Climate Legislative and Executive Workgroup WORK PLAN
DRAFT v. 9-6-13

The Climate Legislative and Executive Workgroup (CLEW) is charged with recommending actions and policies to reduce greenhouse gas emissions in Washington State that, if implemented, would ensure achievement of the State's emissions reductions limits set in Chapter 70.235 by the 2008 Legislature. The goal is for CLEW to report their recommendations to the State Legislature by December 31, 2013.

Meeting	Location	Objective	Desired Outcomes	Resources Needed (materials, people, etc.)
September 11 1:30–3:30	Olympia	1) Review agenda, draft Operating Procedures (including decision-making process), Work Plan, and interview summary 2) SAIC presentation on Task 1 outcomes 3) Task 1 Q&As, discussion/ feedback from CLEW Draft Questions for CLEW: a. Did we miss anything? b. Most compelling points presented? c. How comfortable are we with the outcomes? d. Can we learn anything from our current policies that may inform future policies? 4) Next Steps	• Understand CLEW member perspectives • Understand overall plan from now until December • Understand Task 1 Outcomes and clarify questions • Agree on decision-making process and operating procedures	• Meeting agenda • Agenda Information Form "AIF" for Task 1 • Draft Operating Procedures • Draft Work Plan • Interview Summary • SAIC Final Report for Task 1

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Meeting	Location	Objective	Desired Outcomes	Resources Needed (materials, people, etc.)
September 27 9:00–1:00	Olympia	1) Introductions 2) Review and accept meeting summary 3) Work Plan review 4) SAIC presentation on Task 3 then Task 2, Q&As, discussion <u>Draft Questions for CLEW:</u> a. Initial input on Task 2 and 3 products and requested changes b. What questions or comments do you have on these policies? c. Are there aspects of the policies that are especially pertinent to the state of WA? d. What policies do you think are worth considering for WA? e. Other questions? 5) Review and confirm public meeting agendas and approach 6) Next Steps	• Reach a common understanding of what comes next • Learn about and discuss Task 2 and Task 3 outcomes • Provide input on potential policies for WA and Federal policies relating to WA • Finalize approach for public meetings	• Meeting agenda • AIFs • 9/11 draft Meeting Summary • Draft 10/16 and 10/23 public meeting agendas • Work Plan • SAIC draft final report
October 14 2:00-4:00	Olympia	1) Introductions 2) Review and accept meeting summary 3) Work Plan review	• Develop broad list of possible policies and actions for consideration at future CLEW meetings	• Meeting agenda • AIFs • 9/27 draft Meeting Summary

Meeting	Location	Objective	Desired Outcomes	Resources Needed (materials, people, etc.)
		4) Final preparation and discussion on 10/16 and 10/23 public meetings 5) Presentation of SAIC Final Report 6) Presentation by each CLEW member on their list of desired actions/policies for consideration 7) Discuss and reach initial agreement on broad list of possible policies and actions	• Complete preparations for public meetings	• Work Plan • SAIC final report • Other SAIC materials?
October 16—Public 5:00-7:00	Spokane	Listening Session to hear public comments on the process and any specific actions they would like to have included. 1) Introductions (CLEW, alternates, SAIC, and Triangle) 2) Ground rules 3) Comments from elected officials/tribal leaders (2-3 min/person, will have signed up in advance) 4) Public comments (2-3 min/person, will have signed up in advance) 5) Next Steps ***Note: More discussion on***	• Hear from the public on this effort • Write summary of verbal public comment • CLEW staff will consider all written comments turned in by public	• Meeting agenda • Informational handout • Commenter sign-up cards • Cards for written comments • Directional signs (arrows pointing to the room, etc.) • Logo • Meeting checklist • Other sign-in materials?

Meeting	Location	Objective	Desired Outcomes	Resources Needed (materials, people, etc.)
		public meeting details is needed as we learn more on projected attendance		
October 23—Public 6:00-8:00	Seattle	Listening Session to hear public comments on the process and any specific actions they would like to have included 1) Introductions (CLEW, alternates, SAIC, and Triangle) 2) Ground rules 3) Comments from elected officials/tribal leaders (2-3 min/person, will have signed up in advance) 4) Public comments (2-3 min/person, will have signed up in advance) 5) Next Steps ***Note: More discussion on public meeting details is needed as we learn more on projected attendance***	• Hear from the public on this effort • Write summary of verbal public comment • CLEW staff will consider all written comments turned in by public	• Meeting agenda • Informational handout • Commenter sign-up cards • Cards for written comments • Directional signs (arrows pointing to the room, etc.) • Logo • Meeting checklist • Other sign-in materials?
November 6 2:00–4:00	Olympia	1) Introductions 2) Review and accept meeting summary and public comment summaries 3) Work Plan review, where are we, modifications needed?	• Draft list of recommendations to serve as basis for Report Draft #1	• Meeting agenda • AIFs • 10/14 draft Meeting Summary • Public comment summaries from 10/16 and 10/23

Meeting	Location	Objective	Desired Outcomes	Resources Needed (materials, people, etc.)
		4) Review and discuss public meetings outcomes and approach for December 6th meeting 5) Review outline of report (staff) 6) SAIC presentation on analysis of possible policies and actions, Q&A, Discussion a. Compare potential WA actions to Federal policies and other actions elsewhere 7) Develop draft list of recommendations 8) Discuss and decide on process/criteria for prioritization of policies and actions on 11/21 9) Next Steps		• Work Plan • SAIC materials? • Options for Prioritization Process (dots, clickers, colors, etc.)
November 21 2:00–4:00	Olympia	1) Introductions 2) Review and accept meeting summary 3) Work Plan review 4) Prioritize policies and actions on the table 5) Review draft report and provide input on requested revisions	• Prioritized list of policies and actions • Direction from CLEW for Draft Report #2	• Meeting agenda • AIFs • 11/6 draft Meeting Summary • Work Plan • Draft Report #1 • SAIC materials? • Process for Prioritization

Meeting	Location	Objective	Desired Outcomes	Resources Needed (materials, people, etc.)
		6) Final preparation and discussion on 12/6 public meeting		
December 6—Public 2:00-4:00	Olympia	Listening Session to hear public comments on the process, any specific actions they would like to have included, and specific actions being considered by CLEW 1) Introductions (CLEW, alternates, SAIC, and Triangle) 2) Ground rules 3) Comments from elected officials/tribal leaders **on draft report** (2-3 min/person, will have signed up in advance) 4) Public comments **on draft report** (2-3 min/person, will have signed up in advance) 5) Next Steps ***Note: More discussion on public meeting details is needed as we learn more on projected attendance***	• Hear from the public on the draft report • Write summary of verbal public comment • CLEW staff will consider all written comments turned in by public	• Meeting agenda • Informational handout • Draft Report #2 • Commenter sign-up cards • Cards for written comments • Directional signs (arrows pointing to the room, etc.) • Logo • Meeting checklist • Other sign-in materials?
December 13 2:00-4:00	Olympia	1) Introductions 2) Review and accept meeting summary and public	• Finalize proposed policies and actions • Address timeline and funding	• Meeting agenda • AIFs • 11/21 draft Meeting

Meeting	Location	Objective	Desired Outcomes	Resources Needed (materials, people, etc.)
		comment summary 3) Review Draft Report #3 4) Discuss final proposed policies and actions 5) Discuss timeline and funding for actions 6) Approve report pending discussed changes 7) Evaluation of process 8) Identify next steps a. Agreement on communication with CLEW, constituencies, Legislature, colleagues, and the public	for actions • Clear next steps • Approve report	Summary • 12/6 public comment summary • Work Plan • Draft Report #3 • SAIC materials?

Climate Legislative and Executive Workgroup
Agenda Information Form "AIF"
September 11, 2013

Agenda Item

SAIC Presentation on Task 1 (Analyses of WA State greenhouse gas (GHG) emissions and related energy consumption)

Action Requested

✓ Consider Task 1 findings and discuss questions posed on agenda

Presenters

Christina Waldron and Matthew Cleaver (SAIC)

Project Context/Next Steps

What is Task 1?

- Task 1 focuses on in-state energy and emissions. SAIC analyzed WA State's:
  - Total energy consumption and expenditures (Task 1.a)
  - Existing GHG reduction policies (Task 1.b)
  - Non-energy sources of GHG emissions (Task 1.c)
  - GHG reduction initiatives undertaken by local governments (Task 1.d)
  - Overall effect on global GHG levels if WA State achieves its targets (Task 1.e)

How does Task 1 fit into the overall project?

- Task 1 sets the stage for all further analyses, which includes:
  - Task 2 – evaluate GHG emissions reduction programs outside of Washington
  - Task 3 – quantify contribution to State's emissions reduction from federal policies
  - Task 4 – Final Report – consider results from Tasks 1-3, including policy interactions
  - Task 5 – provide technical support to CLEW for meetings and public hearings, make adjustments to analysis provided in Tasks 1-3, or offer new analyses as directed

Next Steps?

- Tasks 2 and 3 are in progress and will be presented at CLEW's 9/27 meeting
- Task 4 Report draft follows quickly thereafter, at the end of September

Key Takeaways/Summary

GHG Emissions

- Transportation sector is largest source in WA State.
  - On-road gasoline is the largest single source, followed by aviation fuels and diesel fuel.
- The electricity and Residential, Commercial, and Industrial (RCI) sectors are the next largest emitting sectors, in which:
  - Coal consumption is the largest single source for electricity, and
  - Natural gas is the largest single source in the RCI sector.
- Total emissions in the state show a decline since 2007 and a small increase in 2010.

Energy Consumption

- WA consumed just over 1.5 quadrillion BTUs of total energy in 2011.
- In 2011, share of WA fossil fuel consumption by fuel type was:
    - Petroleum – 69%
    - Natural gas – 26%
    - Coal – 5%
- WA consumes less gasoline and diesel per capita than OR, ID or MT, but more than CA.

Energy Prices and Expenditures

- WA spent $27 billion on energy in 2011, over 7% of gross state product.
- Transportation accounts for largest share of state energy expenditures, 58% in 2010.
- Gasoline and diesel prices have been increasing every year since 2003, except for a sharp decline in 2009 during the economic recession.

Local Government Initiatives

- Underway throughout the state, driving factors include jurisdictional level climate change goals, fuel cost savings, compliance with State/Federal policy, and funding opportunity requirements.

Existing Policies – Summary Table

	Projected GHG Emission Reductions in Target Years (MMTCO2e)		
Existing Policy	**2020**	**2035**	**2050**
Renewable Fuel Standard	0.3	0.4	0.5
Washington State Energy Code	1.2	4.5	4.1
GHG Emissions Performance Standards	0	2.9	N/A
Appliance Standards	0.7	0.9	N/A
Energy Independence Act (I-937)	11.2	N/A	N/A
Energy Efficiency and Energy Consumption Programs for Public Buildings	0.03	0.04	0.04
Conversion of Public Fleet to Clean Fuels	0.03	0.04	0.05
Purchasing of Clean Cars	5.0	10.0	11.7
Growth Management Act	1.6	2.4	2.6

Note: See Task 1 Report for more thorough explanation of existing policies.

AIF prepared by:

Christina Waldron (SAIC)

Evaluation of Approaches to Reduce Greenhouse Gas Emissions in Washington State

Task 1.a – Analyze Washington State's total consumption and expenditures for energy
Task 1.c – Analyze the state's non-energy sources of greenhouse gas emissions, such as cement production and agricultural sources, based on available data and information
August 23, 2013

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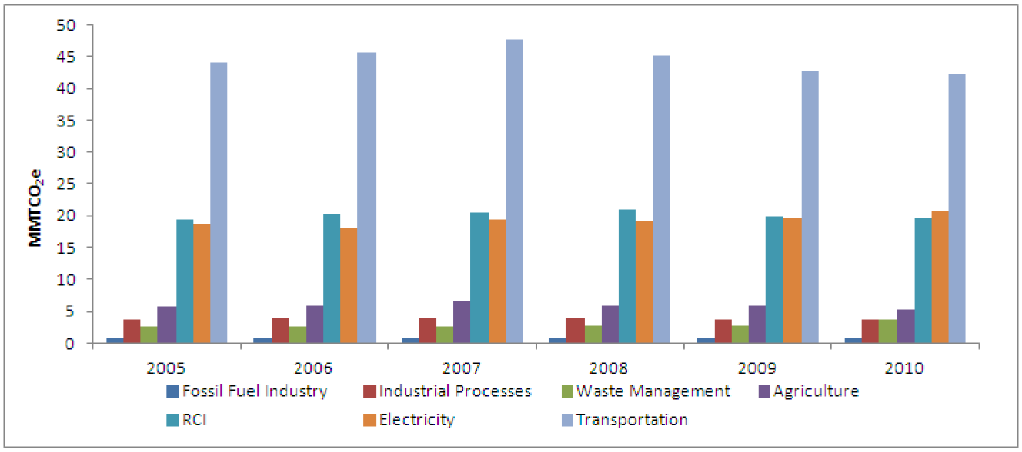
Key Findings

As part of its Evaluation of Approaches to Reduce Greenhouse Gas Emissions in Washington State, the Climate Legislative and Executive Workgroup (CLEW), through the Office of Financial Management (OFM), has tasked Science Applications International Corporation (SAIC) with analyzing Washington State Emissions and Related Energy Consumption (Task 1), in several parts. This document presents the results of Task 1a – Analysis of Washington State's total consumption and expenditures for energy, and Task 1.c – Analyze the state's non-energy sources of greenhouse gas emissions, such as cement production and agricultural sources, based on available data and information. SAIC completed these tasks, with the following analysis of emissions, energy consumption, and energy expenditures in Washington from 1990 to 2011. This document provides an analysis of energy consumption and expenditures in Washington State and examines how energy consumption impacts GHG emissions. Key trends in energy consumption and expenditures are highlighted and additional detail is provided for individual sources within sectors that show the highest GHG emissions, energy consumption, and expenditures. A separate Task 1 document presents the results of other Task 1 items.

Emissions

- The transportation sector is the largest source of emissions in Washington State. Within this sector, on-road gasoline consumption is the largest single source of emissions. Other important emission sources in the transportation sector are aviation fuels and diesel fuel.
- The electricity and residential, commercial, and industrial (RCI) sectors are the second largest emitting sectors, after transportation. In the electricity sector, coal consumption for electricity is the largest single source, while in the RCI sector, natural gas consumption is the largest source.
- Natural gas consumption is the largest source of emission in the RCI sector, primarily heating fuel for buildings, followed by oil, which is primary used in the industrial sector.
- Total emissions in the state have been declining since 2007. There was a small increase in emission in 2010, primarily due to increased fossil fuel electricity consumption in response to drought conditions that reduced hydroelectric power output. The only other sectors that showed increased emissions in 2010 were the industrial processes and waste management sectors.

Emissions by Sector, 2005 - 2010



Source: Washington State Greenhouse Gas Emissions Inventory 1990 - 2010

Energy Production

- Washington has one large coal-fired plant, the Centralia plant owned by TransAlta, which has two units totaling 1,340 MW in generation capacity. The plant originally used coal from the State's only coal mine, which was shut down in 2006, and now imports coal from Wyoming and Montana. Starting by shutting down the first unit in 2020, the State plans to phase out in-state coal-fired generation entirely by the end of 2025.[1]
- Washington produces very few fossil fuel resources, but is a principal petroleum refining center that imports crude and supplies finished products to Pacific Northwest markets.
- Washington is the Nation's largest producer of hydroelectric power; which generally accounts for approximately three-fourths of the State electricity generation.[2]
- Among the State's significant non-hydro renewable resources are existing fuel wood resources, and wind power potential. The State ranked 7th in the nation for wind capacity in 2013[3].
- Washington also has one nuclear plant, the Columbia Generating Station, which generates about one-tenth of the electricity generated in the state.[4]

Energy Consumption

- Washington consumed just over 1.5 quadrillion Btu of total energy in 2011.
- On a per capita basis, Washington consumed about 220 million Btu in 2011. Oregon and California consumed less energy per capita, at 193 and 201 million Btu per capita,

[1] U.S. Energy Information Administration. Washington State Profile and Energy Estimates. http://www.eia.gov/state/analysis.cfm?sid=WA

[2] U.S. Energy Information Administration. http://www.eia.gov/state/analysis.cfm?sid=WA.

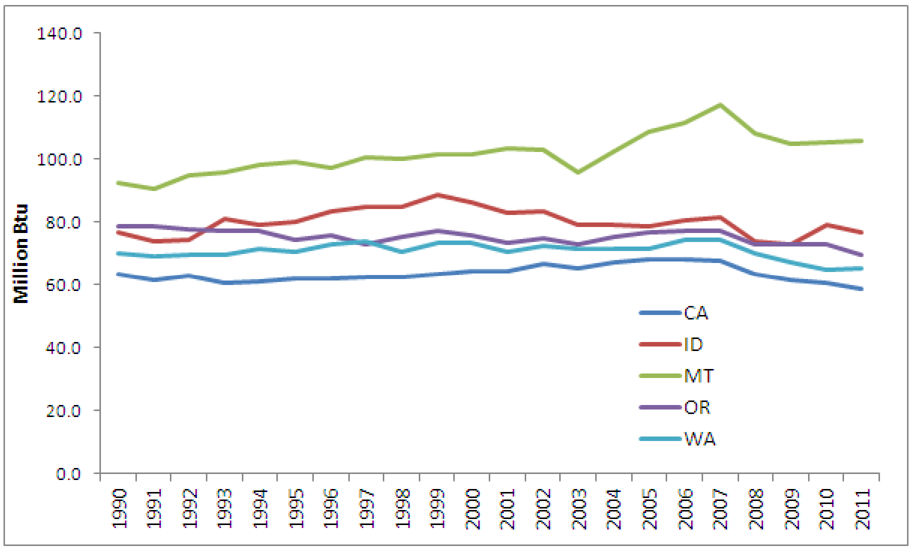
[3] American Wind Energy Association. U.S. Wind Industry First Quarter2013 Market Report. http://awea.rd.net/Resources/Content.aspx?ItemNumber=5400

[4] Although the Columbia Generating Station accounts for one-tenth of electricity generated in Washington, the output from the plant is sold to BPA and marketed to customers throughout the Pacific Northwest, with only about 350 average megawatts actually consumed in Washington.

respectively, in 2011. Idaho and Montana consumed more energy per capita, at 278 and 319 million Btu per capita, respectively, in 2011.

- In the transportation sector, Washington consumes less on-road transportation fuel (gasoline and diesel) per person than all other states in the region, except California. However, consumption of gasoline is still the largest source of emissions in the state.

Per Capita On-Road (Gasoline and Diesel) Fuel Consumption 1990 - 2011

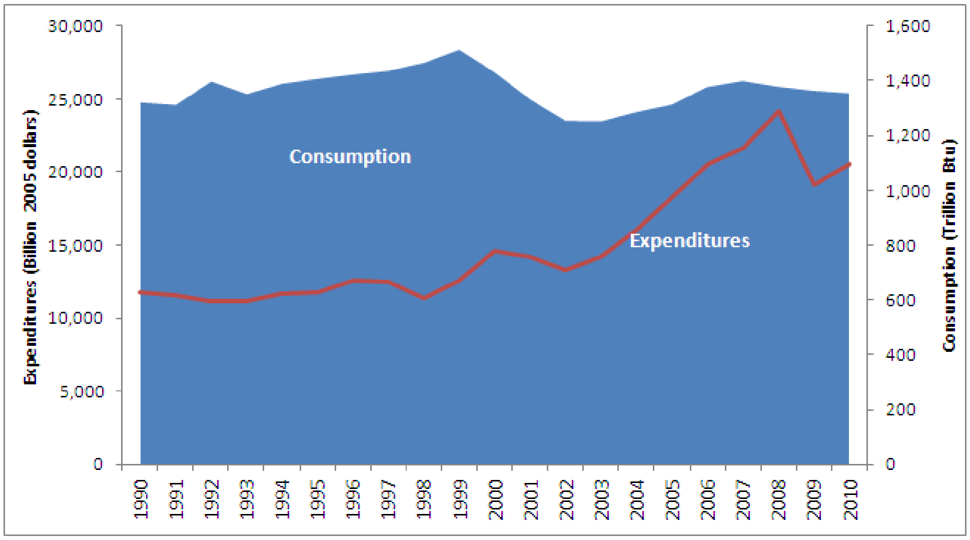


Source: EIA SEDS. Based on resident population including Armed Forces.

Energy Prices and Expenditures

- Washington spent $27 billion on energy in 2011, over 7 percent of gross state product.
- The transportation sector accounts for the largest share of state energy expenditures, 58 percent in 2010. Gasoline accounted for the largest share of expenditures, followed by diesel and aviation fuel.
- On-road fuel (gasoline and diesel) prices have been increasing every year since 2003, except for a sharp decline in 2009 during the economic recession. Gasoline prices increased an annual average of 20 percent in 2010 and 2011. Diesel prices show a similar trend with prices increasing an average of 25 percent annually in 2010 and 2011.

Total Energy Consumption and Expenditures, 1990 - 2010



Source: 2013 Biennial Energy Report. Expenditures in billion 2005 dollars.

1 Introduction – Energy Consumption and Expenditure Analysis

Energy consumption, particularly the combustion of fossil fuels, is the principal source of greenhouse gas (GHG) emissions in Washington State and around the globe. Any discussion of policies and programs aimed at reducing GHG emissions must consider energy consumption and its contribution to GHG emissions. An analysis of energy prices and expenditures allows the State to consider how policies that target emissions relate to energy price and the economy.

The main energy consuming sectors in Washington State, and therefore the sectors that produce the most GHG emissions, are the transportation sector, the residential, commercial, and industrial (RCI) sector[5], and the electricity sector. Together these three sectors were responsible for 86 percent of Washington's total GHG emissions in 2010. The remaining emissions come from non-energy sources in the industrial, agricultural, and waste management sectors, such as industrial process emissions and methane (CH_4) emissions from agricultural and waste management activities.

This document provides an analysis of energy consumption and expenditures in Washington State and examines how energy consumption impacts GHG emissions. Key trends in energy consumption and expenditures are highlighted and additional detail is provided for individual sources within sectors that show the highest GHG emissions, energy consumption, and expenditures. These highlighted sources are compared to similar jurisdictions outside Washington[6] to identify areas where potential reduction measures might be focused.

[5] The RCI sector includes direct fuel consumption in the residential, commercial, and industrial sectors and does not include electricity consumption.

[6] Primarily the Western States, whose energy profile is similar to Washington's, and California, which has GHG reduction policies in place similar to those in Washington.

2 Washington's Greenhouse Gas Profile

Total emissions in Washington State in 2010 were 96.1 million metric tons of carbon dioxide equivalent (MMTCO2e) according to the Washington State Greenhouse Gas Emissions Inventory published in 2012 (which includes data from 1990 to 2010). Washington's emission profile differs slightly from most other states and the United States as a whole. The electric power sector is the largest source of emissions on average in the United States, accounting for about 33 percent of total emissions in 2011.[7] The residential, commercial, and industrial (RCI) and transportation sectors are the next largest sources, at 31 and 28 percent, respectively. In Washington, the largest source of emissions is the transportation sector, which in 2010 accounted for 44 percent of total GHG emissions in the State. This is similar to other Northwestern states where hydropower is a primary source of electricity which offsets emissions from fossil fueled power plants in the electricity sector. Although most of the electricity produced within Washington comes from hydropower, a portion of the electricity actually consumed in the State is imported from fossil fueled power plants outside the State including plants in Montana and Wyoming. Therefore, on a net consumption basis, the electricity sector contributes to a significant portion of emissions and is the second largest emissions source in the state accounting for 22 percent of total emissions in 2010.[8] To determine the GHG inventory boundary approach, we analyzed indirect emissions from electricity consumed rather than only direct emissions from in-state generation only. Washington State decided to emphasize the consumption approach in its 2007 inventory,[9] after analyzing both approaches, and for the purpose of this project, we followed that established approach.

The third largest source of emissions in Washington is the residential, commercial, and industrial (RCI) sector which accounted for 20 percent of total emissions in 2010. Emissions in this sector are primarily from the combustion of fossil fuels in houses and buildings as well as fuel for industrial activities. Figure 1 shows the percent share of emissions by sector in Washington and in the United States.[10]

Figure 1. Share of Emissions by Sector for Washington and United States

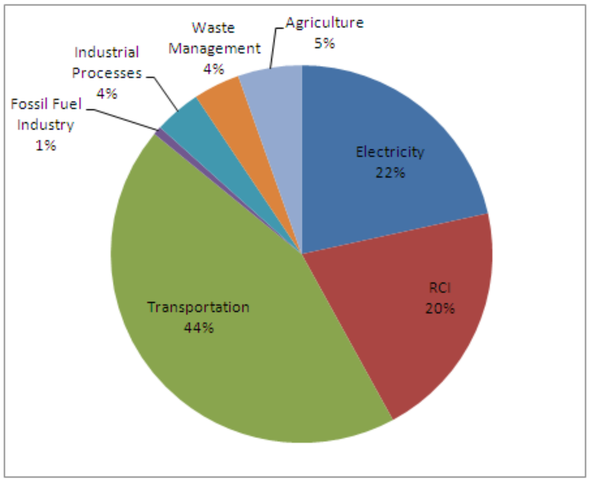
Washington United States

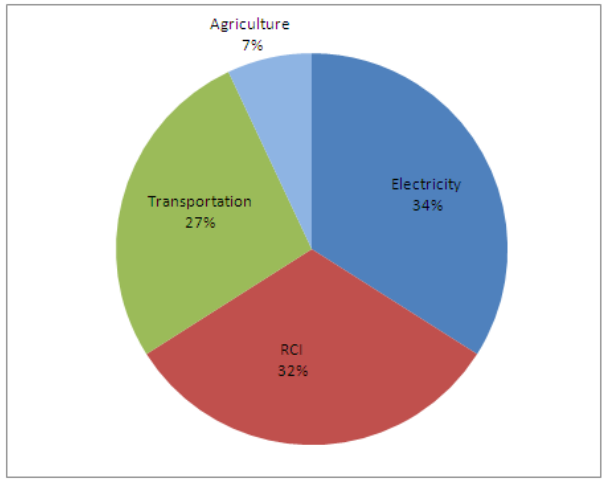
[7] US EPA. Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2011. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

[8] Hydropower cannot supply all of the state's electricity demand. The hydro Washington exports is surplus power in excess of the state's demand at the time it is generated. Washington imports energy at times when hydro cannot meet the state's demand.

