels. By 2035, Washington will reduce emissions 25% below 1990 levels. By 2050, GHG emissions in Washington will be reduced 50% below 1990 levels.
- **Job creation goal**: By 2020, increase the number of clean energy sector jobs to 25,000, a three-fold increase from the 8,400 jobs in 2004.
- **Energy independence goal**: By 2020, reduce expenditures by 20% on fuel imported into the State

Do What is Possible; Change What is Possible to Do

Reducing our reliance on carbon-based energy in our economy and our way of life will require diverse elements in society to form strong partnerships and work together in new ways. The CAT believes that the people of the State of Washington will demonstrate the vision, foresight and commitment to provide the leadership, take the actions, make the decisions and invest the resources that will allow Washington, across all sectors, in all communities, and at all levels and types of government, to do our share of reducing greenhouse gas (GHG)[1] emissions, and build a vibrant Clean Economy[2]. Through this creative, inclusive and equitable approach, we can reduce emissions more effectively and efficiently, and produce more economic benefits to share more broadly throughout society more quickly. Performance-based government policies can support entrepreneurial creativity, thoughtfully direct capital investment, and use natural systems as a key component of the solutions. By giving people real choices on where and how to live in a manner that reduces their carbon emissions, joined by an emphasis on workforce training, opportunities will be created for all Washingtonians, including those often excluded from economic prosperity, to participate in the economic opportunities of responding to climate change, now and into the future.

A Comprehensive Approach Will Achieve the State's Climate Goals

Washington needs a foundational and systematic approach to achieve a lower carbon future. A results-oriented framework can bind together the various actions already taken in Washington in order to provide the certainty, structure, coherence, pace and accountability necessary to produce quantifiable results, and attract sufficient public and private investment in developing solutions. To be effective, Washington's climate strategy must recognize and motivate the countless individual actions by government, business and individuals that collectively are needed to reduce concentrations of GHG emissions in the atmosphere. Most activity in Washington's economy, and many individual behaviors, can be made more energy-efficient, can produce or utilize alternative fuels, and/or can be performed in ways that emit fewer, if any, GHG emissions. Critical to accomplishing this is identifying specific efficiencies and substitutes, making them cost-competitive, and shaping governmental, business and consumer choices so that these alternatives are both available and implemented.

Both broad, enabling strategies and sector-specific strategies are equally necessary for Washington, and are inextricably intertwined. Pursuing both will expand our choices and strategies, and allow us to reach our goals most effectively and efficiently. The implementation of market-based approaches is crucial and will serve to structure and provide certainty in the transition to the Clean Economy, and ensure that emissions reductions goals are achieved efficiently and effectively economy-wide. While market-based

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[1] Greenhouse gases are certain gas molecules in the atmosphere that absorb and reemit infrared solar radiation, warming the earth's surface and the lower atmosphere. GHGs included in the Washington Greenhouse Gas Inventory are Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulfur hexafluoride (SF_6).

[2] The terms *Clean Economy* and *Low-Carbon Economy* are used interchangeably in this report to describe activities related to the production and distribution of goods and services in a way that promotes environmental protection, economic prosperity, high quality jobs, social equity, and future quality of life, while emitting far less carbon and other greenhouse gases into the atmosphere.

mechanisms are necessary and valuable, they are just one component for achieving reductions. Sector-specific strategies will augment, and, in some instances, support development of this market, as well as provide predictable emission reductions from key emission sources, such as transportation, needed to meet the State's goals.

The CAT has identified twelve directional recommendations that lead the State toward achievement of its goals. Five of these are broad, enabling recommendations that set in motion Washington's transition to the Clean Economy, sending signals and building market structures that direct and motivate entrepreneurs, investors, businesses and individuals to pursue opportunities, technologies, and choices that reduce carbon. Seven specific action recommendations target the most important GHG emission reduction challenges in Washington, and complement the broad, enabling recommendations. As a whole, these twelve recommendations are designed to enable the State to build upon actions previously enacted at the State and local levels, to identify the actions that should be implemented as soon as possible, and to provide a road map for thoughtfully achieving the longer term goals.

Five Technical Working Groups (TWGs) structured around different sectors of Washington's economy (Agriculture; Energy Supply; Residential, Commercial, and Industrial; Forestry; and Transportation) supported the work of the CAT by identifying, refining, and analyzing a suite of options and strategies that reduce the extent of climate change, and that fit the unique characteristics of Washington's economy, environment and institutions. From the full suite of 45 strategies that enable significant reduction and removal of GHG emissions, the CAT has identified 31 "most promising" strategies that represent a significant range of policies and programs the State could adopt or undertake to reduce GHG emissions quickly, efficiently and effectively in these specific sectors of the economy.

As long as we seize each substantive opportunity to act in the present to reduce GHG emissions, we have the time—and now, with this report, the road map—to move forward in the future in a thoughtful and deliberate manner. This thoughtful decision-making should be seen as a means to improve our decisions, not a pretext for delay. Overall, assuming complete and timely implementation, the suite of options identified by the CAT, together with recent actions already taken in Washington, enable the State to begin a long-term path of declining emissions, and achieve by 2020 the State's goals of reducing GHG emissions to 1990 levels by 2020, increasing clean energy sector jobs to 25,000 and reducing expenditures by 20% on fuel imported into the State.

The Path Forward for Washington

The following twelve directional recommendations will allow for a broad, flexible and long-term response to Washington's Climate Change Challenge:

Build market-based mechanisms to unleash investment in the creativity and innovation of Washington's economy to deliver cost effective emission reductions. A market-based approach will allow different entities in society to work together and expand our options and choices to pursue GHG emissions reductions. A market, by establishing a price for continued emission of GHGs, can support innovative and efficient ways to cost-effectively reduce emissions or increase the storage of carbon. For this potential within Washington's economy to become a significant part of the solution, both public and private leadership to prepare our citizens and businesses

for this market, and an institutional framework to ensure that this market functions as intended, will be needed.

Washington should continue to participate and provide leadership in the Western Climate Initiative (WCI) and emerging national efforts to develop market mechanisms; develop the legal, technical, and institutional infrastructure that will make a carbon market real and operational as soon as possible; and establish binding limits on GHG emissions consistent with the State's goals to demonstrate that achieving significant carbon reduction targets is a certainty, not an aspiration.

Establish emissions reporting so that progress in emission reductions can be tracked and acknowledged. Regardless of the policy instrument used to achieve GHG reductions, ensuring common and consistent ways of measuring emissions releases and reductions across all parts of the 'system' is critical to tracking and communicating progress towards meeting the GHG emission reduction goals. Washington should establish mandatory GHG emissions reporting by appropriate sources, in addition to the biennial emissions inventory estimates reporting already required by the Departments of Ecology and Community, Trade and Economic Development (CTED). Washington's participation nationally with The Climate Registry (TCR) is a promising and cost-effective way to help accomplish these goals for emissions reporting and application, as long as TCR is designed and implemented as publicized.

Analyze greenhouse gas emissions and mitigation options early in decision-making, planning processes, and development projects. Climate change considerations should be fully incorporated into governmental decision-making, resource and development planning, permitting and approval. The State Environmental Policy Act (SEPA) should be used to support the early identification of GHG emissions reduction opportunities, evaluate emissions, and ensure mitigation options are considered early in the planning phases for significant private and public development activities, regulatory required plans and decisions, and transportation projects.

Invest in worker training for the emerging Clean Economy to ensure having a skilled workforce and to provide meaningful employment opportunities throughout the State. Job gains globally in the Clean Economy are anticipated to be significant. To prepare Washington's companies and workforce to take advantage of these opportunities, to enhance the likelihood of success for existing clean energy industries in Washington, and to attract more energy technology development and manufacturing investment opportunities to the State, Washington should invest in worker training, and provide appropriate education and training at all levels (K-12 curriculum, community college vocational/technical education, internship and apprenticeship programs, and university research and training).

Build and continue to redesign communities that offer real and reliable alternatives to single occupancy vehicles. Transportation is Washington's largest contributor to GHG emissions, representing approximately half of all of the State's GHG emissions. In order to significantly reduce these emissions, the CAT developed three recommendations to achieve less reliance upon single occupancy vehicles in order to reduce vehicle miles traveled (VMT), to ensure 'cleaner' cars (and other vehicles) and fuels, and to support long-term transportation infrastructure investments and choices needed to accomplish the goals.

Reducing transportation-related emissions by shaping growth patterns and changing long-term infrastructure choices will result in compact walkable, bikable and transit-friendly communities. Most promising strategies to tackle this challenge include promoting compact and transit-oriented development; expanding transit, ridesharing and commuter choice programs; establishing State, regional, and local VMT reduction goals and standards; promoting and providing incentives for improved community planning and improved building design and construction in the private and non-state public sectors; establishing transportation pricing mechanisms that raise the cost of single-occupant vehicle travel; improving freight and intercity passenger railroads; and identifying new flexible and reliable long-term funding sources, as well as making better use of existing revenue sources, to fund these strategies.

Ensure Washington has vehicles that are as efficient as possible and use non-carbon or lower carbon intensity fuels developed sustainably from regional resources. In addition to VMT reductions, cleaner vehicles and fuels will also help Washington meet the transportation-related GHG reductions needed to meet the State's goals. Most promising strategies to accomplish cleaner fuels includes establishing a low carbon fuel standard for transportation fuels sold in Washington; maximizing in-state production of sustainable biofuels and biofuel feedstocks; and improving the commercialization of advanced lignocellulosic processes. Strategies for promoting cleaner vehicles include diesel engine emission reductions and fuel efficiency improvements; accelerating and integrating plug-in hybrid electric vehicle use; and improving freight and intercity passenger railroads. Critical to the success of these strategies will be identifying and instituting new flexible and reliable long-term funding sources, as well as making better use of existing revenue sources to fund these strategies.

Focus investments in Washington's transportation infrastructure to prioritize moving people and goods cleanly and efficiently. Washington needs to invest differently in transportation infrastructure, and to use this infrastructure in a manner that moves people and goods, and not just the single occupancy vehicle, as efficiently as possible. Most promising strategies to accomplish this include transportation pricing mechanisms to reduce single occupancy vehicle travel; transportation system management to increase operational efficiency; transit, ridesharing and commuter choice programs to increase the efficiency of our existing infrastructure; and improvements to freight and intercity passenger railroads. Again, identifying and implementing new funding mechanisms and making better use of existing revenue sources in order to build and operate our transportation infrastructure in this way is crucial for success.

Design, build, upgrade, and operate new and existing buildings and equipment to maximize energy efficiency. The existing stock of buildings and equipment hold great promise for cost effective emission reductions through various retrofit strategies. Key strategies to reduce GHG emissions from both the built environment as well as new buildings include funding for efficiency improvements; encouraging energy efficiency gains across the residential, commercial and industrial sectors, and focusing on efficiency considerations during the initial design of communities and new construction; demand-side management including energy efficiency programs, funds, or goals for natural gas, propane, and fuel oil; targeted financial incentives and instruments to encourage energy efficiency improvements in the development, design, and construction of new and existing energy-using buildings and building systems; promoting and providing incentives for improved community planning and improved building design and construction in the private and non-State public sectors; energy efficiency

improvements in existing buildings, with an emphasis on building operations; and combined heat and power and thermal energy recovery and use.

Deliver energy from lower or non-carbon sources and more efficient use of fuels. Washington needs to continue to maximize efficiency and increase the level of renewable and alternative energy that can be delivered to the electric grid. Strategies to increase the level of renewable generation delivered to the Washington State electric grid include grid-based renewable energy incentives and/or removal of barriers and incentives for distributed renewable energy and/or removal of barriers. Additional strategies for delivering energy from lower and non-carbon sources include improved commercialization of advanced lignocellulosic processes and regional sustainable production of biofuels and biofuels feedstocks. Incentives to invest in energy efficiency include strategies to implement rate structures and technologies that promote reduced GHG emissions; transmission system capacity, access, efficiency and smart grid technologies to integrate potential incentives and/or barrier removal to expanding transmission capacity; increasing efficiency improvements at existing renewable and power plants; and promotion of and incentives for combined heat and power and thermal energy recovery and use to capture both the efficiency and emissions benefits.

Restore and retain the health and vitality of Washington's farms and forest lands to increase carbon sequestration and storage in forests and forest products, reduce the releases of greenhouse gas emissions, and support the provision of biomass fuels and energy. Washington needs to keep its forests and farms working, healthy, and productive in storing carbon, and producing biofuels and products that store carbon. By protecting agricultural and forest areas from development, and utilizing appropriate management techniques, the carbon in biomass and soils can be maintained and additional release of GHG emissions to the atmosphere can be avoided. Improvements to the health of Washington's forests can capture numerous GHG emission storage and biomass energy benefits from forests, as well as reduce GHG emissions from catastrophic fires. Healthy farms and forests can store carbon both in the forests and forest products as well as provide the feedstocks to support increased production of biofuels and biomass energy that can replace fossil fuels.

Reduce waste and Washington's emissions of GHGs through improved product choices and resource stewardship. Greatly expanding source reduction, reuse, recycling and composting will result in a low cost/ton for GHG reductions and many co-benefits. This is also a significant opportunity to engage the public in combating global warming at the household level. Public education and outreach to support the long-term success of Washington's efforts should also be provided through consumer education programs, including labeling of embodied life-cycle energy and carbon content of products and buildings. Educational programs for professionals involved in delivering services in support of residential, commercial, industrial, and other policy strategies considered by the CAT should also be developed and implemented. Additional ways to support this recommendation are improved product choices through more stringent appliance/equipment/lighting efficiency standards, appliance and lighting product recycling and design, and availability of climate-friendly products, and increased utilization of waste through in-state production of biofuels from waste biomass.

Allocate sufficient state resources to maintain Washington's leadership role regionally and nationally and to fulfill its responsibilities for structuring and guiding implementation of emission reduction strategies. Accepting the urgency to tackle global warming requires reprioritizing budgets, raising new revenues, and appropriating the funding necessary to accomplish the important work required by both governments and businesses to respond meaningfully and successfully. There is a critical need for adequate financial resources for the State to fulfill its responsibilities associated with these recommendations.
The State should:

- Use incentives and standards judiciously to jump-start, accelerate, and sustain the changes needed to develop the Clean Economy;
- Commit sufficient resources to understand how best to integrate regional and national carbon-control programs into Washington's overall economy;
- Support capacity building for local and tribal governments to fulfill their responsibilities in assessing emissions, identifying emission reductions opportunities, and integrating adaptation and emissions reduction efforts in current development and transportation planning and/or natural resource systems restoration;
- Support research, technology transfer, and commercialization of promising technologies and applications; and
- Commit sufficient resources to further develop these Climate Change Challenge recommendations, including support for continued involvement with WCI; continued engagement by the CAT; education, workforce training and public outreach; and beginning to incorporate climate considerations into State operations.

What Will Meeting the State's Goals Cost?

The CAT recognizes that there are significant public and private investments associated with many of its recommendations. These investments are crucial to combat global warming and to compete in the global Clean Economy. Some of these investments are to support development of essential government functions and programs; others are to provide incentives to jump-start investments, to stimulate changes in business practices, or to alter consumer behaviors. Significant investment will be needed to develop and support clean energy and an effective transportation infrastructure. Business investments will also be needed to invent, provide, and actually deploy the new technologies, develop and supply the alternative power options, create the new communities, and otherwise pay for that which must be accomplished by the private sector to build the Clean Economy and reduce GHG emissions.

The CAT has estimated the net present value costs and benefits of many of the specific action strategies. Based on this analysis, many of these strategies provide positive financial returns on a simple, direct cost basis—in other words, the cost savings from reduced energy or resource consumption more than pays back additional investment costs. The strategies that appear to have most significant net costs—investments in biofuels, plug-in hybrid vehicles, renewable electricity, and land protection, in particular—are those that represent long-term investments, with among the most significant co-benefits and opportunities for developing jobs and industries within the State. The cost estimates for these strategies are quite conservative—they assume a return to oil prices of around $50 a barrel and do not assume any significant cost decreases in emerging technologies. If oil prices are higher or technology costs (e.g., for

advanced biofuels, wind turbines, vehicles) decrease due to learning, scale, and other cost reduction processes, these strategies could begin to yield positive direct cost savings well before 2020. Finally, several strategies are not readily quantified in terms of direct costs, particularly those associated with major infrastructure investments (e.g., transit) that provide multiple benefits.

Overall, the analysis indicates that the CAT strategies and recent actions taken in Washington, for which both costs and emission reductions could be assessed, could yield a net cumulative benefit of over $900 million by 2020 (Net Present Value 2008–2020, in $2006) assuming full and timely implementation.[3] The cost analysis of these strategies does not include what are in many cases very significant co-benefits, such as improved transportation choices, reduced local air pollution and improved public health, functioning natural systems, or hedges against energy price volatility, to name a few, nor do they include the indirect and macroeconomic impacts that that would arise as energy savings are "re-spent" on local goods and services. The CAT has not estimated the overall interactions within the economy of attempting to reduce carbon emissions sufficient to meet the State's goals nor quantified the cost from greater or more severe impacts from climate change of delay or inaction in implementing these strategies.

Determining how to finance initiation of and support for this economic transition will be an important and necessary key to success. The transition itself will create wealth and can generate revenue, and there may be ways to channel that revenue and/or reprogram existing revenue to support and accelerate the transition. The CAT believes that continuing this investigation in overall cost and how to finance this roadmap is a critical component of what needs to be accomplished by the State in 2008.

Next Steps

These directional recommendations illuminate the path forward for Washington to do our part to reduce and store GHGs. In some cases there is still more that needs to be done to ensure implementation of these recommendations and realize this foundation for success. Reducing GHG emissions and adjusting to the impacts of climate change will be a long-term effort, and Washington needs to have an adaptive management attitude coupled with a long-term commitment in order to continue learning about what still needs to be done, to increase understanding from what has previously been implemented, and to change direction or programs as necessary to achieve substantive results.

The CAT has not identified nor analyzed all the possible strategies, potential partnerships, or opportunities that will result as the State takes action to accomplish its goals. Instead, these recommendations establish a roadmap that can guide the engagement, interactions, and mutual reinforcement between the various elements of society that will be critical for unleashing the State's enormous capacity for innovation and entrepreneurship necessary for delivering the solutions that also support the health and well-being of our citizens and natural systems.

The CAT has recommended several major actions to be implemented immediately, and others to be implemented over the longer term. The next phase of work for the State will be to act on those recommendations that are ready for it to do so, and to translate the other recommendations into specific policies and programs that, when authorized, can be implemented. Additional work is needed in 2008 to

[3] All net present value estimates are calculated using a 5% real discount rate.

make the CAT's recommendations a reality. The CAT has been asked by the Co-Chairs to help and support the State with these efforts through 2008, and is ready and willing to do so.

The members of the CAT appreciate the privilege that they have been given by the Governor to be on the CAT and remain committed as individuals and as a team to help further develop and advance these recommendations with the same spirit of cooperation and intellectual integrity in which they were developed. Our collective effort is surely a strong sign that, by working together, we can meet the climate challenge we face from global warming.

I. The Compelling Challenge from Global Warming

This is a watershed moment for Washington State. The convergence of scientific analysis and prediction regarding the reality, pace and causes of global warming, coupled with growing public understanding of the current impacts and future threats of global warming, is creating a powerful mandate for deliberate intervention to reduce humanity's critical role in causing climate change. This clarion call for significant, meaningful action to drastically reduce harmful emissions of greenhouse gases (GHGs) in order to prevent global warming's most pronounced destructive impacts has been heard by Washington's Climate Advisory Team (CAT).

Accomplishing this challenge will be both breathtaking in its scope and exciting in the opportunities it presents the citizens of Washington. If we are to prevail, a clear sense of the path forward to guide our efforts, unwavering determination, and a commitment to succeed are each essential. This interim report by the CAT lays out a comprehensive directional approach for Washington to reduce the emissions causing a warming climate now, in order to build a healthier, more prosperous future. This is the framework for harnessing our collective determination to proceed both urgently, and deliberately, in meeting this challenge.

Stabilizing the climate as quickly as possible with as little residual temperature rise as possible is one of the most critical, if not the defining, issues of the 21st century. The task will take much of this century to complete, even with immediate action. Fluctuations in the temperature of the atmosphere have increased the Earth's average air temperature by 1.33 (+/- 0.32) degrees Fahrenheit during the last 100 years.[4] Average annual temperatures in the Pacific Northwest over the 20th Century have increased 1.5 degrees Fahrenheit, and annual temperatures are predicted to increase approximately 1.0 degree Fahrenheit per decade over the next 50 years.[5] Scientific information, traditional knowledge of native people, and ad hoc observations throughout the populace all confirm the resulting changes in weather, climatic, coastal and terrestrial systems brought about by this warming, often with significant disruptive or destructive effects here in Washington, and throughout the world.

As it is very likely that emissions of heat-trapping gases from human activities have caused most of the observed global warming since the mid-20th century,[6] changing our previous choices and behaviors that have contributed to this warming can reduce its impacts. We must continue to change because the impacts, and the costs to adapt to those impacts, grow with each year of inaction. We must thoughtfully and deliberately persevere until we succeed because the alternative is a legacy of escalating economic and natural dislocation.

We also must succeed because in doing so, we benefit from an enormous and perhaps unprecedented opportunity to be on the forefront of transforming our economy and our lifestyles. As we successfully tackle global warming through responsible, reasonable and practical actions, we can seize the economic

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[4] Intergovernmental Panel on Climate Change: Fourth Assessment Report. Working Group 1. *Climate Change 2007: The Physical Science Basis.* Available at: http://ipcc-wg1.ucar.edu/wg1/wg1-report.html

[5] Based on results from a number of global climate models. From *Overview of Climate Change Impacts for Washington.* Summary by the UW Climate Impacts Group in Preparing for the Impacts of Climate Change in Washington: Draft Recommendations of the Preparation and Adaptation Working Groups. December 21, 2007 draft.

[6] Intergovernmental Panel on Climate Change: Fourth Assessment Report. Climate Change 2007: Summary for Policymakers. Available at: www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

benefits that will accompany the innovation, investment, and job creation that this remarkable endeavor will require and create. The good news is that the following recommendations, if implemented, will enable the State to reach its 2020 goals for GHG emissions reductions, create clean energy jobs, and reduce dependence on imported fuels.

Washington's Climate Advisory Team

Governor Gregoire declared Washington's enduring commitment to address climate change on February 7, 2007, by signing Executive Order No. 07-02 and directing the Washington Department of Ecology (Ecology) and Department of Community, Trade and Economic Development (CTED) to lead the Washington Climate Challenge.[7] The Directors of Ecology and CTED formed the CAT to advise the Directors on the full range of policies and strategies that should be considered in order to achieve the goals specified in the Executive Order to reduce emissions, create clean energy jobs, and reduce expenditures on imported fuels. Business, academic, tribal, State and local government, religious, and environmental leaders were convened to form the CAT in March 2007.[8]

Do What Is Possible; Change What Is Possible to Do

In formulating a sustainable and effective response to the challenge of global warming, the CAT is advocating for a new way of thinking and acting. With other 'pollution' challenges, one party or another has often been seen as the 'source' of the pollution. With this climate change challenge, everyone in society will need to contribute to reducing the currently ubiquitous release of GHG emissions into the environment. Leadership that ensures substantive and balanced contributions by all sectors of society in a thoughtful way will be crucial; persistent action by all sectors that produces sufficient results will be the ultimate measure of success.

Likewise, creating the Clean Economy is a challenge, but can also be seen as an extraordinary opportunity. In response to Governor Gregoire's imperative to both reduce emissions and create economic opportunity, the CAT has developed a Comprehensive Climate Approach for Washington that recommends the

A New Way to See the Future

Imagine a future that does not rely upon carbon-based energy, with natural systems that are healthier and ecologically functional. Imagine government and businesses working together to create this future by supporting entrepreneurial creativity, providing resources for research and development, restoring and protecting natural systems, and creating more economic opportunities for all people through green jobs. Imagine healthy forests and farms, and communities that provide reliable pedestrian-, bicycle-, and transit-friendly options. Imagine having more choices to live more sustainably. This is the future that the CAT believes is necessary to combat global warming, and the future that will result if we do so successfully. In essence, this report is the CAT's roadmap to this future.

[7] The goals of Executive Order 07-02 were legislated during the 2007 Legislative session with the passage of Substitute Senate Bill 6001 (SSB 6001). On May 3, 2007, Governor Gregoire signed this landmark legislation which established in statute the statewide GHG emissions reduction goals and imposed an emissions performance standard on baseload electric generation. See Appendix A for Executive Order 07-02 and Appendix B for SB 6001.

[8] See Appendix C for the CAT charter and the CAT website for additional information: www.ecy.wa.gov/climatechange/cat_overview.htm

framework needed to transition as efficiently and effectively as possible to the Clean Economy. The recommendations developed by the CAT describe responsibilities and identify opportunities that are broadly shared among individuals, businesses and institutions.

The CAT has focused practically on what is possible to do now, and has outlined what will help change what is possible to do. The very good news is that Washington has already begun to meet the challenge and seize the opportunity of addressing climate change and creating economic benefits. In Executive Order 07-02, Governor Gregoire also declared the State's commitment to implement the significant policy actions already taken in 2005 and 2006 to reduce GHGs. In addition, Washington's abundant water, forest, and agricultural resources, along with its significant low-carbon hydropower generation, give the State an advantaged starting position in addressing climate change. Washington has accomplished a lot, and is starting from a good position, but there is more to do. In its deliberations, the CAT has built upon Washington's comparative advantages and what Washington has already accomplished, in a comprehensive and integrated fashion that provides direction on how best to meet Washington's environmental and economic goals:

- **Greenhouse gas emission reduction goals**: By 2020, reduce GHG emissions to 1990 levels. By 2035, reduce emissions 25% below 1990 levels. By 2050, GHG emissions in Washington to be reduced 50% below 1990 levels.
- **Job creation goal**: By 2020, increase the number of clean energy sector jobs to 25,000, a three-fold increase from the 8,400 jobs in 2004.
- **Energy independence goal**: By 2020, reduce expenditures by 20% on fuel imported into the State

Achieving these goals will involve a transformation that the CAT believes should be accomplished in the quickest, most innovative, least disruptive and most economically advantageous way possible. In addition, this transformation should be carried out in the most equitable way possible, preventing disproportional revenues for some and minimizing or reducing undue burden for others. Getting this "right" is critical to our success. This transformation should also give particular attention to the profound impacts of global warming on Washington's tribes, both their culture and their economy. Native people are often the first to experience disruptions to natural systems due to direct impacts on their subsistence economies and utilization of natural resources. The strategies to reduce emissions should incorporate the knowledge and contributions that tribes offer in order to ensure that success occurs 'on the ground.' The CAT believes that the following recommendations provide the foundation for meeting the State's goals in this manner.

Section II of this report provides a brief review of Washington's current and projected emissions profile. Section III provides a broad overview of the Comprehensive Climate Approach. Section IV contains the CAT's specific recommendations and strategies. Section V discusses fundamental principles associated with the Comprehensive Climate Approach and the next steps key to continuing to refine how we can successfully implement it.

II. The Context for Action: The Need for Both Adaptation and Mitigation, Washington's GHG Emissions Inventory, and the Role of Natural Systems

"If there's no action before 2012, that's too late. What we do in the next **two to three years** will determine our future. This is the defining moment." Rajendra Pachauri, head of the Intergovernmental Panel on Climate Change (IPCC) and 2007 Nobel Peace Prize Laureate, issued this call to action upon the release of the IPCC's fourth and final report on November 17, 2007.[9] The IPCC is the scientific body charged by the United Nations with providing objective information about climate change. The fourth IPCC report combines scientific data from three previous IPCC reports, and includes the following conclusions from IPCC scientists:

- *Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.*
- *Global GHG[10] emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004 alone.*
- *Most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations.*
- *Anthropogenic warming could lead to some impacts that are abrupt or irreversible, depending upon the rate and magnitude of the climate change.*[11]

Climate Change and Global Warming

Climate change is the variation in regional or global temperature and weather patterns. Changes in the modern climate include *global warming*, an increase in the average temperatures of the Earth's near-surface air and oceans in recent decades, and its projected continuation.

The greenhouse effect is a naturally occurring process in the Earth's atmosphere that helps retain solar heat. Some of the infrared radiation passing through the atmosphere is absorbed and re-emitted by certain gas molecules (most notably carbon dioxide, CO_2), warming the earth's surface and the lower atmosphere. Increases in these greenhouse gases (GHGs) increase the amount of heat trapped by the atmosphere and cause overall warming of the planet.

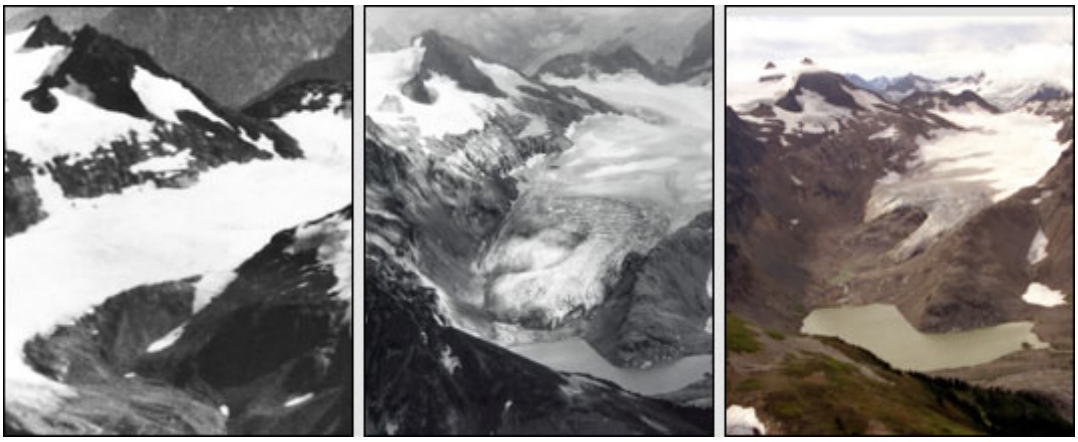
The use of *climate change* in this document is in reference to the various impacts from *global warming*, and both terms are used interchangeably in this report.

[9] Rosenthal, Elizabeth. "U.N. Report Describes Risks of Inaction on Climate Change." NY Times. 17 November 2007. Available online at: www.nytimes.com/2007/11/17/science/earth/17cnd-climate.html?pagewanted=print

[10] The major GHGs include three gases and three groups of fluorinated gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Emissions of these GHGs are presented using a common metric, (CO_2e), which indicates the relative contribution of each gas to global average radiative forcing on a Global Warming Potential (GWP) weighted basis.

[11] Intergovernmental Panel on Climate Change: Fourth Assessment Report. Climate Change 2007: Summary for Policymakers. Available at: www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

Rising global temperatures, changes in precipitation patterns and sea level rise increase the risk of flooding, extreme weather events, food and water shortages, species extinction, and health impacts. Washington is particularly vulnerable to climate change impacts because of our dependence on snowpack for much of our water supply and electricity, and our vulnerability to anticipated sea level rise. Observed changes in Washington State over the 20th century include warming of 1.5 degrees Fahrenheit (about a half-degree higher than the global average); an approximately 30% overall decline in the lower Cascades spring snowpack (from 1950–1997)[12]; peak spring river runoff 10–30 days earlier, and up to a 34% decrease in summer streamflows in sensitive river basins.[13] Based on results from a number of global climate models, annual temperatures in Washington are predicted to increase approximately 1.0 degree Fahrenheit per decade over the next 50 years.[14]



1928 **1979** **2003**

South Cascade Glacier, Washington[15]

Any significant global warming will profoundly disrupt natural and human systems, and has both environmental and economic impacts. Some of the anticipated impacts from changes to Washington's climate include milder winters and hotter summers; increased occurrence and severity of forest fires; reduced snowpack; receding glaciers; hydropower loss; declines in summer water supplies and stress on irrigated agriculture; changes in growing seasons; increases in forest and crop pests; increased occurrence and severity of extreme weather events, flooding and droughts; coastal flooding and erosion; sea level rise; loss of wetlands and estuaries; declines in native plant and animal populations, including extinctions due to habitat loss or inability to adapt to ecological changes; increased threats to the built environment (e.g., landslides); more human health problems such as heat-related illnesses and

[12] Figure referenced from Mote et al. 2005. Research by the Climate Impacts Group at the University of Washington shows that spring snowpack, also referred to as snow water equivalent (SWE), has declined since monitoring became widespread in the 1940s. Many "individual" monitoring sites in the Cascades show 30-60% losses. SWE is affected by both temperature and precipitation, each of which shows large year-to-year and decadal variations associated with natural variability. Relative loses are greater in lower and mid-elevations where mid-winter temperatures are warmer; higher elevation sites where average mid-winter temperatures are still well below freezing don't show declines in SWE. www.climate.washington.edu/snowpackdiscussion.html

[13] Climate Impacts Group, University of Washington. http://cses.washington.edu/cig/

[14] *Overview of Climate Change Impacts for Washington.* Summary by the UW Climate Impacts Group in Preparing for the Impacts of Climate Change in Washington: Draft Recommendations of the Preparation and Adaptation Working Groups. December 21, 2007 draft.

[15] United States Geological Survey Glacier Studies Program. http://geochange.er.usgs.gov/poster/glacier.html

respiratory problems from increasing smog in urban areas due to higher summer temperatures; and loss of recreational opportunities.[16]

Both Adaptation and Mitigation Are Required

Some inevitable climate change is already a reality. Even if all climate change emissions were immediately halted, as described above, effects from the impacts of previously emitted gases are already occurring and are projected to continue into the near future from the elevated concentrations of GHG emissions in the atmosphere. Although charged with examining opportunities to mitigate GHGs, the CAT recognizes the need for adaptation to the effects of global warming. However, adaptation alone will not be sufficient. In order to limit the impacts of further climate change, reduction or storage of current and projected GHG emissions is also an urgent necessity, and effective sustainable action to accomplish this is required.

While both mitigation and adaptation will entail significant investment and expenditures, the longer action is delayed, the greater the impacts and costs to society. A 2006 economic study, sponsored by Ecology and CTED, documented impacts to Washington's economy from climate change already occurring, and warned that without focused efforts to reduce GHG emissions and prepare for impacts, the negative economic effects are likely to grow.[17] By most estimates, the costs of inaction to address global warming would likely dwarf the costs of actions taken to reduce it as much and as soon as possible.[18]

Mitigation and Adaptation

Mitigation in the context of global warming refers to actions taken to reduce the extent of climate change. Mitigation includes specific actions to directly or indirectly reduce GHG emissions, and retention of GHGs through storage or sequestration activities. The charge to the CAT is to develop mitigation policies and strategies.

Adaptation refers to action taken to minimize the effects of global warming. As part of the Washington Climate Challenge, Ecology and CTED formed Preparation and Adaptation Working Groups (PAWGs) to examine the impacts of climate change on Washington State and recommend specific steps and additional research needs as Washington prepares for the impact of global warming on human health, agriculture, coastal and infrastructure, forestry, and water resources and quality. Scientific conclusions about the impacts from global warming and recommendations for how Washington can prepare and adapt to these changes are discussed further in the report from the PAWGs.

Washington's GHG Emissions Inventory

To inform design of GHG mitigation strategies and future analysis of trends and progress being made, it is important to understand the sources and sinks of GHG emissions in Washington State. This section

[16] *Ibid.*
[17] Doppelt et al, 2006. Impacts of Climate Change on Washington's Economy: A Preliminary Assessment of Risks and Opportunities. Washington Economic Steering Committee and the Climate Leadership Initiative Institute for a Sustainable Environment at the University of Oregon. November 2006. Available at: www.ecy.wa.gov/pubs/0701010.pdf
[18] Stern, 2006; Doppelt et al, 2006

references the Washington State Greenhouse Gas Inventory and Reference Case Projections, 1990–2020 (December 2007). For the full report, see Appendix D. Table 1 provides a summary of historic and projected GHG emissions for Washington from 1990 through 2020.

Table 1. Washington Historic and Reference Case GHG Emissions, by Sector[a]

(Million Metric Tons CO2e)	1990	2000	2005	2010	2020
Electricity, Net Consumption-based	**16.9**	**23.3**	**18.9**	**20.2**	**24.9**
Coal	16.8	17.4	15.2	15.9	18.4
Natural Gas	0.1	5.3	3.6	4.2	6.3
Petroleum	0.0	0.6	0.0	0.1	0.2
Biomass and Waste (CH_4 and N_2O)	0.0	0.0	0.0	0.0	0.0
Residential/Commercial/Industrial (RCI)	**18.6**	**20.3**	**19.4**	**21.3**	**24.3**
Coal	0.6	0.3	0.2	0.3	0.3
Natural Gas	8.6	11.4	10.3	11.0	12.7
Oil	9.1	8.4	8.5	9.7	11.0
Wood (CH4 and N2O)	0.2	0.2	0.3	0.4	0.4
Transportation	**37.5**	**45.9**	**44.5**	**48.5**	**56.9**
Onroad Gasoline	20.4	24.5	24.8	26.2	29.1
Onroad Diesel	4.1	7.6	7.5	8.8	12.0
Marine Vessels	2.6	2.9	3.0	3.3	4.1
Jet Fuel and Aviation Gasoline	9.1	10.0	7.8	8.1	8.5
Rail	0.8	0.3	0.8	0.8	0.8
Natural Gas, LPG, other	0.6	0.6	0.7	1.3	2.5
Fossil Fuel Industry	**0.5**	**0.7**	**0.9**	**1.0**	**1.1**
Natural Gas Industry (CH4)	0.4	0.7	0.9	0.9	1.0
Coal Mining (CH4)	0.0	0.0	0.0	0.0	0.0
Industrial Processes	**7.0**	**6.6**	**3.3**	**4.2**	**6.2**
Cement Manufacture (CO2)	0.2	0.5	0.5	0.5	0.5
Aluminum Production (CO2, PFC)	5.9	3.9	0.4	0.4	0.3
Limestone and Dolomite Use (CO2)	0.0	0.0	0.0	0.0	0.0
Soda Ash (CO2)	0.1	0.1	0.1	0.1	0.1
Ozone Depleting Substitutes (HFC, PFC, and SF6)	0.0	1.6	2.1	3.0	5.1
Semiconductor Manufacturing (HFC, PFC, and SF6)	0.0	0.1	0.0	0.0	0.0
Electric Power Transmission & Distribution (SF6)	0.8	0.4	0.3	0.2	0.1
Waste Management	**1.5**	**2.2**	**2.4**	**2.8**	**3.6**
Solid Waste Management	1.0	1.5	1.8	2.0	2.7
Wastewater Management	0.5	0.6	0.7	0.8	0.9
Agriculture	**6.4**	**6.4**	**5.4**	**5.1**	**4.8**
Enteric Fermentation	2.0	1.8	1.6	1.5	1.3
Manure Management	0.7	0.9	0.9	1.0	1.2
Agricultural Soils	3.7	3.8	2.8	2.6	2.2
Total Gross Emissions	**88.4**	**105.4**	**94.8**	**103.0**	**121.9**
Increase relative to 1990		*19%*	*7%*	*17%*	*38%*
Forestry and Land Use	-28.6	-28.6	-28.6	-28.6	-28.6
Agricultural Soils	-1.4	-1.4	-1.4	-1.4	-1.4
Net Emissions (including sinks*)	**58.4**	**75.4**	**64.8**	**73.0**	**91.9**

Activities in Washington accounted for about 95 million metric tons (MMt) of *gross*[19] carbon dioxide equivalent[20] (CO_2e) emissions in 2005, or about 1% of the total U.S. gross GHG emissions.[21] Washington ranks 26th among the 50 states in terms of CO_{2e} emissions.

As illustrated in Figure 1, Washington's historical GHG emissions rose fairly continuously throughout the 1990s until dropping significantly after the year 2000. This drop is largely attributable to the response of industries and utilities to significant energy price swings and limited availability of hydroelectricity during the 2000–2001 period, and in particular to the decline of aluminum production in the State (which requires significant electricity use and produces industrial process emissions). Since 2003, GHG emissions have resumed their increase, and are projected, under a business-as-usual scenario, to climb to 122 $MMtCO_2e$ per year by 2020, about 38% above 1990 levels.[22]

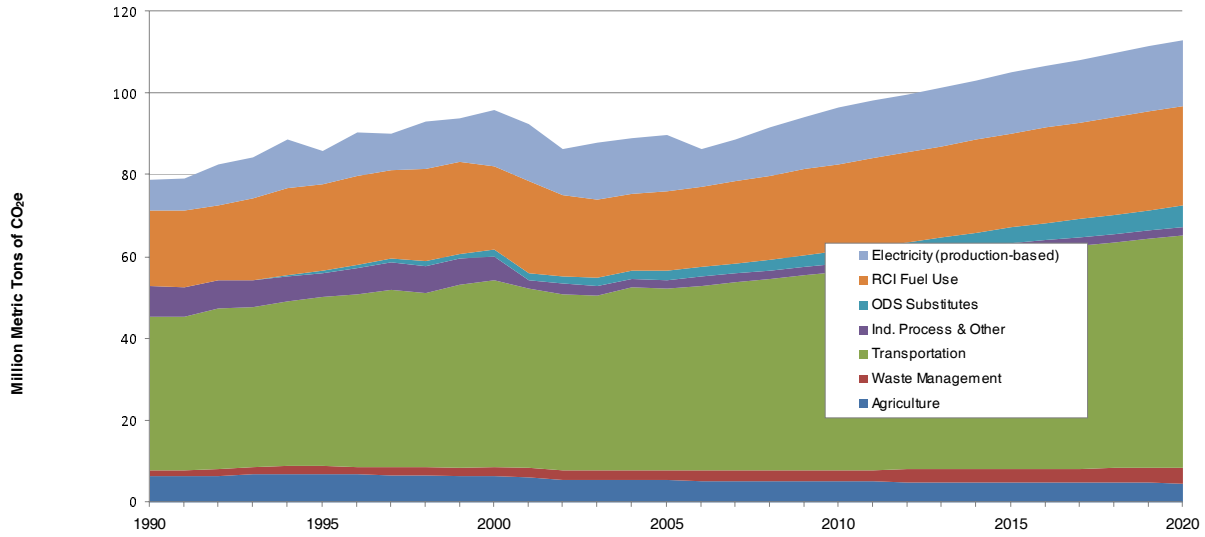


Figure 1: Washington Gross GHG Emissions by Sector, 1990-2020: Historical and Projected

The largest source of Washington's GHG emissions is transportation, accounting for nearly half of total State gross GHG emissions in 2005. The next largest contributors to total gross GHG emissions are fossil fuel combustion in the residential, commercial, and industrial (RCI) sectors at 20%, and in the electricity generation facilities that deliver power to these sectors, also 20%. Agricultural activities such as manure

[19] Gross emissions estimates exclude carbon dioxide removed or sequestered from the atmosphere by as the result of land use, land use change, and forestry activities.

[20] This analysis includes the six gases included in the U.S. Greenhouse Gas Inventory: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Emissions of these GHGs are presented using a common metric, CO_2 equivalence (CO_2e), which indicates the relative contribution of each gas to global average radiative forcing on a Global Warming Potential (GWP) weighted basis. In order to be consistent with the US EPA National GHG inventory, the GWP values in this report are from the Second Assessment Report (SAR) of the Intergovernmental Panel on Climate Change (IPCC).

[21] Gross U.S. emissions in 2005 were 7,260 $MMtCO_2e$ (U.S. EPA, *U.S. Inventory of Greenhouse Gas Emissions and Sinks 1990-2005*).

22 This projection for GHG emissions through 2020 was developed using the State projections of population and employment growth, utilities' projections of electricity use, and input from Washington staff from CTED, Ecology and other departments. For greater detail, see the full report in Appendix D.

management, fertilizer use, and livestock (enteric fermentation) result in methane and nitrous oxide emissions that account for 6% of State GHG emissions. Solid waste and wastewater management also result in methane and nitrous oxide emissions, which are less than 3% of Washington's current emissions. Finally, industrial process emissions include: emissions of high global warming impact gases, such as PFCs from aluminum production (which have decreased by over 5 $MMtCO_2e$ since 1990); the use of hydrofluorocarbons (HFCs) as substitutes for ozone-depleting substances[23] of GHG emissions from Washington State sources; and CO_2 emitted by cement and lime manufacture.

Business-As-Usual

The term *business-as-usual* is used here to describe a set of assumptions about the usual state of activities or other factors contributing to emissions (e.g., existing control programs and economic growth). A 'reference case' is developed to describe anticipated future states when the current, or 'base year' is projected to one or more future years under 'business-as-usual' conditions. This reference case provides a baseline against which to set future targets, and measure progress.

These shares differ significantly from the US as whole, as shown in Figure 2, below. Transportation makes up a larger fraction of Washington's emissions, yet on a per capita basis, Washington consumes about the same amount of gasoline per capita as the US average. While on a per capita basis transportation emissions are similar, emissions from electricity, RCI fuel use, and industrial processes are significantly lower than the US average. This discrepancy, which explains much of the difference in the pie charts shown in Figure 2, is attributable to the State's abundant hydroelectric resources, and the limited presence of large, emissions-intensive industrial sources.

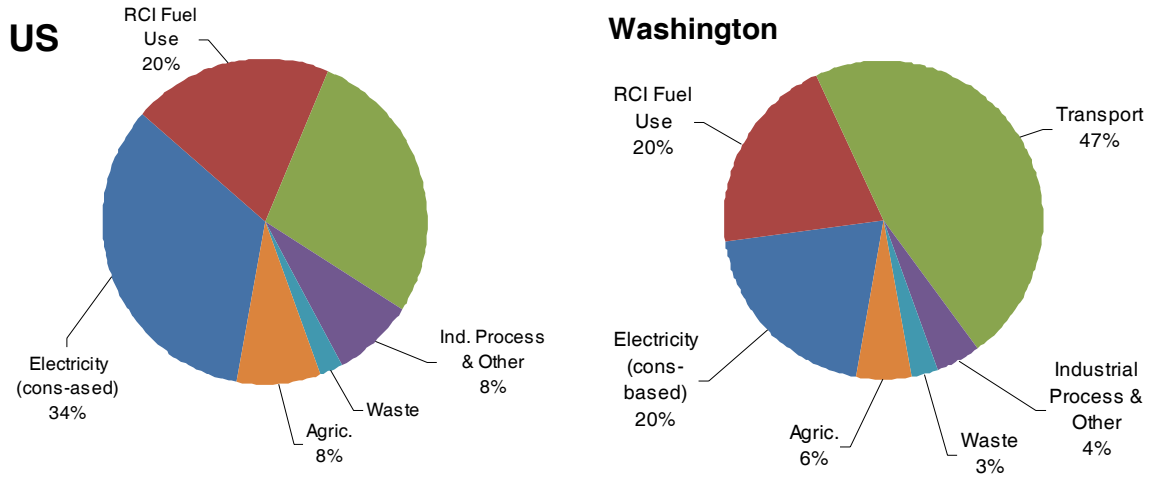


Figure 2: Gross GHG Emissions by Sector, 2005, Washington and US

The other key component of Washington's profile is the carbon stored in forest and agricultural lands. As shown at the bottom of Table 1, these lands are currently estimated to sequester about 30 $MMtCO_2e$, based on estimates from the US Forest Service.

[23] Chlorofluorocarbons and hydrochlorofluorocarbons are also potent greenhouse gases; however they are not included in GHG estimates because of concerns related to implementation of the Montreal Protocol. See Appendix D for more information.

As shown in Figure 3, emissions associated with transportation are also projected to be the largest contributor to future emissions growth in Washington from 2005 to 2020. The figure shows that under business-as-usual, transportation growth could add just over 12 $MMtCO_2e$ to Washington's emissions by 2020. The RCI sector could add another 6 $MMtCO_2e$ over the same time period, while emissions from electricity produced to meet the State's needs could add another 5 $MMtCO_2e$.