[9] Center for Climate Strategies. Washington State Greenhouse Gas Inventory and Reference Case Projections, 1990-2020, December 2007.

[10] Washington State GHG Inventory, 1990 – 2010. United State data from US EPA.



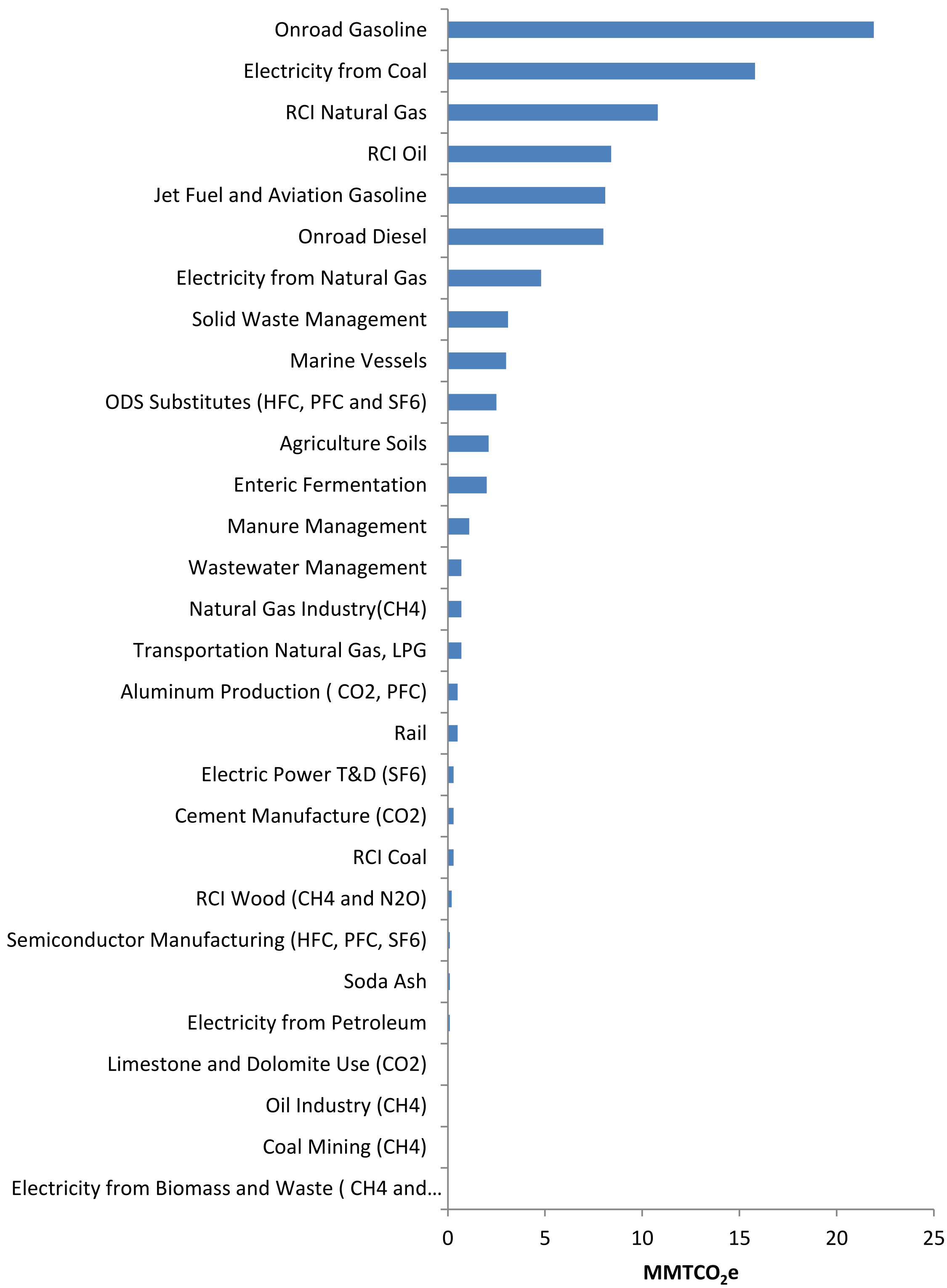


Note: Fossil Fuel Industry, Industrial Processes, and Waste Management are included in the RCI sector in the United States Chart.

The consumption of gasoline in vehicles is the largest single source of emissions in Washington, accounting for over 23 percent of total emissions in 2010. Electricity produced from coal is the second largest source of emissions in the State. Although Washington only has one coal fired power plant, a portion of the electricity consumed in the state is imported from coal burning power plants outside the state and these emissions are included in the inventory. Washington's existing GHG reduction policies targeting fossil fueled power plants, including emission performance standards and renewable portfolio standards, apply to coal and other fossil fueled plants both inside and outside the state. Combustion of natural gas and oil in the RCI sector follow as the next largest sources of emissions. The residential sector is the largest consumer of natural gas in Washington, followed closely by the industrial and electric power sectors. Roughly one-third of Washington households use natural gas as their main energy source for home heating.[11] Consumption of jet fuel is the next largest source of emissions. Washington is one of the largest consumers of jet fuel in the United States, due in part to several large Air Force and Navy installations located in the state. Diesel fuel in vehicles and equipment emit about half as much emissions as coal fired electricity. Figure 2 below shows the contribution of individual sources of emissions in Washington in 2010.

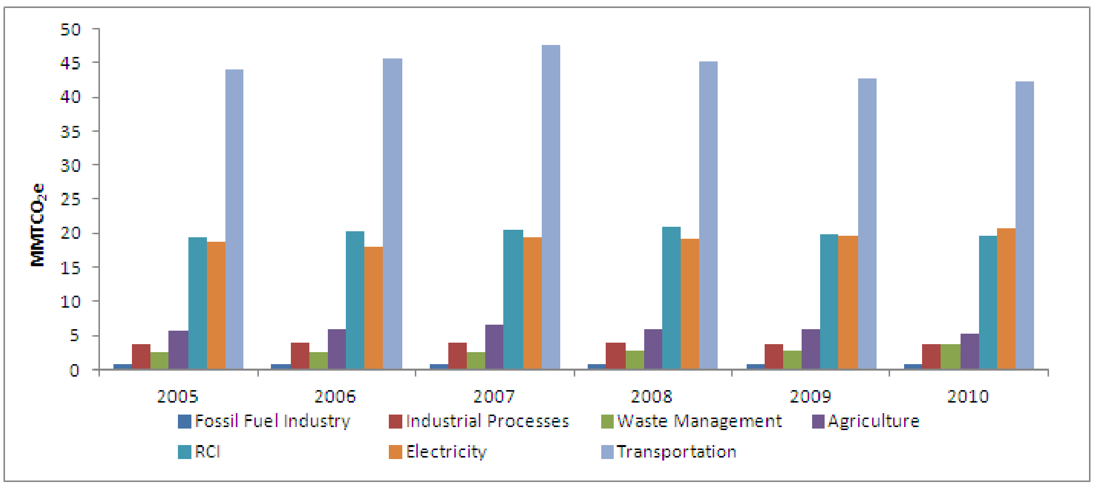
[11] U.S. Energy Information Administration. http://www.eia.gov/state/analysis.cfm?sid=WA

Figure 2. Washington State GHG Emissions by Source in 2010



From 2005 to 2007 emissions increased at an average annual rate of 3.5 percent followed by a comparable decrease in emissions in 2008 and 2009, when emissions dropped to very near 2005 levels. Emissions increased by just over one percent from 2009 to 2010. Figure 3 shows emissions by sector from 2005 to 2010. Total GHG emissions in 2010 were 1.1 MMTCO2e (5.7 percent) higher than in 1990, the baseline year from which emission targets will be measured. In 2010, emissions from the electricity sector overtook emissions from the RCI sector for the first time to become the second largest source of emissions in the state. A contributing factor to the increase in electricity emissions in 2010 was reduced output of hydropower due to the severe drought that occurred in that year. This increased the amount of electricity imported into the state, some of which was generated with fossil fuel. There was also an increase of emissions from the waste management sector in 2010.

Figure 3. Emissions by Sector, 2005 - 2010

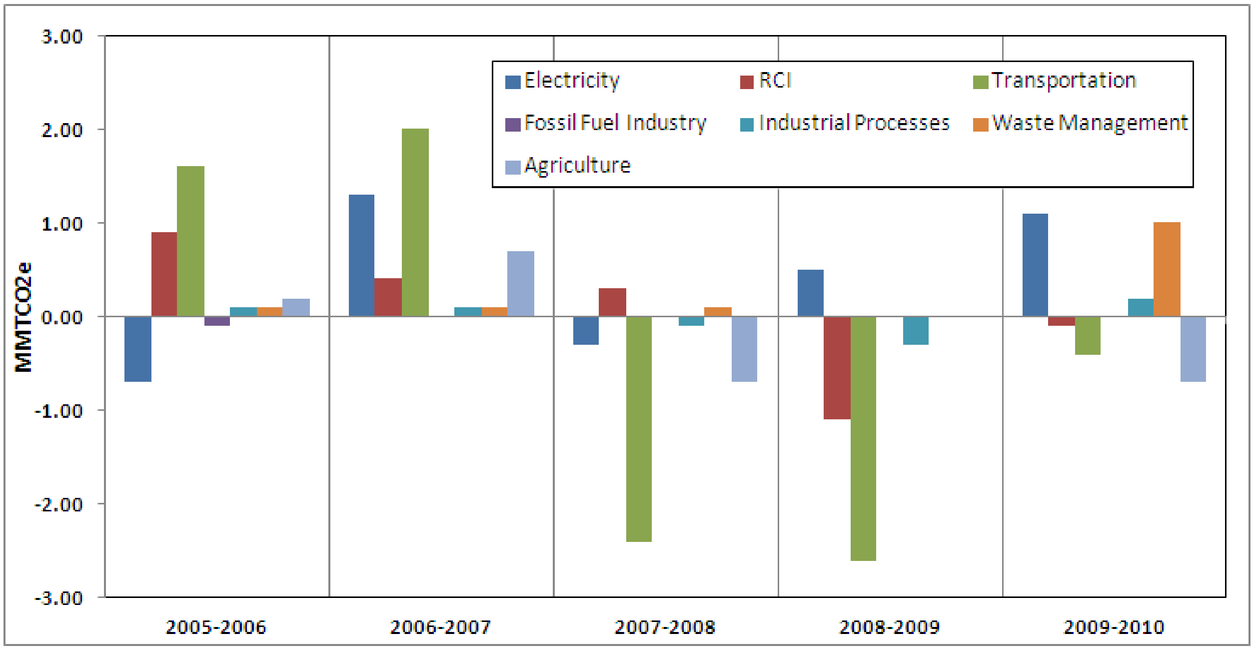


Source: Washington State Greenhouse Gas Emissions Inventory 1990 - 2010

From 2005 to 2006, all sectors except electricity and the fossil fuel industry showed increases in emissions, with the transportation sector showing the largest increase. All sectors increased emissions from 2006 to 2007, with the transportation sector again showing the largest increase. Conversely, the majority of sectors showed decreases in emissions in 2008 and 2009 with the transportation and RCI sectors leading the reductions. Reduced demand for energy, especially transportation fuels, during the global economic recession was a significant contributing factor to the reductions during this time period. The only sector in which emissions increased from 2008 to 2009 was the electricity sector. Figure 4 shows the amount of change year-over-year by sector from 2005 to 2010 in MMTCO2e.[12]

[12] Washington State GHG Inventory, 1990 – 2010.

Figure 4. Change in Emissions by Sector



Non-energy emissions sources in Washington accounted for 13.5 MMTCO2e, or 14 percent of total emissions, in 2010. Non-energy emissions occur in four sectors including the Fossil Fuel Industry, Industrial Processes, Waste Management, and Agriculture. The Fossil Fuel Industry sector emitted 0.7 MMTCO2e in 2010, approximately 0.7 percent of total emissions. This sector includes CH4 emissions that are released due to leakage and venting (fugitive emissions) during the production, processing, transmission and distribution of fossil fuels. All of the emissions in this sector in 2010 were from the natural gas industry.[13]

The Industrial Processes sector accounted for 3.8 MMTCO2e, or 4 percent of total emissions, in 2010. This sector includes CO2 emissions from industrial processes such as aluminum and cement manufacturing, fugitive emissions of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6) used as substitutes for ozone depleting substances (ODS), and fugitive emissions of SF6 from electric power transmission and distribution systems. Fugitive emissions of ODS substitutes, typically used in applications such as refrigeration, air conditioning systems, aerosols, and fire suppression, accounted for 66 percent of emissions in this sector in 2010 and have been increasing at average annual rate of 6.6 percent per year since 2008. Although these gases are less harmful to the ozone layer than the gases they replace, they have much higher global warming potentials than other GHGs.

The Waste Management sector includes CH4 emissions from solid waste management practices and wastewater treatment. This sector accounted for 3.8 MMTCO2e in 2010, or 4 percent of total emissions. Most of the emissions in this sector, 82 percent in 2010, are from solid waste management activities, such as landfills. There has been a general increase in per capita waste generation in Washington since 1999. However, the amount of waste recycled and diverted

[13] There was a small amount of emissions (0.01 MMTCO2e) from coal mining in 2005 before the states only mine was closed in 2006.

over this time period has also increased.[14] The tracking of waste generation and disposal continues to improve and a portion of the increase in emissions from waste management activities from 2009 to 2010 can be attributed to enhanced reporting requirements and improved data quality.[15]

The Agriculture sector accounted for 5.2 MMTCO2e, or 5.4 percent of total emissions, in 2010. This sector includes CH4 and nitrous oxide (N20) emissions from enteric fermentation by livestock, manure management, and agricultural soils. Enteric fermentation from livestock is the largest source of emissions in this sector, followed by agricultural soils. These sources accounted for almost 80 percent of emissions in this sector in 2010 and have been decreasing since 2007. Manure management emissions have remained flat at 1.1 MMTCO2e since 2005.

3 Washington's Energy Profile

3.1.1 Production

Washington produces very few fossil fuel resources but is the Nation's largest producer of hydroelectric power, with much of the output coming from the Columbia and Snake Rivers. Washington also has significant non-hydro renewable resources. The State's western forests offer fuel wood resources, and large areas of the State are conducive to wind power generation and potentially conducive to geothermal power development. The high-temperature geothermal areas in Washington have the potential to produce up to 300 MW of electric power.[16] Washington is a major producer of wind energy and in 2013 ranked seventh in the U.S. in wind capacity.[17] Washington is also a substantial producer of energy from wood and wood waste, accounting for approximately 3 percent of U.S. production.[18] Wood and wood waste biomass is primarily burned for electricity production and process steam at pulp and paper mills and is also used for residential heating.[19]

Although Washington does not produce any petroleum, the state is a principal refining center serving Pacific Northwest markets. There are five refineries in Washington that receive crude oil supply primarily from Alaska, and increasingly from Canada and other states and countries. Washington has one large coal-fired plant, the Centralia plant owned by TransAlta. The plant originally used coal from the State's only coal mine which was shut down in 2006. Coal is now imported from Wyoming and Montana. According to the EPA's Greenhouse Gas Reporting

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[14] For a detailed discussion of solid waste in Washington see the Washington State Department of Ecology report Solid Waste in Washington State: 20th Annual Status Report. December 2011. https://fortress.wa.gov/ecy/publications/publications/1107039.pdf

[15] Washington State Department of Ecology. Solid Waste in Washington State: 20th Annual Status Report. December 2011. https://fortress.wa.gov/ecy/publications/publications/1107039.pdf

[16] Energy Information Administration. State Profile and Energy Estimates. http://www.eia.gov/state/analysis.cfm?sid=WA

[17] American Wind Energy Association. U.S. Wind Industry First Quarter2013 Market Report. http://awea.rd.net/Resources/Content.aspx?ItemNumber=5400

[18] EIA State Energy Profile. Washington. http://www.eia.gov/state/?sid=WA

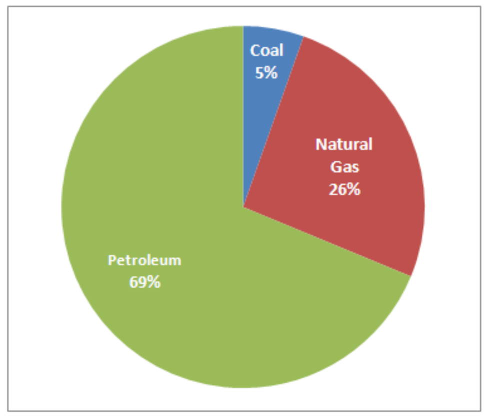
[19] Washington State Department of Commerce. 2013 Biennial Energy Report.

Program (GHGRP), the Centralia plant emitted 5.6 MMTCO2e in 2011.[20] The plant is currently in the process of transitioning away from coal power. One of the two 670 MW coal burning units will shut down in 2020, the other in 2025. Washington also has one nuclear plant, the Columbia Generating Station, which generates about one-tenth of the electricity generated in the state.[21]

3.1.2 Consumption

Washington consumed just over 1.5 quadrillion Btu of total energy in 2011.[22] On a per capita basis, Washington consumed about 220 million Btu in 2011. Oregon and California consumed less energy per capita than Washington, at 193 and 201 million Btu per capita, respectively, in 2011. Idaho and Montana consumed more energy per capita than Washington, at 278 and 319 million Btu per capita, respectively, in 2011.

Figure 5. Share of Fossil Fuel Consumption



Coal, petroleum, and natural gas make up the largest share of fossil fuel consumption. In 2011, petroleum represented 69 percent of total fossil fuel consumption, while natural gas and coal accounted for 26 percent and 5 percent, respectively. Figure 5 shows the share of fossil fuel consumption by fuel in 2011.[23] The trend in fossil fuel consumption by sector from 1990 to 2011 is shown in Figure 6. Consumption increased steadily from 1990 to 1999. The noticeable drop in fossil fuel consumption from 1999 to 2002, particularly in the RCI and Electricity sectors was primarily the result of the closure of several energy intensive aluminum plants during that time. The main drivers for the plant closures were weak aluminum prices and increasing energy prices, particularly electricity prices, which are discussed further in section 6. Fossil fuel consumption showed another steady increase from 2002 to 2008 following general trends in energy demand. The decrease in fossil fuel consumption after 2008, particularly in the transportation and RCI sectors, is largely due to a decrease in demand for energy during the global economic crisis. Fossil fuel consumption in the electricity sector is highly dependent on hydroelectricity production. When hydroelectricity

[20] EPA Greenhouse Gas Reporting Program. 2011. http://www.epa.gov/ghgreporting/ghgdata/reported/index.html

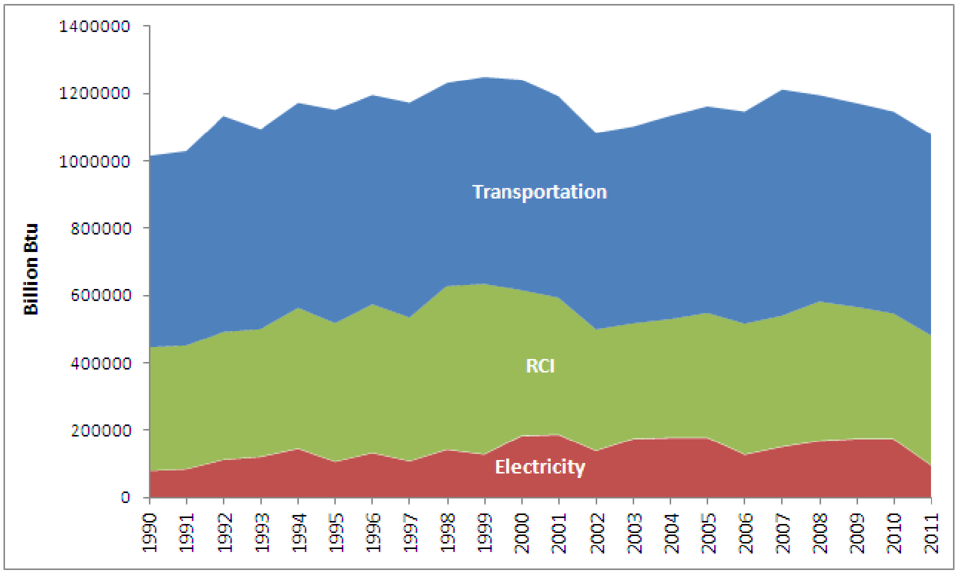
[21] Although the Columbia Generating Station accounts for one-tenth of electricity generated in Washington, the output from the plant is sold to BPA and marketed to customers throughout the Pacific Northwest, with only about 350 average megawatts actually consumed in Washington.

[22] Energy Information Administration. State Energy Database, http://www.eia.gov/state/seds/. Note that EIA converts hydroelectricity net generation from kilowatthours (kWh) to British thermal units (Btu) using the U.S. average heat content of fossil fuels consumed at steam-electric power plants as a conversion factor. In this analysis hydroelectricity is converted from kWh to Btu by applying the constant conversion factor of 3,412 Btu/kWh to remain consistent with the approach Washington State (and the international community) uses to calculate hydroelectricity consumption.

[23] EIA SEDS. Note that this data includes fossil fuels consumed in all sectors, including the electric power sector, within the state. Emissions from the electric power sector are calculated on a net consumption basis and include emissions from electricity that is consumed in the state, but that may have been generated by fossil fuels consumed by generators outside the state. See Section 6 for a more detailed analysis of the Electric Power sector.

output is low, more power is imported from out of state, some of which is fossil fuel power. Fossil fuel use in the electricity sector showed a sharp decline in 2011 due in part to an increase in renewable electricity production, particularly wind power.

Figure 6. Fossil Fuel Consumption by Sector 1990 - 2011



Source: EIA SEDS. Includes residual fuel.

3.1.3 Expenditures

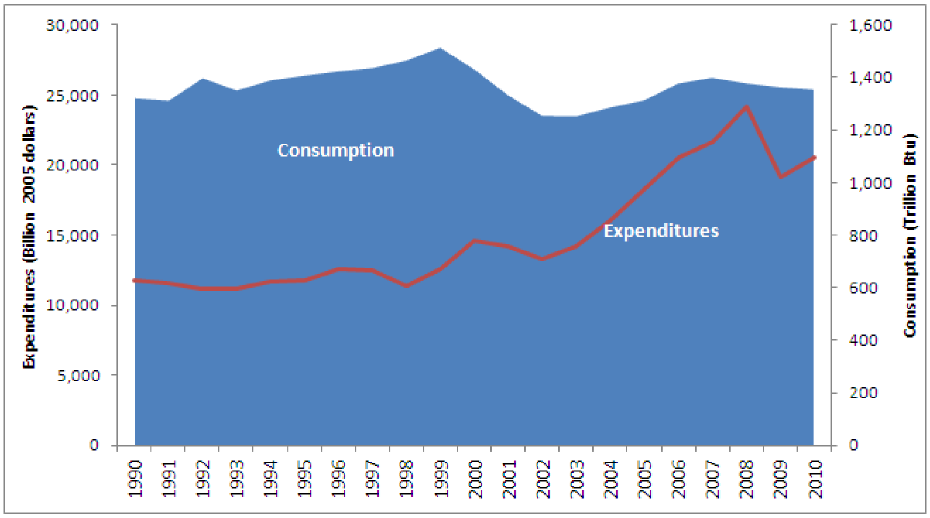
Washington spent more than $27 billion on energy in 2011.[24] Energy expenditures increased modestly from 1990 to 2002 with decreases in 1998 and from 2000 to 2002. After 2002 total energy expenditures increased significantly until 2008, followed by a sharp decline of over 20 percent in 2009. Energy expenditures grew by 9 percent in 2010. The declines from 2000 to 2002 were partly the result of reduced consumption as several industrial facilities, particularly aluminum plants, closed during that period. The increase in expenditures from 2002 to 2008 was due mainly to increased fuel prices as energy consumption grew only modestly during this period and actually declined from 2007 to 2009. Sharp declines in expenditures in 2009 can mostly be attributed reduced fuel demand during the economic recession. Figure 7 shows total energy consumption and expenditures in Washington from 1990 to 2010[25] and Figure 8 shows average prices by fuel, including electricity, from 1990 to 2011.[26]

[24] US Energy Information Administration, State Energy Data System. 2011. http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_sum/html/sum_ex_tx.html&sid=WA .

[25] Washington State Department of Commerce, 2013 Biennial Energy Report.

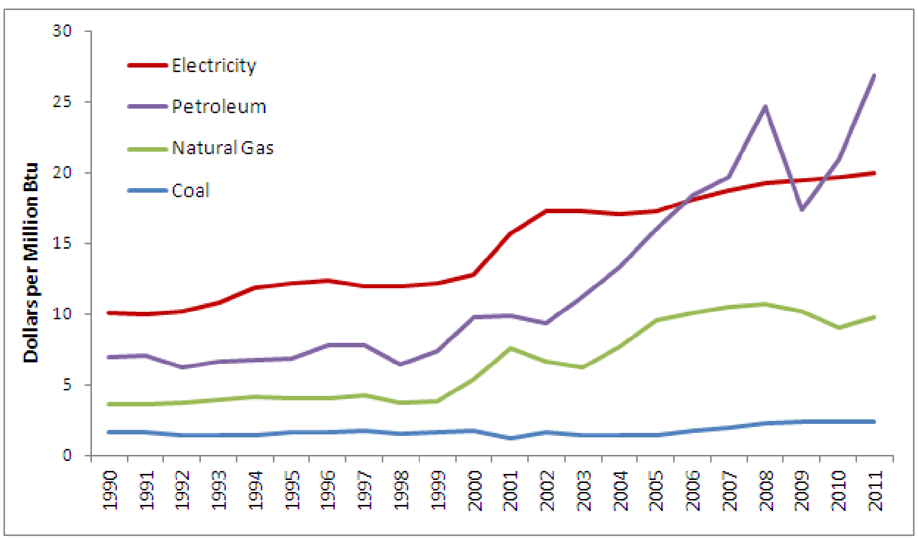
[26] Ibid.

Figure 7. Total Energy Consumption and Expenditures, 1990 - 2010



Source: 2013 Biennial Energy Report. Expenditures in billion 2005 dollars.

Figure 8. Price by Fuel, 1990 - 2010

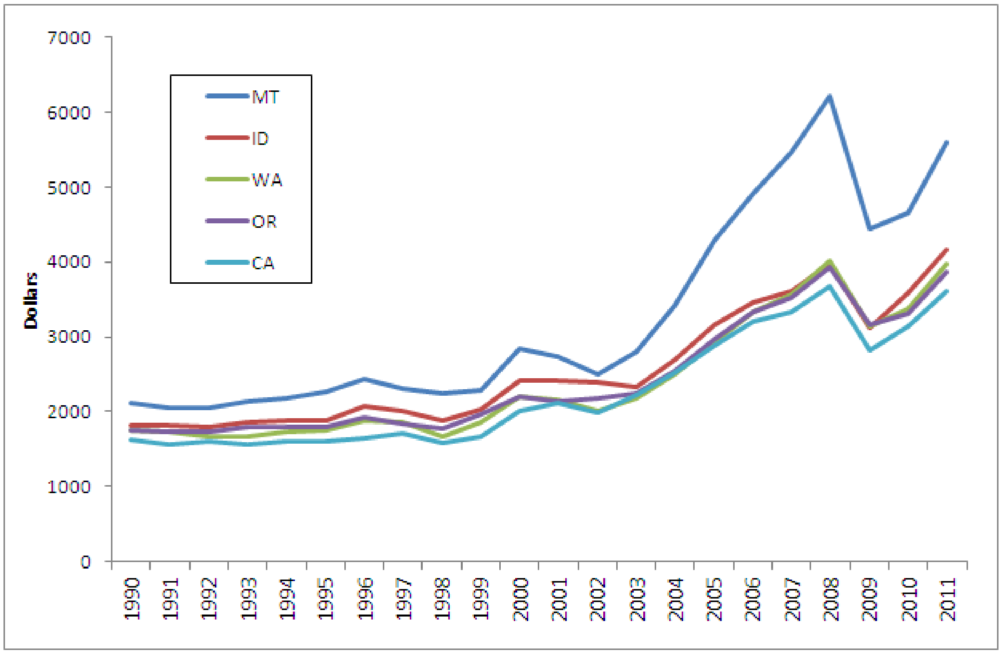


Source: EIA SEDS. Current Dollars.

Washington's total energy expenditure per capita is similar to that of neighboring states, except for Montana whose population spends significantly more on energy per person than Washington. Figure 9 shows total per capita energy expenditures for Washington, Oregon, Idaho, Montana, and California from 1990 to 2011. Oregon and Idaho show slightly larger, although very similar, per capita energy expenditures to Washington, while California is slightly lower over the time period.[27] Figure 10 shows energy expenditures as percent of Gross State Product (GSP) for Washington, Oregon, Idaho, Montana, and California from 1997 to 2011.[28]

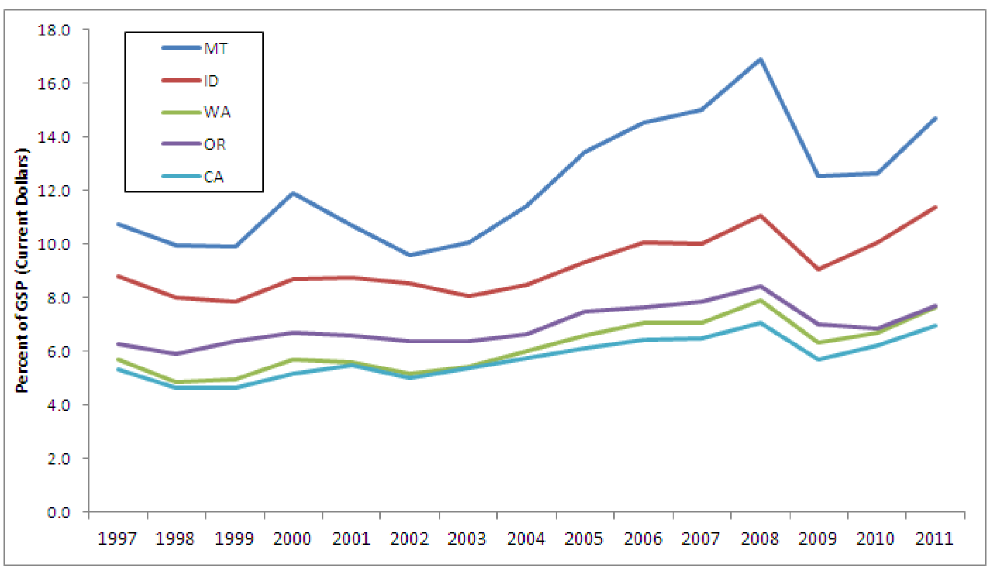
[27] Expenditures are based on data from EIA and represent estimates of money spent directly by consumers to purchase energy, generally including taxes. Tax rates for fuels vary among the states. For example, Washington's

Figure 9. Total Per Capita Energy Expenditures by State



Source: EIA SEDS. Current Dollars.

Figure 10. Total Energy Expenditures as Percent of GSP



Source: EIA SEDS. Current Dollars.

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gasoline and diesel fuel taxes are higher than those in Oregon, Idaho, and Montana. Source: Federation of Tax Administrators. January 2013. http://www.taxadmin.org/fta/rate/mf.pdf.

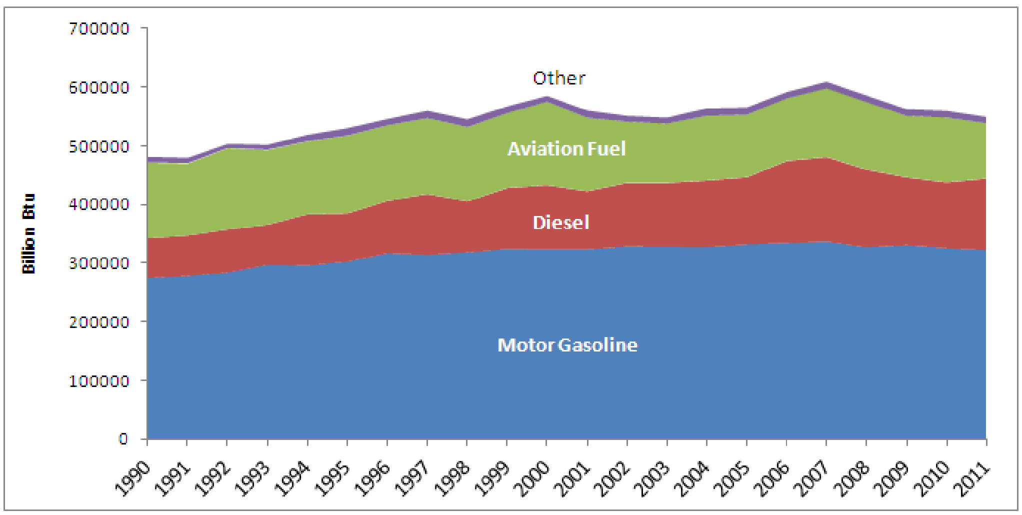
[28] This data is presented from 1997 because there is a discontinuity in the GSP by state time series at 1997, where the data changes from Standard Industrial Classification (SIC) industry definitions to North American Industry Classification System (NAICS) industry definitions.

4 Transportation Sector

4.1.1 Consumption

The transportation sector is the largest energy consuming sector in Washington and the largest source of GHG emissions. Figure 11 shows the share of consumption by fuel in the transportation sector from 1990 to 2011. Motor gasoline, diesel, and aviation fuel (aviation gasoline and jet fuel) accounted for 90 percent of fossil fuel consumption in the transportation sector in 2011, with motor gasoline accounting for the largest share at over 54 percent. Residual fuel, which accounted for 8 percent of consumption in 2011, is not included in this chart. Bunker fuel makes up the majority of residual fuel used for transportation and consumption is highly variable depending on marine traffic at Washington ports.[29]

Figure 11. Transportation Consumption by Fuel, 1990 - 2011



Source: EIA SEDS. Other includes lubricants, LPG, electricity, natural gas and coal.

Washington is a major consumer of aviation fuel and is home to several military bases. Aviation fuel consumption has dropped more than 20 percent since 2000, mostly due to changes in commercial transportation patterns and more efficient aircraft engines. Motor gasoline consumption remained relatively flat from 2000 to 2011 following a period of rapid growth from 1990 to 2000. Diesel consumption shows a period of significant growth from 2006 to 2007 followed by a sharp decline through 2010. Diesel fuel consumption increased 9 percent in 2011. Interestingly, gasoline consumption declined only minimally, by just over 1 percent, during the height of the economic recession, from 2008 to 2009, which is in contrast to the trend in diesel consumption, which declined by almost 13 percent during that period. Statewide fuel

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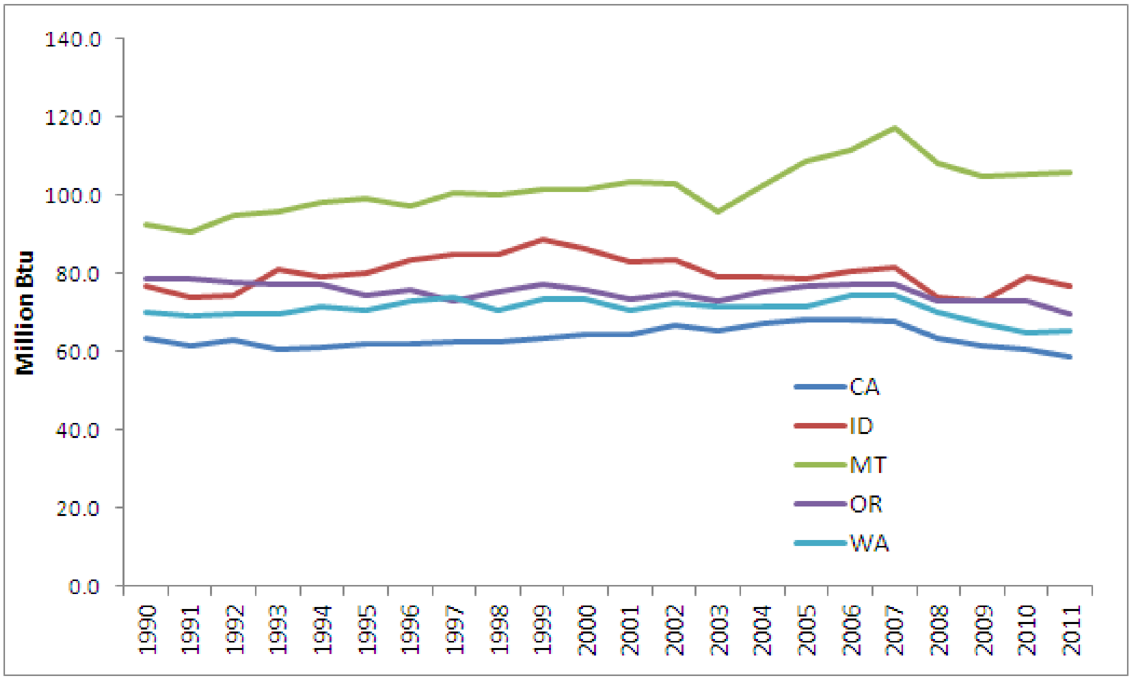
[29] Washington State Department of Commerce, 2013 Biennial Energy Report, www.commerce.wa.gov/Documents/2013-biennial-energy-report.pdf. Also note that residual fuel consumption includes both fuel consumed on ships and fuel transported by ships, complicating the allocation of emissions from this fuel.

consumption models prepared by the Washington State Department of Transportation show that diesel consumption has a strong positive correlation to the rate of Washington real personal income which helps to explain the decline in consumption during the period of reduced personal income.[30]

Washington's per capita on-road (gasoline and diesel) fuel consumption is the second lowest in the region after California. Per capita on-road fuel consumption remained relatively steady from 1990 to 2007 followed by an average annual decrease of 3.3 percent from 2007 to 2010 and increased 0.3 percent in 2011. Figure 12 shows per capita on-road fuel consumption for Washington and neighboring states from 1990 to 2011.

Figure 12. Per Capita On-Road (Gasoline and Diesel) Fuel Consumption 1990 - 2011



Source: EIA SEDS. Based on resident population including Armed Forces.

4.1.2 Expenditures

The transportation sector accounts for the largest share of energy expenditures in Washington (58 percent in 2010).[31] The largest energy expenditures in the transportation sector are for motor gasoline, followed by diesel fuel and aviation fuel. Figure 13 shows expenditures for these fuels in the transportation sector from 1990 through 2011. Other fuels used in the transportation sector in Washington, including electricity, LPG, and natural gas, represent too small a share compared to gasoline, diesel, and aviation fuel to appear on this chart. Residual fuel is not included because it is primarily used in large ocean going vessels.

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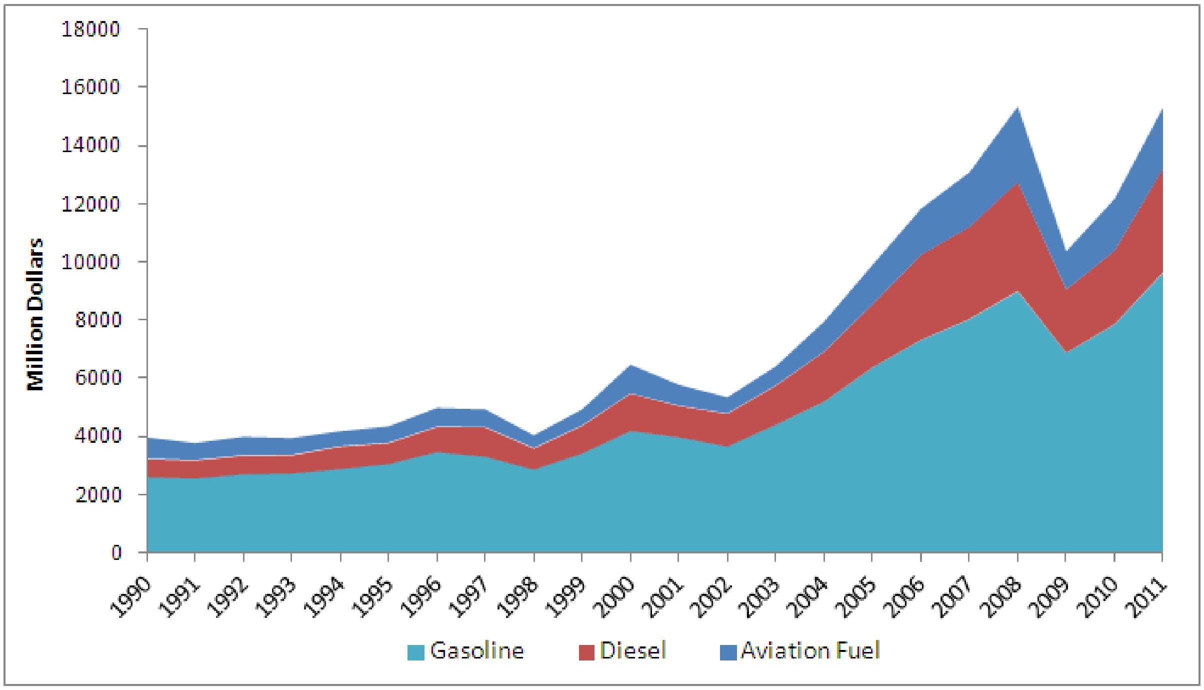
[30] Washington State Department of Transportation. Statewide Fuel Consumption Forecast Models.

[31] 2013 Biennial Energy Report. http://www.commerce.wa.gov/Documents/2013-biennial-energy-report.pdf

Figure 13. Transportation Expenditures, 1990 - 2011



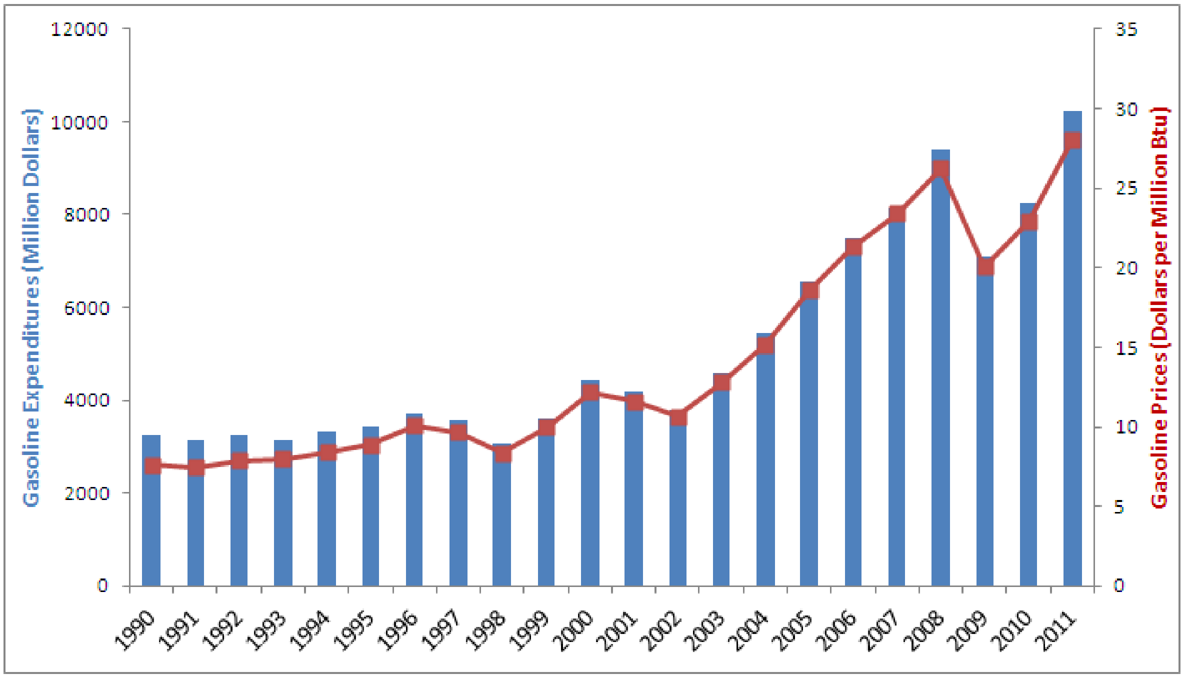
Source: EIA SEDS. Current Dollars. Expenditures represent estimates of money spent directly by consumers to purchase energy, generally including taxes.

As in the rest of the nation, gasoline prices have increased significantly in Washington since 2000. Adding to a general increase in demand for transportation fuels there was a large price increase in 2005 caused by supply disruptions following hurricanes Katrina and Rita. Two other significant increases occurred in 2006 and 2007. These increases were caused by a combination of several factors, including refinery capacity reductions due to the transition away from methyl tertiary butyl ether (MTBE) in gasoline and several unplanned refinery outages.[32] Figure 14 and Figure 15 show prices and expenditures for gasoline and diesel, respectively, in the transportation sector from 1990 to 2011.[33]

[32] Federal Trade Commission. Gasoline Price Changes and the Petroleum Industry: An Update. September 2011. http://www.ftc.gov/os/2011/09/110901gasolinepricereport.pdf

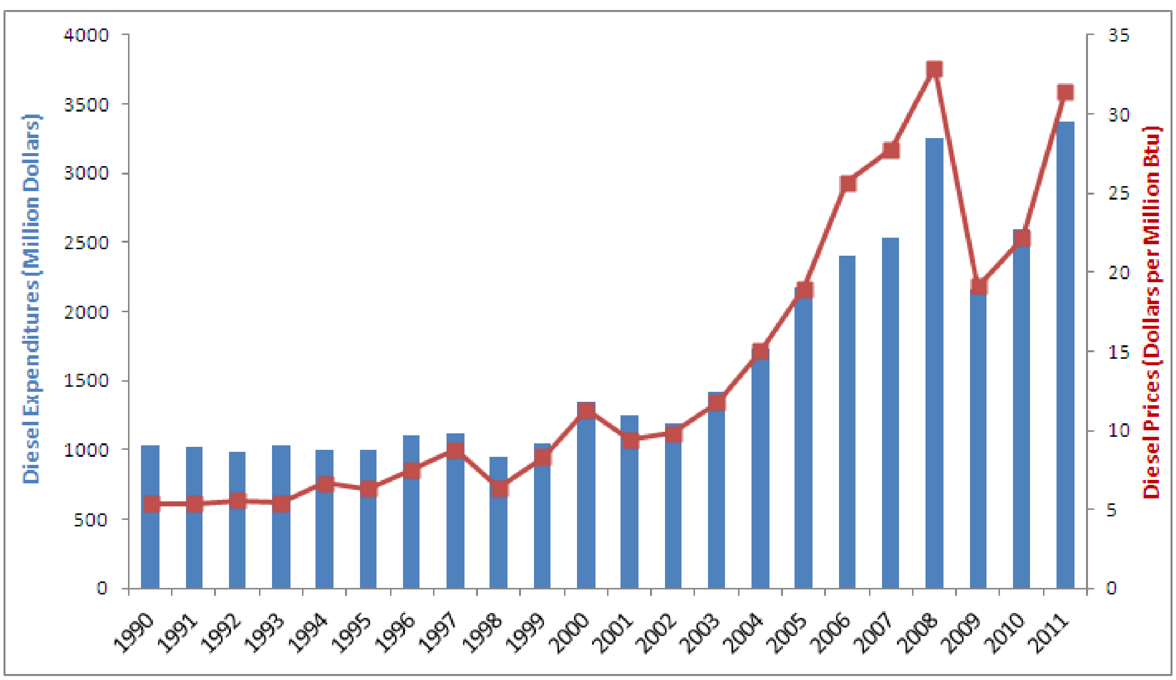
[33] EIA State Energy Data System

Figure 14. Gasoline Prices and Expenditures, 1990 - 2011



Source: EIA SEDS. Current Dollars. Expenditures represent estimates of money spent directly by consumers to purchase energy, generally including taxes.

Figure 15. Diesel Prices and Expenditures, 1990 - 2011



Source: EIA SEDS. Current Dollars. Expenditures represent estimates of money spent directly by consumers to purchase energy, generally including taxes.

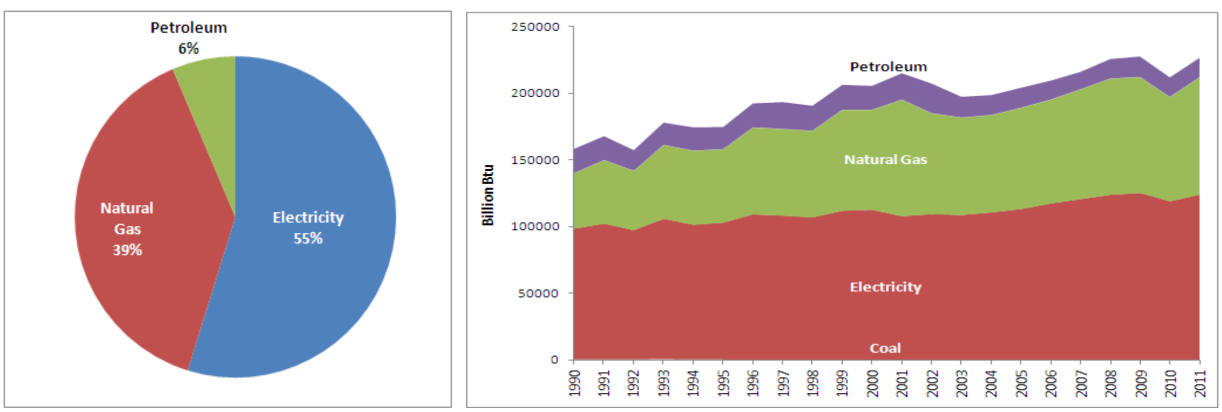
5 Residential Commercial Industrial (RCI) Sector

Washington's GHG Inventory categorizes the residential, commercial, and industrial sectors into one energy consuming group referred to as the RCI sector. This sector consumes fuel and electricity primarily for heating and cooling buildings and for industrial activities. This analysis explores each sector individually as each has unique trends relating to energy consumption and expenditures. The analysis focuses on fossil fuel consumption as this is the source of GHG emissions in the RCI sector. The main fossil fuels consumed in the sector are petroleum and natural gas. A small amount of coal is consumed in the industrial sector. Electricity consumption is also included because it makes up a significant share of energy consumption in each sector; however, emissions associated with electricity consumption are accounted for in the electricity sector which is treated as a separate energy consuming sector. See Section 6 for a more detailed analysis of the electricity sector.