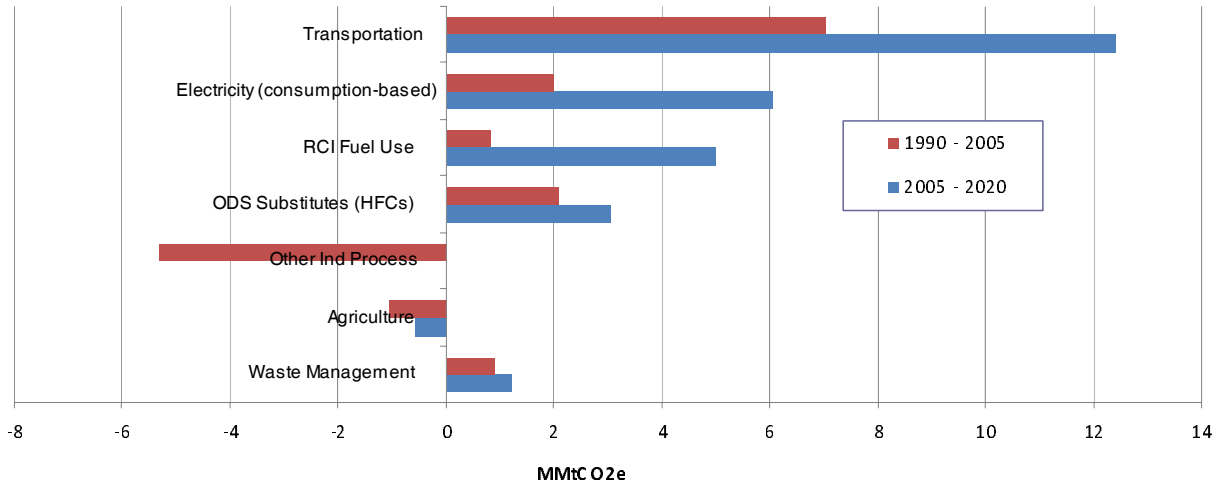


Figure 3: Sector Contributions to Emissions Growth in Washington

Carbon Storage—Sequestration and Sinks

Carbon *sequestration* occurs naturally through the removal of atmospheric carbon dioxide by plants through the process of photosynthesis. Oceans also sequester carbon dioxide naturally through biochemical processes. Forest biomass, agricultural soils, and oceans *store* carbon, and serve as natural carbon *sinks*, or reservoirs (e.g. approximately 29 $MMtCO_2e$ are sequestered annually in Washington forest biomass).

Carbon can also be sequestered artificially through human activities. This includes enhancing natural sequestration processes (e.g., increasing the amount of soil carbon sequestered through farming practices like no-till/direct seeding); storing carbon in biomass-related products (e.g., nearly 12 $MMtCO_2e$ is sequestered annually in wood products from Washington forests); or capturing carbon before it is released (e.g., from a power plant) and storing it in either geological formations, deep oceans, or mineral carbonates (this last approach, referred to as carbon capture and storage or reuse (CCSR), has not yet been commercialized). Several CAT strategies are designed to increase carbon storage through retention of sinks, or increases in sequestration.

Function and Resiliency of Natural Systems with Regards to Global Warming

A key underlying assumption used to assess the sufficiency of actions taken to mitigate and adapt to climate change is the ongoing function and resiliency of natural systems. In recent years, Washington's forests have sequestered carbon in an amount equivalent to about a third of the State's GHG emissions.

However, climate-driven natural disturbances such as fire and insect infestations, or human activities such as forest conversion, are likely to diminish this sink in the future. Agricultural soils are a significant potential sink for carbon, but in many cases are already degraded or will be without management changes. While most assessments of climate change impacts and solutions focus on the GHG contributions from human activities related directly to energy use, human activities that have impacted and altered the natural environment also have implications for climate change, the effectiveness of mitigation efforts, and even the continued functioning of these systems under a changing climate context. As the ecological structure is altered, the function and natural capacity to store carbon and provide other ecosystem benefits that can reduce the severity of impacts from climate change (e.g., ability of forest and agricultural soils to absorb precipitation and reduce surface runoff) is degraded.

The conservation, use and restoration of natural systems to reduce emissions and store carbon are significant. While beyond the scope of this effort, in its deliberations the CAT suggested that future efforts consider restoration activities to natural systems as part of a holistic and effective climate change response, in addition to the behavioral and technical changes proposed to address global warming. Investments in ecosystem and natural resource rehabilitation and recovery will pay dividends in enhancing our mitigation efforts. Washington's natural carbon storage capacity and potential should be evaluated, and a baseline developed for potential credit of restoration activities and to measure the efficacy of environmental improvements.

III. The Climate Change Challenge Requires a Comprehensive Approach by Washington

Taken as a whole, the recommendations from the CAT comprise a Comprehensive Climate Approach, a coherent and systematic strategy for Washington to rise to the real and urgent threat of global warming, and to seize the opportunity to build a healthier and more prosperous future. The CAT has identified a directional, encompassing road map that leads the State towards achievement of its emissions, fuel import reduction, and clean energy job goals. By following this road map, and implementing practical solutions that enable significant reduction, sequestration, and removal of GHG emissions, Washington can develop a more robust economy, enhance rural prosperity, provide good jobs, improve our position in the global economy, and build healthier, more sustainable communities.

The CAT's Recommendations Meet Washington's Environmental and Economic Goals

The suite of options identified by the CAT, together with recent actions already taken in Washington, should enable the State to meet the goals set by Governor Gregoire if implemented in a complete and timely manner:

- **Greenhouse gas emission reduction goals**: By 2020, reduce GHG emissions to 1990 levels. By 2035, reduce emissions 25% below 1990 levels. By 2050, GHG emissions in Washington to be reduced 50% below 1990 levels.
- **Job creation goal**: By 2020, increase the number of clean energy sector jobs to 25,000, a three-fold increase from the 8,400 jobs in 2004.
- **Energy independence goal**: By 2020, reduce expenditures by 20% on fuel imported into the State

Full Range of Policies and Strategies Needed to Jump-Start the Clean Economy and Reduce GHG Emissions Quickly, Effectively and Efficiently

The CAT is building on a strong base of policies already adopted by the State of Washington that reduce or remove GHG emissions. However, although Washington has made significant headway in addressing climate change through these recent policy actions,[24] additional actions are needed to achieve the 2020

[24] The recent decision on December 19, 2007 by EPA to deny California's request for a waiver from the Clean Air Act so that it could implement tailpipe emissions standards for GHGs illustrates that reductions in GHG emissions can not be counted on until they actually occur. Washington State has also adopted the California standards, and the potential reductions from their implementation in Washington has been factored into the emission reductions and net cost/benefits of the 'recent actions' referred to in this interim report. The US Congress has passed and the President has signed, also on December 19, 2007, federal legislation that increases the Corporate Average Fuel Efficiency (CAFE) standards as well. Washington has joined a lawsuit against EPA over its decision. This report and the cumulative analyses of potential emissions reductions and net costs/benefits, have not been adjusted or modified to reflect what either the delay or denial of the State's ability to implement the California standards or the increase of the CAFE standards might mean for either emission reductions or cost benefits. At minimum, given the pending litigation, implementation of the California standards will be delayed. This delay will diminish the anticipated GHG emissions reductions (18.3 MMtCO2e cumulative GHG savings from 2008-2020) and benefits ($2.6 billion in overall benefits to the state on a cumulative net present basis through 2020), and the overall positive contribution of this recent action towards meeting the Executive Order goals. Also, the increases in CAFÉ standards will go into effect later than the original date on the California standards, so they will not fully make up for the California standards.

GHG emissions reduction goal for Washington State and put Washington on a low-carbon emissions path to achieve sufficient long-term GHG emission reductions. The CAT has identified strategies that, when implemented, will enable the State to meet these goals, as discussed further below.

As the CAT deliberated on how best to meet the near and longer-term goals, and achieve a lower carbon future for Washington, the need for a foundational and systematic approach became clear. A results-oriented framework can bind together diverse and disparate actions and provide needed certainty, structure, coherence, pace and accountability, ensure a focus on quantifiable results, and attract sufficient public and private investment in successful solutions. In this Comprehensive Climate Approach for Washington, the CAT has articulated directional recommendations that:

- Support the use of market-based mechanisms as valuable instruments to ensure that emissions reductions goals are achieved efficiently and effectively economy-wide;
- Provide specific strategies to enable emission reductions goals to be met, while addressing other State goals;
- Call for the tools, resources and authorities government will need to implement and guide this Approach over time;
- Recognize the need for sufficient funding to support the investments needed to harvest the environment, social, and economic benefits identified; and
- Identify some of the substantive economic opportunities within Washington's economy that are enhanced by this Approach.

Recognizing that the opportunities and partnerships for Washington will far exceed those that can be identified here, the CAT seeks to set in motion a framework that will allow for a broad and flexible response to Washington's Climate Change

Recent Actions

Recent actions, as referred to throughout this report, represent policies and initiatives undertaken by State government in the past few years that are expected to make a significant contribution towards achieving the goals of Executive Order 07-02. Overall, the CAT process evaluated nine specific actions, and where possible, quantified their emissions reductions and costs or cost savings in a manner similar to the CAT policy options. (See the recent actions memo at www.ecy.wa.gov/climatechange/CATdocs/80707RecentActionsMemo.pdf) These actions included the vehicle tailpipe emissions standards enacted by the legislature in 2005, several legislative and executive initiatives to promote biofuel production and use, green building and fleet efficiency standards for State buildings, building code enhancements, appliance standards, and renewable energy and energy efficiency requirements established by the Energy Independence Act. Achieving the full emissions reductions and cost savings associated with the recent actions will require ongoing efforts to ensure complete and timely implementation.

The Future Clean, Low-Carbon Economy

The terms *Clean Economy* and *Low-Carbon Economy* are used interchangeably in this report to describe activities related to the production and distribution of goods and services in a way that promotes environmental protection, economic prosperity, high quality jobs, social equity, and future quality of life, while emitting far less carbon and other greenhouse gases into the atmosphere.

The characterization of the clean energy sector for purposes of calculating the jobs goal defines the clean energy sector as a narrow subset of the Clean, Low-Carbon Economy. This sector consists of ten sub-industries: renewables, fuel cells, PV/solar, geothermal, small-scale hydro, wind, biomass, efficiency, smart, and unidentified industry categories.

Challenge. The CAT's Comprehensive Climate Approach is designed to drive and accelerate significant GHG emission reductions, spur innovative technological creativity, attract private investment in developing and implementing solutions, help Washington share 'the pain and the gain' of this transformation equitably, and help Washington compete successfully in the global marketplace that is rapidly emerging for GHG emission reduction and clean energy solutions. As well, the CAT sees this report as interim; significant work will be needed in 2008 to further scope and develop the specific policies and programs needed to implement these directional recommendations.

A New Way of Preventing GHG 'Pollution' Is Emerging

Smart GHG emission reduction policies will need to both signal economic opportunity and produce the necessary environmental safeguards. A new way of thinking and acting is needed to guide the simultaneous engagement, positive interactions, and mutual reinforcement between the various elements of society that are critical for success in reducing the reliance of carbon-based energy in our economy and way of life. If this is done correctly, the CAT believes we can unleash the State's enormous capacity for innovation and entrepreneurship to deliver solutions which will also support the health and well-being of our citizens and our natural systems. When this approach of appropriate government policy that supports entrepreneurial creativity and directs thoughtful capital investment is joined by a strong emphasis on workforce training, then opportunities for all citizens to participate in the opportunity side of responding to climate change, now and into the future, can be created.

Meeting the challenge of climate change requires diverse elements in society to form strong partnerships and work together in new ways. Business, labor, government at all levels, environmental groups, educational, academic and research institutions, and individuals through their purchases and their behaviors, will all need to contribute to move Washington forward in meeting the State's GHG emission reduction goals and creating the Clean Economy. Reducing GHG emissions—and protecting and enhancing carbon stocks—will not be accomplished by identifying one component or sector of society as the 'problem' and then authorizing government to compel compliance. Instead, because of the overwhelming and pervasive use of carbon-based energy by all sectors of society, we all have to make a significant contribution to reducing GHG emissions. While recognizing that significant interim costs and behavioral changes may be necessary to transform parts of our economy to a lower carbon model, a creative and inclusive approach can reduce emissions more effectively and efficiently, and produce more economic benefits to share more broadly throughout society more quickly.

Reducing Emissions from Both the 'Top Down' and the 'Bottom Up' Is Essential

To be effective, this climate strategy must recognize and motivate the countless individual actions by government, business, and individuals that collectively are needed to reduce GHG concentrations in the atmosphere sufficient to stabilize the climate. The Comprehensive Climate Approach includes both broad, enabling ('top down') and sector-specific ('bottom up') strategies, which are inextricably intertwined and equally necessary. Pursuing both broad and specific approaches will expand our choices and strategies, and allow us to reach our goals most effectively and efficiently. The implementation of a market mechanism will serve to structure and provide certainty in the transition to the Clean Economy of the future. While market-based mechanisms are necessary and valuable, they are just one component for achieving reductions. Sector-specific strategies will augment, and in some instances support,

development of this market as well as ensure predictable emission reductions are achieved from key emission sources, such as transportation, in order to meet the State's goals. In addition, the market mechanism will take time to implement and mature: until the market is fully functional, some specific strategies can be deployed immediately to pursue 'low-hanging fruit'; actions that have both immediate reductions benefits and cost savings.

Broad, Enabling Strategies are Critical to Success

As a prime component of the comprehensive approach to reduce GHG emissions and take advantage of opportunities created by the transition to the Clean Economy, the CAT proposes several directional recommendations designed to set in motion and support an economic market that recognizes and directs how carbon should become a 'cost' that can then be factored into business and consumer decisions. [25]

Because the transformation to a Low Carbon Economy will engage all of society, it is critical that investment capital be deployed as effectively and efficiently as possible. To ensure that this occurs, the CAT strongly recommends that whenever possible, the targets that drive choices be performance-based and not prescribed for a particular technology. Government should stimulate the direction of the market through clear, direct targets, and appropriate tools and programs, and the market can respond to the resulting price signal by developing and sorting out 'winning' technologies, efficiencies, or choices to reach the target. For example, government can set a standard for low carbon fuels, and the subsequent capital attracted to that market opportunity will flow into fuel and vehicle technology that creates the necessary solutions.

This does not mean the government should be technology indifferent. While government target setting should be as technology-neutral as feasible, government can and should stimulate technology development through research and development incentives that provide affirmative and intentional support for promising technologies or programs. These actions encourage and support entrepreneurs to seek innovative solutions, allowing them to 'push' technology

Broad, Enabling Strategies

Directional recommendations designed to set in motion Washington's transition to a Low-Carbon Economy:

- Recommendation 1: Build market-based mechanisms to unleash investment in the creativity and innovation of Washington's economy to deliver cost-effective emission reductions.
- Recommendation 2: Establish emissions reporting so that progress in emission reductions can be tracked and acknowledged.
- Recommendation 3: Analyze greenhouse gas emissions and mitigation options early in decision-making, planning processes, and development projects
- Recommendation 4: Invest in worker training for the emerging clean economy to ensure having a skilled workforce and to provide meaningful employment opportunities throughout the State.
- Recommendation 12: Allocate sufficient state resources to maintain Washington's leadership role regionally and nationally and to fulfill its responsibilities for structuring and guiding implementation of emission reduction strategies.

[25] Members of the CAT organized and attended a meeting with representatives of the financial and entrepreneurial communities to discuss how best to enhance investments to reduce carbon and spur technological innovation throughout Washington's economy. This text builds on findings from these discussions.

envelopes prior to market acceptance of them. Incentives may be needed to spur the market response more quickly, and/or demonstrate that specific solutions do or don't work as anticipated, and thus help get more efficient and cleaner technology out more quickly than the market alone would. Incentives may also take the form of investments in human capital through workforce training programs or educational initiatives that inspire people to consider choices they may otherwise not have been aware of.

Establishing a Market for Carbon

The following considerations of a carbon market serves to illustrate how dynamic engagement between government action and regulation, business response, innovation and investment, and workforce preparedness and readiness can accomplish this.

To establish a market for carbon that will attract private investments in solutions and provide the benefits of reduced GHG emissions and Clean Economy opportunities, government must first set a limit or a price on GHG emissions. The market for carbon, regardless of the precise mechanism, is predicated on the constraint of carbon—a limit or cost on the amount of carbon emitted within Washington State. Such a clear limit, when accompanied by appropriate market mechanisms, will translate into the price that business and individuals either have to pay to use some of that limited carbon, or to reduce their use to meet the limit. This price is what attracts and directs investment to develop more efficient and less costly ways of reducing carbon—or ways to increase the storage of carbon. (This limit need not necessarily be applied economy-wide; government can set limits on carbon in specific sectors as well.) Once this strong market signal is in place, entrepreneurs, investors, business operators and individuals will be motivated to identify and invest in emerging opportunities, technologies, and choices to reduce carbon, thus facilitating establishment of a self-sustaining market to continue progress toward meeting the carbon limits.

Specific Action Strategies are Needed to Meet the Challenges within Key Areas of the Economy and Society

To achieve Washington's goals in reducing GHG emissions, the broad, enabling strategies should also be complemented by strategies that are appropriate for specific areas of Washington's economy and aspects of individual behaviors. Implementing these types of strategies ensures that Washington's GHG emissions reduction and economic goals are achieved in meaningful ways. The specific strategies developed by the CAT represent a significant range of policies and programs the State of Washington could adopt or undertake. The suite of recommended strategies provide specific ways and target specific priorities for GHG emissions reductions to be achieved, and harnesses the participation across the sectors of society that will be required to meet the State's goals.

Most activity in Washington's economy, and many individual behaviors, as well as each way carbon-based energy is currently produced and used, can be made more efficient, can produce or utilize alternative fuels, and/or be performed in ways that do not emit nearly as much, if any, GHG emissions. Critical to accomplishing this shift is identifying these specific efficiencies and substitutes, making them cost-competitive with carbon intensive options, and shaping governmental, business and consumer choices so that these alternatives are both available and implemented through those choices.

Through its five Technical Working Groups (TWGs), the CAT conducted significant analysis of potential policy options and opportunities for specific sectors of the economy.[26] The TWGs were convened in April 2007 to advise the CAT on options that fit the unique characteristics of Washington's economy, institutions and environment, and that have the potential to help achieve Washington's economic and emissions reduction goals. TWGs were structured around five sectors of Washington's economy:

- **Agriculture**, including biofuels, waste reduction, recycling and energy recovery and solid waste management;
- **Energy Supply**, including heat and power generation, electrical generation, and transmission;
- **Forestry**, including forest restoration, sustainable forest management, wood energy and carbon sequestration;
- **Residential, Commercial, and Industrial**, including energy efficiency and conservation, industrial process, and the 'customer side' of the energy meter; and
- **Transportation**, including vehicle efficiency, alternative fuels and demand reduction programs.

TWGs met regularly during 2007 to identify, refine, and analyze options, and to estimate the emissions reduction impact, costs, and other factors of each option, if implemented. The complete list of 45 options recommended by the TWGs and affirmed by the CAT are listed in Tables 4.1-4.5 at the end of this report, with complete descriptions of each option contained in Appendices F through J. The CAT assessed the 45 options that the TWGs analyzed, and affirmed that these options highlight a credible path forward to accomplish the specific transformations needed in these sectors of the economy and society in order to meet Washington's goals. An overview of the reductions anticipated from the specific actions recommended follows; a detailed discussion of how they accomplish this is in Section IV.

Specific Action Recommendations

Directional recommendations designed to ensure GHG emission reductions:

- Recommendation 5: Build and continue to redesign communities that offer real and reliable alternatives to single occupancy vehicles.
- Recommendation 6: Ensure Washington has vehicles that are as efficient as possible and use non-carbon or lower carbon intensity fuels developed sustainably from regional resources.
- Recommendation 7: Focus investments in Washington's transportation infrastructure to prioritize moving people and goods cleanly and efficiently.
- Recommendation 8: Design, build, upgrade and operate new and existing buildings and equipment to maximize energy efficiency.
- Recommendation 9: Deliver energy from lower or non-carbon energy sources and more efficient use of fuels.
- Recommendation 10: Restore and retain the health and vitality of Washington's farms and forest lands to increase carbon sequestration and storage in forests and forest products, reduce the release of greenhouse gas emissions and support the provision of biomass fuels and energy.
- Recommendation 11: Reduce waste and Washington's emissions of GHGs through improved product choices and resource stewardship.

[26] See Appendix E for a list of TWG members. Additional information is available on the website: www.ecy.wa.gov/climatechange/cat_twg_overview.htm

Reducing Emissions Sufficient to Meet the State's Goals is Achievable

As illustrated in Figure 4, the 45 options, together with recent actions already underway in Washington, appear capable of enabling the State to turn the corner on otherwise increasing emissions, to begin a long-term path of declining emissions, and to achieve—and perhaps even exceed—the State's goal of reducing GHG emissions to 1990 levels by 2020. Overall, assuming full and timely implementation, these strategies could yield almost 50 million metric tons carbon dioxide equivalent ($MMTCO_2e$) in annual emission reductions by 2020.[27] This would represent a reduction of nearly 40% below business-as-usual projections for that year (122 $MMtCO_2e$) and reduce the State's emissions below the 1990 levels (88 $MMtCO_2e$) by approximately 17%.[28]

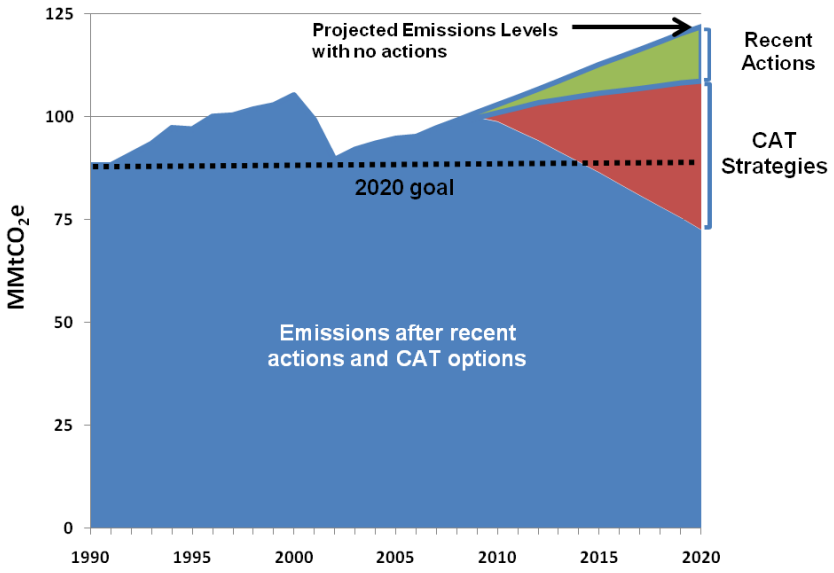


Figure 4: Projected GHG Emissions from Business-as-Usual and Anticipated Reductions from Recent Actions and CAT Strategies

The potential GHG emissions reductions identified here appear quite significant for several reasons. First and foremost, this analysis presumes that these strategies can be put into place in the timely and often quite ambitious fashion envisioned by the TWGs. Since many of these strategies may prove challenging to enact, or follow a slower implementation path, the CAT recognizes that reaching this nearly 50 $MMtCO_2e$ in reductions by 2020 will be very hard to achieve, and should in no way been seen as any form of 'mission accomplished' at this time. At the same time, this realization that a sufficient reduction of

[27] The options were analyzed for their net GHG reduction potential in $MMTCO_2e$ using IPCC 100 year global warming potential, reported for 2012, 2020, and cumulatively 2008–2020 (where applicable, longer-term reduction potential was noted as an additional benefit, but not quantified due to uncertainties associated with extended projections of reductions). Details of additional benefits that are likely to accrue from each option are contained in the complete policy options documents in Appendices F–J.

[28] For a summary of the key elements of the recommended methodology for quantifying the GHG impacts and costs for those TWG policy options that were considered amenable to quantification, see Appendix K.

emissions is possible from these strategies argues for the serious pursuit of a broad suite of strategies to ensure our emission goals can be met.

Furthermore, this estimated reduction potential may appear quite large—on a percentage basis compared with what has been found possible in other States or regions—because of several factors specific to Washington. Most notably, the State's sizeable and productive agriculture and forestry sectors could provide particularly large carbon sequestration benefits as well as potentially produce substantial quantities of low-carbon fuels. In addition, the fact that much of the State's electricity needs are met by hydroelectric resources means that additional energy efficiency, renewable energy and other low-carbon electricity resources could displace a larger percentage of the State's more limited reliance on fossil fuel-based electricity sources.