5.1.1 Residential

The majority of energy consumption in the residential sector in Washington is from electricity, followed by natural gas. Electricity accounted for 55 percent of residential energy consumption in 2011 while natural gas accounted for 39 percent. A small amount of petroleum is used, about 6 percent, which consists mostly of fuel oil for home heating. A very small amount of coal was consumed in the residential sector until 2004. Energy consumption in the residential sector has been increasing steadily since 1990, with a noticeable decline in consumption in 2002. Consumption increased steadily through 2009 then decreased 6 percent in 2010 followed by a 5 percent increase in 2011. Figure 16 shows the share of fuel consumption in the residential sector in 2011 and consumption by fuel in the sector from 1990 to 2011.

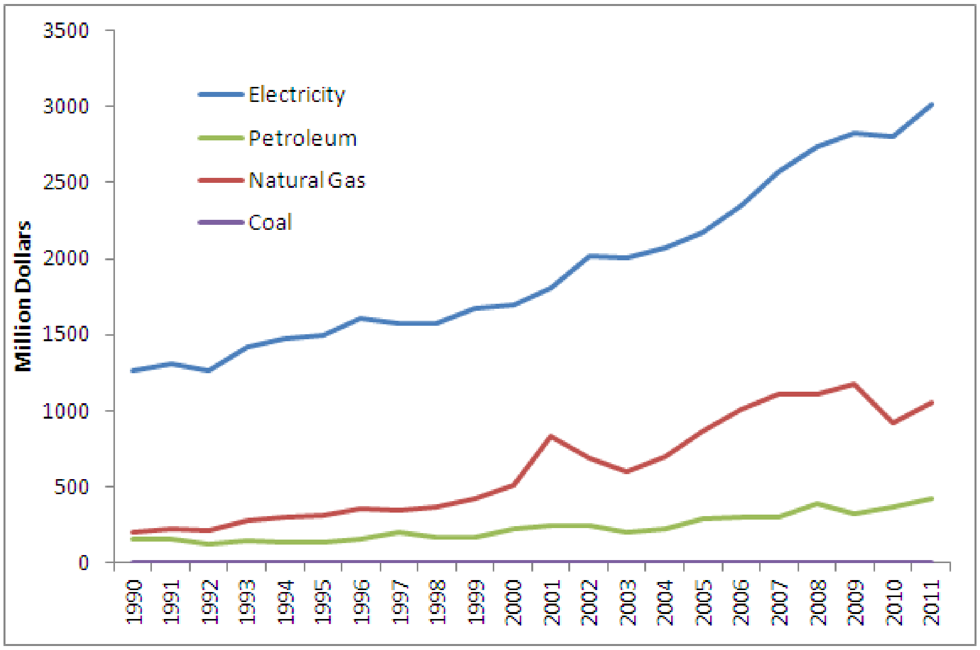
Figure 16. Residential Fuel Share in 2010 and Consumption by Fuel, 1990 – 2011



Source: EIA SEDS.

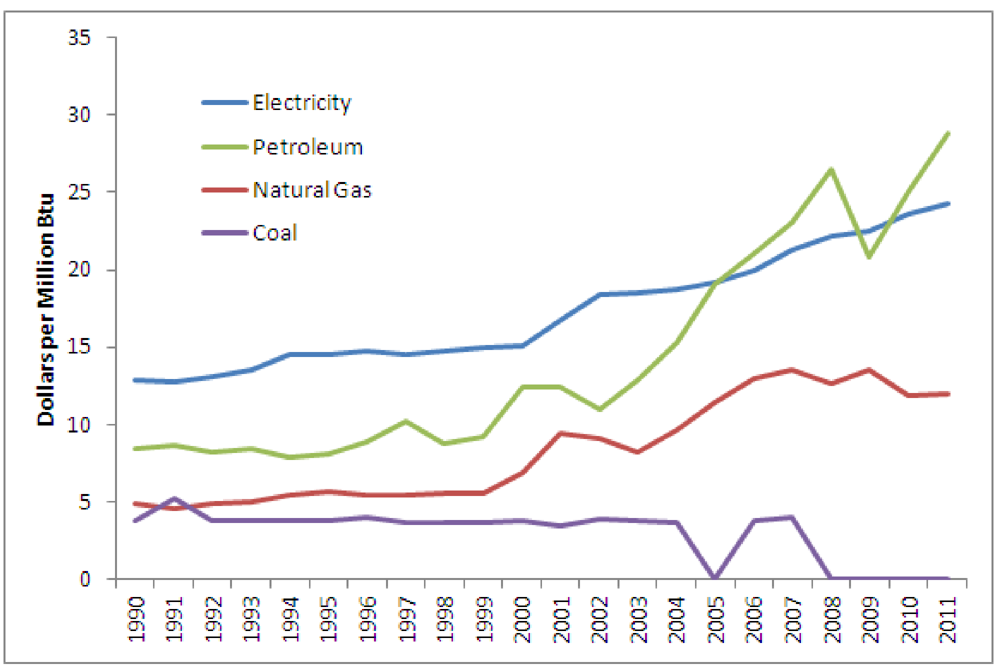
Expenditures for fuels in the residential sector increased steadily from 1990 through 2000 and then sharply from 2000 to 2009. A notable spike in expenditures for natural gas and electricity occurred in the early 2000's. Some year-over-year consumption and expenditure changes result from above or below average temperatures that increase building heating and cooling demands, which affect regional supply and therefore price. Natural gas expenditures decreased significantly in 2010, by 21 percent, then increased 14 percent in 2011. Electricity expenditures increased by 7 percent in 2011. Figure 16 shows expenditures by fuel in the residential sector from 1990 to 2011. Figure 17 shows prices in the residential sector, by fuel, from 1990 to 2011.[34]

Figure 17. Residential Expenditures by Fuel, 1990 - 2011



Source: EIA SEDS. Current Dollars. Expenditures represent estimates of money spent directly by consumers to purchase energy, generally including taxes. Coal represents a very small portion of residential energy expenditures.

Figure 18. Residential Prices by Fuel, 1990 - 2011



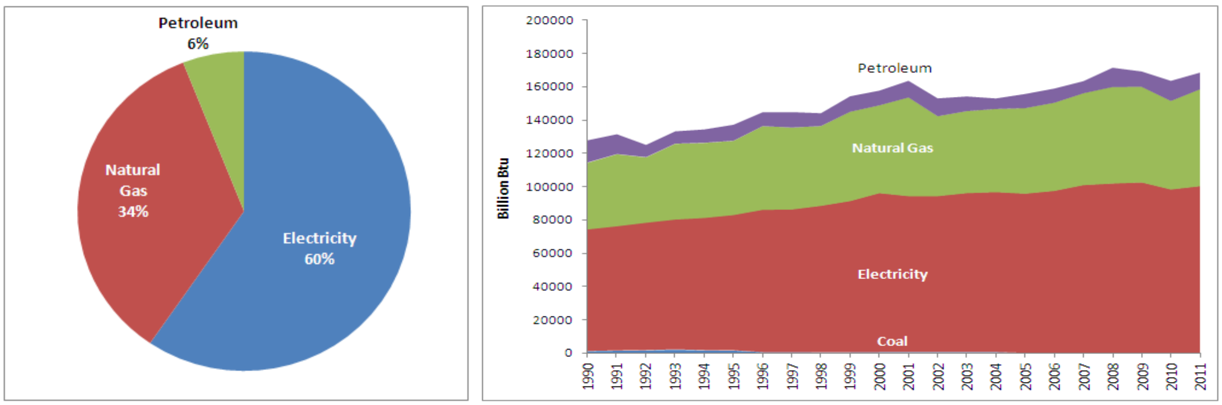
[34] Coal is not shown as it accounts for an insignificant portion of consumption in the residential sector

Source: EIA SEDS. Current dollars.

5.1.2 Commercial

Energy consumption in the commercial sector is primarily for heating and cooling buildings. Energy consumption follows a pattern similar to the residential sector. The principal fuel consumed is electricity, followed by natural gas. However, the commercial sector consumes less total energy than the residential sector. Figure 18 shows the share of fuel consumption in the commercial sector in 2011 and consumption by fuel in the sector from 1990 to 2011.

Figure 19. Commercial Fuel Share in 2010 and Consumption by Fuel, 1990 – 2011

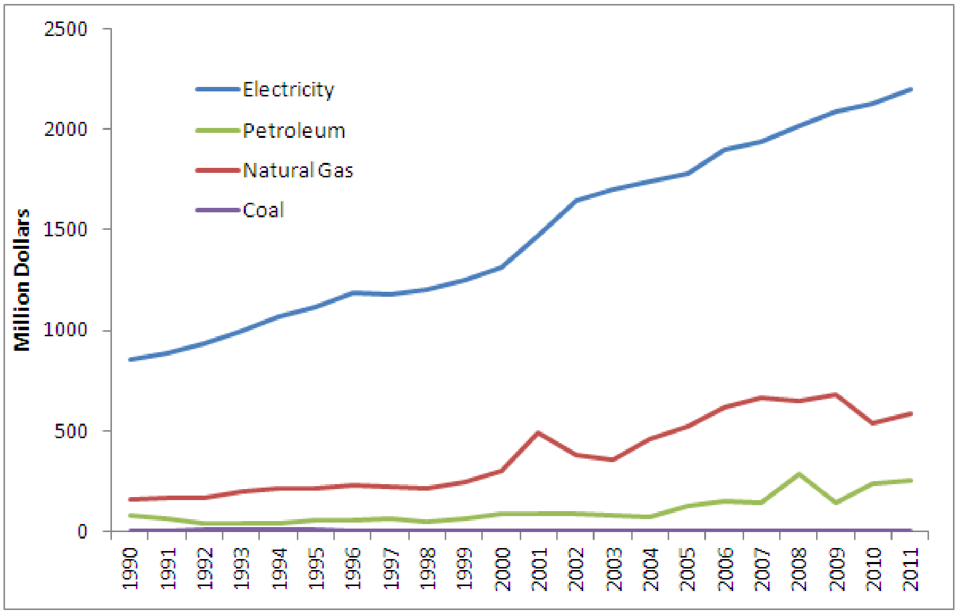


Source: EIA SEDS.

Energy expenditures in the commercial sector show a similar trend as the residential sector. There was a 21 percent decrease in natural gas expenditures in 2010 followed by a 9 percent increase in 2011. Expenditures on electricity in the commercial sector increased almost 4 percent in 2011. Figure 20 shows expenditures by fuel in the commercial sector from 1990 to 2011. Figure 21 shows prices in the commercial sector, by fuel, from 1990 to 2011.[35]

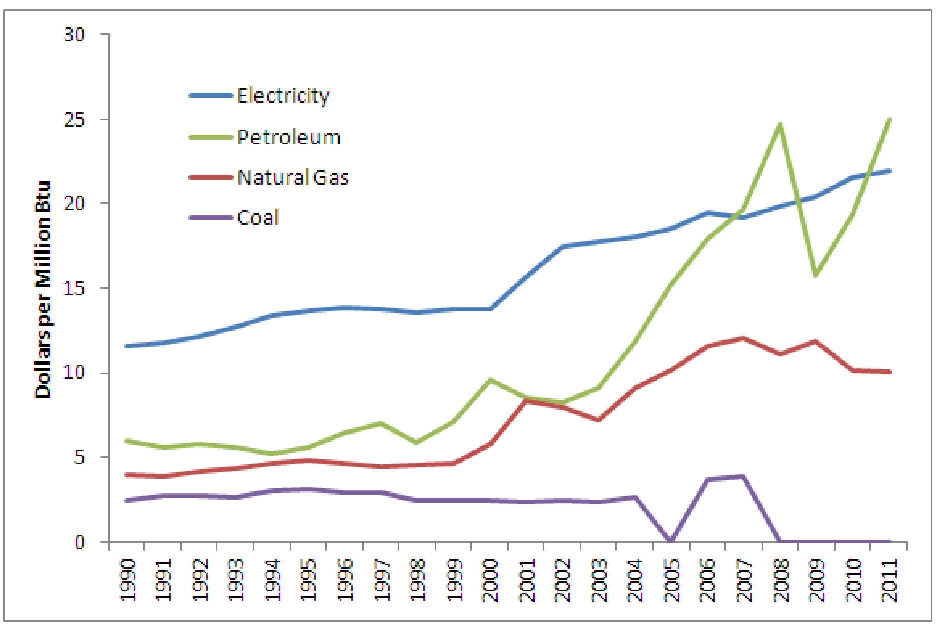
[35] Coal is not shown as it accounts for an insignificant portion of consumption in the commercial sector.

Figure 20. Commercial Expenditures by Fuel, 1990 - 2011



Source: EIA SEDS. Current Dollars. Expenditures represent estimates of money spent directly by consumers to purchase energy, generally including taxes. Coal represents a very small portion of residential energy expenditures.

Figure 21. Commercial Prices by Fuel

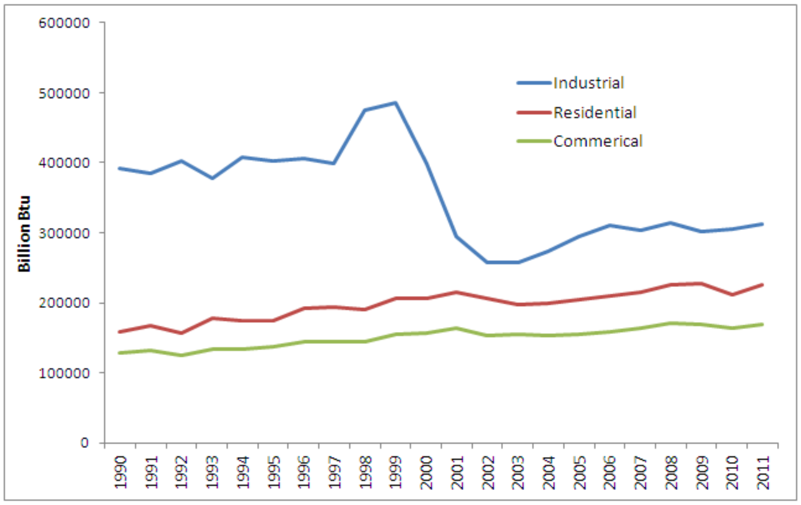


Source: EIA SEDS. Current dollars.

5.1.3 Industrial

A large portion of energy consumption in the industrial sector in Washington is from refining. Although Washington does not produce any crude oil, it is a major refining center in the Northwest. Washington is home to five refineries and ranked sixth in the Nation in crude oil refining capacity in 2011.[36] The industrial sector consumes a larger amount of energy than either the residential or commercial sectors. This sector also has a much different fuel mix and consumption trend. Figure 20 shows the energy consumption for the industrial, residential, and commercial sectors from 1990 to 2011.

Figure 22. Energy Consumption in the Industrial, Residential, and Commercial Sectors 1990 - 2011

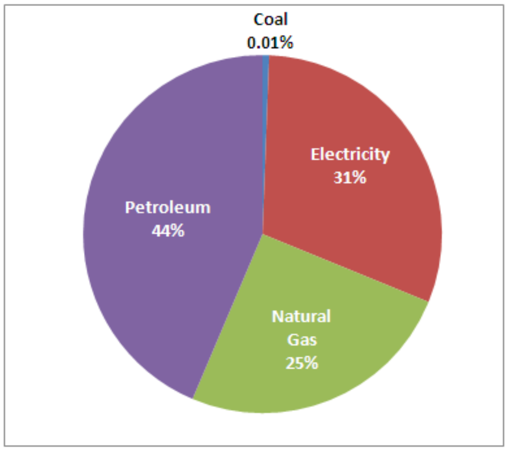


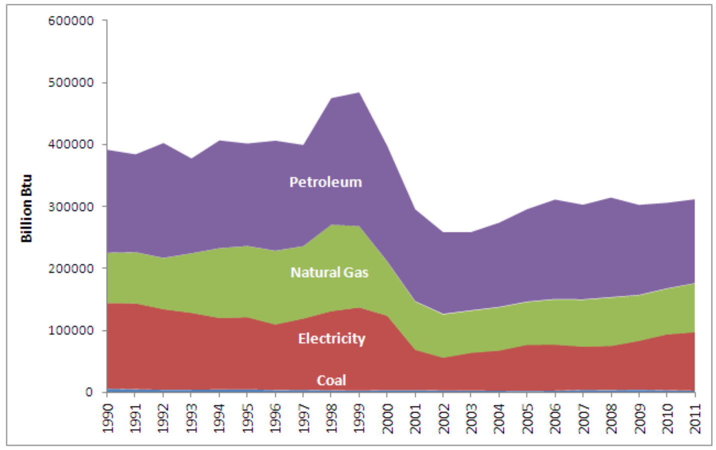
Source: EIA SEDS.

Petroleum had the largest share of consumption in the industrial sector in 2011 at 44 percent, followed by electricity at 31 percent and natural gas at 25 percent. The industrial sector also consumes a small amount of coal representing less than 1 percent of total consumption in the sector in 2011. Energy consumption in the industrial sector was relatively flat from 1990 to 1997. Consumption rose sharply from 1997 to 1999, and then decreased dramatically until 2004. As discussed previously, this large decrease was due to the closure of several energy intensive aluminum plants in the state during this time period. Consumption increased moderately through 2006 followed by an average decrease of 0.4 percent through 2010 and an increase of 1.8 percent in 2011. Figure 23 shows the share of fuel consumption in the industrial sector in 2011 and consumption by fuel in the sector from 1990 to 2011.

[36] EIA State Energy Profiles. http://www.eia.gov/state/?sid=WA#tabs-5

Figure 23. Industrial Fuel Share in 2010 and Consumption by Fuel, 1990 - 2011

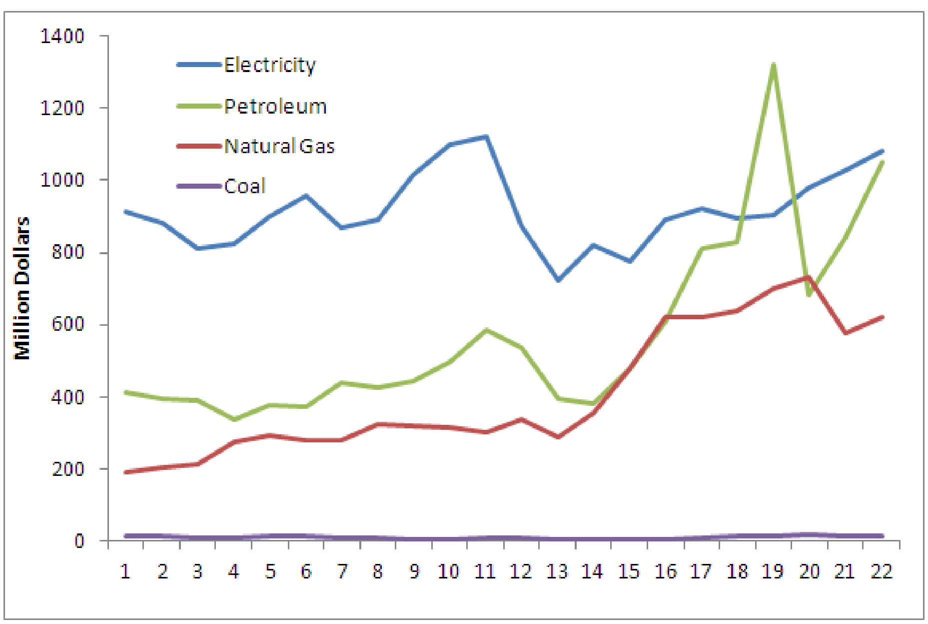




Source: EIA SEDS.

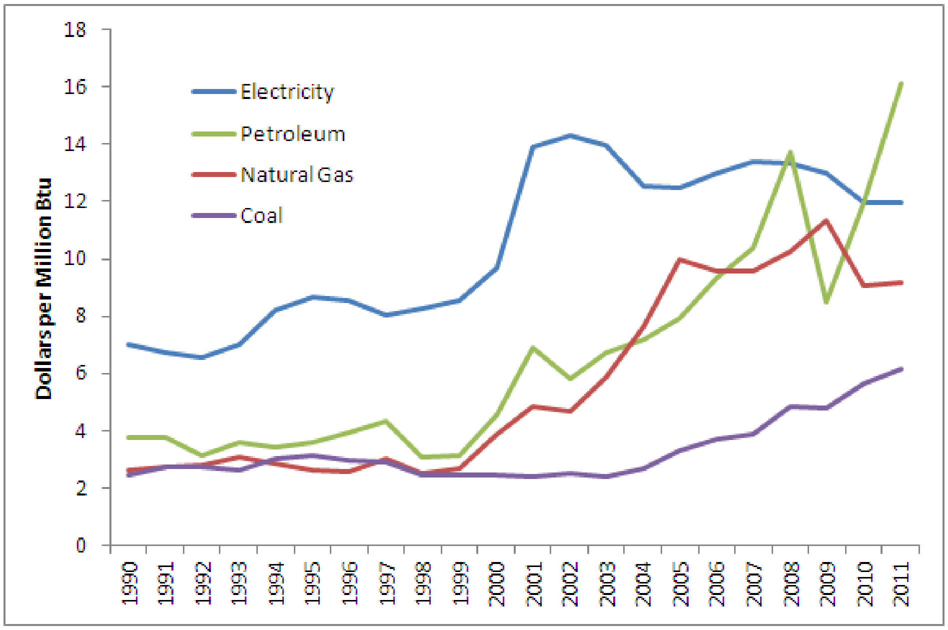
Energy expenditures in the industrial sector have been highly variable since 1990. Expenditures increased moderately from 1990 to 1997 then sharply through 2000. Decreases in expenditures from 2000 to 2003 mimic the large reductions in consumption during that time. Expenditures increase significantly from 2003 to 2008, particularly for natural gas and petroleum. Petroleum spiked to a high in 2008 when it accounted for 43 percent of total expenditures in the sector. Both petroleum and electricity expenditures for the industrial sector increased in 2010 and 2011, petroleum by an average of 24 percent and electricity by an average of 5 percent. Natural gas expenditures decreased 21 percent in 2010 followed by an increase of 7 percent in 2011. Figure 24 shows expenditures by fuel in the industrial sector from 1990 to 2011. Figure 25 shows prices in the industrial sector, by fuel, from 1990 to 2011.

Figure 24. Industrial Expenditures by Fuel, 1990 - 2011



Source: EIA SEDS. Current Dollars. Expenditures represent estimates of money spent directly by consumers to purchase energy, generally including taxes

Figure 25. Industrial Prices by Fuel, 1990 - 2011



Source: EIA SEDS. Current dollars.

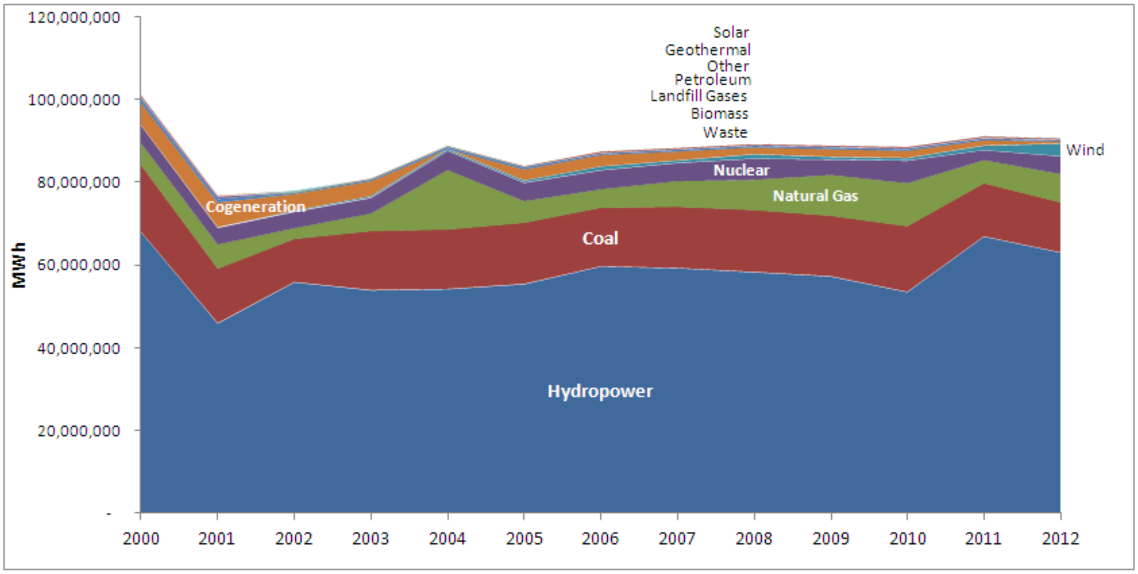
6 Electricity Sector

6.1.1 Consumption

According to the Washington State GHG Inventory for 2010 the electricity sector accounts for the second largest amount of emissions after the transportation sector with 22 percent of total emissions. Although the vast majority of electricity generated within the state is from hydropower, Washington imports a significant amount of electricity from other states to meet demand. Some of this electricity is generated with fossil fuel and therefore there are GHG emissions associated with its use. The GHG emissions for the electricity sector were calculated using a load based, or net consumption, method. A load-based method includes emissions from all electric power generation used to meet demand for electricity in Washington, regardless of where the generating plant is located or what fuel was used to produce the electricity. Beginning in 2000 Washington has tracked sales of electricity by generating resource for each electric utility in the state under legislative action known as the Fuel Mix Disclosure (FMD). The FMD provides a statewide picture of all the energy sources used to generate electricity consumed in the state. This analysis of energy consumption for the electricity sector relies heavily on the FMD because this data is reported directly from utilities and represents a complete account of fuel consumption in the sector. Some of the analysis in this section uses a time period of 2000 – 2012 because that is the time period for which FMD data were available.

Energy consumption in the electric power sector dropped sharply after 2000 following a statewide trend of reduced energy consumption resulting from a reduction in industrial activity during that time. Consumption in the sector has grown at an average annual rate of 1.7 percent since 2001. Figure 26 shows total consumption in the electricity sector by fuel from 2000 to 2012.[37] Figure 27 shows the share of fuels in the electricity sector in 2012.[38]

Figure 26. Electricity Sector Consumption by Fuel 2000 – 2012

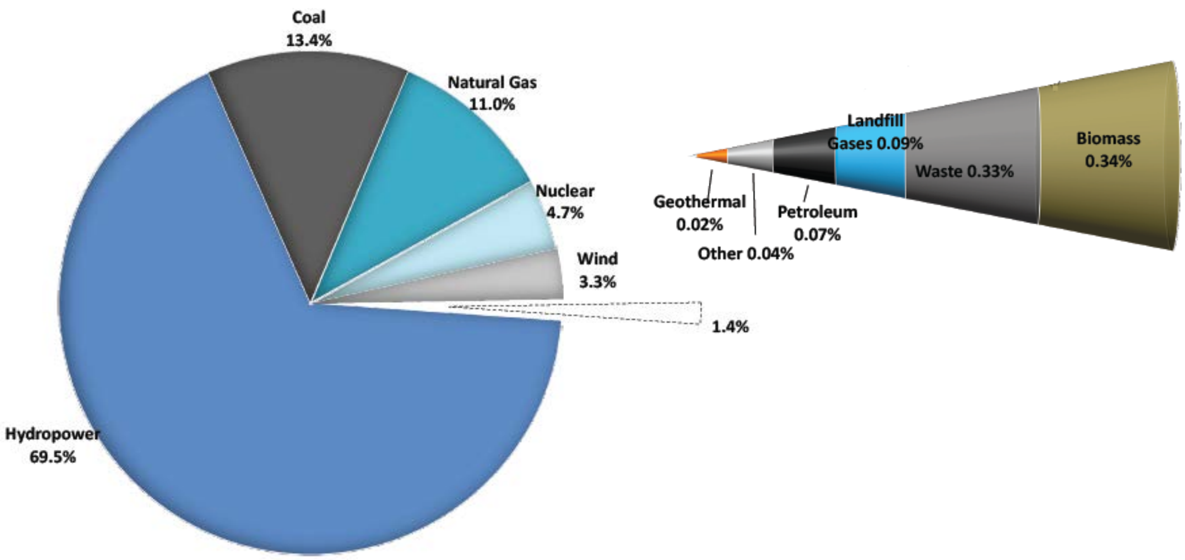


Source: Washington State Department of Commerce. Fuel Mix Disclosure. http://www.commerce.wa.gov/Programs/Energy/Office/Utilities/Pages/FuelMix.aspx. Other includes: blast furnace gas, other biomass gas such as digester gas and methane, and purchased steam.

[37] Washington State Department of Commerce. Fuel Mix Disclosure. http://www.commerce.wa.gov/Programs/Energy/Office/Utilities/Pages/FuelMix.aspx

[38] Ibid.

Figure 27. Share of Fuels in the Electricity Sector 2012

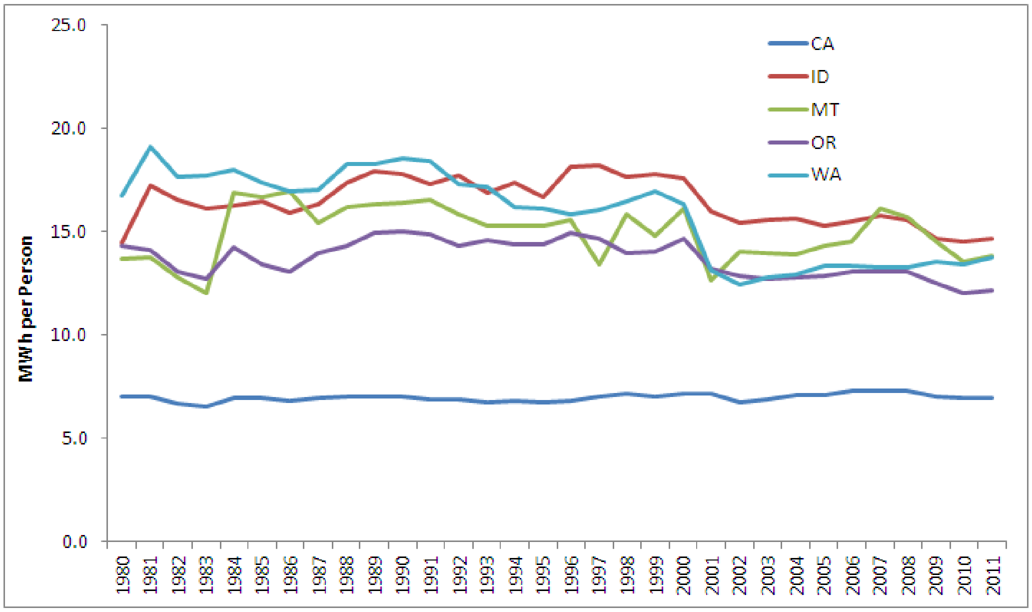


Source: Washington State Fuel Mix Disclosure 2012.

Washington consumed 13.7 MWh of electricity per capita in 2011, slightly less than Idaho and Montana (14.7 and 13.8 MWh per capita, respectively) and slightly more than Oregon (12.2 MWh per capita). California's per capita electricity consumption was 7.0 MWh in 2011, which is among the lowest in the nation due primarily to a mild climate and strong energy efficiency programs.[39] The impact of energy efficiency measures on the electricity sector in Washington and other states can be seen Figure 28, which shows per capita electricity consumption by state from 1980 to 2011. Washington's per capita electricity consumption decreased significantly from the early 1990's to the early 2000's, largely due to the decline in industrial activity during that period. Per capita consumption has been increasing at an average annual rate of 1 percent since 2003, but remains about 25 percent lower than 1990 levels. All states showed an increase in per capita electricity consumption in 2011.

[39] Energy Information Administration. California State Energy Profile. http://www.eia.gov/state/?sid=CA

Figure 28. Per Capita Electricity Consumption 1980 to 2011



Source: EIA SEDS. Total electricity consumption (million kWh) divided by resident population (including armed forces)

Washington is the Nation's largest producer of hydroelectric power and in 2011 accounted for 29 percent of the Nation's net hydroelectricity generation.[40] The Grand Coulee Dam on the Columbia River is the largest hydroelectric power producer in the United States, with a total generating capacity of 6,809 megawatts.[41] The volume of output from hydroelectricity is seasonal and depends heavily on the volume of water stored in snowpack during the winter that melts into rivers in the spring and summer. When hydroelectric output is high much of the excess power is exported out of state. However, when the capability of hydroelectric power is reduced the energy is largely replaced with generation from fossil fuels.[42] Hydropower production in the Pacific Northwest is depends largely on natural water storage in snow pack and glaciers. The amount of water available that is available for hydropower production is sensitive to changes in climate, for example, when water storage is reduced due to changes in precipitation or warmer temperatures, hydropower production is reduced.

The principal fossil fuels used for generation of electricity that is ultimately consumed in Washington, and the main source of GHG emissions in the sector, are coal and natural gas. Coal has accounted for 60 percent of fossil fuel consumption for electricity generation, on average, across the time period and accounted for 62 percent in 2012. Natural gas represents an average of 39 percent of fossil fuel consumption for electricity generation and accounted for 38 percent in 2010. Petroleum accounts for a very small portion of consumption and has remained well

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[40] Energy Information Administration. Washington State Energy Profile. http://www.eia.gov/state/print.cfm?sid=WA

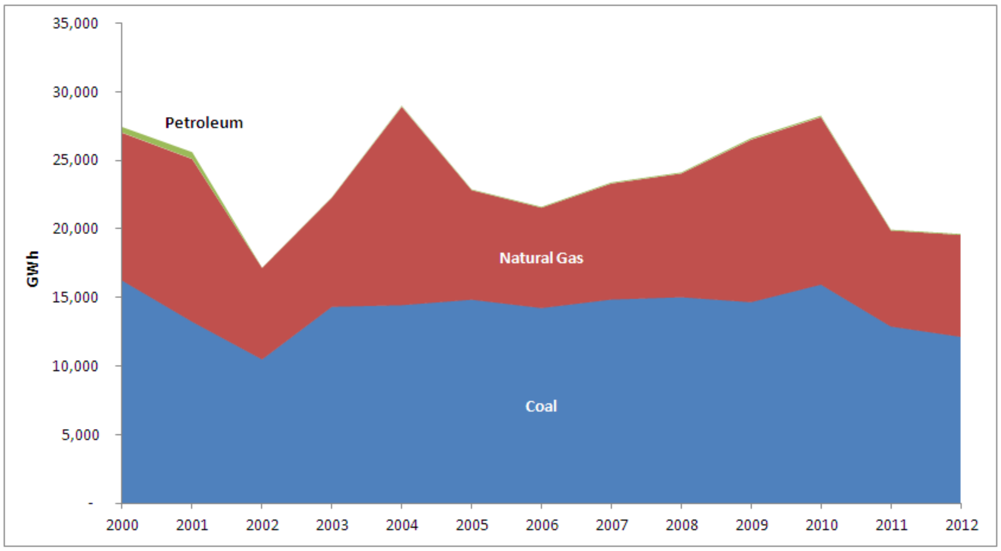
[41] U.S. Department of the Interior. Bureau of Reclamation. Pacific Northwest Region. Grand Coulee Dam. http://www.usbr.gov/pn/grandcoulee/

[42] Some demand is replaced with nuclear power.

below 1 percent of total fossil fuel consumption for electricity generation over the time period, except for 2000 and 2001 when it represented just below 2 percent of consumption.

Fossil fuel consumption for electricity generation increased in 2010 due to drought conditions that reduced hydropower output. Since then, fossil fuel consumption has declined significantly in response to increasing hydropower consumption as well as increased consumption of nuclear power and wind power. Figure 29 shows fossil fuel consumption in the Electricity Sector from 2000 to 2012.[43]

Figure 29. Electricity Sector Fossil Fuel Consumption

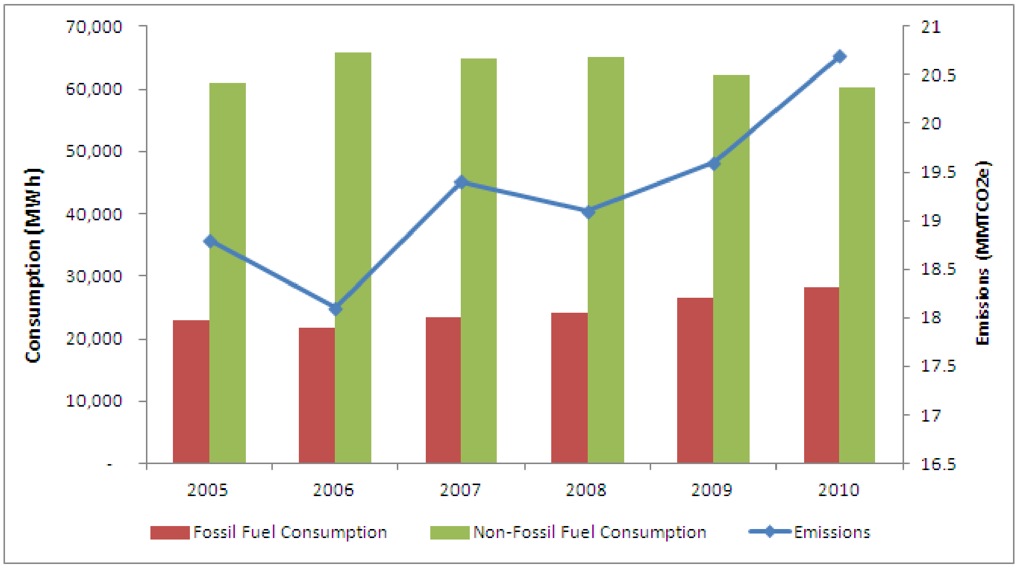


Source: Washington State Fuel Mix Disclosure 2012.

Emissions in the electric power sector result from the consumption of fossil fuels used to generate electricity. Figure 30 shows the total electricity consumption produced by fossil fuels and non-fossil fuels compared to emissions from 2005 to 2010.

[43] Washington State Department of Commerce. Fuel Mix Disclosure. http://www.commerce.wa.gov/Programs/Energy/Office/Utilities/Pages/FuelMix.aspx

Figure 30. Electricity Sector Consumption of Fossil and Non-Fossil Fuels and Emissions



Sources: WA Fuel Mix Disclosure and WA GHG Inventory 1990 -2010

Although 2010 is the latest year that GHG inventory data is available for Washington, the state will almost certainly see reduced emissions in the electricity sector in 2011 and 2012 due to reduced fossil fuel consumption. The reduction in fossil consumption is primarily the result of increased hydropower production and rapidly increasing production of wind power, most of which is produced in the state. Washington was an early leader in the wind industry and ranked seventh in the nation for installed capacity in early 2013.[44] Washington's first utility-scale wind project went online in 2001, and wind power development has continued to grow, particularly in the Columbia Gorge region. Washington consumed over 3 million MWh of electricity from wind power sources in 2012, accounting for 3.3 percent of total electricity consumption.[45]

6.1.2 Expenditures

Expenditures in the electricity sector are driven by fossil fuels prices, particularly coal and natural gas prices. Regional natural gas prices in the electricity sector spiked in 2001 because shortages in hydroelectricity resulted in high demand for natural gas.[46] Prices decreased sharply in 2002 followed by significant increases through 2008. Prices for natural gas fell sharply in 2009 during the economic recession, but began to increase again in 2010. Natural gas prices remain low partly due to the growth of production from nonconventional sources. Average price trends for coal are similar to natural gas, but the price swings have been less dramatic. Figure 31 shows prices and expenditures for natural gas from 1990 to 2011 and Figure 32 shows prices and expenditures for coal from 1990 to 2011.[47]

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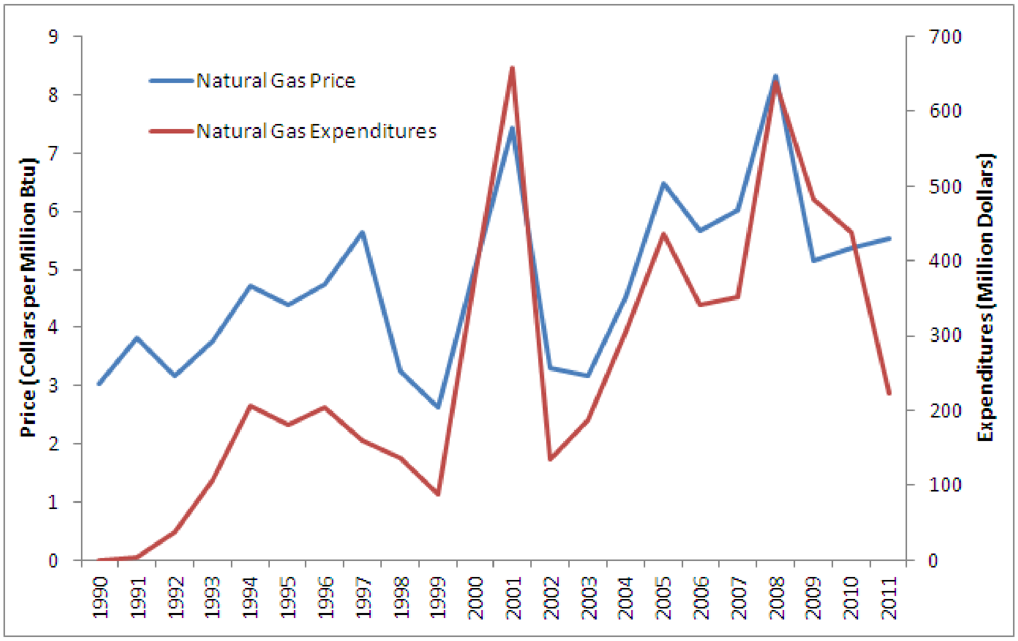
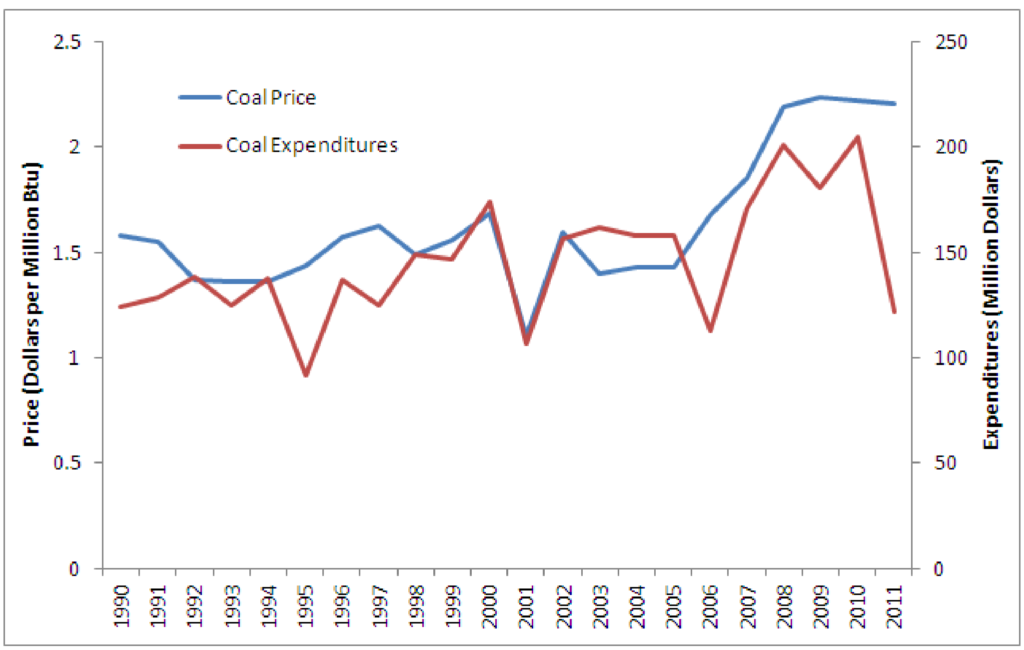
[44] American Wind Energy Association. U.S. Wind Industry First Quarter2013 Market Report. http://awea.rd.net/Resources/Content.aspx?ItemNumber=5400
[45] Washington State Fuel Mix Disclosure 2012.
[46] 2013 Biennial Energy Report. http://www.commerce.wa.gov/Documents/2013-biennial-energy-report.pdf
[47] Energy Information Administration. State Energy Data System. http://www.eia.gov/state/seds/

Figure 31. Electricity Sector Prices and Expenditures for Natural Gas



Source: EIA SEDS. Current dollars. Expenditures represent estimates of money spent directly by consumers to purchase energy, generally including taxes

Figure 32. Electricity Sector Prices and Expenditures for Coal



Source: EIA SEDS. Current dollars. Expenditures represent estimates of money spent directly by consumers to purchase energy, generally including taxes

Evaluation of Approaches to Reduce Greenhouse Gas Emissions in Washington State

Task 1.b – Evaluate existing State greenhouse gas emissions reduction policies

Task 1.d - Evaluate significant greenhouse gas emissions reduction initiatives undertaken by local governments in the State of Washington

August 23, 2013

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Summary of Local Government Initiatives

Executive Summary

As part of its Evaluation of Approaches to Reduce Greenhouse Gas Emissions in Washington State, the Climate Legislative and Executive Workgroup (CLEW), through the Office of Financial Management (OFM), has tasked Science Applications International Corporation (SAIC) with analyzing Washington State Emissions and Related Energy Consumption (Task 1), in several parts. This document presents the results of Task 1b – Evaluate the State existing greenhouse gas emissions reduction policies that will contribute to meeting the greenhouse emissions targets, and Task 1d – Evaluate significant greenhouse gas emissions reduction initiatives undertaken by local governments in the State of Washington. A separate Task 1 document presents the results of other Task 1 items.

The following policies are included in the Task 1b analysis, the results of which are summarized in Table 1:

- Renewable Fuel Standard
- Washington State Energy Code
- GHG Emissions Performance Standards
- Appliance Standards
- Energy Independence Act (I-937)
- Energy Efficiency and Energy Consumption Programs for Public Buildings
- Conversion of Public Fleet to Clean Fuels
- Purchasing of Clean Cars
- Growth Management Act

The Task 1d evaluation included a data call to Washington cities and counties. The results demonstrates that local government initiatives are underway throughout the state, driven by a range of factors such as jurisdictional level climate change goals, fuel cost savings, compliance with State or Federal policy, and funding opportunity requirements.

Table 1. Estimated GHG emissions reductions for existing policies in target years.

	GHG Emission Reductions in Target Years (MMTCO2e)		
Existing Policy	**2020**	**2035**	**2050**
Renewable Fuel Standard[1]	0.3	0.4	0.5
Washington State Energy Code	1.2	4.5	4.1
GHG Emissions Performance Standards[2]	0	2.9	N/A
Appliance Standards[3]	0.7	0.9	N/A
Energy Independence Act (I-937)[4]	11.2	N/A	N/A
Energy Efficiency and Energy Consumption Programs for Public Buildings	0.03	0.04	0.04
Conversion of Public Fleet to Clean Fuels	0.03	0.04	0.05
Purchasing of Clean Cars[5]	5.0	10.0	11.7
Growth Management Act	1.6	2.4	2.6

Notes: Not all numbers presented in table are significant figures.

Reductions of these policies are not additive because of interactions.

Achievement of these reductions presented above is highly dependent on implementation, as discussed further for each policy.

N/A = not estimated.

[1] These emissions reductions are associated with an RFS of 5%. This calculation is for biodiesel only. Federal RFS supersedes ethanol requirement, and this will be calculated separately.
[2] There is a high uncertainty regarding the expected emission rate under the policy in 2050. All current resources expected to be impacted by the policy will have reached the end of their designed lifetime before 2050.
[3] The current analysis only includes reductions from potential new standards in WA as a demonstration of possible reductions. Data regarding existing standards was not available. The analysis used to calculate emissions included reductions for 2025, but not 2020, therefore the 2025 emission reductions are shown.
[4] There is a high level of uncertainty regarding the expected fuel mix for electricity generation in 2035 and 2050. Assumptions are based on the Northwest Power and Conservation Council that projected emissions to 2030.
[5] Note that these reductions only represent reductions from the Paveley Standards. An estimate of emission reductions in Washington from recently updated standards (LEV-III) is included in Section 8 of this report.

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Introduction – Evaluation of Existing State Policies

The purpose of the analysis is to estimate approximate GHG emission reductions from each policy for each target year (2020, 2035, and 2050). The results will be used to determine the approximate amount of GHG reductions from existing policies and identify the amount of additional reductions required to meet emissions targets. An analysis of potential future policies and policy types that could be implemented in Washington to help meet the targets will be included in Task 2 of this project.

Simplified methodologies and assumptions were developed and applied, based on available data and resources, to calculate an estimate of emission reductions for each policy in the target years. It is important to note that any projection of future emission reductions is subject to considerable uncertainty. This uncertainty increases the further out in the target years the projection is calculated. Factors that drive uncertainty can include unexpected changes in energy markets, economic growth, technology developments, state and Federal policies, and even temperatures. To mitigate uncertainty as much as possible, published data sources and State forecasts were used where available. However, the reductions provided should be viewed as "best estimates" as the scope of this analysis did not allow for a detailed quantitative assessment of uncertainty.

As a first step in estimating reductions, existing policy documentation and implementation history were reviewed to develop an understanding of each policy's evolution, requirements, and available data sets. This information was used to identify the specific energy and fuel resources impacted directly and indirectly by each policy. Next, simplified quantification methodologies were developed and executed for each policy independent of all other policies. The methodological approach used to calculate GHG reductions was tailored specifically for each individual policy based on policy requirements, the sectors and resources impacted, and data availability. Sections 1 through 9 of this document contain the evaluation of each policy and include a summary of the existing policy, a description of the methodology used to quantify emission reductions, a list of the assumptions and data sources used, and a presentation of the results.[6] Section 10 contains a qualitative discussion of the potential interactions between the policies, including both synergistic and competing interactions.