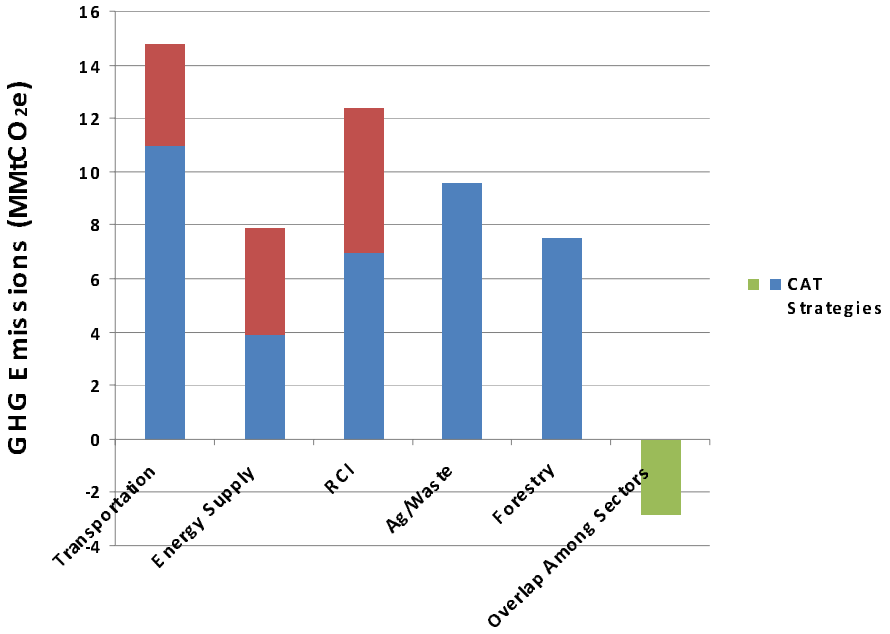


Figure 5: GHG Emissions Savings in 2020 from Recent Actions and CAT Strategies, and Overlap in Reductions among Sectors

All five TWG sectors present significant opportunities for emissions reductions and removals, as shown in Figure 5. Some highlights are outlined here, and more discussion is provided in Section IV. Not surprisingly, the transportation sector, which accounts for nearly half the State's emissions, offers significant emissions reduction potential through increasing vehicle and transportation system efficiency, and reducing vehicle travel using transit, community design, and other measures. Alternative vehicle fuels can also play a major role in the transportation sector by 2020, through a low carbon fuel standard and plug-in hybrid electric vehicle incentives, as well as through the agriculture and forestry sector, where the CAT recommends goals for producing 250 million gallons of liquid fuels from biomass by 2020. Another major contributor to potential emissions savings in the agriculture and forestry sectors by 2020 is avoiding the conversion of farm and forest lands, and the resulting loss of carbon stored in trees and soil. Expanding recycling, reuse, and source reduction of municipal waste accounts for about half the emissions reductions in the agriculture/waste sector, as shown in Figure 5. Improvements in building energy efficiency, building materials and community design, increasing natural gas efficiency programs, and increasing efficiency standards account for a significant fraction of the emissions reduction shown for

the residential, commercial, and industrial sectors. In the energy supply sector, increasing the contribution of renewable and combined heat and power sources are the principal sources of quantified emission reductions shown.

Many of the strategies affirmed by the CAT are overlapping and reinforcing, as in the example case of the various transportation, agriculture, and forestry initiatives that support both biofuel use and production.[29] The last bar in Figure 5 illustrates the overlap *between* sectors—and reflects the results of interactions with biofuel initiatives, combined heat and power and other strategies.[30]

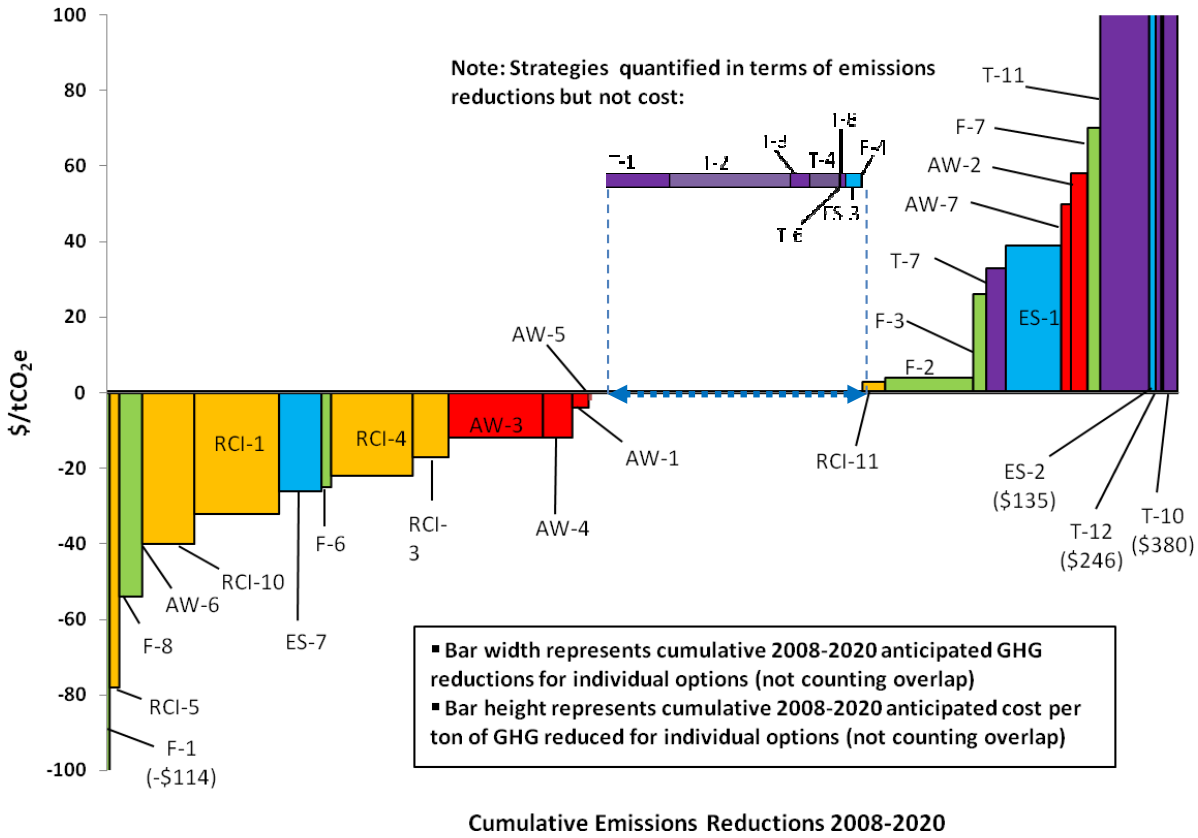


Figure 6: Anticipated GHG Emissions Reductions ($MMtCO_2e$) and Cost Impacts for Quantified Strategies (as calculated for the strategies individually, from 2008–2020)

Figure 6 depicts the emissions reduction potential and cost impacts for the suite of quantified strategies, as calculated for the strategies individually (i.e., not fully accounting for overlaps). Strategies below the x-axis are those that are projected to yield cost savings, while those above the line are those with projected direct costs.[31] As illustrated, there is a mix of strategies with net cost savings (below the line)—largely

[29] While most strategies were separately assessed in terms of emission and cost implications as if they were implemented alone, their combined impact was also analyzed and overlapping emission reductions were subtracted to avoid double counting.

[30] Overlaps among options *within* sectors are included in the overall sectoral results shown. The total estimated emissions reduction shown in Figure 5 for 2020 thus represents the sum of all the bars shown in Figure 5.

[31] The height of each bar indicates its cost per ton of CO2e reduced or removed, while the width represents its

those involving energy efficiency or resource conservation—and strategies with net costs (above the line). As well, there are a handful of policy strategies—in particular transit, pricing, and other VMT reduction strategies—that are typically difficult to quantify in terms of incremental cost (and are not often shown in cost curves of this nature).[32]

While some strategies present net direct costs and others create net savings, together, they could provide an overall economic benefit to Washington residents and businesses, especially if recent actions are taken into account, and are assumed to be fully implemented. As noted above, and depicted in Figure 6—the raised bar indicated by dashed lines—costs for several strategies, most notably those with impacts on vehicle miles traveled, could not be as readily estimated. The strategies and recent actions for which both NPV costs and GHG savings could both be estimated could potentially yield a net cumulative benefit of over $900 million by 2020 (Net Present Value 2008–2020, in $2006).[33]

Many of the strategies yield cost savings, largely through overcoming barriers and providing incentives to more efficient resource use. Table 2 shows the anticipated cost impacts and GHG emissions reductions for quantified strategies; additional details are contained in Tables 4.1–4.5 at the end of this document and in Appendices F–J). At the same time, there are some measures which appear quite costly from a direct cost basis:

- Increasing in-State production and utilization of biofuels and biofeedstocks (AW-2, F-7, T-11) might present overall costs to Washington of over $1.8 billion[34] on a cumulative net present value basis through 2020.
- Accelerating the use and integration of plug-in hybrid electric vehicles (T-10) might present overall costs to Washington of over $2.0 billion on a cumulative net present value basis through 2020.
- Increasing renewable energy generation, systems, and technologies (ES-1, ES-2) might present costs to Washington of over $0.8 billion on a cumulative net present value basis through 2020.
- Protecting Washington's forests and farms (F-2, F-3, AW-7) might present costs to Washington of over $0.8 billion on a cumulative net present value basis through 2020.

While these cost estimates may appear quite high, it is important to recognize that they do not account for future cost declines that might accompany increasing experience and production, the benefits of reduced dependence on imported energy, or the economic benefits from job creation. This cost analysis also does not include what are in many cases very significant social and environmental co-benefits, such as improved transportation choices, reduced local air pollution and improved public health, functioning natural systems, or hedges against energy price volatility, to name a few. For example, the benefits of fuel diversity, reduced dependence on petroleum imports, and regional job creation are important motivators in advancing alternative vehicle fuel strategies, but these benefits are not included in the cost comparison.

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cumulative emissions savings through 2020. The area is equivalent to its net present value cost to 2020, or cost savings if below the axis.

[32] A recent report from McKinsey & Company (2007) does a similar analysis of the US as a whole and this analysis correlates well with what the CAT found regarding its strategies.

[33] All net present value estimates are calculated using a 5% real discount rate.

[34] This figure reflects the estimated cost of the Low-Carbon Fuel Standard (T-11). This option would require significantly more biofuel (or other low carbon fuels) than the agriculture and forestry options would provide, and thus the costs of In-State Production of Biofuels & Biofuels feedstocks (AW-2) and Improved Commercialization of Advanced Lignocellulosic Processes (F-7) are assumed to overlap with the overall cost of the standard.

Table 2: Anticipated Cumulative GHG Emissions Reductions (2008–2020) and Cost Impacts for Quantified Options

	0-10 MMtCO_2e	<10 MMtCO2e
>$50/t$CO_2$e	➔ Zero Emission Vehicle Standards (T-12) ➔ Improved Commercialization of Advanced Lignocellulosic Processes (F-7) ➔ Acceleration and Integration of Plug-In Hybrid Electric Vehicle Use (T-10)	➔ Low Carbon Fuel Standard (T-11)
10-$50 /t$CO_2$e	➔ Distributed Renewable Energy Incentives and/or Barrier Removal (ES-2) ➔ Enhanced Carbon Sequestration in Forests (F-3) ➔ Diesel Engine Emission Reductions and Fuel Efficiency Improvements (T-7)	➔ Grid-based Renewable Energy Incentives and/or Barrier Removal (ES-1)
$0-$10/tCO_2e	➔ Reductions In On-Farm Energy Use and Improvements in Energy Efficiency (AW-6) ➔ Agricultural Nutrient Management (AW-5) ➔ Rate structures and Technologies to Promote Reduced GHG Emissions (RCI-5) ➔ Preservation of Open Space/Agricultural Land (AW-7) ➔ In-State Production of Biofuels & Biofuels feedstocks (AW-2) ➔ Manure Digesters/Other Waste Energy Utilization (AW-1) ➔ Policies and/or Programs Specifically Targeting Non-energy GHG Emissions (RCI-11) ➔ Agricultural Carbon Management (AW-4)	➔ Reduced Conversion to Nonforest Cover (F-2) ➔ Significant Expansion of Source Reduction, Reuse, Recycling and Composting (AW-3)
<0/tCO_2e	➔ Expanded Urban and Community Forests (F-8) ➔ Expanded Use of Biomass Feedstocks for Electricity, Heat and Steam Production (F-6) ➔ Improved Forest Health (F-1)	➔ Promotion and Incentives for Improved Community Planning and Improved Design and Construction in the Private and Non-State Public Sectors (RCI-3) ➔ Combined Heat and Power (CHP) and Thermal Energy Recovery and Use (ES-7) ➔ Demand-Side Management (DSM) Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil (RCI-1) ➔ Energy Efficiency Improvement in Existing Buildings, with Emphasis on Building Operations (RCI-4) ➔ More Stringent Appliance/Equipment/ Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design (RCI-10)

In addition, these cost estimates are based on some conservative assumptions about long-term oil prices. The analysis presumes international oil prices average about $50 per barrel of oil through 2020, based on USDOE projections. However, if oil prices remain at their current high levels or otherwise average well above $50 per barrel over the coming decade, many of the higher cost strategies noted above could become cost-effective on a direct-cost basis. Furthermore, this cost analysis does not consider the indirect and macroeconomic impacts that that would arise as energy savings are 're-spent' on local goods and services, as consumers and businesses respond to changes in energy prices, and as investments and jobs shift towards lower-emission (or carbon sequestering) products and services. The CAT used

this holistic approach when assessing these strategies, and when identifying from this complete set of options those which it deemed 'most promising' for most immediate consideration (discussed further in Section IV, below).

Several of these strategies also contribute to the other State goals to create clean energy jobs and reduce expenditures on fuel imports.[35] The jobs creation goal for Washington is to increase the number of specifically defined clean energy sector jobs to 25,000 by 2020, a three-fold increase from 8,400 jobs in 2004. The combination of TWG strategies and recent actions appears capable of increasing the number to over 30,000 by 2020, as illustrated in Figure 7 and Table 3. Because of how this goal was defined, and because the clean energy sector is a narrower subset of the broader Clean Economy, the total does not include additional indirect jobs created that support these sub-industries, direct jobs arising from GHG policy strategies in agriculture, forestry and transportation (see the example of added transit jobs shown in Figure 7), or indirect job gains or losses due to increased consumer spending (resulting from energy and other cost savings) and shifting away from emissions-intensive activities and products, or changes in energy or other prices that might occur.

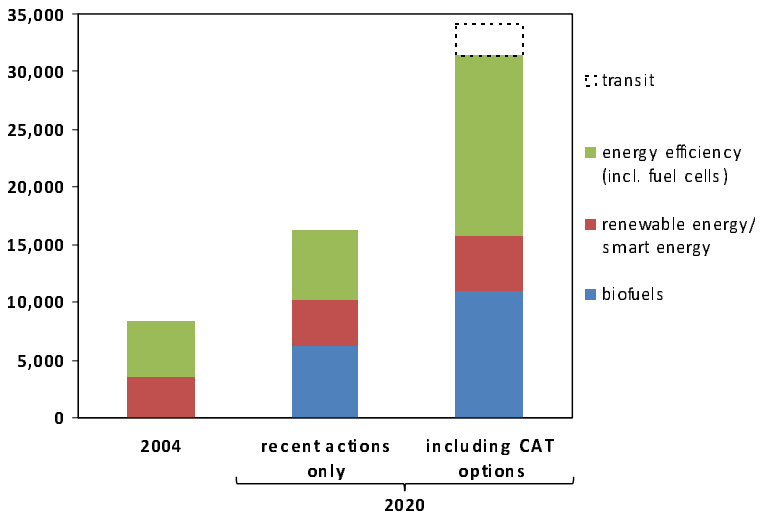

Figure 7: Anticipated Growth in Washington Clean Energy Jobs

Table 3: Direct Clean Energy Jobs from CAT Policy Measures, as of 2020

Totals may not equal sums due to rounding

sector	jobs
RCI	
Recent actions	1,300
CAT strategies	7,300
Energy Supply	
Recent actions	700
CAT strategies	3,000
Transportation	
Recent actions	6,000
CAT strategies	--
Forestry	
Recent actions	--
CAT strategies	1,900
Agriculture/Waste	
Recent actions	--
CAT strategies	3,000
Total	**23,100**
Existing jobs	8,400
GRAND TOTAL	**31,500**

Washington's energy independence goal is a 20% reduction in expenditures on fuel imported into the State by 2020. The contribution of the CAT's recommendations, along with recent actions, to the overall fuel expenditure savings goal is $4.9 billion avoided expenditures achieved by recent actions and TWG strategies, as illustrated in Figure 8 (based on estimates that Washington residents and businesses would have otherwise, under business-as-usual, spent $13.3 billion on fossil fuel imports in 2020, with the 20% reduction goal corresponding to $2.6 billion of avoided expenditures).[36]

[35] See Appendix L for additional information on the fuel and jobs goals methodology and analysis.

[36] Fuel imports are understood as *State* imports; fuel produced domestically in another State is considered an import. Biofuels are also to be included when progress toward the goal is tracked, as it is also presumed that import (versus

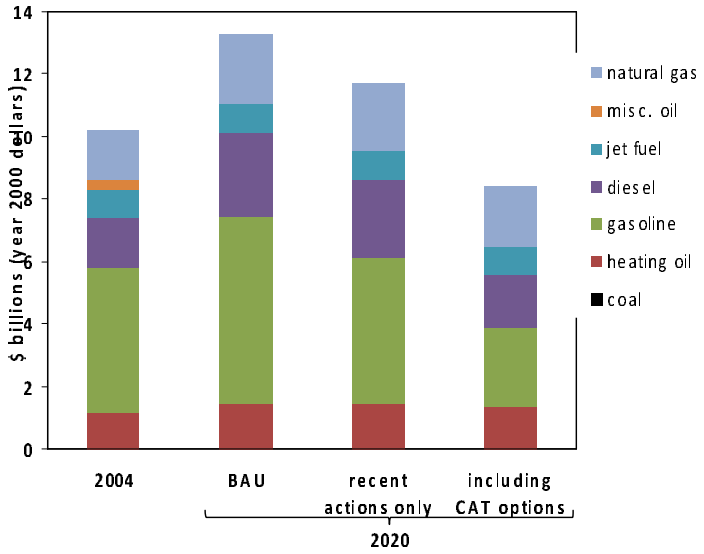

Figure 8: Washington Fuel Expenditures

How Soon Will These Strategies Actually Be Implemented?

The potential emissions reductions from these strategies, their contributions to the other goals, and any additional benefits they would produce need to be considered in light of one critical consideration: whether these strategies will actually be implemented in time to have achieved the emissions reductions impacts that the TWGs estimated they might have by 2020. Many of the recommendations include timelines for legislative action and/or State agency implementation. If fully implemented, these recommendations will allow the State to meet its goals. While additional development of the actual design and other factors associated with implementation is still needed for some of the strategies, the actual decision to implement many of them will take significant leadership, courage and foresight. The tons of GHG emissions reductions or carbon storage that will actually occur from these strategies are, at this time, highly dependent on this timely implementation. (See *Next Steps for 2008 and Beyond* in Section V for additional discussion about implementing the strategies.)

The good news is that the work of the CAT and TWGs demonstrates that Washington can meet its goals if we have the political will and make the deliberate commitment to do so. The CAT believes that the specific recommendations and strategies detailed in Section IV, next, represent the best thinking at this time as to what Washington can and should do as it takes the threat of global warming seriously and charts what the transformation to a Low Carbon Economy entails.

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in-State production) of biofuels is to be minimized. Fuels that are technically imported into the State for the purpose of generating electricity are not necessarily energy imports into the State, since electricity generated in Washington is often delivered outside the State. Segregating fuel imports used for in-State electric delivery versus out-of-State electric delivery is extremely difficult and hence changes in the electric generation sector cannot be tracked; these fuel imports are therefore omitted from the analysis. See Appendix L for additional information on the fuel goal methodology and analysis.

IV. Meeting the Climate Change Challenge: 12 Powerful, Directional Recommendations

The CAT offers the following twelve powerful, directional recommendations that together create the framework for the Comprehensive Climate Approach, a coherent and systematic strategy for Washington to minimize its contributions to global warming from GHG emissions and maximize its opportunities in the emerging Clean Economy.

The CAT emphasizes that there is a full range of actions and policies encompassed within these twelve 'headlines.' Some need legislative authorization in order to become operative; others can be accomplished by rule-making. Many need public investment, often of a significant magnitude, in order to be effective. Others will become part of an overall market-based approach and still others will be implemented because of their eventual price advantage over business-as-usual choices. Some entail new programs; others build on what is already happening. Some, when implemented, may qualify for credit as early actions.

Headlines and 'Most Promising' Strategies

The CAT identified specific policy options that appear 'most promising' at this time, and organized and sorted these to create powerful 'headline' challenges that articulate the direction the State can take by implementing specific action recommendations.

Most promising is used to denote those strategies that have significant GHG reduction potential, contribute to the jobs growth and fuels expenditure reduction goals, have lower cost and/or positive net present value, have significant additional benefits, are politically feasible, and/or are 'ripe' for action. Options that the CAT felt were advanced by other recommendations are not explicitly included in this categorization (e.g., several specific options include changes to SEPA, which the CAT addressed in Recommendation 3). These most promising strategies are briefly discussed under each headline, below.

Taken as a whole, the overall effort to transform to a Clean Economy is a huge undertaking. Progress on reducing GHG emissions will be done 'a ton at a time,' in many different places and in many different ways throughout the economy. The changes that these recommendations represent, particularly for the sector-specific strategies, often look like they are at the margin of business-as-usual: reduce VMT by 20%; increase efficiency by 15%; add another 5% to the renewable power mix; increase forest productivity so that carbon stock levels increase by 0.3 tons of carbon/acre/year, etc. While those kinds of reductions might appear incremental in light of the overall amount of emissions from a particular source, achieving the targeted amount may actually require a transformational approach to accomplish it. This tension between seeking 'tons' from many places and realigning our economy and behaviors to lower the release of carbon throughout the economy is one that the CAT has been acutely aware of.

The CAT's recommendations are organized into 'headline' directives to show the diversity of effort and change that will be needed, and to emphasize the results that are imperative to achieve. Accomplishing what each headline describes will significantly contribute to success; fulfilling them all guarantees that the State's goals will be met. By identifying the 'most promising' of the specific strategies, we chart the ways that these changes are likely to occur in the most productive manner. The titles and brief summaries of

these specific strategies contained here can only convey the essence of each strategy; for the full description and greater detail on the recommended actions and policies, see the option descriptions in Appendices F through J.

Recommendation 1: Build market-based mechanisms to unleash investment in the creativity and innovation of Washington's economy to deliver cost effective emission reductions

By creating a market for carbon, over time the creativity and innovation of, and investment in, the Washington economy can become the prime driver of many of the decisions that need to be made in order to reach the State's goals. The 2020 goal for Washington State established by Executive Order 07-02 and codified in SB 6001—to return to the 1990 GHG emissions level—is the limit of the amount of carbon to be released into the atmosphere from all sources of emissions in Washington State by 2020. The CAT strongly supports building market-based mechanisms as one of the key strategies to achieving this target. Both public and private leadership to prepare our citizens and businesses for this market, and an institutional framework to ensure that this market functions as intended, will be needed in order for this potential within Washington's economy to become a significant part of the solution.

In particular, the CAT recommends that the State:

- Continue to participate and provide leadership in the Western Climate Initiative and emerging national efforts to develop market mechanisms

  The CAT supports the regional and collaborative approach being taken by Washington to develop a regional cap-and-trade mechanism through the Western Climate Initiative (WCI), and recommends that Washington continue to play a leading role in its successful development. In addition, Washington

Market Mechanisms:
Cap-and-Trade and Emission Taxes

A cap-and-trade, or 'emissions trading' system establishes an overall limit on the amount of emissions in regulated sectors (e.g., electricity or industry). Regulated emission sources must hold sufficient emission permits or allowances to cover their allowed emissions. Emissions allowances are allocated—freely to specific entities and/or though auction—and can then be traded. In addition, 'offset' allowances may be generated by verified emission reduction activities outside the capped entities. The economic rationale for emissions trading is that it enables emissions reductions to occur where costs are lowest, yielding an economically efficient approach to achieving a given emissions target. For over two decades, emission trading systems have functioned in the US for local and regional air pollutants. In recent years, the European Union, and a consortium of states in the eastern US, have established one of the first emission trading systems for GHG emissions. Furthermore, emissions trading provides the basis for the Kyoto Protocol, and for the most widely supported climate legislation being proposed in the current US Congress.