[6] Note regarding baseline emissions: A presentation of the reductions from existing policies as compared to a business-as-usual (BAU) reference case projection of emissions is forthcoming. A reference case GHG emission inventory and projection was developed by the Department of Ecology in 2007 to determine the baseline from which emission reduction targets would be measured (1990 emission levels). This report estimated historical and projected emission in Washington from 1990 to 2020. However, there have been two additional GHG inventories prepared since this report, the 1990 to 2008 and 1990 to 2010 GHG inventories. Each of these documents has calculated a different emission value for 1990. It was not clear which 1990 baseline emission value is most appropriate for the purposes of this project. Therefore, further discussion with the state is required before an analysis of reductions compared to baseline emissions can be conducted.

1 Renewable Fuels Standard

1.1 Policy Summary

The Washington Legislature passed a renewable fuel standard (RFS) in 2006. The standard requires that, starting in 2008, at least 2 percent of total gasoline sold in the state must be denatured ethanol and at least 2 percent of total diesel fuel sold in the state must be biodiesel or renewable diesel.[7]

The ethanol requirement has effectively been superseded by the introduction of ethanol content requirements under the Federal renewable fuel standard. The Federal standards have led to a current average ethanol content of just over 9 percent in Washington, 7 percent over the state's 2 percent requirement. Washington consumed over 2.5 billion gallons of motor gasoline in 2011.[8] With a 9 percent average ethanol content, annual motor gasoline reductions resulting from the ethanol component of RFS2 can be approximated at about 230 million gallons. Further analysis of the Federal RFS is included in the Federal Policy Analysis conducted in Task 3 of this project.

The biodiesel portion of the requirement has proven difficult to implement and enforce. The standard requires that the minimum fraction of total annual sales of diesel fuel consist of biodiesel or renewable diesel. This volumetric requirement necessitates tracking of all blendstocks entering into the fuel supply throughout the year which has resulted in an administrative challenge. In addition, there is no requirement for any individual company to comply which has resulted in the standard being difficult to enforce.[9] As of 2012 the requirement has not been met and biodiesel levels were less than 1 percent of total sales.[10]

The RFS legislation as written is designed to increase the biodiesel requirement to 5 percent of total annual diesel fuel sales when the state determines that both in-state oil seed crushing capacity and feedstock grown in Washington State can satisfy a 3 percent requirement.[11] Diesel that contains 5 percent biodiesel, known as B5, is already sold in certain markets in Washington and petroleum fuel distributors are continuing to add biodiesel storage and blending infrastructure to support biodiesel requirements in Oregon and British Columbia, which are largely dependent on Washington refineries and distributors for their fuel supply.[12] Prices for B5

[7] Note that this standard was designed to increase to 5% 180 days after the Washington State Department of Agriculture (WSDA) determines that in-state feedstocks and oil-seed crushing capacity can meet a 3% requirement.
[8] Data provided by Department of Commerce in comment on draft version.
[9] Washington State Department of Commerce. 2012 Washington State Energy Strategy.
[10] Email correspondence with Mary Beth Lang, Bioenergy and Special Projects Coordinator., Washington State Department of Agriculture. July 29, 2013.
[11] RCW 19.112.110. http://apps.leg.wa.gov/RCW/default.aspx?cite=19.112.110
[12] Washington State Department of Commerce. 2012 State Energy Strategy. http://www.commerce.wa.gov/Documents/2012WAStateEnergyStrategy.pdf

have become cost competitive and in some cases have been less expensive than regular diesel. In April 2013, B5 was $0.62 per gallon less than the average diesel price.[13]

Efforts have been made to modify the existing biodiesel standard from a 2 percent volumetric requirement to a 5 percent universal requirement, similar to the RFS implemented in Oregon. A universal standard requires all diesel fuel sold at the pump to contain the minimum fraction of biodiesel. This can be verified by random testing which would alleviate the administrative burden of a volumetric requirement and simplify enforcement. However, recent attempts to implement this change during the 2012 legislative session were unsuccessful.[14]

1.2 Methodology

The following analysis of potential GHG reductions resulting from the RFS is focused on the biodiesel segment. The Federal RFS standard, which has effectively superseded the ethanol requirement, is discussed in the Federal Policy Analysis. Although there are a multitude of variables that impact the amount of potential diesel consumption, especially in the transportation sector, such as changes in transportation patterns and overall vehicle miles travelled (VMT), the increased consumption of biodiesel as a replacement for a portion of petroleum diesel is expected to achieve a modest reduction in GHG emissions in the target years.

GHG emissions reductions were estimated using projections of diesel consumption and projections of biodiesel consumption in the transportation sector in Washington. Most diesel fuel is consumed in the transportation sector which accounted for almost 80 percent of diesel consumption in the state in 2010. Projections of diesel consumption to 2040 were provided by the Office of Financial Management Transportation Revenue Forecast Council. These projections were extrapolated to 2050 using the average growth rate for the last five years of the forecast period. Consumption of biodiesel was projected to 2020, 2035, and 2050 using the assumption that the RFS requirement of 2 percent biodiesel will be met, but not exceeded, in the target years. A parallel projection of the GHG emissions reductions if a biodiesel requirement of 5 percent is met, but not exceeded, in the target years is also provided. GHG emissions reductions were calculated by multiplying the gallons of diesel avoided by the carbon intensity for diesel fuel and adjusting for the carbon intensity of biodiesel. The energy density of biodiesel is lower than that of diesel and therefore more biodiesel is needed to meet the original demand, also referred to as the energy economy ratio (EER). However, this difference is

[13] Washington State Department of Transportation. The Fuel and Vehicle Trends Report. April 30, 2013. http://www.wsdot.wa.gov/NR/rdonlyres/5EDEBF3D-4617-4A51-ADB7-61842F1ABC02/0/FuelandVehicleTrendsApr2013.pdf
[14] House Bill 2740. http://apps.leg.wa.gov/billinfo/summary.aspx?bill=2740&year=2011

negligible at low-level biodiesel blends up to B5.[15] For the purposes of this analysis B5 is assumed to have an EER of 1.0 compared to diesel.

The principal feedstocks used to produce biodiesel consumed in Washington are Midwest soybeans, Northwest canola oil, and waste grease.[16] A small percentage of biodiesel produced from corn oil is also expected to enter the market in the future.[17] Carbon intensities for regular diesel and biodiesel were adapted from the report *A Low Carbon Fuel Standard in Washington: Informing the Decision* prepared by TIAX LLC in February 2011.[18] The carbon intensity for corn oil was taken from the California Low Carbon Fuel Standard (LCFS)[19] as the TIAX report did not provide a carbon intensity for this pathway.[20] Table 1 below shows the carbon intensities used for fuels in this analysis.

Table 2. Carbon Intensity Values for Diesel and Biodiesel Fuels

Fuel	Carbon Intensity (gCO2e/MJ)
Baseline Diesel	92
Biodiesel, MW Soybeans	68
Biodiesel, NW Canola	26
Biodiesel, Waste Grease	20
Biodiesel, Corn Oil	4

Source: TIAX LLC. A Low Carbon Fuel Standard in Washington: Informing the Decision. Adapted from Table 5-6. Corn oil carbon intensity from California LCFS.

There may be GHG emissions associated with land use when new land is brought into cultivation to replace crops used in biofuel production. These emissions are referred to as indirect land use change (ILUC) and can occur with increased biofuel production. The carbon intensities used in this analysis include ILUC where applicable.[21]

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[15] The Alternative Fuels Data Center (AFDC) reports that biodiesel contains about 8% less energy per gallon than petroleum diesel. For B20, this may result in a 1% to 2% difference, but AFDC reports that most B20 users report no noticeable difference in performance or fuel economy. Source: Alternative Fuels Data Center, http://www.afdc.energy.gov/fuels/biodiesel_blends.html

[16] Washington State Department of Commerce. 2012 State Energy Strategy. Phone conversation with Department of Commerce, Peter Moulton.

[17] Phone conversation with Peter Moulton, Department of Commerce.

[18] TIAX LLC. A Low Carbon Fuel Standard in Washington: Informing the Decision. Adapted from Table 5-6. http://www.ecy.wa.gov/climatechange/docs/fuelstandards_finalreport_02182011.pdf.

[19] California Air Resources Board (ARB), Low Carbon Fuel Standard. http://www.arb.ca.gov/fuels/lcfs/CleanFinalRegOrder112612.pdf

[20] Note that CARB is planning revise the carbon intensity for corn oil in the near future and it is expected to increase, however, the magnitude of the increase is unclear until the revised intensity is published.

[21] MW soybeans is the only biodiesel pathway that includes ILUC in the TIAX report.

Table 2 shows the assumed share of biodiesel produced from each feedstock in Washington in the target years.[22] The share of each biodiesel feedstock was used to determine the average biodiesel carbon intensity for each target year. It is likely that advanced biofuels, including renewable biodiesel and other advanced conversion pathways, will be available to the Washington market in increasing quantities in the future, particularly in 2035 and 2050. Advanced biofuels will most likely have lower carbon intensities, which would reduce the average carbon intensity of biodiesel and help to increase GHG reductions. However, assumptions regarding the availability and level of adoption of these fuels are highly uncertain. To approximate the decreasing carbon intensity of biodiesel this analysis assumes an increase in the target years of biodiesel produced from canola oil, waste grease, and corn oil, and a reduction in biodiesel produced from MW soybeans. Biodiesel fuels produced from canola, waste grease, and corn oil all have lower carbon intensities than biodiesel produced from MW soybeans as shown in Table 3.

Table 3. Share of Biodiesel Fuel Consumed in Target Years

		Ratio of Biodiesel Fuel in Target Years		
Fuel	**2013**	**2020**	**2035**	**2050**
Biodiesel, MW Soybeans	0.50	0.35	0.20	0.15
Biodiesel, NW Canola	0.25	0.30	0.35	0.40
Biodiesel, Waste Grease	0.25	0.30	0.35	0.35
Biodiesel, Corn Oil	0.00	0.05	0.10	0.10
Average Biodiesel CI (gCO_2e/MJ)		**37.8**	**30.1**	**28.0**

1.3 Assumptions

The GHG emission reductions associated with the RFS for biodiesel were projected for the target years utilizing the following assumptions:

- Legislative action is taken to modify the RFS from the existing volume-based standard to a universal standard that is enforceable and practicable.
- The biodiesel requirements are met, but not exceeded, in the target years. The analysis provides an estimate of reductions at a 2 percent and 5 percent requiement.
- Primary feedstocks for biodiesel consumed in Washington are Midwest soybeans, Northwest canola, and waste grease. Canola and waste grease quantities increase through the target years and small amount of corn oil is included in 2035 and 2050.

[22] Email correspondence with Peter Moulton, Department of Commerce, August 22, 2013.

1.4 Data Sources

The following data sources were used for the analysis:

- Diesel consumption projections 2014-2040: Transportation Revenue Forecast Council. Email correspondence with Office of Financial Management, Transportation Revenue Forecast Council, August 22, 2013.
- Carbon intensities for fuels: TIAX LLC. A Low Carbon Fuel Standard in Washington: Informing the Decision. Adapted from Table 5-6. http://www.ecy.wa.gov/climatechange/docs/fuelstandards_finalreport_02182011.pdf. The carbon intensity for corn oil is from the California LCFS: California Air Resources Board (ARB), Low Carbon Fuel Standard. http://www.arb.ca.gov/fuels/lcfs/CleanFinalRegOrder112612.pdf
- Energy density for diesel: California Air Resources Board (ARB), Low Carbon Fuel Standard. Look up Tables. (http://www.arb.ca.gov/fuels/lcfs/lu_tables_11282012.pdf, and http://www.arb.ca.gov/fuels/lcfs/CleanFinalRegOrder112612.pdf)

1.5 Results

Based on the method outlined above, total projected diesel consumption and biodiesel consumption for 2020, 2035, and 2050 and the estimated GHG emission reductions associated with a 2 percent and 5 percent biodiesel requirement at the target years are shown in Table 4.

Table 4. Emissions reductions associated with the RFS for biodiesel.

Target Year	Gallons diesel avoided	Metric Tons CO2e from Diesel	Metric Tons CO2e from Biodiesel	Net Reduction in CO2e (Metric Tons)
2020	15,083,062	186,596	80,500	**106,096**
2035	18,985,405	234,873	80,687	**154,186**
2050	23,218,048	287,236	91,791	**195,445**

Target Year	Gallons diesel avoided	Metric Tons CO2e from Diesel	Metric Tons CO2e from Biodiesel	Net Reduction in CO2e (Metric Tons)
2020	37,707,654	466,490	201,250	**265,240**
2035	47,463,512	587,182	201,716	**385,466**
2050	58,045,120	718,090	229,477	**488,613**

Note: Not all numbers presented in table are significant figures.

2 Washington State Energy Code

2.1 Policy Summary

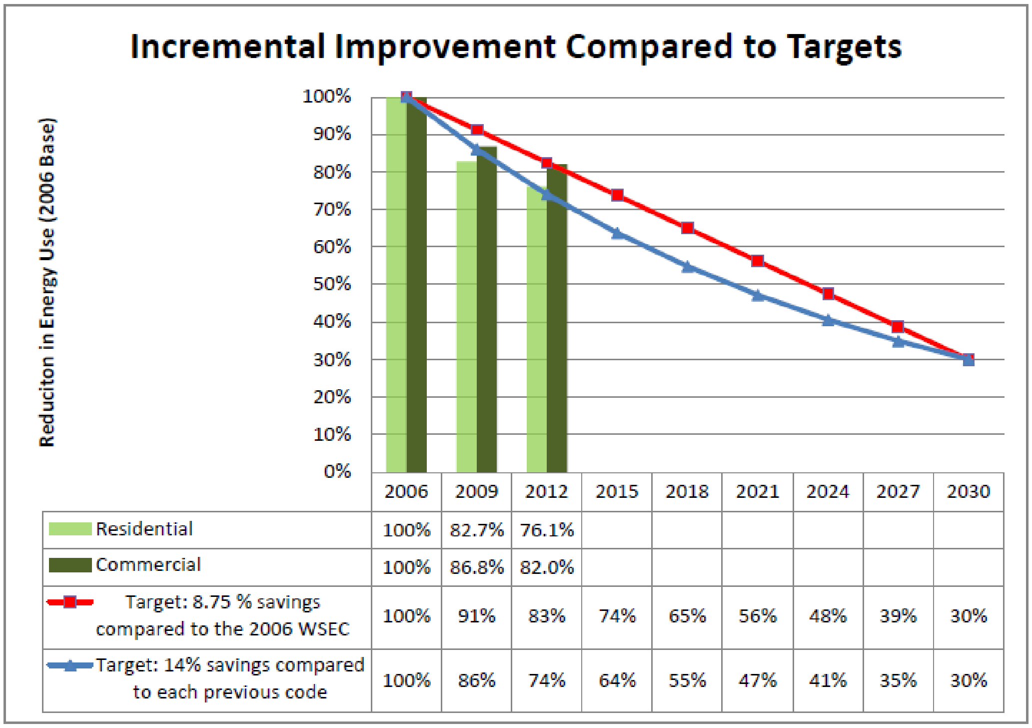
Building energy codes are a key element in the effort to reduce GHG emissions from energy use in buildings. The State has mandated that Washington State Energy Codes (WSEC) adopted from 2013 through 2031 must achieve a 70 percent reduction in annual net energy consumption for new residential and commercial buildings by 2031, using the adopted 2006 WSEC as a baseline.[23] This policy builds on more than 30 years of energy code development and implementation in Washington State.

The Washington State Building Code Council submitted a report to the legislature that provides two models to measure incremental change for each code cycle:

- Each three-year code cycle; reduce target energy use by 8.75 percent compared to the 2006 WSEC (linear trajectory).
- Each code cycle; reduce target energy use by 14 percent compared to the previous edition of the WSEC (early adoption trajectory).[24]

The 2012 WSEC (RCW 19.27A.020) went into effect on July 31, 2013. The Improvements to the 2012 WSEC meet the incremental measurement model of 8.75 percent compared to the 2006 WSEC. The graphic below displays current progress along with targets for each of the energy reduction models mentioned above. As of 2012, there has been an approximate 24% reduction in energy consumption in residential buildings and an 18% reduction in commercial buildings from the 2006 baseline. [25]

[23] RCW 19.27A.160. http://apps.leg.wa.gov/rcw/default.aspx?cite=19.27A.160
[24] 2012 Washington State Energy Code. Legislative Report. December 2012. https://fortress.wa.gov/ga/apps/sbcc/File.ashx?cid=2498
[25] WSEC Legislative Progress Report found here: https://fortress.wa.gov/ga/apps/sbcc/File.ashx?cid=2498



	2006	2009	2012	2015	2018	2021	2024	2027	2030
Residential	100%	82.7%	76.1%						
Commercial	100%	86.8%	82.0%						
Target: 8.75 % savings compared to the 2006 WSEC	100%	91%	83%	74%	65%	56%	48%	39%	30%
Target: 14% savings compared to each previous code	100%	86%	74%	64%	55%	47%	41%	35%	30%

Figure 1. Current progress and targets for each of the energy reduction models outlined in the 2012 Washington State Energy Code Legislative report that measures progress towards the 70% reduction in net energy consumption goal by 2031.

2.2 Methodology

Annual emission reductions in each target year were estimated separately for commercial and residential space and then summed. Emission reductions from electricity savings were calculated by multiplying the estimated electricity savings by eGRID CO_2e electricity emission factors for the Northwest Power Pool (NWPP) sub-region. Emission reductions from natural gas savings were calculated by multiplying the estimated gas savings by the Climate Registry CO_2, CH_4, and N_2O emission factors for natural gas, then converting emissions to units of CO_2e.[26] To estimate energy savings, baseline electricity and natural gas intensity values were established for commercial floor space and single-family and multifamily residences built according to the base code, WSEC 2006. In the commercial sector, baseline electricity and gas use intensities were determined based on bill data collected during a survey of various types of facilities constructed 2002-2004 in the Pacific Northwest and normalized on a per-square-foot basis[27]. Similarly, in

[26] The Climate Registry (TCR) uses EPA emission factors for CO2 from natural gas. TCR uses IPCC emission factors for CH4 and N2O from natural gas because EPA does not have factors specific to residential and commercial sectors (only industrial and energy sectors).

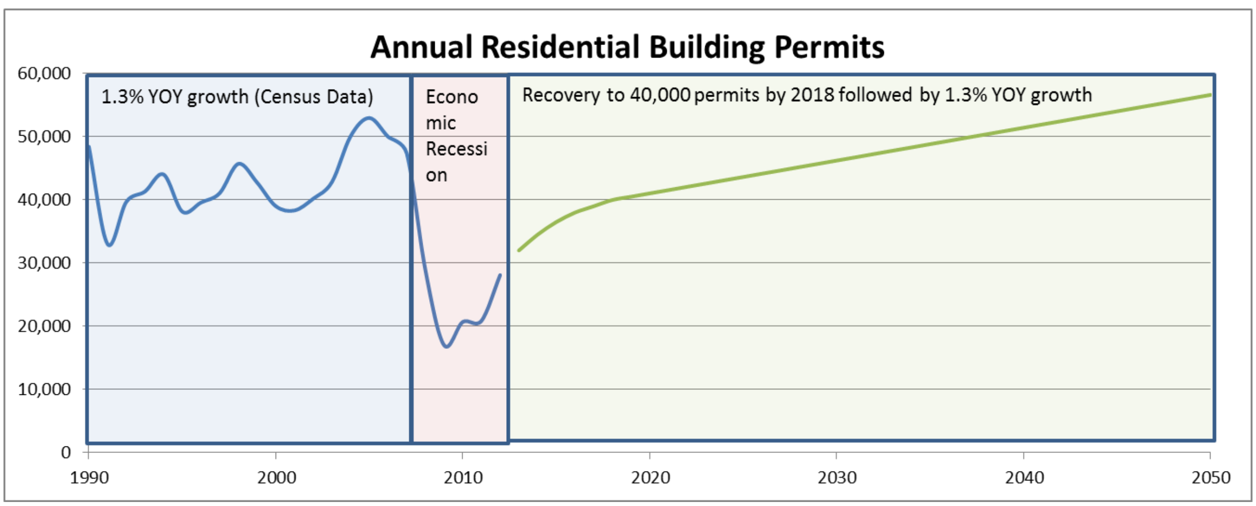
[27] Ecotope. 2008. Baseline Energy Use Index of the 2002-2004 Nonresidential Sector: Idaho, Montana, Oregon, and Washington. Accessed August 2013 at: http://neea.org/docs/reports/baselinecharacteristicsofthe20022004nonresidentialsectoridahomontanaoregonandwashingtoneuireport82536194fb35.pdf

the residential sector, baseline use intensities were determined based on 2006-2007 bill data collected during a survey of new single-family and multifamily homes in the Pacific Northwest and normalized on a per-housing-unit basis[28]. Total baseline electricity use and natural gas use for new buildings and homes in each year were then calculated by summing the products of the use intensity for each fuel and building type combination and the projected amount of new construction per building type in each year over the life of the program. Estimated first-year savings were calculated by multiplying the baseline electricity and natural gas consumption in each year by the corresponding target savings percentage of the energy code vintage effective in that year. Separate calculations were made for the linear and early adoption savings targets for comparison and energy codes were assumed to be updated on a three year cycle beginning January 1, 2011 with WSEC 2009. Once first-year savings were calculated, total annual savings were calculated by cumulating savings from all new construction after 2010.

2.3 Assumptions

The GHG emission reductions associated with improved energy codes were projected for the target years utilizing the following assumptions:

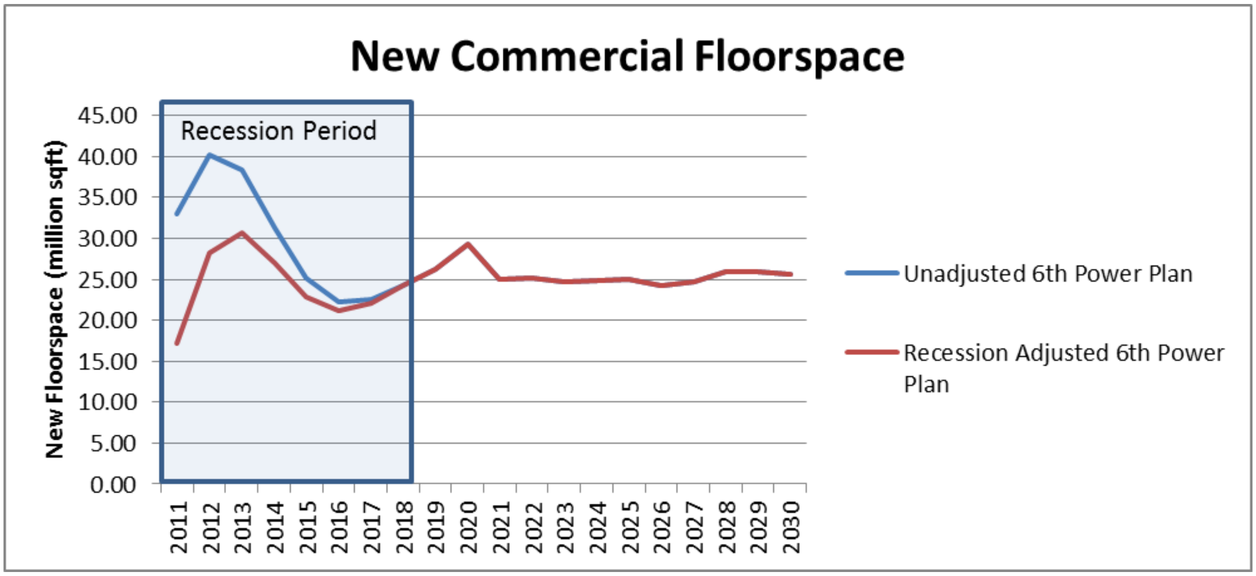
- Slowed growth of residential housing units resulting from economic recession is evident from 2007 to 2012 Census building permit data; this analysis assumes a recovery to 40,000 new annual units in 2018 followed by year-over-year growth of 1.3 percent (the growth rate observed from 1992 to 2007).



- Forecast growth of commercial floor space is based on Sixth Power Plan projections adjusted to account for the economic recession; the Sixth Power Plan projection for 2011 was reduced by 50 percent and a full recovery was reached in 2018; the pace of recovery

[28] RLW Analytics. 2007. Residential New Construction (Single and Multi-Family) Billing Analysis. Accessed August 2013 at: http://neea.org/docs/reports/residentialnewconstruction6322ead37dde.pdf

in the commercial sector during 2011 to 2018 matches that used in the residential sector. Projections for 2031-2050 assumed constant at 2030 levels.



- Electricity emission factors assumed to continuously improve from 2009 to 2050 according the rate projected for the NWPP by AEO2013.
- This policy only impacts energy codes adopted 2009-2030 and effective 2011-2034 (new energy codes that are contingent on new legislative action and that are outside the scope of this policy will likely become effective in 2035). As a result, buildings constructed 2035-2050 are not captured in this analysis, thus, annual energy and GHG savings are constant at 2034 levels through 2050.
- Energy savings in existing buildings (e.g. lighting upgrades, equipment replacements, required economizers) resulting from energy code improvements are not captured in this analysis and would substantially add to the outcomes.
- The energy savings for commercial buildings applies equally to electricity and gas on a percentage basis.
- Baseline use intensities for electricity and natural gas are presented in the table below by commercial building type:

Table 5. Baseline use intensities for electricity and natural gas by commercial building type.[29]

Building Type	Electricity Use Intensity		Natural Gas Use Intensity	
	kwh/sf	kbtu/sf	therm/sf	kbtu/sf
Office	17.7	60.4	0.12	12
Retail	21.3	72.7	0.20	20
Education	10.2	34.8	0.28	28
College	12.7	43.3	0.18	18
Warehouse	13.8	47.1	0.11	11
Grocery	46.6	159.0	0.59	59
Restaurant/Bar	86.2	294.1	1.57	157
Residential/Lodging	10.4	35.5	0.22	22
Hospital	31.4	107.1	0.92	92
Health Services	14.3	48.8	0.69	69
Assembly	13.4	45.7	0.41	41
Other	21.1	72.0	0.23	23

- Baseline use intensities for electricity and natural gas are presented in the table below by residential housing type (weighted average of gas-heated and electrically-heated units):

Table 6. Baseline use intensities for electricity and natural gas by residential housing type (weighted average of gas-heated and electrically-heated units).[30]

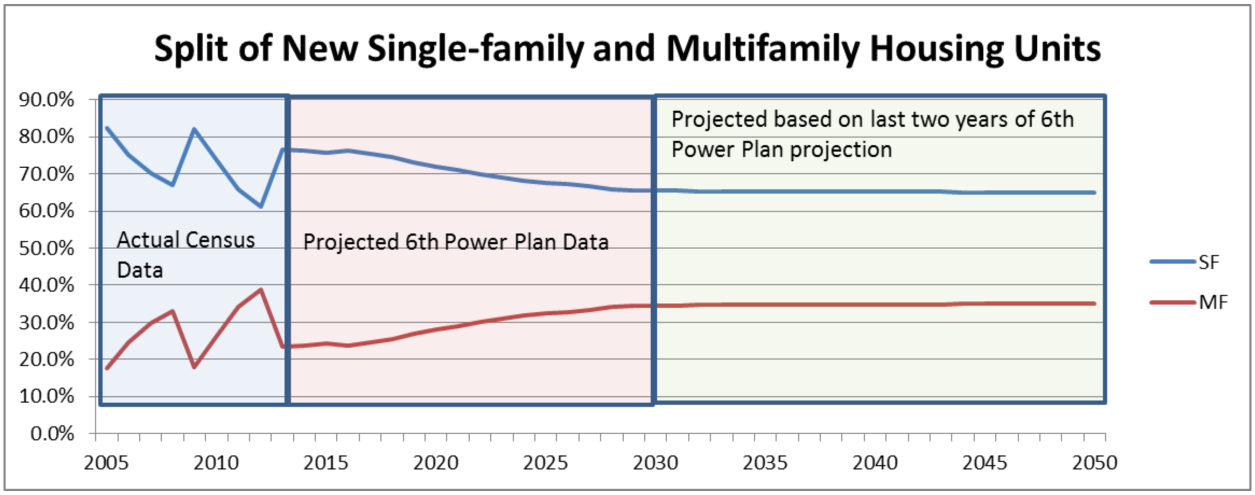
Building Type[31]	Electricity Use Intensity		Natural Gas Use Intensity	
	kwh/unit	kbtu/unit	therm/unit	kbtu/unit
Single-family	11,626	39.7	686	68.6
Multifamily	9,392	32.0	145	14.5

- Split of new single-family and multifamily housing units projected according to Sixth Power Plan through 2030; trend extrapolated for 2031 through 2050 projections.

[29] Ecotope. 2008. Baseline Energy Use Index of the 2002-2004 Nonresidential Sector: Idaho, Montana, Oregon, and Washington (Tables B-7 and B-18). Accessed August 2013 at: http://neea.org/docs/reports/baselinecharacteristicsofthe20022004nonresidentialsectoridahomontanaoregonandwashingtoneuireport82536194fb35.pdf

[30] RLW Analytics. 2007. Residential New Construction (Single and Multi-Family) Billing Analysis. Accessed August 2013 at: http://neea.org/docs/reports/residentialnewconstruction6322ead37dde.pdf

[31] Energy intensity (kbtu/unit) for single family units is higher than that for multi-family units primarily because, on average, single family units have more floor space per unit and more exterior walls which increases energy requirements for heating and cooling.



2.4 Data Sources

The following data sources were used for the analysis:

Table 7. Data sources for the Energy Code analysis.

Data	Source
Commercial sector baseline electricity and natural gas use intensities by building type	Ecotope. 2008. Baseline Energy Use Index Of The 2002-2004 Nonresidential Sector: Idaho, Montana, Oregon, And Washington (Tables B-7 & B18) (http://neea.org/docs/reports/BaselineCharacteristicsofthe20022004NonresidentialSectorIdahoMontanaOregonandWashingtonEUIReport82536194FB35.pdf?sfvrsn=8)
Residential sector baseline electricity and natural gas use intensities by housing unit type	NEEA. 2007. Residential New Construction (Single and Multi-Family) Billing Analysis (Tables 6 & 12) http://neea.org/docs/reports/residentialnewconstruction6322ead37dde.pdf
Residential sector new construction data for Washington from 1960-2012	Department of Commerce. 2013. New Privately-Owned Housing Units Authorized by Building Permits in Permit-Issuing Places in the State of: Washington http://www.census.gov/construction/bps/pdf/annualhistorybystate.pdf
Commercial sector new construction forecast through 2030	NWCC. 2010. Sixth Northwest Conservation and Electric Power Plan: Conservation Supply Curve Files (For commercial see: Floor Area and Population Forecast) (For residential see: Residential Supply Curve Housing and Appliance Units) (http://www.nwcouncil.org/energy/powerplan/6/supply-curves)
Electricity CO_2e emission factor for Northwest Power Pool	EPA. 2012. eGRID2012 year 2009 Summary Tables http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf
Electricity emission factor improvement rate	EIA. 2013. Annual Energy Outlook 2013. Electric Power Projections for Northwest Power Pool Area http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2013&subject=0-AEO2013&table=62-AEO2013&region=3-21&cases=ref2013-d102312a

Natural gas CO_2, CH_4, and N_2O emission factors	The Climate Registry. 2013. The Climate Registry's 2013 Default Emission Factors (http://www.theclimateregistry.org/downloads/2013/01/2013-Climate-Registry-Default-Emissions-Factors.pdf)
Global Warming Potential for CO_2, CH_4, and N_2O	IPCC. 1995. IPCC Second Assessment Report: Climate Change 1995 (SAR) (https://docs.google.com/uc?export=download&confirm=no_antivirus&id=0B1gFp6Ioo3aka3NsaFQ3YlE3XzA)

2.5 Results

This policy only impacts energy codes effective through 2034 (new energy codes outside the scope of this policy will likely become effective in 2035). As a result, buildings constructed 2035-2050 are not captured in this analysis, thus, annual energy and GHG savings are constant at 2034 levels through 2050.

Table 8. Emissions reductions associated with the Washington State Energy Code.

Target Year	Annual Emissions Reduction (mtCO2e)					
	Linear Targets			Early Adoption Targets		
	Commercial	Residential	Total	Commercial	Residential	Total
2020	330,000	540,000	870,000	470,000	770,000	1,240,000
2035	1,560,000	2,230,000	3,790,000	1,830,000	2,650,000	4,480,000
2050	1,420,000	2,090,000	3,510,000	1,660,000	2,480,000	4,140,000

Note: Not all numbers presented in table are significant figures.

The magnitude of potential emissions savings from energy code improvements is substantial. Compared to the other policies analyzed in this document, energy codes represent the third highest level of savings behind only Emissions Performance Standards and the Energy Independence Act (I-937).

3 Greenhouse Gas Emission Performance Standard

3.1 Policy Summary

In 2007, Washington established a greenhouse gas (GHG) Emission Performance Standard (EPS) for baseload electricity generation.[32] The EPS set the GHG emission rate as the lower of 1,100 pounds per megawatt-hour (lb/MWh)[33] or the average available GHG emissions output of combined cycle combustion turbines (CCCT) as calculated by the Department of Commerce.

[32] Baseload generation is defined as electric generation from a power plant that is designed and intended to provide electricity at an annualized plant capacity factor of at least sixty percent.
[33] This is the same rate specified by EPS policies in Oregon and California.

The legislation required the Department of Commerce Energy Office to survey the emissions of GHGs for new and commercially available natural gas-fired CCCT plants to determine the average available GHG emissions output from these turbines.[34] Commerce surveyed 13 CCCT models and calculated an average GHG emission rate of 970 lb/MWh, which became the new performance standard in 2013. The survey also evaluated existing CCCT plants and found that the proposed EPS value of 970 lb/MWh is conservative and will accommodate power plant ageing and a wide range of sub-optimal operation.

Under the EPS, utilities will not be able to enter into or renew long-term contracts (five years or more) with a baseload generating facility, within or outside the state, if the emission rate of that facility exceeds the standard. In addition, utilities may not invest in a new facility or upgrade[35] a facility that exceeds the standard. The EPS does not apply to utilities that own facilities with emission rates above the standard if the output serves that utility's own load.[36] All cogeneration facilities in the state that are fueled by natural gas or waste gas or a combination of the two fuels, and that are in operation as of June 30, 2008, are deemed to be in compliance with the EPS until the facilities are the subject of a new ownership interest or are upgraded.[37]

For investor owned utilities (IOUs), the Washington Utilities and Transportation Commission may provide a case-by-case exemption from the EPS in the event of unanticipated electric system reliability needs, catastrophic events, threat of significant financial harm that may arise from unforeseen circumstances, or extraordinary cost impacts on utility ratepayers. The governing boards of consumer-owned utilities have similar exemption authority. [38,39]

3.2 Methodology

In order to determine the GHG emissions reductions associated with the EPS in the target years, the first step was to identify the specific generating resources that are expected to be affected by the policy. The survey used to develop the average emission rate of 970 lbs/MWh found that the standard is sufficiently generous to allow all high-efficiency installations to comply under reasonable operating conditions. Three natural gas plants in the state currently have emission rates that exceed the standard.[40] However, these plants are owned by Puget Sound Energy (PSE)

[34] As provided under RCW 80.80.050

[35] "Upgrade" means any modification made for the primary purpose of increasing the electric generation capacity of a baseload electric generation facility. RCW 80.80.10 Sec 20 http://apps.leg.wa.gov/rcw/default.aspx?cite=80.80&full=true#80.80.010

[36] Washington State Department of Commerce. Survey of Combined Cycle Combustion Turbine Greenhouse Gas Emission Rates. DRAFT for public review, released 16 January 2013. http://www.commerce.wa.gov/Documents/Survey-Commercially-Available-Turbines-Rev-2013-01-16.pdf

[37] RCW 80.80.040 (5). http://apps.leg.wa.gov/rcw/default.aspx?cite=80.80.040

[38] RCW 80.80.060 (5). http://apps.leg.wa.gov/rcw/default.aspx?cite=80.80&full=true#80.80.060

[39] RCW 80.80.070 (4). http://apps.leg.wa.gov/rcw/default.aspx?cite=80.80&full=true#80.80.070

[40] The three natural gas plants with emission rates above the standard are Encogen, Ferndale, and Sumas.

which uses the power from the plants to serve its own load and are therefore not impacted by the EPS.

The emission rate of coal-fired power plants typically far exceeds the EPS standard. Two large baseload plants located outside of Washington, the Jim Bridger plant in Wyoming and the Colstrip plant in Montana, provide electricity to Washington customers and were identified as potentially being impacted by the EPS. The Jim Bridger plant is partially owned by PacifiCorp, which operates as Pacific Power in Washington. Pacific Power uses electricity from the Jim Bridger plant to serve its own load in the state and was assumed not to be impacted by the EPS. The Colstrip plant does not currently provide electricity to Washington under long term contracts and is therefore also assumed not to be impacted by the EPS. Washington has one coal-fired baseload power plant in the state, the Centralia plant owned by TransAlta. Centralia has two 670 MW coal fired boilers that, combined, emitted 5.6 million metric tons of CO_2e in 2011.[41] The EPS contains provisions that allow for coal-fired electricity to comply with the standard in a "reasonable period of time to ensure grid stability and to maintain affordable electricity resources".[42] The EPS states that a coal-fired baseload electric generation facility in Washington that emits more than one million tons of GHG annually, which applies to Centralia, must have one generating boiler in compliance by December 31, 2020, and any other generating boiler in compliance by December 31, 2025. This analysis includes the GHG reductions associated with Centralia's compliance with the EPS.

The calculations of GHG reductions associated with Centralia's compliance with the EPS were developed in consultation with staff at the Washington State Energy Office to establish an estimate of the amount of electricity generated by Centralia that is consumed in Washington. Centralia is a merchant plant, which means it is not owned or operated by an electric utility and can sell its power output to any utility in the region on the wholesale or retail market. It is therefore difficult to determine exactly where the electricity from Centralia is ultimately consumed. However, a portion of the power from Centralia that will be consumed in Washington is known based on a power purchase agreement through 2025 between TransAlta and PSE. Under the agreement, PSE will purchase 180 average megawatts (aMW)[43] of power from Centralia in December 2014, 280 aMW in 2015, 380 aMW from 2017 to 2024, and 300 aMW in 2025.[44] The remaining amount of power from Centralia consumed in Washington was estimated using the average amount of coal power market purchases reported in Fuel Mix Disclosure data from 2010 to 2012, subtracting the PSE purchases from total coal power market

[41] US Environmental Protection Agency. Greenhouse Gas Reporting Program. http://www.epa.gov/ghgreporting/
[42] RCW 80.80.010. http://apps.leg.wa.gov/rcw/default.aspx?cite=80.80&full=true
[43] An average megawatt is one megawatt of capacity produced continuously over a period of one year.
[44] TransAlta. http://www.transalta.com/us/2012/07/transalta-and-puget-sound-energy-sign-power-purchase-agreement/

purchases, and assuming that half the remaining purchases are attributable to Centralia.[45] An emission factor for Centralia (1.08 metric tons CO2e/MWh) was developed using emissions data reported to the EPA Greenhouse Gas Reporting Program and total output reported to the Northwest Power and Conservation Council. It was assumed that output from Centralia was replaced with electricity from a mix of natural gas and renewable resources. Because Centralia provides baseload power, it is assumed that most of the electricity would be replaced with electricity from natural gas. Further, it is assumed that 90 percent of electricity was replaced with natural gas resources and 10 percent from renewable resources. An emission factor was developed for replacement electricity using an average emission factor new CCCTs[46] in Washington and using an emission factor of zero for renewable resources.[47]

3.3 Assumptions

The following assumptions were used to project the GHG emission reductions associated with the implementation of the EPS for the target years:

- The transition of the Centralia plant from coal to cleaner fuels is attributable to the EPS policy.
- The amount of electricity generated at Centralia that is ultimately consumed in Washington includes power purchases from PSE and 50 percent of additional market purchases
- Coal fired electricity from Centralia is replaced with electricity from a mix of natural gas CCCT and renewable resources.
- Reductions from the transition of the Centralia plant occur after 2020 as the RPS requires the first boiler to be in compliance by December 31, 2020.
- The Centralia plant would have reached its designed lifetime before 2050

3.4 Data Sources

The following data sources were used:

- Northwest Power and Conservation Council. Power Plants in the Pacific Northwest. www.nwcouncil.org/media/8773/Projects.xlsm
- Washington State Fuel Mix Disclosure. http://www.commerce.wa.gov/Programs/Energy/Office/Utilities/Pages/FuelMix.aspx

[45] Note that this is a simplified assumption as it is difficult to determine the exact amount of power from Centralia due to its status as a merchant plant.
[46] Washington State Department of Commerce. Survey of Combined Cycle Combustion Turbine Greenhouse Gas Emission Rates. DRAFT for public review, released 16 January 2013. http://www.commerce.wa.gov/Documents/Survey-Commercially-Available-Turbines-Rev-2013-01-16.pdf
[47] This is a simplified assumption as there are a relatively small amount of emissions associated with the use of renewable electricity resources, particularly when measured on a lifecycle basis.

- US EPA Greenhouse Gas Reporting Program. http://www.epa.gov/ghgreporting/
- Washington State Department of Commerce. Survey of Combined Cycle Combustion Turbine Greenhouse Gas Emission Rates. DRAFT for public review, released 16 January 2013. http://www.commerce.wa.gov/Documents/Survey-Commercially-Available-Turbines-Rev-2013-01-16.pdf

3.5 Results

Based on the method outlined above, total projected GHG emission reductions associated with the implementation of the EPS are shown below. The analysis only goes out to the 2035 target year because the Centralia plant would likely have reached the end of its designed lifetime before 2050 and therefore reductions would not be attributed to the EPS.

Table 9. Emission reductions associated with the Emission Performance Standard.

Year	Emissions Without EPS (MT CO2e)	Emissions With EPS (MT CO2e)	Emission Reductions (MT CO2e)
2020	4,404,234	4,404,234	0
2035	4,404,234	1,530,971	2,873,263
2050	N/A	N/A	N/A

Note: Not all numbers presented in table are significant figures.

4 Appliance Standards

4.1 Policy Summary

Appliance standards increase equipment efficiency, reduce energy use, and subsequently reduce the market cost of energy efficiency improvements by advancing the technology of base appliance models. Benefits also include lower energy costs for consumers and an increase in technological innovation in a competitive market with energy efficient products.[48] Washington State appliance standards provide energy or water savings to the residents of the state. They have also been credited with introducing additional products to the federal appliance standards process. However, many of Washington's standards have been superseded by federal standards.

[48] Globe Advisors and The Center for Climate Strategies. 2012. The West Coast Clean Economy: Opportunities for Investment and Accelerated Job Creation. A report commissioned by the Pacific Coast Collaborative, p. 33. Online at: http://www.pacificcoastcollaborative.org/Documents/Reports%20and%20Action%20Items/WCCE_Report_WEB_FINAL.pdf.

The Department of Energy (DOE) currently enforces minimum standards for 50 different appliance categories and is continually reviewing and updating existing standards and conducting research for the adoption of new standards.[49] Although many state standards have been preempted by federal standards, it is reasonable to credit the continuing benefits to the State's action to adopt progressive standards.

Washington enacted appliance efficiency legislation in 2005 (in the Energy Policy Act, RCW 19.260), creating minimum efficiency standards for twelve products, all of which have been preempted by federal law. HB 1004, signed in May 2009, added efficiency standards for several more products not yet superseded by federal standards, which took effect January 1, 2010. These products include:

- Wine chillers designed and sold for use by an individual
- Hot water dispensers and mini-tank electric water heaters
- Bottle-type water dispensers
- Pool heaters, residential pool pumps, and portable electric spas
- Commercial hot food holding cabinets

The Washington Standards do not apply to the following:

- New products manufactured in Washington and sold outside the State.
- New products manufactured outside Washington and sold at wholesale inside Washington for final retail sale and installation outside the State.
- Products installed in mobile manufactured homes at the time of construction
- Products designed expressly for installation and use in recreational vehicles.

RCW 19.260 stipulates that existing standards and test methods may be increased and updated. Any recommendations are transmitted to the appropriate committees of the legislature sixty days before the start of any regular legislative session.[50]

The Washington Department of Commerce anticipated that the efficiency standards would result in the following energy and water savings in the year 2020:

- 900,000 megawatt-hours of Electricity,
- 13,000,000 therms[51] of Natural Gas, and

[49] U.S. Department of Energy, Energy Efficiency and Renewable Energy Building Technologies Office. Standards and Test Procedures (Updated August 2013). Online at: http://www1.eere.energy.gov/buildings/appliance_standards/standards_test_procedures.html
[50] Department of Energy Database of State Incentives for Renewables and Efficiency. Appliance and Equipment Energy Efficiency Standards: Washington State. Online at: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=WA12R
[51] One therm equals 100,000 Btu

- 1,700,000,000 gallons of water

These savings are expected to yield a total net present value of 490 million dollars to buyers in 2020.[52]

4.2 Methodology

Many of Washington's previous appliance standards have been superseded by federal standards, but Washington should be credited with introducing additional products to the federal appliance standards process since many state standards encouraged the adoption of federal standards.[53] The standards outlined above that have not been preempted by federal standards did not have quantifiable data for analysis. We contacted State agency staff, and the Appliance Standards Awareness Project (ASAP)[54] to inquire about any state-specific historic or new data related to the aforementioned products, but no analyses or data were available. It is likely that there will be small emissions reductions from the current Washington standards not already preempted by federal standards.

In the absence of data for current standards, the results from a recent study completed by ASAP and the American Council for an Energy Efficient Economy (ACEEE) on energy savings and emissions reductions from potential new appliance standards, will be used.[55] The procedure for how ASAP and ACEEE chose which standards to analyze is described here. DOE is required to review and, if necessary, update several standards between January 2013 and December 2015. DOE also began work in 2010 on developing new standards on multiple product categories including appliances such as set-top boxes, fans, pumps, and blowers to list a few. ASAP and ACEE created a list of 100 products for which standards could "conceivably be developed"[56] based on the appliances that DOE is considering. ASAP and ACEE then narrowed that list to focus on products that would both deliver significant savings and be adopted within the next four years at the national or state level.[57] The final list included:

- 11 new national standards scheduled for completion in January 2013.
- 16 standards that DOE is legally required to review between 2013 and 2015

[52] Energy Policy Division of the Washington State Department of Commerce. 2005. Biennial Energy Report, p. 2-2.
[53] Personal Communication with members of the Washington State Energy Office, Department of Ecology, and Department of Commerce. August 15, 2013.
[54] Personal Communication with Marianne DiMascio, at the Appliance Standards Awareness Project. August 15, 2013 and August 26, 2013.
[55] Lowenberger, A., Mauer, J., deLaski, A., DiMascio, M., Amann, J., and S. Nadel. 2012. The Efficiency Boom: Cashing In on the Savings from Appliance Standards. Report # ASAP-8/ACEEE-A123. 87pp. Online at: http://www.appliance-standards.org/content/efficiency-boom
[56] Lowenberger et al., p. 9.
[57] Lowenberger et al., p. 9-10.

- Product categories for which DOE has begun work (e.g., computer equipment and components, set-top boxes, non-general purpose electric motors, fans and blowers, and pumps).
- Products that states have adopted prior to federal adoption. DOE initiated research on some of these standards (e.g., portable and outdoor lighting fixtures) in 2010.[58]

Note that data, methods and analyses from this report are presented for the purpose of providing a perspective on the possible impacts these potential standards may have for Washington. Although these results do not necessarily reflect current policies, they reflect savings opportunities and ideas for future new and updated standards. Table 10 lists those appliances evaluated in the 2012 ASAP/ACEEE report.

[58] Ibid, p. 10.

Table 10. Products evaluated for potential appliance standards in the ASAP and ACEEE report.[59]

Product	Federal standards Adoption date	Federal standards Effective date	State standards Adoption date	State standards Effective date
Residential:				
Air handlers	2013	2017		
Battery chargers	2012	2014	2011	2013
Boilers (nat. gas)	2015	2020		
Clothes washers	2012	2015		
Computer equipment and components	2014	2019	2013	2014
Dishwashers	2012	2013		
External power supplies	2012	2014		
Faucets (residential lavatory)	2013	2016	2013	2014
Game consoles	2015	2020	2013	2014
Microwave ovens	2012	2015		
Set-top boxes & digital communication equipment	2013	2018	2013	2014
Televisions	2013	2016	2013	2014
Toilets	2013	2016	2013	2014
Water heaters	2015	2020		
Commercial/Industrial:				
Air conditioners, air-cooled	2015	2017		
Automatic ice makers	2013	2016		
Clothes washers	2015	2018		
Distribution transformers	2012	2016		
Electric motors	2012	2016		
Fans, blowers & ventilation equipment	2015	2020	2014	2015
Furnaces, commercial warm-air	2013	2016		
Pre-rinse spray valve	2013	2016		
Pumps	2013	2016	2013	2014
Refrigeration equipment	2013	2016		
Walk-in coolers and freezers	2012	2015		
Unit heaters	2013	2016		
Urinals	2013	2016	2013	2014
Lighting:				
Candelabra & int. base incandescent lamps	2013	2020		
General service fluorescent lamps	2014	2017		
HID lamps	2014	2017		
Incandescent reflector lamps (previously exempted)	2012	2015		
Incandescent reflector lamps (all products)	2014	2017		
Luminaires (portable light fixtures)	2014	2019	2013	2014
Metal halide lamp fixtures	2012	2015		
Outdoor lighting fixtures	2014	2019	2013	2014

ASAP and ACEEE have quantified electricity, natural gas, and water savings along with emissions reductions for these prospective standards for 2025 and 2035. ASAP breaks these savings and reductions down into the following categories:

- State-level benefits from potential state appliance standards[60]
- State-level benefits from potential national appliance standards[61]

[59] Lowenberger et al. 2012, p. 11.
[60] Data found here: http://www.appliance-standards.org/map/benefits-from-state
[61] Data found here: http://www.appliance-standards.org/map/benefits-from-federal

State-level benefits were generally similar when a state standard overlapped with a federal standard (e.g., standards for battery chargers had the same savings and reductions whether enacted by the state or the federal government). The study considered several more prospective future national appliance standards than state standards. The difference between benefits of these different standards was then calculated to get the additional benefits (energy and water savings and emission reductions) that national standards may provide. We did not extend the forecast to the year 2050 because many of the proposed appliance regulations apply to products with fairly short lives, which impacts future potential. For example, a battery charger for a phone may last 3-5 years, and within 5 years, all of the energy savings potential will be captured. Replacement chargers would continue to provide savings, but there will be no additional energy savings. Furthermore, although current federal standards include long life products such as commercial boilers or heat pumps, most of these products will be replaced before 2050.[62]

ASAP and ACEEE calculated energy and water savings of potential new standards using national estimates of equipment sales, per-unit energy and/or water use, potential energy and/or water savings, product lifetime, and incremental costs. The study estimated electricity and natural gas energy savings by multiplying annual national sales for each appliance product by the per-unit energy savings.[63] Water savings were calculated with the same method as energy savings, but only direct water savings counted towards overall water savings.[64]

In the 2012 ASAP/ACEEE study, emissions reductions were quantified by multiplying electricity and natural gas savings by the national average emissions factors for the U.S.[65] The analysis used a 0.91 transmission and distribution loss factor[66] and average U.S. electricity emissions factors to provide an approximation of emissions reductions due to the significant uncertainty as to the impact of appliance standards on the future electric load profile. For this project, the national electricity emissions factor was replaced with EPA eGRID emissions factors for the Northwest Power Pool so as to better reflect the clean fuel mix in Washington.[67] Natural gas emissions factors come from the EPA Office of Air Quality Planning and Standards.