Emissions trading is not the only market-based mechanism that can be used to address GHG emissions. Emissions or 'carbon' taxes are widely discussed mechanisms, often favored by economists, that can achieve many of the same innovation-driving, economic efficiency benefits as emissions trading. Implemented in a number of European countries, carbon taxes, as the name implies, involve the collection of revenue typically based on the carbon content of fossil fuels (coal, oil, natural gas) supplied.

should actively participate in the development of national climate change legislation and emissions trading markets in order to allow the State to take advantage of emerging opportunities, and position Washington to maximize our competitive advantages.

The State of Washington is a founding partner in the WCI, which was established in February 2007 by the governors of Washington, Oregon, Arizona, California and New Mexico. WCI has formally expanded to include several other partner and observer States and Canadian Provinces.[37]

WCI partners have developed regional GHG emission reduction goals, and are currently designing a multi-sector market mechanism to achieve the regional goals. WCI partners also agree to participate in a multi-state registry to enable tracking, management, and crediting for entities that reduce their GHG emission (Washington is meeting this WCI commitment as a charter member of The Climate Registry, discussed further in Recommendation 2, below).

The market-based mechanism that WCI partners have chosen to design is a regional cap-and-trade system. While carbon taxes and emissions trading can be implemented in tandem (as in Norway and Sweden, for example), they are commonly viewed as competing policy instruments with a mix of advantages and disadvantages. Generally speaking, an emissions trading system provides greater certainty for achieving a given emissions reduction, while an emissions tax provides greater certainty regarding the price signal that a unit of carbon costs.

To the extent emission trading systems and programs can be linked across State and national boundaries, an emissions trading system can enable a coordinated, cross-border strategy to address this global problem. While effective linkage requires that different emission trading systems have similar rigor and design features—not a simple task—carbon taxes are generally viewed as more difficult to coordinate among regions. A carbon tax is, in principle, simpler to design and implement than cap-and-trade, although both require rigorous monitoring of emissions, tracking and reporting. Enacting a tax can face significant political hurdles, while allowing trading of emission allowances can raise complex design issues.

While the pros and cons of emissions trading vs. emission taxes continue to be actively debated, Washington is proceeding with the design of a regional cap-and-trade system through the WCI since it provides a potent mechanism for achieving many of the objectives articulated here, most notably economic efficiency, innovation, and achievement of near-term and long-term emission targets. Furthermore, through its participation with WCI, Washington can influence the design of regional (and eventually participate in and influence, national and international) emission trading systems. The CAT recommends that Washington participate to the fullest extent possible in larger emission trading markets in order to maximize the potential for cost-effective emission reductions; and in doing so, that Washington establishes appropriate in-State stakeholder outreach to receive comments regarding the WCI process and design options.

- Develop the legal, technical, and institutional infrastructure that will make a carbon market real and operational as soon as possible

[37] See Appendix M and the WCI website for more information: www.westernclimateinitiative.org/

A market will allow different entities in society to work together in expanding our options and choices. The State should establish the infrastructure to support market-based approaches that are efficient in stimulating and supporting the investments, business practices and behavioral changes needed to reduce GHG emissions. The market should be reliable and transparent for all participants so that choices become obvious and apparent. The market should also be equitable. The State should not be uninterested in technology development, but should be as technology-neutral as possible by directing market-based approaches at performance targets.

- Establish binding limits on GHG emissions

  By demonstrating that achieving significant carbon reduction targets is a certainty, not merely an aspiration, binding limits on GHG emissions are essential to form a market for carbon. Legally established limits on GHG emissions will allow market participants to plan and invest with confidence. This is a necessary intersection between regulation and innovation: by constraining carbon and establishing the parameters for a market-mechanism, government provides the private sector the certainty necessary to spur investment and innovation in solutions.

Recommendation 2: Establish emissions reporting so that progress in emission reductions can be tracked and acknowledged

Ensuring emissions releases and reductions are measured is critical to any GHG reduction effort, regardless of the policy instrument used to achieve those reductions. Common and consistent ways of measuring will ensure that 'a ton is a ton is a ton,' and determine whether that ton of GHG emissions is still being emitted, or has been eliminated as an emission.

In addition to the biennial emissions inventory estimates reporting already required by Ecology and CTED, the CAT recommends that the State establish mandatory GHG emissions reporting by appropriate sources. By developing a reliable emissions reporting system that allows for a common way of reporting across all parts of the 'system,' the State can track progress towards meeting GHG emission reduction goals and provide a platform that supports a common way to communicate the progress being made. In addition, a common approach to reporting will allow Washington to prepare to participate in carbon markets by supporting emissions trading, enabling the potential pursuit of verifiable offsets, and documenting early voluntary reduction actions in order to reward early responders.

The Climate Registry (TCR)

Washington is a charter member of TCR, a national collaborative effort formed in May 2007 to develop and manage a common GHG emissions reporting system that enables tracking, management, and crediting for reductions. TCR is scheduled to begin accepting data early in 2008, and has a growing membership from many States, provinces, and tribes. Emerging support appears to be growing in Congress around America's Climate Security Act of 2007 (S. 2191, introduced by Senators Lierberman and Warner). S 2192 would establish a national cap-and-trade system, and references TCR to be used for the national GHG registry and for mandatory federal GHG reporting. For more information on TCR, see www.theclimateregistry.org

While emissions reporting information can support the implementation and success of market-based mechanisms, the manner in which information about emissions is collected should not be allowed to serve as a surrogate for, unduly influence, or preempt, market-mechanism design decisions.

The CAT supports participation with TCR as a promising and cost-effective way to help Washington accomplish these goals for emissions reporting and application, as long as TCR is designed and implemented as publicized.

Recommendation 3: Analyze greenhouse gas emissions and mitigation options early in decision-making, planning processes, and development projects

The CAT recommends that the State clarify application of the State Environmental Policy Act (SEPA) in order to ensure that climate change considerations are fully incorporated into governmental decision-making, resource and development planning, permitting and approval. In this way, SEPA, as the primary way of assessing environmental impact on State-approved rules decisions, plans, and projects, can support the early identification of GHG emissions reduction opportunities. SEPA can be applied to evaluate emissions, and to consider mitigation options early in the planning phases for significant private and public development activities, regulatory-required plans and decisions, and transportation projects. The CAT believes SEPA should be focused on those decisions and projects that are of sufficient magnitude that, if properly analyzed and designed, they can contribute towards significant GHG emission reductions.

SEPA is the State policy that requires State and local agencies to consider the likely environmental consequences of a proposal before approving or denying it.[38] SEPA environmental review is required for any proposal which involves a defined government 'action,' and which is not otherwise categorically exempt. This can include specific projects such as transportation projects or decisions on private development projects, as well as non-project actions such as government regulation, decisions on policies, issuance of plans, and program development. 'Elements of the environment' that must be assessed for impact include both the natural environment (earth, air, water, plants and animals, energy and natural resources) and the built environment (environmental health, land and shoreline use, transportation, public services and utilities).

In order to learn from and avoid challenges experienced in other States over the use of procedures like SEPA to include examination of climate change impacts, the CAT proposes clarifying SEPA requirements. The State should explain that SEPA can and should be used to identify and analyze climate change impacts. Climate change is currently identified as an element of the environment that must be assessed under SEPA, but how to do that is not explicit in the SEPA guidance. The State can also provide guidance to implementing agencies by sharing existing methods for quantifying emissions, and share existing approaches other States have begun to use to mitigate environmental impacts from GHG emissions associated with the decision, plan or project under review. In addition, the State should begin the process to amend the SEPA checklist to better address climate change, develop State

[38] Chapter 43.21C RCW. Enacted in 1971, SEPA provides the framework for agencies to consider the environmental consequences of a proposal before taking action. It also gives agencies the ability to condition or deny a proposal due to identified likely significant adverse impacts. The Act is implemented through the SEPA Rules, Chapter 197-11 WAC.

guidance on impacts analysis, and identify what is required and possible in terms of effective mitigation through the SEPA review.

Recommendation 4: Invest in worker training for the emerging Clean Economy to ensure having a skilled workforce and to provide meaningful employment opportunities throughout the State

The State should invest in worker training and education to prepare Washington's companies and workforce to take advantage of opportunities in the Clean Economy. In addition to investing in Washington's human capital, preparing the Clean Energy workforce by providing appropriate education and training at all levels (K-12 curriculum, community college vocational/technical education, internship and apprenticeship programs, and university research and training) enhances the likelihood of success for existing clean energy industries in Washington and attracts more energy technology development and manufacturing investment opportunities to the State by having a well-qualified and robust work force available.

The CAT has heard evidence that an aging workforce in the trades and ongoing strong economic development has combined to produce serious skilled labor shortfalls. Significant opportunities for high wage employment in the trades now exist, and will increase in the future as the Clean Economy develops. Training needs to occur at all levels of Washington's educational system to produce a skilled workforce prepared to meet this opportunity. The CAT believes this perspective is consistent with the findings of Washington Learns[39]—that our current education system was designed for the previous economy, and "as our economy and the world around us changes ever more dramatically, we must transform our education system in order to better prepare our children."[40]

Job gains in the Clean Economy are anticipated to be significant. The development of clean, renewable energy technologies and associated jobs in research, industry and manufacturing is anticipated to bring this decade's new wave of high-quality, 'green collar' jobs. Several of the Comprehensive Climate Approach strategies directly increase the number of Clean Economy jobs.[41]

An opportunity exists to create jobs for nontraditional environmental and energy workforce participants as well. A key concern to the CAT is ensuring that the poor and disenfranchised members in our communities, often also the most vulnerable to climate change impacts, are protected from negative consequences related to either climate change impacts or policy responses to limit these impacts. People of lower socio-economic means often have lower-earning potential, poorer quality housing, limited transportation options, and lower resilience to changing economic conditions. All citizens in Washington should be prepared to succeed in the Clean Economy; special consideration should be given in the

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[39] SB 5441 passed by the 2005 Legislature created the Washington Learns Steering Committee, which was co-chaired by Governor Gregoire, and after a year of intensive study, developed a final report with comprehensive, long-term recommendations for Washington's education system. www.washingtonlearns.wa.gov/

[40] 2006. Washington Learns Final Report: World Class, Learner Focused, Seamless Education. Available at: www.washingtonlearns.wa.gov/ourwork.htm

[41] The estimates developed for the CAT on job creation from its strategies (see Section III) are based on aggregate information about clean energy activity and jobs, and implicitly assume that the same relationship between jobs and expenditures as witnessed historically will hold through 2020. Actual deployment of changing technologies and production practices will inevitably produce a different outcome, but the promise of significant skilled labor employment appears bright.

design of educational opportunities and worker training programs to reach those who live on the margins of society. A commitment to "give the work that most needs to be done to the people who most need the work," takes on two pressing problems—pollution and poverty—at once.[42] Retrofitting our buildings and our cities, restoring our watersheds, farmlands and forests can provide meaningful work for many people in their own communities, and contribute to the major goal of job creation within Washington.

Recommendation 5: Build and continue to redesign communities that offer real and reliable alternatives to single occupancy vehicles

The 'most promising' strategies under this recommendation are:

- New Funding Mechanisms (T-0)
- Transit, Ridesharing, and Commuter Choice Programs (T-1)
- State, Regional, and Local VMT Reduction Goals and Standards (T-2)
- Transportation Pricing (T-3)
- Promotion of Compact and Transit-Oriented Development (T-4)
- Improvements to Freight Railroads and Intercity Passenger Railroads (T-6)
- Promotion and Incentives for Improved Community Planning and Improved Building Design and Construction in the Private and Non-State Public Sectors (RCI-3)

Transportation is Washington's largest contributor to GHG emissions, representing approximately half of all of the State's GHG emissions. In order to significantly reduce these emissions, growth patterns and long-term infrastructure choices that result in compact walkable, bikable and transit-friendly communities must be supported, funded and implemented. Cleaner cars and fuels alone will not sufficiently reduce Washington's transportation-related emissions challenge, nor will improved business practices and more efficient energy use alone. Compounding the challenge, most cap-and-trade market mechanisms being considered throughout the world at this time do not directly reduce transportation-related emissions. To put it bluntly, without reductions in vehicle miles traveled (VMT) by single occupancy vehicles, we are unlikely to meet the State's goals for emission reductions. And people will not—in fact, cannot—get out of their cars in sufficient numbers if they do not have viable alternative options for conducting the activities, trips and travels needed and desired for daily life. The strategies deemed 'most promising' here by the CAT are designed to tackle this challenge head on. To implement them will require significant political leadership from all sectors of society and will depend on the willingness of our citizens to invest, one way or another, in creating this set of transportation alternatives and community development patterns. If we are successful in doing so, GHG emissions achieved through reductions in VMT can be achieved; if not, emissions from ever increasing VMT will likely grow through 2020 despite our best efforts to improve vehicle efficiency and provide alternative fuel sources.

The CAT realizes that the entire question of community growth patterns, transportation infrastructure and financing for transit and other transportation alternatives is a complex, controversial and expensive endeavor. We are not naïve about the difficulty of accomplishing what we are recommending here. In assessing recent attempts to move ahead with the CAT's vision of what is needed to reduce GHG emissions by reducing VMT, we can see 'steps forward and steps backward.' The CAT hopes that the

[42] Quote from Van Jones, a Yale-educated lawyer who founded the Ella Baker Center for Human Rights in Oakland. Jones believes that green-collar jobs are exactly what unemployed residents of cities like Oakland need. Walsh, Bryan. *Bring Eco-Power to the People.* November 21, 2007. Time Magazine. www.time.com/time/magazine/article/0,9171,1686811,00.html. Accessed December 18, 2007.

reality of global warming will coalesce the political leadership from all sectors and the support of the public to see the strategies outlined below (and in the next two headlines also addressing transportation related emission reductions) as critical necessities whose time has come, and not as merely personal choices that can be accepted or rejected with no real consequences for Washington's future beyond more or less traffic congestion or urban sprawl, etc. The debate regarding how Washington provides the human and freight mobility necessary for our dynamic economy and the high quality of life to which our citizenry rightly aspires has reached a new intensity and a new imperative due to global warming. The CAT strongly believes that the strategies outlined below, many of which are already happening and are indeed expanding in some important ways, must be seen as key drivers in the future growth-related and transportation policies and investments by the State and local governments if transportation-related GHG emissions are to be reduced to the extent necessary to meet the State's goals. In particular, strategies that can successfully raise the funding necessary to make some of the other transportation strategies viable is absolutely essential. While only briefly summarized below, Appendix F has much greater detail on this crucial, daunting task. The CAT believes that the question of transportation infrastructure funding is a major issue needing additional work in 2008.

The following strategies, working in concert, are intended to reduce VMT from a variety of fronts:

Promotion of Compact and Transit-Oriented Development (T-4) would reduce VMT and GHG emissions by encouraging development patterns that facilitate travel by transit, walking, and bicycling. Such actions would involve new incentives and requirements, including amendments to the State's Growth Management Act, and would be designed to reduce urban area VMT by 7–15% in 2020 and by 25–50% in 2050, compared to baseline levels. **Transit, Ridesharing, and Commuter Choice Programs** (T-1) provides leadership and resources necessary to help create a transit and ridesharing system that connects activity centers on both an intra- and an inter-regional basis, as well as incentives for employers to allow telecommuting. **State, Regional, and Local VMT Reduction Goals and Standards** (T-2), establishes a schedule of targets for reducing statewide per capita VMT and working alongside with local governments and regional planning organizations to achieve those targets. Compared to a business-as-usual baseline, these goals would target a reduction in statewide annual per capita VMT of 18% by 2020, 30% by 2035, and 50% by 2050.

A number of the other policy strategies appear most promising in contributing to reducing VMT emissions. **Promotion and Incentives for Improved Community Planning and Improved Building Design and Construction in the Private and Non-State Public Sectors** (RCI-3) uses a combination of financial and other incentives, plus regularly-revised performance targets, to encourage and promote the use of climate-friendly products in both commercial and residential buildings, in building materials and in building operational processes. This would include using informational approaches, certifications, and other means to support the consideration of life-cycle emissions in the building sector (reductions of 50% or more by 2020 are anticipated).

Additional strategies to support reductions in VMT include **Transportation Pricing** (T-3), which seeks to reduce vehicle travel through pricing mechanisms that raise the cost of single-occupant vehicle travel, and **Improvements to Freight Railroads and Intercity Passenger Railroads** (T-6), which targets the improvement of efficiency and increase in capacity of Washington's railroad system. Efforts would be undertaken to improve Sounder and Amtrak capacity and service to shift intercity travelers and commuters from road to rail.

New Funding Mechanisms (T-0) identifies new flexible and reliable long-term funding mechanisms, as well as makes better use of existing revenue sources, in order to fund these other transportation strategies. Revenue tools for immediate consideration include user fees, local option taxes, and statewide revenue sources.

Recommendation 6: Ensure Washington has vehicles that are as efficient as possible and use non-carbon or lower carbon intensity fuels developed sustainably from regional resources

In addition to VMT reductions, cleaner vehicles and fuels will also be needed to help Washington meet the transportation-related reductions needed to meet the State's goals. While 'headline' challenge number 5, above, is how to achieve 'less car,' this recommendation is about how to get 'cleaner cars' (and other vehicles).

The 'most promising' strategies under this recommendation are:

- New Funding Mechanisms (T-0)
- Improvements to Freight Railroads and Intercity Passenger Railroads (T-6)
- Diesel Engine Emission Reductions and Fuel Efficiency Improvements (T-7)
- Acceleration and Integration of Plug-In Hybrid Electric Vehicle Use (T-10)
- Low Carbon Fuel Standard (T-11)
- In-State Production of Biofuels and Biofuels Feedstocks (AW-2)
- Improved Commercialization of Advanced Lignocellulosic Processes (F-7)

Strategies for clean, lower-carbon fuel includes the **Low Carbon Fuel Standard** (T-11) for transportation fuels (gasoline and diesel) sold in Washington, which would reduce carbon intensity of fuels by at least 10% by 2020. Carbon intensity (GHG emissions per unit of energy) would be measured on a lifecycle ('well-to-wheels') basis. A low carbon fuel standard would establish the demand for lower carbon fuels such as biofuels, hydrogen, compressed natural gas (CNG), liquefied petroleum gas (LPG) and electricity. **In-State Production of Biofuels and Biofuels Feedstocks** (AW-2) would maximize GHG emission benefits from these biofuels and further contribute to reducing fuel imports, as would **Improved Commercialization of Advanced Lignocellulosic Processes** (F-7), which increases utilization of waste biomass for biofuels. Together these last two options target the production of 250 million gallons of biofuels per year by 2020.

Strategies for cleaner vehicles include **Diesel Engine Emission Reductions and Fuel Efficiency Improvements** (T-7), which seeks to reduce diesel emissions and the use of diesel fuel in the public and private sectors, both on- and off-road, through promotion and deployment programs for a variety of technologies and practices. These technologies and practices include, among others, anti-idling and fuel efficiency technologies for trucks, use of biodiesel in public and private fleets, replacement of freight handling equipment with battery electric and hybrid electric equipment, reduced fuel use in ferries through engine modifications, positive restraints, shore power, and waste heat recovery.

Acceleration and Integration of Plug-In Hybrid Electric Vehicle (PHEV) Use (T-10) speeds up the deployment of PHEV technology, removes barriers to more rapid adoption, creates initial incentives, and provides for the integration of PHEVs with other energy systems. This strategy aims for PHEVs to account for 10% of car, SUV and small truck VMT statewide by 2020. **Improvements to Freight Railroads and Intercity Passenger Railroads** (T-6) includes expanded use of anti-idle technologies and practices that would reduce locomotive idling.

In order to fund strategies that reduce emissions from transportation sources, flexible and reliable long-term **New Funding Mechanisms** (T-0), and better use of existing revenue sources, are needed.

Recommendation 7: Focus investments in Washington's transportation infrastructure to prioritize moving people and goods cleanly and efficiently

The 'most promising' strategies under this recommendation are:

- New Funding Mechanisms (T-0)
- Transit, Ridesharing, and Commuter Choice Programs (T-1)
- Transportation Pricing (T-3)
- Improvements to Freight Railroads and Intercity Passenger Railroads (T-6)
- Transportation System Management (T-9)

We need to invest differently in transportation infrastructure in order to move people and goods, not just more cars, and we need to use this vital infrastructure in a manner that moves people and goods as efficiently as possible. Re-envisioning our transportation goals, systems and infrastructure in this manner is essential to demonstrating to the public that the investments in infrastructure are both efficient and effective, and thus worthy of the financial support needed to build, operate and maintain them. **Transportation Pricing** (T-3) seeks to reduce vehicle travel through pricing mechanisms. Such mechanisms include implementation of system-wide variable roadway pricing in major urban areas and a 15% parking surcharge in the Puget Sound region, increasing to 20% by 2009. These mechanisms would also include expansion of parking cash-out programs, and a mileage-based automobile insurance program to cover 20% of Washington drivers by 2020.

To increase the efficiency of our existing infrastructure, **Transit, Ridesharing, and Commuter Choice Programs** (T-1) provides leadership and resources necessary to help create a transit and ridesharing system that connects activity centers on both an intra- and an inter-regional basis. Specific components of this strategy include operating support for public transportation, grants for capital programs, subsidized transit fares, traveler information systems, commute trip reduction programs, telecommuting incentives, and VMT reduction innovation grants. **Improvements to Freight Railroads and Intercity Passenger Railroads** (T-6) targets the improvement of efficiency and increase in capacity of Washington's railroad system. Efforts would be undertaken to maximize the amount of freight that can be moved by rail and to improve Sounder and Amtrak capacity and service to shift intercity travelers and commuters from road to rail. **Transportation System Management** (T-9) involves active management of the transportation system to increase operational efficiency, thereby minimizing fuel use and GHG emissions. Strategies include, among others, traveler information and dynamic re-routing, traffic management centers, traffic signal synchronization, managed lanes, incident response efficiency, and optimization in ferry systems.

Again, **New Funding Mechanisms** (T-0) identifies new flexible and reliable long-term funding mechanisms, as well as makes better use of existing revenue sources, in order to fund these other transportation strategies. Revenue tools for immediate consideration include user fees, local option taxes, and statewide revenue sources.

Recommendation 8: Design, build, upgrade, and operate new and existing buildings and equipment to maximize energy efficiency

Several strategies support this recommendation to reduce GHG emissions from both the built environment as well as new buildings. While significant progress has been made in the design and construction of new buildings, equipment, appliances, lighting systems, etc. (and more is needed and possible), the existing stock of buildings and equipment hold great promise for often cost effective emission reductions through various retrofit strategies, and use of climate-friendly products and building materials. Key strategies involve channeling the funding for these efficiency improvements. **Demand-Side Management (DSM), Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil** (RCI-1) addresses the non-electric side of the energy efficiency savings, employing a number of different program, funding, and incentive mechanisms. These provide significant emission savings and are generally quite cost-effective due to short pay back periods based on the energy costs that efficiency investments save over time. These DSM activities can work in concert with other RCI strategies to encourage energy efficiency gains across the residential, commercial and industrial sectors, including **Targeted Financial Incentives and Instruments to Encourage Energy Efficiency Improvements (Business Energy Tax Credit and Private/Public Efficiency Funds)** (RCI-2), which establishes targeted financial incentives and instruments to encourage energy efficiency in the development, design, and construction of new and existing energy-using building and building systems.

The 'most promising' strategies under this recommendation are:

- Demand-Side Management (DSM), Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil (RCI-1)
- Targeted Financial Incentives and Instruments to Encourage Energy Efficiency Improvements (Business Energy Tax Credit and Private/Public Efficiency Funds) (RCI-2)
- Promotion and Incentives for Improved Community Planning and Improved Building Design and Construction in the Private and Non-State Public Sectors (RCI-3)
- Energy Efficiency Improvement in Existing Buildings, with Emphasis on Building Operations (RCI-4)
- Consumer Education Programs, Including Labeling of Embodied Life-cycle Energy and Carbon Content of Products and Buildings (RCI-8)
- More Stringent Appliance/Equipment/ Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design (RCI-10)
- Expanded Use of Wood Products for Building Materials (F-5)
- Transmission System Capacity, Access, Efficiency, and Smart Grid (ES-6)

Two primary mechanisms suggested—business energy tax credits and private/public efficiency funds—also support implementation of programs to improve energy efficiency in new and existing buildings, as well as the utilization of climate-friendly building materials, as described in **Promotion and Incentives for Improved Community Planning and Improved Building Design and Construction in the Private and Non-State Public Sectors** (RCI-3) and **Energy Efficiency Improvement in Existing Buildings, with Emphasis on Building Operations** (RCI-4). **Expanded Use of Wood Products for Building Materials** (F-5) supports the use of green building materials through the substitution of wood products in place of other energy intensive materials to store carbon as well as avoid higher GHG emissions from the production of alternative materials.

Greater gains can typically be achieved by focusing on efficiency considerations during the initial design of communities and new construction, when it is easier to take advantage of opportunities like **Combined Heat and Power (CHP) and Thermal Energy Recovery and Use** (ES-7). By increasing the overall

efficiency of fuel use and by reducing energy losses where facilities are located near heat and power demands, CHP and thermal energy recovery and use can provide significant GHG emission reductions and energy cost savings.

Supporting strategies include education and certification programs for professionals involved in delivering services in support of RCI and other policy strategies, as well as "carbon labeling" of products and buildings: **Consumer Education Programs, Including Labeling of Embodied Life-Cycle Energy and Carbon Content of Products and Buildings** (RCI-8). Another supporting strategy for this recommendation is **More Stringent Appliance/Equipment/Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design** (RCI-10), which increases energy efficiency and saves on energy costs through strengthened standards for new lighting, equipment, appliances and consumer electronic products, and which encourages product recycling and reuse. **Transmission System Capacity, Access, Efficiency, and Smart Grid** (ES-6) includes improving efficiency and reducing line losses in the electric transmission and distribution system, and providing support to 'smart grid' technologies that optimize the electricity grid and integrate innovative electricity choices such as smart meters for buildings and plug-in hybrids.

Recommendation 9: Deliver energy from lower or non-carbon sources and more efficient use of fuels

Washington needs to continue to maximize efficiency and increase the level of renewable and alternative energy that can be delivered to Washington's electric grid. **Grid-based Renewable Energy Incentives and/or Barrier Removal** (ES-1) pursues a variety of strategies to increase the level of renewable generation that can be delivered to the State's electric grid, taking into account economic and environmental impacts, as well as system reliability constraints. These strategies aim to assist in integrating intermittent resources (e.g., wind) into the grid, reduce regulatory uncertainty regarding cost recovery, overcome barriers to non-utility generation, and address high transmission costs. The strategies also consider financial incentives for grid-based renewable energy generation that exceeds legal requirements, such as the State's renewable energy portfolio standard, adopted as part of the Energy Independence Act (Initiative I-937). The I-937 standard requires 15% of electricity sales in the year 2020 to be met by renewable energy sources; quantification of this policy strategy considers the emission and cost implications if these strategies are able increase this level to 20%. A complementary strategy, **Distributed Renewable Energy Incentives and/or Barrier Removal** (ES-2) establishes targets for, and helps to overcome specific barriers faced by, distributed renewable energy systems, and thereby spur markets and job

The 'most promising' strategies under this recommendation are:

- Grid-based Renewable Energy Incentives and/or Barrier Removal (ES-1)
- Distributed Renewable Energy Incentives and/or Barrier Removal (ES-2)
- Efficiency Improvements at Existing Renewable and Power Plants (ES-3)
- Transmission System Capacity, Access, Efficiency, and Smart Grid (ES-6)
- Combined Heat and Power and Thermal Energy Recovery and Use (ES-7)
- In-State Production of Biofuels and Biofuels Feedstocks (AW-2)
- Improved Commercialization of Advanced Lignocellulosic Processes (F-7)
- Rate Structures and Technologies to Promote Reduced GHG Emissions (including Decoupling of Utility Sales and Revenues) (RCI-5)

creation in Washington State. Sited at, and directly serving, residences and commercial and industrial facilities, distributed renewable energy technologies include, among others, solar photovoltaic systems, solar water heating and space heating systems, wind power systems in rural areas, and geothermal and biomass heat and generation systems. Additional lower and non-carbon sources for delivering energy include **Improved Commercialization of Advanced Lignocellulosic Processes** (F-7) and **In-State Production of Biofuels and Biofuels Feedstocks** (AW-2).

Rate Structures and Technologies to Promote Reduced GHG Emissions (including Decoupling of Utility Sales and Revenues) (RCI-5) supports other RCI strategies by implementing cost recovery rules that 'decouple' the level of sales from net revenues earned by investor-owned utilities. The goal of this strategy is to remove disincentives for utilities to invest in energy efficiency, while not 'penalizing' demand side investments made by energy users (by not enabling them to recoup investments through lower energy costs). Decoupling mechanisms should be carefully designed so as to avoid, as much as possible, adverse economic impacts on ratepayers so that factors other than energy efficiency investments—such as economic downturns—do not adversely affect rates, and to assure that any decoupling mechanism is fair to both consumers and shareholders. Other recommendations focus on other elements of utility rate design and related technologies—such as tiered (increasing block) rates for electricity and natural gas use and 'smart metering'—that are geared toward reducing GHG emissions, often with other benefits as well, such as reducing peak power demand. **Transmission System Capacity, Access, Efficiency, and Smart Grid** (ES-6) calls for a report, based on input from an advisory group, to investigate potential incentives and/or barrier removal to expanding transmission capacity, and how that can maximize or enable emission reductions. General objectives include 1) increasing transmission system capacity for, and access to the grid by, clean energy technologies; 2) improving efficiency and reducing line losses in the electric transmission and distribution system; and 3) providing support to 'smart grid' technologies that optimize the electricity grid (and unlock additional renewable resource alternatives) through devices that help manage electricity demand and supply.

Additional actions that support efficiency improvements include **Efficiency Improvements at Existing Renewable and Power Plants** (ES-3), which spurs increased electricity generation at existing renewable projects (e.g., hydro, biomass, solar or wind) and fossil-fueled power plants by supporting operational and equipment changes that result in more electric energy output without increasing the amount of fuel consumed. Policies to encourage improvements at existing plants include policies and principles, new laws and regulations, market-driven incentives, and further study of opportunities for gains in the federal hydro system. **Combined Heat and Power (CHP) and Thermal Energy Recovery and Use** (ES-7) promotes incentives, communications, and permitting procedures to capture the efficiency and emissions benefits of CHP and thermal energy recovery and use in the State. By increasing the overall efficiency of fuel use and by reducing energy losses where facilities are located near heat and power demands, CHP and thermal energy recovery and use can provide significant GHG emission savings.

Recommendation 10: Restore and retain the health and vitality of Washington's farms and forest lands to increase carbon sequestration and storage in forests and forest products, reduce the releases of greenhouse gas emissions and support the provision of biomass fuels and energy

Washington needs to keep its forests and farms working, healthy, and productive in storing carbon and producing biofuels and products that store carbon. To do so involves strategies to reverse the current trends of degradation of naturals systems in both agricultural and forest lands. By protecting agricultural areas from development and utilizing crop management techniques, the carbon in biomass and soils can be maintained and additional release of CO_2e to the atmosphere can be avoided. **Preservation of Open Space/Agricultural Land** (AW-7) calls for a 50% reduction by 2020 in the number of acres of agricultural land converted to urban or developed uses each year, relative to historical trends. A complementary strategy is **Agricultural Carbon Management** (AW-4), which increases implementation of farming practices such as no-till/direct seeding, cover cropping, high-residue retention, organic residuals application, improved grazing management, and increased perennial cropping. These actions increase the amount of carbon sequestered and stored in agricultural soils and biomass as a result of increased biomass inputs (either through production, translocation, or residue management strategies) coupled with reduced soil disturbance.

The 'most promising' strategies under this recommendation are:

- In-State Production of Biofuels and Biofuels Feedstocks (AW-2)
- Preservation of Open Space/Agricultural Land (AW-7)
- Agricultural Carbon Management (AW-4)
- Improved Forest Health (F-1)
- Reduced Conversion to Non-Forest Cover (F-2)
- Expanded Use of Wood Products for Building Materials (F-5)
- Improved Commercialization of Advanced Lignocellulosic Processes (F-7)
- Expanded Urban and Community Forests (F-8)

The CAT identified improvements to the health of Washington's forests, and maintaining the extent of healthy forests, as critical first steps in capturing numerous GHG emission storage and biomass energy benefits from forests, as well as reducing GHG emissions from catastrophic fires. Forests store relatively large amounts of carbon in biomass and soils originating from atmospheric carbon dioxide. When forests are converted to development or urban uses, the stored carbon is emitted as a result of tree and vegetation burning and decomposition and soil disturbance. Subsequent developed or urban land uses generally contain lower carbon storage levels than perpetuation of forests, resulting in a net loss of carbon to the atmosphere. **Reduced Conversion to Non-Forest Cover** (F-2) calls for a 70% reduction by 2020 in the number of acres of forestland converted to urban or developed uses each year, compared to baseline projections. **Expanded Urban and Community Forests** (F-8) enables Washington's local governments, utilities and large urban landowners to protect, plant and maintain an additional 3 million urban or community trees by 2020. Tree planting and maintenance in urban and suburban areas have multiple benefits, including avoided GHG emissions due to energy conservation (primarily reduced demand for cooling in hot weather) and enhanced carbon sequestration in trees. To the extent that urban and community forests increase the desirability of more dense urban living, they may also contribute to reducing transportation related emissions. Other benefits of urban and community forests include improving air quality, reducing storm water runoff, and aesthetics. **Improved Forest Health** (F-1) implements fuel reduction treatments on 25% of forest acres identified as being at high-risk of catastrophic wildfires by 2020, with the long term aim of treating all such acres by 2050. An estimated 3 million acres of Washington's forests are at risk of catastrophic wildfires as a result of unnaturally high fuel loads (i.e., live and dead biomass), due to past fire suppression and management practices. Forest fire mitigation to improve forest health reduces fuel loads through thinning and controlled burns. Reducing the severity of forest fires to more natural levels reduces carbon emissions directly and speeds

reforestation and sustainable carbon re-storage after natural fires. The biomass removed during thinning treatment can be used to produce bio-energy or durable wood products, leading to avoided fossil fuel emissions or long-term storage of carbon in wood products. The potential for either of these benefits is lost when forest biomass instead is burned during uncharacteristically large or severe wildfires.

Healthy farms and forests can store carbon (in forests and forest products) as well as provide the feedstocks to support increased production of 250 million gallons of biofuels per year by 2020. Both agricultural and forestry feedstocks would be used to meet that level of production. **Expanded Use of Wood Products for Building Materials** (F-5) supports the substitution of wood products in place of other energy intensive materials to store carbon as well as avoid higher GHG emissions from the production of alternative materials. Encouraging the use of long-lived wood products increases the total carbon sequestration from the harvested and replanted growing stock, and the storage of carbon in building materials. **Improved Commercialization of Advanced Lignocellulosic Processes** (F-7) details specific steps and opportunities for using feedstocks from the forestry sector and calls for the construction of both a pilot and commercial scale bio-refinery within 10 years. **In-State Production of Biofuels and Biofuels Feedstocks** (AW-2) targets the increased utilization of waste biomass for biofuels from agricultural sources, increased production of high biomass perennial feedstock crops (80,000 acres by 2020), and sustainable production practices of corn and oil seed crops (at least 200,000 acres by 2020).

Priority should be given to biofuels and feedstocks that maximize GHG mitigation benefits and minimize impacts on natural ecosystems.

Recommendation 11: Reduce waste and Washington's emissions of GHGs through improved product choices and resource stewardship

The 'most promising' strategies under this recommendation are:

- Significant Expansion of Source Reduction, Reuse, Recycling and Composting (AW-3)
- In-State Production of Biofuels and Biofuels Feedstocks (AW-2)
- Consumer Education Programs, Including Labeling of Embodied Life-cycle Energy and Carbon Content of Products and Buildings (RCI-8)
- More Stringent Appliance/Equipment/ Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design (RCI-10)
- Expanded Use of Wood Products for Building Materials (F-5)

Greatly expanding source reduction, reuse, recycling and composting will result in a low cost/ton for GHG reductions and many co-benefits. The CAT strongly supports **Significant Expansion of Source Reduction, Reuse, Recycling, and Composting** (AW-3) because most communities and many businesses in Washington now have strong recycling programs that can be enhanced, there is a low cost/ton for the resulting GHG reductions and the many co-benefits, and this also represents significant opportunity to engage the public in combating global warming at the household and local business levels.[43] This strategy sets targets to reduce the total amount of household and business waste by 15%, recycle at least 50% of the waste remaining, and compost over 90% of compostable organics through expanded source reduction, reuse, recycling, and composting of household, business, industrial, agricultural, and construction-related waste streams. In addition to

[43] This strategy incorporates and builds upon the State's recently developed Beyond Waste Plan.

traditional recycling programs, this strategy encourages cradle-to-cradle design and manufacturing, and proposes to take advantage of market and business-based activities.[44]

In order to provide consumers with a better understanding of the impacts of their choices and empower them to make better choices, enhanced public education and outreach to support the long-term success of Washington's mitigation actions should be provided through **Consumer Education Programs, Including Labeling of Embodied Life-Cycle Energy and Carbon Content of Products and Buildings** (RCI-8). Education and certification programs for professionals involved in delivering services in support of RCI and other policy strategies considered by the CAT should also be developed and implemented. 'Carbon labeling' of products and buildings should be considered and evaluated as potential effectiveness and how this might be done in a consistent and verifiable manner, possibly on a regional or federal level.

Another way to support improved product choices is **More Stringent Appliance/Equipment/Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design** (RCI-10), which increases energy efficiency through strengthened standards for new lighting, equipment, appliances and consumer electronic products and encourages product recycling and reuse, thus avoiding the generation of solid waste and the production and emissions of toxic materials. Reduction of GHG emissions through improved product choices is also supported by the **Expanded Use of Wood Products for Building Materials** (F-5), which promotes substitution of wood products in place of other energy intensive materials (e.g., steel and concrete) to store carbon and avoid production emissions. Increased utilization of waste is accomplished through **In-State Production of Biofuels and Biofuels Feedstocks** (AW-2), which targets waste biomass for biofuels.

Recommendation 12: Allocate sufficient State resources to maintain Washington's leadership role regionally and nationally and to fulfill its responsibilities for structuring and guiding implementation of emission reduction strategies

There is a critical need for adequate financial resources for the State to fulfill its responsibilities associated with these recommendations. The transformation to the Clean Economy will involve considerable investment and other expenses for many sectors of the economy as well. Adapting to the impacts from climate change will be also be expensive, and inaction or delay in reducing the emissions that cause these impacts will raise the costs of adapting to climate change ever more dramatically. Accepting the urgency to tackle global warming requires reprioritizing budgets, raising new revenues, and appropriating the funding necessary to accomplish the important work required by both governments and businesses to respond meaningfully and successfully.

The CAT recognizes that its recommendations call for significant work to be accomplished by the State, and that the State requires sufficient resources to further develop, implement, and maintain this

[44] A partial list of the approaches in this strategy includes: source reduction (waste prevention) initiatives; expanding existing and encouraging more reuse, recycling, composting, and processing in businesses; establishing product stewardship programs; using environmentally preferable procurement practices; facilitating safe byproduct "synergy" strategies; achieving a reduction of toxics in packaging and products to make them safer to manufacture, use and recycle while increasing their value and use in the market place; increasing closed-loop recycling and the percentage of recycled-content in products, and expansion of disposal bans. Additional detail on this and all strategies is available in Appendices F–J.

Comprehensive Climate Approach, and to provide and sustain the critical institutional infrastructure and analytic support needed to continue to lead regionally and nationally.

Therefore, the CAT recommends that the State should have the resources to accomplish these functions and tasks:

- Use incentives and standards judiciously to jump-start, accelerate, and sustain change

  For those areas of the economy that emissions trading markets will not reach, the State should investigate how incentives might accelerate the business case for change towards the Clean Economy, and to leverage larger private investments in innovative and promising approaches. The State should also have the capacity to develop and use standards and regulations judiciously, along with incentives to promote and sustain this change as businesses, investors, and individuals respond to the need to reduce emissions.

  While State 'start-up' support to accelerate the initial transition away from a carbon-based economy is crucial, this does not necessarily mean the State's role might not change over the long-term. Once the initial governmental support described above accomplishes its aims, market-based approaches can begin to drive many of the choices and investments which will reduce carbon throughout the economy over the long term. The role of the State could then be transformed once the market is up and functioning, and incentives have done their job as well. While it is premature to describe precisely how the State will need to support reductions past 2020 at this time, remaining flexible about the State's evolving role can only help ensure the State is learning and adapting as this Comprehensive Approach is implemented.

- Commit sufficient resources to understand how best to integrate regional and national carbon-control programs into Washington's overall economy

  The State must commit sufficient resources to understand how to best integrate the regional cap-and-trade program being designed through the WCI, and emerging federal proposals, into Washington's overall economy. Decisions are required in 2008 and 2009 to build the market system; the window of opportunity to influence the development of the regional cap-and-trade program is now. As work products emerge from WCI, the State should undertake robust in-State stakeholder outreach and engagement in order to understand perspectives on critical design elements of the regional cap-and-trade program.

- Support capacity building for local and tribal governments

  Many actions of the Comprehensive Climate Approach will require local implementation or site-specific attention to be successful. The State should support capacity building for local and tribal governments to fulfill their responsibilities in assessing emissions, identifying emission reductions opportunities, and integrating adaptation and emissions reduction efforts in current development and transportation planning and/or natural resource systems restoration.

- Support research, technology transfer and commercialization of promising technologies and applications

  The State should be technology-neutral in its establishment of performance targets, but not uninterested in technology development. Promising technologies and applications can benefit from

State support of research, technology transfer, and commercialization, which can stimulate University-level participation and help private sector ventures compete in a global marketplace for solutions that are applicable not just for Washington, but are competitive for export elsewhere as well.

- Commit sufficient resources to further develop the Climate Change Challenge recommendations

  The State must commit sufficient resources to further develop these recommendations for a Comprehensive Climate Approach; support education, workforce training and public outreach; and begin to incorporate climate considerations into State operations. The CAT recommends that it continue its work throughout 2008 to refine the most promising strategies in this comprehensive road map into policy instruments for consideration by the Legislature or State agencies in 2009 and beyond.

Building the Future –

The CAT has a vision of a low-carbon future with economic opportunities for all, and has used these headlines and strategies in broad terms to describe the choices needed to create this future. How would you create this future? What choices would you make today to ensure that your family and your community can have a cleaner future with more opportunities for all? What decisions would you make today to build towns, neighborhoods, parks, jobs, businesses, and harness government in a way that makes this future a reality?

Here's an example. Say you want to live in a future where low carbon energy is supplied to and used by communities in smart, integrated and networked patterns. To accomplish this, you would need compact development for the physical proximity necessary to minimize waste, to share energy resources efficiently and to encourage transit-based commuting. You could then decide to pursue plug-in hybrid vehicles because of the large efficiency gains they represent. You could then add smart grid capability and develop enhanced energy transmission systems to have the electricity delivered efficiently, utilize renewable energy options that support localized electricity generation, and link combined heat and power opportunities that enable your community to use 'waste' heat from industry or a central power plant. All of these possibilities can be realized and become a blueprint for your communities low carbon energy future. The 'headline' and supporting CAT recommendations or this particular future could be:

Build communities that have smart, integrated and networked energy supply and use patterns

- ➔ Promote Compact and Transit-Oriented Development (T-4)
- ➔ Actions to Accelerate and Integrate Plug-In Hybrid Electric Vehicle Use (T-10)
- ➔ Transmission System Capacity, Access, Efficiency, and Smart Grid (ES-6)
- ➔ Distributed Renewable Energy Incentives and/or Barrier Removal (ES-2)
- ➔ Combined Heat and Power (CHP) and Thermal Energy Recovery and Use (ES-7)
- ➔ Promotion and Incentives for Improved Community Planning and Improved Design and Construction (Third-party Sustainability, Green, and Energy Efficiency Building Certification Programs) in the Private and Non-State Public Sectors (RCI-3)

What other low carbon, clean economy futures do you see for your community? How would you arrange the CAT's recommendations to create the roadmap for the future that you want to live?

How Expensive Will Meeting the Goals be and How Might These Costs be Covered?

The CAT recognizes that there are often significant public and private investments associated with its recommendations listed above. Some of these investments are to support development of essential government functions and programs; others are to provide incentives to jump-start investments in promising and proven technologies, and to stimulate changes in business practices or alter consumer behaviors; others are to invest in necessary human and physical infrastructure without which neither the economy nor the climate will benefit. As well, significant private investments will be needed to invent, provide and actually deploy the new technologies, develop and supply the alternative power options, create the new communities and otherwise pay for that which must be accomplished to build the Low Carbon Economy and reduce GHG emissions. The payback on these private and public investments and choices will often be accompanied by energy savings and other significant co-benefits. The investments are crucial to combat global warming and to compete in the global Low Carbon Economy.

The CAT has estimated the net present value costs and benefits of many of the specific action strategies and finds that many of them, seen in this light, are relatively inexpensive or even have positive financial returns. Others are not so easily quantified or, like building appropriate transportation infrastructure and providing alternative transportation options, or changing community development patterns, can involve large amounts of public and private funding. Securing this up-front investment funding is generally a daunting exercise, and while estimating the funding needs can be done to some degree, as the CAT has done, doing so does not imply that this funding will be easy to secure and deploy. Determining how to finance initiation of and support for this economic transition will be an important key to success. There are several models to consider in assessing funding sources, mechanisms, and what might be the best approach for Washington. The transition itself will create wealth and can generate revenue, and there may be ways to channel that revenue and/or reprogram existing revenue to support and accelerate the transition. Reductions in GHG emissions will come more quickly once market forces, revenue reallocation approaches and revenue-investment generating systems have been determined and aligned. Washington needs to take the first step of identifying and then choosing among these different approaches.

The CAT has just begun its conversation regarding how these funds might be raised. Several of the strategies, such as T-0 (New Funding Mechanisms) and T-3 (Transportation Pricing) are expressly concerned with using prices to change behavior and raise funds for needed investments. The CAT realizes that this discussion is essential to provide policy makers with information and strategies on how to raise necessary public funds, how to most effectively leverage private funding and how to use pricing to support meeting the State's goals. The CAT believes that continuing this investigation is a critical component of what needs to be accomplished in 2008.

V. Through Immediate and Sustained Action, Continued Learning, and a Flexible Approach, Washington Can Meet the Climate Change Challenge

In order to achieve the emissions reductions, economic opportunities, and other significant additional benefits from this Comprehensive Climate Approach, Washington must maintain sustained action over time to meet it goals in 2020, 2035 and 2050. The CAT has identified some fundamental principles that can help ensure that we will continue moving in the right direction and be able to sustain these comprehensive efforts to mitigate emissions and adapt to the inevitable impacts of climate change successfully.

- The need for more learning should not prevent action now. Washington should **'leverage going quickly with going smartly.'** In order to act as quickly as possible to the threat that global warming represents to Washington, the State should aggressively implement those strategies deemed viable now while being cognizant of the uncertainties and potentially unintended consequences that may be associated with them. When dealing with something as complex as transforming to a Low Carbon Economy, the Legislature and the Governor should make being both 'quick and smart' a priority as they strike a balance between the unavoidable tension that arises between moving forward immediately or waiting until additional information is available. As long as we seize each substantive opportunity to act in the present that builds out this comprehensive approach, we have the time and now, with this report, the road map, to move forward in the future in a thoughtful and deliberate manner. The CAT sees this thoughtful decision-making as a means to improve our decisions, not a pretext for delay.

- Likewise, the need for action now should not prevent more learning. Like managing intentional interventions in any complex system, Washington needs to have **'an adaptive management attitude and a long term commitment'** in order to continue learning about what still needs to be done, to increase understanding from what has been previously implemented, and to change direction or programs as necessary over time to achieve substantive results. We will not build the Low Carbon Economy with one set of recommendations or programs and then be done with it. Reducing GHG emissions and adjusting to the impacts of climate change will be a long-term effort.[45]

- Washington should emphasize its **'historic economic strong suits, comparative advantages, and natural landscapes'** when deciding where to invest and what to support in seeking

[45] The science regarding the causes of global warming, the extent of its impacts, the pace at which it is occurring, and the amount of GHG emissions reductions needed to stabilize the climate are all continuing to evolve. All interested parties will need to stay abreast of these developments and the State will need to be able to react accordingly as the science becomes more specific about or changes regarding the above issues. While the CAT was not charged with examining the science, to the extent that some interests believe that climate change is either not happening or is not influenced by human actions and conversely that other interests believe climate change is happening to a greater extent and more quickly than currently predicted, the CAT believes that being adaptive and nimble however the science 'proves out' is crucial to having a efficient and effective response to global warming.

reductions, pursuing efficiencies and developing alternative technologies. These could include solar, tidal, and bio energy; information technology; intellectual property; and smart grid design, etc. Washington is a national leader in international trade and should consider any investments in technology and energy solutions with an eye on providing them to the world, not just within our borders.

The CAT realizes that it has not identified nor analyzed all of the possible strategies through which each of the major sectors of the economy could change in order to reduce emissions; nor has it identified all the potential partnerships and opportunities that will emerge to accomplish the State's goals; nor has it estimated, with whatever degree of accuracy broader economic models may be able to display, the overall interactions within the economy of attempting to reduce carbon emissions sufficient to meet the State's goals in this comprehensive way.

The CAT has also not quantified beyond the work done to date by the State of the costs of delay or inaction in implementing these strategies; such delay would inevitably contribute to even greater impacts from global warming. The study commissioned by Ecology and CTED on the Economic Impacts of Climate Change (2006) suggests that every aspect of Washington's $268 billion economy stands to be impacted by climate change.[46] All of this underscores that those of us engaged in and committed to reaching the State's goals will need to continually learn from the actual changes that occur in the economy, from the evolving science regarding climate stabilization, and the desires of future generations for productive and meaningful lives in order to keep on the right track for the multi-decade effort this will involve. Informed decision-making can maximize our chances for short-, mid-, and long-term emission reduction and economic success, and minimize the avoidable disruption that such a dramatic change in the economy could otherwise represent, provided that continued analysis does not become a substitute for significant and meaningful action to reduce as many emissions as possible as quickly as possible.

Implementing what is called for in this report—in light of these principles—will help Washington do its share of emissions reductions needed to stabilize the climate worldwide, and can thus contribute to keeping the unavoidable impacts, and costs, of global warming to as small as possible.

Public Comment

Over the past 11 months, members of the public engaged in dialogue with the CAT and TWGs about what actions will best address climate change in Washington. All meetings of the CAT were open to the public, and the work from each group was made available online throughout the process for review and comment. Almost 80 people provided comments to the CAT at eight public meetings, and almost 150 written comments were received on the draft CAT recommendations. The CAT also received almost 20,000 postcards of support from citizens around the State.

Comments received throughout the process were considered by the TWGs and CAT, and served to enhance the technical structure of the proposed actions. The CAT also received many detailed comments on its final draft recommendations. This draft has been updated to address several of the comments that provided more specificity to the actions the CAT proposed and helped ensure greater

[46] The CAT recognizes that these costs, in light of how large they actually will become, underscore the compelling need for action to occur sooner rather than later in implementing these recommendations.

clarity. All comments have been posted to the website. The CAT encourages the Governor and the Legislature to consult and use the comments as they make specific decisions in the 2008 session and beyond. As the CAT continues its next round of work in 2008, it will continue to engage the public in dialog, and use the comments received to date in designing specific actions for implementation in Washington.

Next Steps for 2008 and Beyond

In this interim report, the CAT has laid out a Comprehensive Climate Approach for Washington to address its part of the Climate Change Challenge declared in the Governor's Executive Order. The CAT has recommended several major actions that should be initiated immediately and others that will need to be implemented over the longer term. The CAT has identified the specific implementation pathways for some, but not all, of the policies and programs that it has recommended in this report. The next phase of work for the State will be act on those that are ready for it to do so and to translate the others into specific policies and programs that, when authorized, can then be implemented.

The CAT believes that its interim report provides a strong foundation for this next phase of work, and urges the State to continue to make use of the CAT in 2008. So that the specific work needed in 2008 can be identified, prioritized and accomplished, the CAT requests that Ecology and CTED develop an explicit work plan with action steps, a timeline, and assigned responsibilities for further developing and preparing for implementation the most promising strategies and recommendations of the CAT. The State should identify available resources and expertise to do this and direct them to get this work done in 2008. In addition, the CAT requests that the State continue assessing how adaptation to the inevitable impacts of global warming should proceed, and how mitigation and adaptation can best be linked together when appropriate to take advantage of the synergistic possibilities the work of the CAT and the PAWGs have created. The CAT is ready and willing to help as requested and supported by the State.

The State is currently acting on some of these recommendations and will continue to be extremely active in 2008 and 2009 both in-State, as well as regionally and nationally. Continued focused use of and support for the CAT through 2008 can help the State with this effort. This roadmap can serve as a guide to assist in the development of a much more specific blueprint that can drive implementation of this Comprehensive Climate Approach over the next several years. Development of this blueprint should entail further identifying the critical next steps, understanding the interactions among strategies and recommendations, sequencing implementation of the most promising strategies, and identifying their costs and benefits and implementation mechanisms in a more rigorous manner. Given what will need to happen in 2008 and 2009 to keep the State moving aggressively and purposely forward on building the long term framework needed to reach its goals, a comprehensive package of substantive proposals will be needed for consideration by the Governor and the 2009 Legislature. Given the importance of continued engagement in the coming year on determining the next round of specific actions that the State should take to best reduce GHG emissions, the CAT views this report as an interim report.

The State is also going to be actively involved through the WCI in the actual design of a regional cap-and-trade market mechanism. The State will be engaging interested in-State parties on the approaches and decisions that effort will entail, which will surely help the State make better informed decisions. While the interests the WCI process encompasses do not expressly overlap with the CATs, the CAT recognizes the value of the State reaching out in 2008 to seek input from in-State interests on the design of the regional

cap-and-trade system and encourages the State to do so in a structured and transparent manner. The CAT recognizes that Washington is one of many States and Provinces at the negotiating table and any convergence of in-State opinion should be viewed as a way to inform the State's negotiators, not dictate the actual outcome of these negotiations.

Conclusion

Washington faces enormous risks and substantial opportunities from a warming climate and the urgent need to develop a Clean Economy. In order to reduce that risk and seize this opportunity, we must act now, decisively, and continue to act thoughtfully for many years to come. Our forests, our farms, our fish, our power supply, our marine and terrestrial ecosystems, our heritage and culture, and our communities—indeed, in a most profound way, our entire quality of life—depend on us doing so. The CAT believes that the people of the State of Washington will demonstrate the vision, foresight and commitment to provide the leadership, take the actions, make the decisions and invest the resources to do our share across all sectors, in all communities, and at all levels and types of government, to reduce GHG emissions and build a vibrant Clean Economy. The CAT hopes that this interim report gives the people of Washington the road map for action that affirms what we need to do, and gives us all the confidence to know that by working together we will indeed be successful.

The members of the CAT appreciate the privilege that they have been given by the Governor to be on the CAT and remain committed as individuals and as a team to help further develop and advance these recommendations with the same spirit of cooperation and intellectual integrity in which they were developed. Our collective effort is surely a strong sign that, by working together, we can meet the climate challenge we face from global warming.

Mitigation Strategies for Washington (Tables 4–4.5)

The following tables summarize the mitigation strategies. Further detailed information about each strategy, including information about additional benefits and design details, can be found in Appendices F–J, which contain the Policy Option Descriptions documents from each TWG.

The first table, Table 4, is a summary of the integrated results of the complete suite of mitigation strategies, accounting for overlaps. The next five tables contain the complete summary list of strategies by sector, along with the GHG emission reduction and cost savings for each individual strategy, not including overlaps, where quantified and anticipated assuming full implementation. These strategies were developed by the TWGs and analyzed for their net GHG emission reduction potential in million metric tons carbon dioxide equivalent ($MMTCO_2e$) using IPCC 100 year global warming potential, reported for 2012, 2020, and cumulatively 2008–2020. The output of the collective strategies was aggregated; to avoid double counting of GHG emission reduction potential and cost, interactive effects were estimated and emission and cost totals reflect those overlaps; therefore, the total emissions reductions are lower than the sum of the results of individual strategies.

Net present value (NPV) costs (or cost savings) are reported for the period 2008–2020 in 2006 constant dollars, using a 5% real discount rate.[47] Positive numbers represent strategies with net costs; negative numbers represent numbers with net cost savings. Cost per metric ton of CO2 equivalent emissions reduced (or removed) is calculated in units of $/MTCO2e. This figure represents the NPV cost divided by the cumulative emission reductions, both over the 2008–2020 period. Strategies which have net cost savings, as well as strategies noted as 'most promising' by the CAT, are noted in the tables, below.

Some Context on the Analysis: Risks and Opportunities

The CAT process employed a set of widely-used methods for estimating the emissions impacts, costs, and cost effectiveness of the CAT's policy options, often referred to as bottom-up mitigation potential assessment.[48] The analysis involved a collaborative effort among members of the TWGs and support team from the Center for Climate Strategies to gauge the amount of greenhouse gas savings that individual policy options might achieve. These estimates are based on the reference case projection of GHG emissions described above, and a number of additional assumptions, as detailed for individual policy options. It is important to recognize that these estimates are subject to uncertainty and outcomes may differ.

[47] The general approach of direct (NPV) cost and cost effectiveness analysis is used, as widely applied to GHG mitigation policy options. Included are the direct, economic costs from the perspective of the state as a whole (e.g. avoided costs of electricity rather than consumer electricity prices). In contrast to macroeconomic analysis, this bottom-up approach is relatively transparent and capable of reflecting the costs (and cost savings) associated with an individual policy option.

[48] These methods are described generally in Section 2.4.3 of the IPCC Fourth Assessment Report, Working Group III. The specific policy option quantification methods used in the CAT process are described in a memo posted at the CAT website: http://www.ecy.wa.gov/climatechange/CATdocs/100407Policy_Option_Quantification_Methods.pdf

The precise emission reductions that a policy option will ultimately achieve—to the extent they can actually be measured[49]—will depend on a number of factors as outlined below. As noted elsewhere, the TWGs developed "directional recommendations" rather than detailed, specific policy designs. In general, these options establish targets—e.g., the acreage of preserved croplands or the extent to which new building efficiency should be improved—together with a set of potential implementation mechanisms (e.g., funding, incentives, standards, and/or new programs, etc.). The quantification shown here reflects the emissions and cost impacts that might occur if these targets are achieved. For many options, it does not reflect specific implementation mechanisms and pathways, as these have yet to be developed. Ultimately, these mechanisms and pathways will determine more precisely the likely cost savings, and emission impacts, as well as the distribution of costs and cost savings among government, businesses, and consumers.

This bottom-up approach used here has the advantage of being relatively transparent and of reflecting costs (and cost savings) associated with individual policy options. In contrast, top-down, macroeconomic models aim to capture flows and interactions across all sectors of the economy.

When reviewing the cost analysis and results described in this report, bear in mind that they do not include:

- Social or environmental costs or benefits, often termed "externalities," that are not valued in market prices, such as health impacts of reduced local air pollution or quality-of-life improvements associated with community design.
- Energy security benefits (or costs) associated with reduced (or increased) dependence on imported fuels.
- Estimates of the distribution of cost or cost savings among specific sectors or groups, though some potential distributional impacts are discussed qualitatively in the policy option documents.
- Macroeconomic impacts related to the impact of increased or reduced consumer spending due to energy efficiency savings or price changes.

More broadly it is important to recognize that not only the analysis, but the suite of policy options themselves, as well as the underlying Washington State economic and demographic context are also subject to a number of key risks and uncertainties. These risks and uncertainties include, among others:

- Timely implementation. As noted above, policies may not be developed and implemented as fully or on as timely a basis as discussed in this report. Industry may not have the capacity to deliver the technology within the anticipated timeframe.
- Technology development. Several options outlined in this report depend on ongoing development and deployment of emerging technologies, such as those related to cellulosic biofuels or other renewable energy technologies. At the same time, breakthroughs or the benefits of learning by doing could lead to cost declines not assumed in this analysis.
- Market penetration. The success of many policy mechanisms, particularly market-based ones, depend on uncertain future pricing, price responses, as well as the behavior of market actors (e.g., avoiding undue market power). Market anomalies (rapid escalation in equipment costs) may occur if demand for a particular technology exceeds supply.
- Consumer responsiveness. The success also depends upon consumer (and business) receptivity to the incentives, regulations, and other measures envisioned.

[49] Emissions reductions are the difference between emissions with and without a given policy or action. Therefore emission reduction estimates are always based on a counterfactual—a "without" policy or action scenario which has not taken place—and thus can never been known with the same precision as emissions estimates themselves.

- Social and environmental impacts. Beyond the recognition that as noted above, the environmental and social co-benefits are not quantified in the analysis, there is also the risk of unintended and unexpected impacts, e.g., from the development of large-scale biofuels markets. Many of these potential impacts and co-benefits are discussed in the specific sectoral policy option documents.
- Policy interactions. While the overall analysis does consider the overlap among policy option in terms of costs and emissions savings in a relatively simple manner, the implementation of the full suite of interactions among the various policies could lead to synergies or conflicts not yet identified.

Many of these risks can also be viewed as opportunities, e.g., for leadership in spurring technology innovation, creating new markets, or providing new consumer choices. The next stage for the CAT process—developing implementation strategies for the many policy options recommended here—provides the means to identify and make recommendations to minimize risk and enhance opportunity.

Table 4: Summary of Anticipated GHG Savings and Costs (or Cost Savings)[50]

Sector/ Mitigation Option	GHG Savings 2012 ($MMtCO_2e$/yr)	GHG Savings 2020 ($MMtCO_2e$/yr)	Cumulative GHG Savings (2008-2020) ($MMtCO_2e$)	Net Present Value 2008–2020 (Million $)
* **Transportation**				
Recent Actions	0.7	3.8	21.9	-$2,235
CAT Policy Options	1.8	11.0	55.6	$3,360
TOTAL Transportation	**2.5**	**14.8**	**77.5**	**$1,125**
* **Energy Supply**				
Recent Actions	0.0	4.0	15.9	$582
CAT Policy Options	1.1	3.9	22.3	$210
TOTAL Energy Supply	**1.1**	**7.9**	**38.2**	**$792**
* **RCI**				
Recent Actions	2.6	5.4	43.9	-$1,400
CAT Policy Options	2.0	7	42.2	-$878
TOTAL RCI	**4.6**	**12.4**	**86.1**	**-$2,278**
* **Agriculture / Waste**				
CAT Policy Options	1.97	8.84	52.42	-$77
TOTAL Agriculture / Waste	**2.0**	**8.8**	**52.4**	**-$77**
* **Forestry**				
CAT Policy Options	2.0	7.5	46.4	$298
TOTAL Forestry	**2.0**	7.5	46.4	$298
Overlap among sectors				
Biofuels (AW-2, F-7, T-11)	0.0	-2.4	-8.3	-$907
Net electricity supply/demand interactions between ES, RCI, and Transportation (T-10 hybrid-electric vehicle) options	0	0.2	-16.5	0
Combined Heat and Power in Forest industries (F-6) and Overall (ES-7)	-0.13	-0.6	-3.4	$85
Urban forestry (F-8) and Residential/Community energy efficiency (RCI)	-0.01	-0.02	-0.1	$13
TOTAL Overlap among sectors	**-0.2**	**-2.8**	**-28.3**	**-$809**
TOTALS	**12.0**	**48.7**	**272.3**	**-$949**

* For detail, see break-out tables on following pages.

[50] As noted in the text above, the emissions reductions and costs have not been estimated for all options. See detailed tables below to see which options are included in the totals shown. In some cases, emissions reductions are estimated, but not costs; therefore, an overall cost-effectiveness per sector cannot be calculated (as this would implicitly treat the uncosted reductions as zero cost reductions).

Table 4.1: Transportation Sector Policy Strategies

TRANSPORTATION Sector Policy Options	GHG Savings in 2012 ($MMtCO_2e/yr$)	GHG Savings in 2020 ($MMtCO_2e/yr$)	Cumulative GHG Savings 2008-2020 ($MMtCO_2e$)	Net Present Value 2008–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
Recent Actions					
Motor Vehicle Emissions Standards Act		3.4	18.3	-$2,600	
Biofuels (Fuel Quality Standards Act)†		0.1	1.2	$307	
State Fleet Efficiency		0.0	0.6	$58	
Cleaner Energy Act		0.2	1.8		
TOTAL Recent Actions	**0.7**	**3.8**	**21.9**	**-$2,235**	
CAT Policy Options (after adjusting for overlaps)	**1.8**	**11.0**	**55.6**	**$3,360**	
TOTAL: Transportation	**2.5**	**14.8**	**77.5**	**$1,125**	

Transportation Sector Policy Options Detail				
T-0: **New Funding Mechanisms ‡**	Not quantified			
Develops new flexible and reliable long-term funding mechanisms, as well as makes better use of existing revenue sources, in order to fund strategies that reduce emissions from transportation sources, such as many of those noted below. Revenue tools for immediate consideration include User Fees, Local Option Taxes, and Statewide Revenue Sources.				
T-1: **Transit, Ridesharing, and Commuter Choice Programs ‡**	1.2	3.6	23.6	Not quantified
Provides leadership and resources necessary to help create a transit and ridesharing system that connects activity centers on both an intra- and an inter-regional basis. Specific components include operating support for public transportation, grants for capital programs, subsidized transit fares, traveler information systems, commute trip reduction programs, telecommuting incentives, and vehicle miles traveled (VMT) reduction innovation grants.				
T-2: **State, Regional, and Local VMT and GHG Reduction Goals and Standards ‡**	1.3	6.8	36.7	Not quantified
Establishes a schedule of targets for reducing statewide per capita VMT and working alongside local governments and regional planning organizations to achieve those targets. Compared to a business-as-usual baseline, these goals would target a reduction in statewide annual per capita VMT 18% by 2020, 30% by 2035, and 50% by 2050. A number of the other policy options would contribute to meeting these goals.				
T-3: **Transportation Pricing ‡**	0.1	1.0	6.2	Not quantified
Seeks to reduce vehicle travel through pricing mechanisms. Such mechanisms include implementation of system-wide variable roadway pricing in major urban areas and a 15% parking surcharge in the Puget Sound region, increasing to 20% by 2009. They would also include expansion of parking cash-out programs, and a mileage-based automobile insurance program to cover 20% of WA drivers by 2020.				
T-4: **Promotion of Compact and Transit-Oriented Development ‡**	0.3	1.6 / 3.8	8.9 / 20.8	Not quantified
Ensures that growth management plans promote compact and transit-oriented development to reduce VMT and GHG emissions. Such actions would involve new incentives and requirements, including amendments the Growth Management Act, and would be designed to reduce urban area VMT by 7%-15% in 2020 and by 25-50% in 2050, compared to baseline levels.				
T-5: **Quantification of GHG Impacts of Transportation Plans, Programs, & Projects**	Not quantified			
Requires that all significant transportation system plans, programs, and projects be evaluated for their contribution to GHG emissions. Current models would be improved, and new models developed, to provide more accurate estimates of changes in GHG emissions resulting from proposed plans, programs, and projects.				
T-6: **Improvements to Freight Railroads and Intercity Passenger Railroads ‡**	0.0	0.1	0.7	Not quantified

TRANSPORTATION Sector Policy Options	GHG Savings in 2012 ($MMtCO_2e/yr$)	GHG Savings in 2020 ($MMtCO_2e/yr$)	Cumulative GHG Savings 2008-2020 ($MMtCO_2e$)	Net Present Value 2008–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
Targets the improvement of efficiency and increase in capacity of Washington's railroad system. Efforts would be undertaken to improve freight railroad systems to maximize the amount of freight that can be moved by rail and to improve Sounder and Amtrak capacity and service to shift intercity travelers and commuters from road to rail. Expanded use of anti-idle technologies and practices would reduce locomotive idling.					
T-7: **Diesel Engine Emission Reductions and Fuel Efficiency Improvements ‡**	0.2	1.0	5.1	$170	$33
Seeks to reduce diesel emissions and the use of diesel fuel in the public and private sectors, both on- and off-road, through promotion and deployment programs for a variety of technologies and practices. These technologies and practices include, among others, anti-idling and fuel efficiency technologies for trucks, use of biodiesel in public and private fleets, replacement of freight handling equipment with battery electric and hybrid electric equipment, reduced fuel use in ferries through engine modifications, positive restraints, shore power, and waste heat recovery.					
T-8: **Bicycle and Pedestrian Infrastructure Improvements**	0.1	0.2	1.3	Not quantified	
Prioritizes funding for transportation facilities that support biking and walking, and provides significant new taxing authority for local government to support these priorities. Additional policies at the state and local level would require that projects are designed to encourage biking and walking needs. Overall, this policy targets an increase in the bicycle and walking mode share (all trips) in Washington urban growth areas to 15% by 2020.					
T-9: **Transportation System Management ‡**	Not quantified				
Involves active management of the transportation system to increase operational efficiency, thereby minimizing fuel use and GHG emissions. Strategies include, among others, traveler information and dynamic re-routing, traffic management centers, traffic signal synchronization, managed lanes, incident response efficiency, and optimization in ferry systems.					
T-10: **Acceleration and Integration of Plug-In Hybrid Electric Vehicle Use ‡**	0.2	1.0	5.3	$2,007	$380
Speeds up the deployment of PHEV technology, removes barriers to more rapid adoption, creates initial incentives, and provides for the integration of PHEVs with other systems. This strategy aims for PHEVs to account for 10% of light-duty VMT statewide by 2020.					
T-11: **Low Carbon Fuel Standard ‡**	0.4	3.6	15.2	$1,801	$119
Creates a Low Carbon Fuel Standard for transportation fuels (gasoline and diesel) sold in Washington that would reduce carbon intensity of fuels by at least 10% by 2020. Carbon intensity (GHG emissions per unit of energy) would be measured on a lifecycle ("well-to-wheels") basis.					
T-12: **Zero Emission Vehicle Standards**	0.1	0.4	1.8	$446	$246
Involves adopting the Zero Emission Vehicle (ZEV) standard, a component of the California vehicle emission standards that require large vehicle manufacturers to produce and sell zero emitting vehicles. Expected technology is either battery electric or fuel cell vehicles. In addition, this strategy would promote alternatives to HFC 134a, the standard refrigerant used in vehicle air conditioning systems and a greenhouse gas with high global warming potential.					
Overlap among Transportation options	-1.8	-8.2	-49.3	-$1,064	

Key * denotes an option with net cost savings
‡ denotes an option determined to be most promising

Table 4.2: Energy Sector Policy Strategies

ENERGY Sector Policy Options	GHG Savings in 2012 ($MMtCO_2e/yr$)	GHG Savings in 2020 ($MMtCO_2e/yr$)	Cumulative GHG Savings 2008-2020 ($MMtCO_2e$)	Net Present Value 2008–2020 (Million $)	Cost-Effectiveness ($\$/tCO_2e$)
Recent Actions					
GHG Performance Standards (SB 6001)		0	0		
Energy Independence Act (I-937) RPS		4.0	15.9	$582	
TOTAL: Recent Actions	**0**	**4.0**	**15.9**	**$582**	
CAT Policy Options	**1.1**	**3.9**	**22.3**	**$210**	
TOTAL: Energy Supply	**1.1**	**7.9**	**38.2**	**$792**	

Energy Sector Policy Options Detail					
ES-1: **Grid-based Renewable Energy Incentives and/or Barrier Removal ‡**		3.1	17.2	$668	$39
Pursues a variety of strategies to increase the level of renewable generation that can be delivered to the Washington State electric grid, taking into account the economic, environmental impacts and system reliability constraints. These strategies aim to assist in integrating intermittent resources (e.g., wind) into the grid, reduce regulatory uncertainty regarding cost recovery, overcome barriers to non-utility generation, address high transmission costs, and consider financial incentives for grid-based renewable energy generation that exceeds legal requirements, such as the State's renewable energy portfolio standard adopted as part of the Energy Independence Act (Initiative I-937). The I-937 standard requires 15% of electricity sales in the year 2020 to be met by renewable energy sources; quantification of this policy option considers the emission and cost implications if these strategies are able increase this level to 20%.					
ES-2: **Distributed Renewable Energy Incentives and/or Barrier Removal ‡**		0.3	2.3	$135	$135
Establishes targets for, and helps to overcome specific barriers faced by, distributed renewable energy systems, and thereby spurs markets and job creation in Washington State. Sited at, and directly serving, residences and commercial and industrial facilities, distributed renewable energy technologies include, among others, solar photovoltaic systems, solar water heating and space heating systems, wind power systems in rural areas, and geothermal and biomass heat and generation systems.					
ES-3: **Efficiency Improvements at Existing Renewable and Power Plants ‡**		0.7	4.9	Not quantified	
Spurs increased electricity generation at existing renewable projects (e.g., hydro, biomass, solar or wind) and fossil-fueled power plants by supporting operational and equipment changes that result in more electric energy output without increasing the amount of fuel consumed. Policies to encourage improvements at existing plants include policies and principles, new laws and regulations, market-driven incentives, and further study of opportunities for gains in the federal hydro system.					
ES-4: **Technology Research & Development, Plus Technology-Focused Initiatives**	Not quantified				
Drives advances in technologies that provide cleaner energy supplies and lowers emissions from existing fossil fuel energy sources and encourages deeper investment in implementation opportunities for these new technologies. The core element of this strategy is the establishment of an emerging energy technology program by strengthening an existing program, such as the Washington Technology Center, or by creating a new stand-alone entity.					
ES-5: **CCSR (including pre and post-combustion) Incentives, Requirements and/or Enabling Policies Plus R&D**	Not quantified				
Calls for a report, by one or more advisory groups, to either the Governor or the legislature identifying the various regulatory and/or legal barriers to the commercialization of carbon dioxide (CO2) capture and storage or reuse (CCSR) projects (i.e., for coal, natural gas, and biomass) and estimating the potential for GHG reductions in Washington through these technologies and practices. CCSR is a process consisting of the separation of CO2 from industrial and energy-related sources, transport to a storage location, and long-term isolation from the atmosphere. This effort builds upon the rulemaking underway pursuant to Engrossed Substitute Senate Bill 6001 (ESSB 6001), which created a process for developing regulatory requirements for carbon capture and sequestration plans for new electricity generation.					
ES-6: **Transmission System Capacity, Access, Efficiency, and Smart Grid ‡**	Not quantified				
Calls for a report, based on input from an advisory group, to investigate potential incentives and/or barrier removal to expanding transmission capacity, and how that can maximize or enable emission reductions. General recommendations include 1) increasing transmission system					

ENERGY **Sector Policy Options**	GHG Savings in 2012 ($MMtCO_2e/yr$)	GHG Savings in 2020 ($MMtCO_2e/yr$)	Cumulative GHG Savings 2008-2020 ($MMtCO_2e$)	Net Present Value 2008–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
capacity for, and access to the grid by clean energy technologies; 2) improving efficiency and reducing line losses in the electric transmission and distribution system; and 3) providing support to "smart grid" technologies that optimize the electricity grid (and unlock additional renewable resource alternatives) through devices that help manage electricity demand and supply.					
ES-7: **Combined Heat and Power (CHP) and Thermal Energy Recovery and Use *‡**		2.1	12.1	-$317	-$26
Promotes incentives, communications, and permitting procedures to capture the efficiency and emissions benefits of CHP and thermal energy recovery and use in the State. By increasing the overall efficiency of fuel use and by reducing energy losses where facilities are located near heat and power demands, CHP and thermal energy recovery and use can provide significant GHG emission savings. Policies can be adopted to encourage these resources through streamlined permitting (without compromising other environmental goals), by ensuring that the full cost (including related electric energy transmission and distribution infrastructure costs plus transmission losses) of the alternative technology generation is compared to the cost of generating electricity at a CHP site. Other policies include financial incentives, such as loan guarantees and tax credits; Oregon's Business Energy Tax Credit (BETC) program and recent updates to Oregon's UM1129 provide useful examples for Washington to consider.					
Overlap among ES options (and with recent actions)		-2.3	-14.2	-$276	

Key * denotes an option with net cost savings
‡ denotes an option determined to be most promising

Table 4.3: Residential, Commercial and Industrial Sector Policy Strategies

RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL Sector Policy Options	GHG Savings in 2012 ($MMtCO_2e/yr$)	GHG Savings in 2020 ($MMtCO_2e/yr$)	Cumulative GHG Savings 2008-2020 ($MMtCO_2e$)	Net Present Value 2008–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
Recent Actions					
RCI-1: Existing Gas Utility DSM Spending		0.2	1.7		
State Green Building Standard		0.2	1.3		
Building Codes		0.5	4.5	TBD	
Appliance Standards		0.5	5.1	TBD	
Energy Independence Act (I-937)—Efficiency		3.9	31.3	-$1,400	
TOTAL Recent Actions	**2.6**	**5.4**	**43.9**	**$1,400**	
CAT Policy Options (total after adjusting for overlap)	**2.0**	**7.0**	**42.2**	**-$878**	**-$21**
TOTAL: Residential, Commercial, and Industrial	**4.6**	**12.4**	**86.1**	**-$2,278**	

Residential, Commercial, and Industrial Sector Policy Options Detail					
RCI-1: **Demand-Side Management (DSM) Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil *‡**	0.6	2.7	15.6	-$498	-$32
Employs a number of different program, funding, and incentive mechanisms to increase the investment in demand-side management programs for natural gas, propane, and fuel oil. Among the key recommendations are that gas utilities obtain 100 percent of cost-effective, achievable DSM savings in their service territories by the year 2020, and that DSM programs for LPG and fuel oil customers be instituted so as to achieve a similar level of performance. These DSM activities can work in concert with other RCI strategies to encourage energy efficiency gains across the residential, commercial and industrial sectors.					
RCI-2: **Targeted Financial Incentives and Instruments to Encourage Energy Efficiency Improvements (Business Energy Tax Credit and Private/Public Efficiency Funds) ‡**	Not quantified separately				
Establishes targeted financial incentives and instruments to encourage energy efficiency in the development, design, and construction of new and existing energy-using buildings and building systems. Two primary vehicles are suggested—business energy tax credits and private/public efficiency funds—that support implementation of programs to improve energy efficiency in new and existing buildings (RCI-3 and RCI-4).					
RCI-3: **Promotion and Incentives for Improved Community Planning and Improved Design and Construction in the Private and Non-State Public Sectors *‡**	0.5	2.0	11.5	-$193	-$17
Uses a combination of financial and other incentives, plus regularly-revised performance targets, to induce the owners and developers of buildings and the communities in which they are located to build and operate new and substantially-renovated buildings and communities that produce markedly lower GHG emissions than existing buildings and communities (reductions of 50% or more by 2020). Education and other resources provided to building industry professionals can help achieve the desired level of building performance. A variety of policy and administrative levers should be used to promote and provide incentives for community planning that incorporates GHG emissions considerations, and to discourage the construction of communities that do not support GHG emissions reduction goals.					
RCI-4: **Energy Efficiency Improvement in Existing Buildings, with Emphasis on Building Operations *‡**	1.0	4.2	24.2	-$529	-$22
Promotes and provides incentives for the improvement of the resource (energy, water, and other) efficiency of the existing building stock, emphasizing both retrofitting of existing systems and building operations, maintenance, and occupant behavior. A variety of approaches to measuring, monitoring, and providing information on the efficiency of buildings are used in this option, together with incentives for building owners and others, in order to induce a reduction in GHG emissions of an average of 20 percent in 50 percent of Washington buildings by 2020.					
RCI-5: **Rate structures and Technologies to Promote Reduced GHG Emissions (including Decoupling of Utility Sales and Revenues) *‡**	0.1	0.4	2.9	-$226	-$78

RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL Sector Policy Options	GHG Savings in 2012 ($MMtCO_2e/yr$)	GHG Savings in 2020 ($MMtCO_2e/yr$)	Cumulative GHG Savings 2008-2020 ($MMtCO_2e$)	Net Present Value 2008–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
Supports other RCI options by implementing cost recovery rules that "decouple" the level of sales from net revenues earned by investor-owned utilities. The goal is to remove disincentives for utilities to investment in energy efficiency. Other recommendations focus on other elements of utility rate design and related technologies—such as tiered (increasing block) rates for electricity and natural gas use and "smart metering"—that are geared toward reducing greenhouse gas emissions, often with other benefits as well, such as reducing peak power demand.					
RCI-6 [See ES-2]: **Provide Incentives to Promote and Reduction of Barriers to Implementation of Renewable Energy Systems**	Quantified in coordination with ES TWG. See ES-2.				
RCI-7 [See ES-7]: **Provide Incentives and Resources to Promote and Reduction of Barriers to Implementation of Combined Heat and Power and Waste Heat Capture**	Quantified in coordination with ES TWG. See ES-7				
RCI-8: **Consumer Education Programs, Including Labeling of Embodied Life-cycle Energy and Carbon Content of Products and Buildings ‡**	Not quantified				
Provides for enhanced public education and outreach to support the long-term success of Washington's mitigation actions. Education and certification programs for professionals involved in delivering services in support of RCI and other policy options considered by the CAT should also be developed and implemented. "Carbon labeling" of products and buildings should be considered and evaluated, including consideration of how this might be done in a consistent and verifiable manner, possibly on a regional or federal level.					
RCI-9: **Identification of GHG Emissions Impacts and Measures to Avoid, Minimize, or Mitigate them for Projects Requiring Government Review, and in Designing Government Rules and Regulations**	Not quantified				
Requires identification of the net impacts on GHG emissions of new government rules and regulations, and the identification of measures to avoid, minimize or mitigate increases in emissions. This option would additionally require SEPA (State Environmental Policy Act) review to quantify GHG emissions and identify measures to avoid, minimize, or mitigate emissions for state-funded and/or privately funded projects, and would emphasize the incorporation of GHG emissions consideration in community planning and zoning decisions.					
RCI-10: **More Stringent Appliance/Equipment/ Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design *‡**	1.7	3.2	26.6	-$1,075	-$40
Increases energy efficiency through strengthened standards for new lighting, equipment, appliances and consumer electronic products and encourages product recycling and reuse, thus avoiding the generation of solid waste and the production and emissions of toxic materials. New energy-efficiency standards are included for devices not covered by existing federal or state standards, or in some cases to provide standards higher than current federal standards.					
RCI-11: **Policies and/or Programs Specifically Targeting Non-energy GHG Emissions**	0.3	1.5	7.8	$5	$1
Combines voluntary industry agreements with new equipment specifications to reduce the emissions of greenhouse gases from industrial processes and specialized uses (refrigeration, insulation, etc.). A variety of implementation mechanisms are suggested to achieve reduction of process emissions of carbon dioxide from the cement and aluminum industries, emissions of products used in refrigeration applications (hydrofluorocarbons), and emissions of sulfur hexafluoride used in electricity transmission and distribution equipment.					
Overlap among RCI options (and with recent actions)	-2.2	-6.9	-46.2	$1,637	

Key * denotes an option with net cost savings
‡ denotes an option determined to be most promising

Table 4.4: Agriculture/Waste Sector Policy Strategies

AGRICULTURE/WASTE Sector Policy Options	GHG Savings in 2012 ($MMtCO_2e/yr$)	GHG Savings in 2020 ($MMtCO_2e/yr$)	Cumulative GHG Savings (2008-2020) ($MMtCO_2e$)	Net Present Value 2008–2020 (Million $)	Cost-Effectiveness ($/tCO_2e$)
CAT Policy Options	**2.0**	**8.8**	**52.4**	**-$77**	**-$1**
TOTAL: Agriculture/Waste	**2.0**	**8.8**	**52.4**	**-$77**	**-$1**

Agriculture/Waste Sector Policy Options Detail					
AW-1: **Manure Digesters/Other Waste Energy Utilization ***	0.2	0.9	5.1	-$20	-$4
Establishes goals for the use of anaerobic digesters to treat manure from cows and to process food waste. The resulting biogas would be captured and used to generate electricity or produce compressed liquefied biomethane. Anaerobic digestion of manure and wet organic wastes is a commercially available technology. Capture and recovery of "biogas" from anaerobic digestion directly reduces emissions of methane to the atmosphere.					
AW-2: **In-State Production of Biofuels and Biofuels feedstocks ‡**	0.0	1.5	4.6	$264	$58
Targets the increased utilization of waste biomass for biofuels, about half of which would come from agricultural sources (the other half would come from forest-based sources, see also F-7). In addition, this policy aims to increases production of high biomass perennial feedstock crops (80,000 acres by 2020) and encourages sustainable production practices on of corn and oil seed crops (at least 200,000 acres by 2020). A Low Carbon Fuel Standard (see T-11) would establish the demand for lower carbon fuels such as biofuels, and in-State production of biofuels would maximize GHG benefits and further contribute to reducing fuel imports. Agricultural processing, field, and animal wastes are among the largest potential sources for in-state biofuels feedstocks. In addition, research has demonstrated that potential perennial biofuel crops, such as switchgrass, hybrid poplars, and other crops may be far more productive in Washington State than in other areas of the country.					
AW-3: **Significant Expansion of Source Reduction, Reuse, Recycling and Composting *‡**	1.3	4.8	29.2	-$353	-$12
Sets targets to reduce the total amount of household and business waste by 15%, recycle at least 50% of the waste remaining, and compost over 90% of compostable organics through expanded source reduction, reuse, recycling, and composting of household, business, industrial, agricultural, and construction-related waste streams. In addition to traditional recycling programs, this option proposes to take advantage of newer market and business-based activities. A partial list of these approaches includes: source reduction (waste prevention) initiatives; expanding existing and encouraging more reuse, recycling, composting and processing in businesses; establishing product stewardship programs; using environmentally preferable procurement practices; encouraging cradle-to-cradle design and manufacturing; facilitating safe byproduct "synergy" strategies; achieving a reduction of toxics in packaging and products to make them safer to manufacture, use and recycle while increasing their value and use in the market place; increasing closed-loop recycling and the percentage of recycled-content in products, and expansion of disposal bans.					
AW-4: **Agricultural Carbon Management *‡**	0.2	1.1	9.0	-$110	-$12
Increases implementation of farming practices such as no-till/direct seeding, cover cropping, high-residue retention, organic residuals application, improved grazing management, and increased perennial cropping. These actions increase the amount of carbon sequestered and stored in agricultural soils and biomass as a result of increased biomass inputs (either through production, translocation, or residue management strategies) coupled with reduced soil disturbance.					
AW-5: **Agricultural Nutrient Management ***	0.0	0.2	0.9	-$2	-$2
Reduces nutrient application rates and thus nitrous oxide (N2O) emissions through statewide soil testing, increased implementation of practices such as precision farming (i.e., precise identification of nutrient demands, resulting in targeted application rates and locations), application of existing sources of nutrient concentrated biomass, and the use of biologically fixed nitrogen. Agriculture is the primary source of N2O emissions in the US, resulting from low nutrient use efficiencies in agricultural systems, the consequence of biological, technological and management factors. Improving on-farm nutrient use efficiencies, using alternative, biological sources of nutrients, and enhanced recovery/relocation of nutrients will substantially reduce ag-related greenhouse gas emissions, improved economic returns for farmers, and reduced fossil energy use.					
AW-6: **Reductions In On-Farm Energy Use and Improvements in Energy Efficiency ***	0.0	0.1	0.3	-$23	-$74
Targets the reduction of on-farm energy use and associated GHG emissions through reducing liquid fuel consumption, improving electrical and thermal energy use efficiencies in agricultural facilities, reducing the amount of irrigation –related energy use, and producing renewable energy on-farm. A large fraction of energy consumption occurs on-farm through the material and fuel consumption needed to produce crops and livestock.					

AGRICULTURE/WASTE Sector Policy Options	GHG Savings in 2012 ($MMtCO_2e/yr$)	GHG Savings in 2020 ($MMtCO_2e/yr$)	Cumulative GHG Savings (2008-2020) ($MMtCO_2e$)	Net Present Value 2008–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
AW-7: **Preservation of Open Space/Agricultural Land ‡**	0.2	0.4	3.3	$167	$50
Calls for a 50% reduction by 2020 in the number of acres of agricultural land converted to urban or developed uses each year, relative to historical trends. By protecting agricultural areas from development, the carbon in biomass and soils can be maintained and additional emissions of CO2e to the atmosphere can be avoided. It is estimated that approximately 23,000 acres of Washington farmland are converted out of agriculture every year (USDA, 1997 Natural Resource Inventory), contributing significant CO2e emissions through the loss of stored carbon in biomass and soils.					
AW-8: **Support for an Integrated Regional Food System**	Not quantified				
Provides guidance on developing a regional food system that integrates the whole food supply chain (production, processing, packaging, distribution, purchase, preparation, and waste management) in strategies to reduce GHG emission. The policy calls for life cycle assessment research that addresses food production practices, transportation method (boat, truck, plane), vehicle fuel used in transportation, etc., to identify and provide incentives for production and use of low carbon footprint food products.					
Overlap among AW options		0	0	$0	0

Key * denotes an option with net cost savings
‡ denotes an option determined to be most promising

Table 4.5: Forestry Sector Policy Strategies

FORESTRY Sector Policy Options	GHG Savings in 2012 ($MMtCO_2e/yr$)	GHG Savings in 2020 ($MMtCO_2e/yr$)	Cumulative GHG Savings 2008-2020 ($MMtCO_2e$)	Net Present Value 2008–2020 (Million $)	Cost-Effectiveness ($/$tCO_2e$)
CAT Policy Options	**2.0**	**7.5**	**46.4**	**$298**	**-$93**
TOTAL: Forestry	**2.0**	**7.5**	**46.4**	**$298**	**-$93**

Forestry Sector Policy Options Detail					
F-1: **Improved Forest Health *‡**	0.5	0.5	7	-$376	-$54
Implements fuel reduction treatments on 25% of forest acres identified as being at high-risk of catastrophic wildfires by 2020, with the long term aim of treating all such acres by 2050. An estimated 3 million acres of Washington's forests are at risk of catastrophic wildfires as a result of unnaturally high fuel loads (i.e., live and dead biomass). Forest fire mitigation to improve forest health reduces fuel loads through thinning and prescribed burns. The biomass removed during treatment can be used to produce bio-energy or durable wood products, leading to avoided fossil fuel emissions or long-term storage of carbon in wood products. The potential for either of these benefits is lost when forest biomass instead is burned during wildfires.					
F-2: **Reduced Conversion to Nonforest Cover‡**	1.1	4.7	26.8	$556	$4
Calls for a 70% reduction by 2020 in the number of acres of forestland expected to be converted to urban or developed uses each year. Forests store relatively large amounts of carbon in biomass and soils originating from atmospheric carbon dioxide. When forests are converted to developed or urban uses, the stored carbon is emitted as a result of tree and vegetation removal and soil disturbance. Subsequent developed or urban land uses generally contain lower carbon storage levels than the original forested land, resulting in a net loss of carbon to the atmosphere.					
F-3: **Enhanced Carbon Sequestration in Forests**	0.2	0.6	4	$107	$26
Increases the amount of carbon stored in Washington's forests through changes in forest management. The following forest management practices have the potential to increase and maintain overall forest carbon stocks in Washington: improved restocking of under-stocked areas; reforestation; increased harvest rotation length; silvicultural techniques such as stand fertilization, using genetically improved trees, and changes in stocking and thinning practices; and riparian/watershed restoration. The policy envisions the potential to, at a minimum, improve productivity on half of the existing low-productivity Douglas Fir forest acres by 2020. Periodic reporting of Washington's forest carbon baseline, in conjunction with development of forest accounting protocols, could allow emerging carbon markets to enable such changes in forest management.					
F-4: **Enhanced Carbon Sequestration in Harvested Wood Products**	0.0	0.01	0.1	Quantified in coordination with F-3	
Increases the amount of carbon sequestered and stored in harvested wood products through the forest management practices described in option F-3. In particular, native Douglas-fir forests of Washington have high productivity rates and extremely desirable structural characteristics for long-lived wood products. Increasing the productivity of these forests (where the potential exists) can result in larger volumes of carbon being transferred to and stored in harvested wood products.					
F-5: **Expanded Use of Wood Products for Building Materials ‡**	Not quantified				
Supports the substitution of wood products in place of other energy intensive materials (e.g., steel and concrete), to store carbon (as addressed in F-4) as well as to avoid higher GHG emissions from the production of alternative materials. The GHG benefits of using wood products as opposed to substitute materials have been documented in numerous life cycle assessments. The potential level of implementation of this option is difficult to assess and may be limited by building codes and safety standards.					
F-6: **Expanded Use of Biomass Feedstocks for Electricity, Heat and Steam Production ***	0.1	0.6	3.4	-$85	-$25
Achieves additional combined heat and power (CHP) production at Washington State forest products facilities (paper and lumber/wood), in conjunction with option ES-7. The potential to expand CHP in Washington has been documented and this goal would achieve roughly 50% of the identified technical potential. The expanded use of CHP can reduce greenhouse gas emissions by displacing the use of fossil energy in two ways: using waste heat or steam that is a combustion by-product, and powering CHP with woody biomass. Using biomass from forest fuel reduction treatments will help to achieve the goals identified in F-1.					
F-7: **Improved Commercialization of Advanced Lignocellulosic Processes ‡**	0.0	0.9	3.7	$261	$70
Increases utilization of waste biomass for biofuels and targets the production of 250 million gallons of biofuels per year by 2020. While both agricultural and forestry feedstocks would be used to meet that level of production, this option details specific steps and opportunities for using feedstocks from the forestry sector (see AW-2 for opportunities to produce feedstocks in the agricultural sector) and calls for the construction of both a pilot and commercial scale bio-refinery within 10 years. While advanced lignocellulosic technology for wood biomass conversion to					

FORESTRY **Sector Policy Options**	GHG Savings in 2012 ($MMtCO_2e/yr$)	GHG Savings in 2020 ($MMtCO_2e/yr$)	Cumulative GHG Savings 2008-2020 ($MMtCO_2e$)	Net Present Value 2008–2020 (Million $)	Cost-Effectiveness ($/t$CO_2e$)
biofuels and chemicals is believed to be feasible, further research and development are needed for full-scale commercialization of these conversion processes.					
F-8: **Expanded Urban and Community Forests *‡**	0.1	0.2	1.4	-$165	-$114
Enables Washington's local governments, utilities and large urban landowners to protect, plant and maintain an additional 3 million urban or community trees by 2020. Tree planting and maintenance in urban and suburban areas have multiple benefits, including avoided greenhouse gas emissions due to energy conservation (primarily reduced demand for cooling in hot weather) and enhanced carbon sequestration in trees. To the extent that urban and community forests increase the desirability of urban living, they may also contribute to reducing transportation related emissions. Other benefits of urban and community forests include improving air quality, reducing storm water runoff, and aesthetics.					
Overlap among F options		0	0	0	0

Key * denotes an option with net cost savings
‡ denotes an option determined to be most promising

Appendices

A. Executive Order 07-02

B. SB 6001: An act relating to mitigating the impacts of climate change; adding a new section to chapter 80.50 RCW; adding a new chapter to Title 80 RCW; and creating a new section.
http://www.leg.wa.gov/pub/billinfo/2007-08/Pdf/Bills/Session%20Law%202007/6001-S.SL.pdf

C. Climate Advisory Team Charter

D. Washington State Greenhouse Gas Inventory and Reference Case Projections, 1990-2020 (December 2007)
http://www.ecy.wa.gov/climatechange/docs/WA_GHGInventoryReferenceCaseProjections_1990-2020.pdf

E. TWG Member List

F. Transportation Sector TWG Policy Option Descriptions
http://www.ecy.wa.gov/climatechange/CATdocs/122107_TWG_trans.pdf

G. Energy Supply Sector TWG Policy Option Descriptions
http://www.ecy.wa.gov/climatechange/CATdocs/122107_TWG_es.pdf

H. Residential, Commercial and Industrial Sector TWG Policy Option Descriptions
http://www.ecy.wa.gov/climatechange/CATdocs/122107_TWG_rci.pdf

I. Agriculture Sector TWG Policy Option Descriptions
http://www.ecy.wa.gov/climatechange/CATdocs/122107_TWG_agr.pdf

J. Forestry Sector TWG Policy Option Descriptions
http://www.ecy.wa.gov/climatechange/CATdocs/122107_TWG_for.pdf

K. Memo: Methods for quantification of draft greenhouse gas (GHG) mitigation policy options

L. Memo: Fuel import and job goals in the Washington State climate action process.

M. Memorandum of Understanding directing the states of California, Oregon, Washington, New Mexico and Arizona to pursue a cap and trade program under the title of the Western Regional Climate Action Initiative