[62] Personal communication with Chuck Murray, Washington State Department of Commerce. August 20, 2013.
[63] Per-unit energy savings in this study refers to the difference between the energy use of a product meeting the potential standard and the energy use of a product that meets the current standard (or a typical baseline appliance product if no current standard exists).
[64] Direct water savings refers efficient water-using appliances such as commercial clothes washers and pre-rinse valves.
[65] Lowenberger et al. 2012, p. 59.
[66] Lowenberger et al. 2012, p. 58.
[67] Environmental Protection Agency. 2012. eGRID2012 Version 1.0: Year 2009 Summary Tables. Online at: http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf

Table 11. Emissions factors used to quantify appliance standards emissions reductions.

Electricity(MT CO_2/GWh)[68]		Natural Gas (MMT CO_2/Quad)
2025	**2035**	
317	315	53.1

4.3 Assumptions

The ASAP and ACEEE report made the following general assumptions to project annual energy, water, and GHG emissions savings and reductions[69]:

- The analysis is static and assumes equipment sales stay at projected 2015 levels for all appliance products.
- In the absence of standards, energy efficiency levels remain at present levels.
- Only direct water savings from efficient water-using appliances (e.g., commercial clothes washers and pre-rinse valves) were considered when calculating water savings numbers.

4.4 Data Sources

The following data sources were used for the analysis:

- American Council for an Energy Efficient Economy (ACEEE). http://aceee.org
- Appliance Standards Awareness Project (ASAP). http://www.appliance-standards.org/

4.5 Results

Based on the method outlined above, total projected energy and water savings along with GHG emission reductions associated with the implementation of potential future state (Table 12) and Federal (Table 13) appliance standards are shown below. Table 14 calculations show the additional savings and GHG reductions provided by national appliance standards after taking the difference of the state and federal appliance standards benefits.

[68] Change in electricity emission factors in 2025 and 2035 are based on electric power sector data from the Energy Information Administration Annual Energy Outlook 2013 electric power projections for Northwest Power Pool Area.
[69] A comprehensive list of assumptions can be found in Appendix A of Lowenberger et al. 2012 on pages 53-62.

Table 12. Annual energy and water savings along with GHG reductions from potential new Washington appliance standards.

	Annual Savings and Reductions from Washington State Standards			
	Electricity (GWh)	**Natural Gas (therms)**	**Water (billion gallons)**	**Emissions Reductions ($mtCO_2e$)**
2025	1,971	2,310,000	2	698,661
2035	2,402	4,320,000	4	853,720

Note: Not all numbers presented in table are significant figures.

Table 13. Annual energy and water savings along with GHG reductions for Washington from potential future federal appliance standards.

	Annual Savings and Reductions from Federal Standards			
	Electricity (GWh)	**Natural Gas (therms)**	**Water (billion gallons)**	**Emissions Reductions ($mtCO_2e$)**
2025	4,663	27,430,000	6	1,769,530
2035	6,791	52,230,000	9	2,626,148

Note: Not all numbers presented in table are significant figures.

Table 14. Additional energy and water savings along with GHG reductions for Washington from potential future federal appliance standards. These numbers represent the difference between the federal and state benefits.

	Additional Savings and Reductions with Federal Standards			
	Electricity (GWh)	**Natural Gas (therms)**	**Water (billion gallons)**	**Emissions Reductions ($mtCO_2e$)**
2025	2,692	25,120,000	4	1,070,869
2035	4,389	47,910,000	6	1,772,428

Note: Not all numbers presented in table are significant figures.

The ASAP/ACEEE study also yields the following net present values in the year 2035:

- Approximately 1.25 billion dollars (2010 dollars) from state-level benefits from potential state appliance standards.
- Approximately 2.53 billion dollars (2010 dollars) from state-level benefits as a result of potential national appliance standards.

Similar to energy, water, and GHG savings and reductions, the national standards provide an additional net present value of 1.28 billion dollars (2010 dollars).

5 Energy Independence Act (I-937)

5.1 Policy Summary

Adopted in 2007 under RCW 19.285, the Energy Independence Act (commonly referred to as I-937) calls for state electric utilities serving 25,000 or more customers to obtain 15 percent of their electricity from new renewable resources by 2020 and undertake all cost-effective energy conservation. Of the state's 62 utilities, 17 are required to meet these targets. These 17 qualifying utilities provide 81% of the electricity in Washington. One additional utility, City of Richland, will be subject to EIA targets beginning in 2018.[70] All 17 utilities have met the renewables target for 2012 based on their annual reports.[71]

Each qualifying utility is required to use eligible renewable resources or acquire equivalent renewable energy credits, or any combination of them, to meet the following annual targets:

- At least three percent of its load by January 1, 2012, and each year thereafter through December 31, 2015.
- At least nine percent of its load by January 1, 2016, and each year thereafter through December 31, 2019.
- At least fifteen percent of its load by January 1, 2020, and each year thereafter.[72]

The Energy Independence Act also contains "cost cap" provisions that provide an exception to the aforementioned RPS requirements. A utility does not have to meet a renewables target as long as it invests at least 4 percent of its revenue requirement on the incremental cost of renewables. If a utility's load is not growing, the cost cap is 1 percent of the total cost of renewables.[73]

5.2 Methodology

To quantify emissions reductions from Washington's I-937 policy, a baseline scenario for electricity consumption by fuel source in megawatt hours (MWh) was developed for the 81% of covered electricity. RPS, cost cap, and energy conservation components were then incorporated in a policy scenario for the target years of 2012, 2016, and 2020, and out to 2030. For this analysis, the 2035 and 2050 target years were note estimated as there is too much uncertainty concerning the fuel mix and load growth that far out to make any reasonable assumptions.

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[70] Energy Independence Act description found online at:
http://www.commerce.wa.gov/Programs/Energy/Office/Utilities/Pages/EnergyIndependence.aspx
[71] Annual reports found online at:
http://www.commerce.wa.gov/Programs/Energy/Office/Utilities/Pages/EnergyIndependence.aspx
[72] RCW 19.285.040(2): http://apps.leg.wa.gov/rcw/default.aspx?cite=19.285&full=true
[73] RCW 19.285.050: http://apps.leg.wa.gov/rcw/default.aspx?cite=19.285.050

5.2.1 Baseline Scenario

The baseline total electricity consumption in Washington State through 2030 was calculated by applying Northwest Power and Conservation Council (NWPCC) load growth rates to Washington's policy eligible consumption (81% of total). The following assumptions were used to estimate the baseline scenario electricity consumption.

- Washington State provided fuel mix and consumption data through 2012, however since I-937 was enacted in 2007, it was assumed that 2007 would provide the business-as-usual baseline consumption and fuel mix. Therefore, fuel mix and consumption needed to be calculated and forecasted starting in 2008 for the baseline even though Washington has actual data for 2008 through 2012.
    - The NWPCC's Sixth Northwest Conservation and Electric Power Plan (Power Plan) provided regional load growth data between 2007 and 2010 (total 3 year growth of 0.8%). This was assumed to be the same growth pattern Washington State would have experienced in absence of the I-937 policy. A total load growth rate of 0.8 percent was applied for the years from 2007-2010.[74]

- After 2010, forecast energy load through 2030 based on annual load growth rate of 1.4 percent, as forecasted in NWPCC's Power Plan.[75]
- Energy supply from hydro fluctuates annually with various climate patterns and is projected to decrease as a result of climate change impacts on snowpack.[76] It was assumed that this resource would not show a steady increase through 2030. To account for this fact, the baseline was derived by keeping hydro consumption (MWh) constant at 2007 levels. As total consumption rises over time, hydro consumption remains constant, reducing hydro's percentage of the total fuel mix.
- The remaining non-fossil fuel sources (renewables, landfill, nuclear) were assumed to maintain their baseline percent of total fuel mix. As consumption increased over time, each of these remaining non-fossil fuels incrementally increased, however the assumption was that no major increases would have occurred without the policy. Consequently, utilities would produce or import more electricity from other fossil fuel sources[77] to meet the additional demand.
- Other fuel sources (e.g., coal, natural gas, co-generation, petroleum) are added to the mix based on the simplified assumption that the increase in electricity consumption is

[74] Northwest Power and Conservation Council. 2010. Sixth Northwest Conservation and Electric Power Plan, p. 3-5. Online at: http://www.nwcouncil.org/energy/powerplan/6/plan/
[75] Ibid, p. 3-5.
[76] Washington CAT GHG Inventory and Reference Case Projections for 1990-2020: Appendix A, p. A-1: http://www.ecy.wa.gov/climatechange/CATdocs/042407GHGreportdraft.pdf
[77] Based on mix of resources for new electricity demand in the Washington CAT 2007 policy analysis: http://www.ecy.wa.gov/climatechange/interimreport/122107_TWG_es.pdf

allocated according to the percentages in Table 13. Table 13 shows additions to Washington's future fuel mix by fuel source. These calculations were used to forecast the baseline Washington fuel mix through 2030.

Table 15. Energy Information Administration Annual Energy Outlook: Cumulative Additions (excluding renewables), Electric Power Projections for EMM Region, Western Electricity Coordinating Council / Northwest Power Pool Area, Reference case. [78]

Fuel Source	Additions to Future Fuel Mix
Hydro	0%
Coal	26%
Co-generation	0%
Natural Gas	68%
Nuclear	0%
Petroleum	6%
Landfill Gases	0%

5.2.2 Policy Scenario

In this scenario, the baseline estimates were adjusted to account for the impacts of the policy I-937 based on the following:

- It was assumed that actual data, since the I-937's inception, would reflect the policy impacts, so actual consumption and fuel mix, rather than forecasted data were used through 2012.
- To account for energy conservation aspect of I-937, the NWPCC's 6th Power Plan conservation target calculator was used.[79] The total conservation calculated for each year 2013 through 2030, was then subtracted out of the total consumption for that year. For example, the forecasted consumption in 2016 was 78,357,127 MWh, conservation for that year was estimated to be 1,174,158 MWh, reducing total consumption to 77,182,969 MWh. This was done for each year 2013-2030.
- Utilities are expected to meet the RPS targets for 2012 and 2016; however, per discussion with Washington State, the assumption that all utilities will meet the 2020 target of 15 percent before hitting their cost caps is unlikely. There is a good probability that independently owned utilities (IOUs) will meet the RPS target while public utility districts (PUDs) may reach their cost cap first due to lower annual revenues, as two PUDs have already filed for the cost cap provision.[80] Based on this logic, a 12 percent overall RPS target for Washington in 2020 was applied to the calculations to account for some eligible utilities reaching their cost cap before reaching the 15 percent goal. As

[78] http://www.eia.gov/forecasts/aeo/
[79] NWPCC Conservation Target Calculator online at: http://www.nwcouncil.org/energy/powerplan/6/assessmentmethodology/
[80] Personal communication with Chuck Murray and Howard Schwartz, Department of Commerce, August 20, 2013

consumption and revenues increase over time, it was assumed all utilities would meet the 15% target by 2030, increasing linearly between the 12% in 2020 and 15% in 2030.

- Hydroelectric generation was held constant at 2012 consumption levels, for the reasons discussed above. Because of increases in conservation and renewable resources relative to the baseline, additional load had to be removed from the remaining fuel sources. The amount of load from each fuel source removed relative the baseline was determined by Table 14.

Table 16. Existing resources that are reduced. Adapted from Washington's CAT Policy Analysis document, all reductions from fossil fuel resources, excluding cogeneration, which is not reduced (scenario A). [81]

Fuel Source	Existing Resource Reductions
Hydro	0%
Coal*	75%
Co-generation	0%
Natural Gas	25%
Nuclear	0%
Petroleum	0.3%
Landfill Gases*	0%

**Original table had 1% reduction coming from landfill gas resources, as this resource is expected to increase slightly, the 1% was instead added to the original 74% listed for coal, making it 75% of resource reductions.*

As an example of how this approach impacts overall load growth in the policy scenario, the following shows the percentage of load growth between 2007 and the target years 2016 and 2020 that each fuel source accounted for using the above methodology.

Table 17. Percent of Load Growth accounted for by fuel source between 2007 and given target year.

Fuel Source	2016	2020
Hydro	45%	27%
Coal	-74%	-50%
Cogeneration (NG)	2%	2%
NG	16%	24%
Nuclear	5%	5%
Petroleum	4%	4%
Landfill Gases	-1%	-1%
Renewables	86%	77%

[81] Washington CAT 2007 policy analysis Appendix B, p. 47

Conservation	17%	12%
Total	**100%**	**100%**

5.2.3 Emissions

To calculate emissions for the baseline and policy scenarios, state-specific emissions factors were derived from the 2007 consumption and emissions data provided by Washington State.[82] The table below shows these factors. These factors were applied to data years through 2012 to ensure consistency with previously published emission estimates. For all forecasted data years, 2013-2030, NWPP (WECC Northwest) regional emissions factors from eGRID2012 version 1.0 (data year 2009) were used to calculate emissions from fossil fuel generation. The landfill emission factor remained the same across all years.

Table 18. Emissions factors by fuel source derived from the Washington Fuel Mix Disclosure emissions calculations.

Fuel Source	2007-2012 Emissions Factor derived from 2007 Washington State Provided Generation and Emissions. (MTC02/MWh)	2013-2030 Emission Factors. eGRID2012 NWPP (WECC Northwest)
Hydro	0	
Coal	1.03	1.025
Natural Gas	0.454	0.392
Nuclear	0	
Biomass	0	
Petroleum	1.38	0.858
Waste	0	
Geothermal	0	
Landfill Gases	0.523	
Wind	0	
Other	0	

5.3 Data Sources

The following data sources were used for the analysis:

- Washington State Fuel Mix Disclosure 2000-2012. http://www.commerce.wa.gov/Programs/Energy/Office/Utilities/Pages/FuelMix.aspx

[82] For the purpose of this analysis, fuel types including wind, geothermal, waste, biomass, and other were aggregated into one category of eligible renewables in accordance with the definition of "Renewable Resources" in the I-937 legislation text.

- Northwest Power Conservation Council 6th Power Plan. http://www.nwcouncil.org/energy/powerplan/6/plan/
- Washington Climate Advisory Team Policy Analysis. http://www.ecy.wa.gov/climatechange/interimreport/122107_TWG_es.pdf
- Energy Information Administration Annual Energy Outlook. http://www.eia.gov/forecasts/aeo/
- NWPCC Conservation Target Calculator: http://www.nwcouncil.org/energy/powerplan/6/assessmentmethodology/

5.4 Results

Based on the method outlined above, the following graph shows the trend in emissions for the baseline and policy scenarios through 2030.

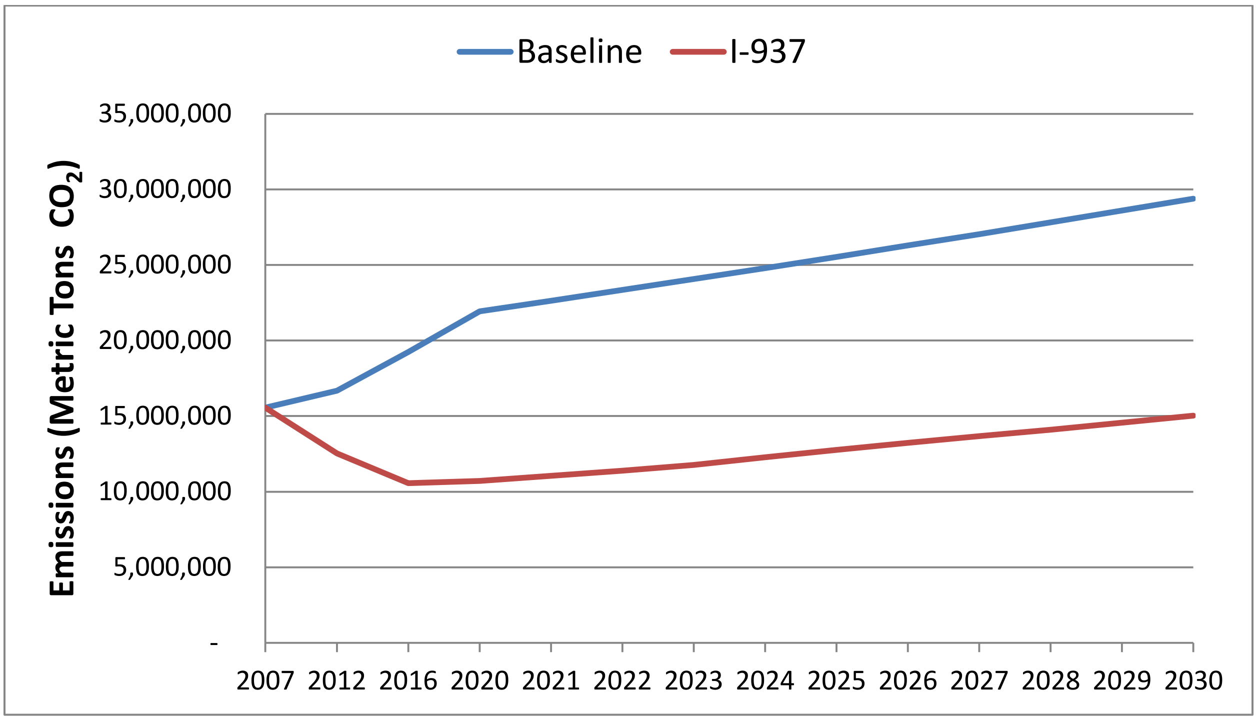

Figure 2. Emissions comparison between the I-937 and Baseline scenario estimates.

Total projected GHG emission reductions associated with the implementation of the Energy Independence Act are shown in the table below.

Table 19. Emissions reductions associated with the Energy Independence Act (I-937) RPS.

Results (Metric Tons CO_2)	2007	2012	2016	2020	2030
Baseline Scenario					

Emissions	15,558,205	16,675,615	19,232,235	21,935,062	29,387,829
Policy Scenario Emissions	15,558,205	12,538,664	10,552,772	10,714,305	15,020,046
Emission Reductions	-	4,136,951	8,679,464	11,220,756	14,367,783

Note: Not all numbers presented in table are significant figures.

6 Energy Efficiency and Energy Consumption Programs for Public Buildings

6.1 Policy Summary

The 2005 Legislature passed ESSB 5509, which established high performance building requirements for public buildings (RCW 39.35D). The policy requires certain state-funded "major facility projects" to meet high performance building standards. The legislation defines a "major facility project" as:

- A construction project larger than 5,000 gross square feet of occupied or conditioned space as defined in the Washington State Energy Code; or
- A building renovation project when the cost is greater than 50 percent of the assessed value and the project is larger than 5,000 gross square feet of occupied or conditioned space as defined in the Washington State Energy Code.

The high performance building requirements apply to state agencies, state institutions of higher education, and public school districts receiving state construction assistance. The requirements also apply to recipients of state capital funds in the form of community development grants or via the Housing Trust Fund. The legislation also identifies a number of different projects that do not qualify as major facility projects, such as transmitter buildings, pumping stations, hospitals or projects where high performance design is determined to be not practical. The legislation also includes exemptions for affordable housing projects funded under the Housing Trust Fund.

The legislation specifies use of the Leadership in Energy and Environmental Design (LEED) Silver standard or better for some entities and allows school districts to choose between use of the LEED standard or the Washington Sustainable Schools Protocol (WSSP). For affordable housing projects, the Department of Commerce adopted the Evergreen Sustainable Development Standard (ESDS) modeled after the Enterprise Green Communities' national green building standard for affordable housing. While LEED and similar standards generally contain some minimum energy efficiency requirements, they do not guarantee improved energy performance. To assure that state projects achieve greater energy efficiency through green building programs, the programs will need to continuously update the green building standards. The State could further improve the energy performance of its buildings by requiring all additional and optional energy efficiency criteria within these standards to be met.

The Legislature staggered the effective dates for meeting the new high performance building requirements according to the following schedule:

Table 20. High performance building project type requirements and dates.

Project Type	Effective Date
State Agencies & Higher Education Institutions	7/25/2005
Volunteer School Districts	7/1/2006
Class One School Districts	7/1/2007
Class Two School Districts	7/1/2008
Housing Trust Fund Recipients	7/1/2008

6.2 Methodology

A rough estimate of emissions reductions attributable to high performance building requirements was developed by assuming that newly constructed high-performance State-owned buildings are 10 percent more efficient, on average, than facilities built according to the minimum effective energy code requirements. Baseline (i.e. energy code-compliant) electricity and natural gas use intensities were established using intensities by building type from *Baseline Energy Use Index Of The 2002-2004 Nonresidential Sector: Idaho, Montana, Oregon, And Washington*[83] and 2012 Facilities Inventory System (FIS)[84] data for State-owned buildings. Data from these two sources were used to calculate weighted average electricity and natural gas use intensities representative of the State's owned building portfolio. These code-compliant energy use intensities were then projected out to 2050 according to the State's energy code improvement policy (see section 2).

With the exception of K-12 school buildings, the amount of newly constructed floor space was estimated in each target year by extrapolating the observed trend in state-owned floor space from 1982 to 2012 out to 2050. This data indicates that about 1.1% of buildings are new year-over-year. In addition, the *2012 Facilities Inventory System Report* discusses that about one third of newly constructed floor space replaces demolished floor space, while the remaining two thirds is new and additional to the portfolio. For K-12 schools, Sixth Power Plan projections of total floor space and a floor space retirement rate of 0.41 percent were used to determine the annual amount of newly constructed floor space.

First-year electricity and natural gas savings were then calculated by multiplying the amount of newly constructed floor space by the weighted average electricity and natural gas use intensities

[83] Ecotope. 2008. Baseline Energy Use Index Of The 2002-2004 Nonresidential Sector: Idaho, Montana, Oregon, And Washington. Accessed August 2013 at: http://neea.org/docs/reports/baselinecharacteristicsofthe20022004nonresidentialsectoridahomontanaoregonandwashingtoneuireport82536194fb35.pdf

[84] Office of Financial Management. 2012. 2012 Facilities Inventory System Report. Accessed August 2013 at: http://www.ofm.wa.gov/budget/facilities/documents/FacilitiesInventorySystemReport2012.pdf

and the 10 percent savings factor in each year. Total annual electricity and natural gas saving were then determined by cumulating the first-year savings over time.

Annual emissions reductions were calculated by multiplying annual electricity and natural gas savings by their respective emission factors and summing the results in units of metric tons carbon dioxide equivalent. The electricity emission factor for the Northwest Power Pool (NWPP) from *eGRID2012* (2009 data year)[85] was used to calculate electricity emission reductions. Separate natural gas emission factors for CO_2, CH_4, and N_2O were taken from *2013 Climate Registry Default Emission Factors*[86]. Calculated emissions of CO_2, CH_4, and N_2O were subsequently multiplied by their respective global warming potential (GWP) values from the IPCC Second Assessment Report and summed in units of metric tons carbon dioxide equivalent.

6.3 Assumptions

The GHG emission reductions associated with the implementation of high performance public buildings were projected for the target years utilizing the following assumptions:

- Electricity and natural gas savings due to High-Performance Buildings Standards are 10 percent relative to the effective energy code (this requires that minimum high-performance standards are continuously updated according to the latest industry-accepted green building codes).
- State-owned floor space (excluding K-12 schools) increases 0.73 percent (two thirds of 1.1 percent) year-over-year. In addition, 0.37 percent (one third of 1.1 percent) of existing floor space is replaced annually.
- K-12 school floor space increases according to Sixth Power Plan projections through 2030; 2031 through 2050 projections are based on extrapolated 10-yr linear trend observed from 2021 to 2030.
- Electricity emission factors assumed to continuously improve from 2009 to 2050 according the rate projected for the NWPP by AEO2013.

6.4 Data Sources

The following data sources were used for the analysis:

Table 21. Data sources used for the high performance public buildings analysis.

Data	Source
Baseline electricity and natural gas use intensities	Ecotope. 2008. Baseline Energy Use Index Of The 2002-2004 Nonresidential Sector: Idaho, Montana, Oregon, And Washington (Tables B-7 and B-18).

85 http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf
86 http://www.theclimateregistry.org/downloads/2013/01/2013-Climate-Registry-Default-Emissions-Factors.pdf

	http://neea.org/docs/reports/baselinecharacteristicsofthe20022004nonresidentialsectoridahomontanaoregonandwashingtoneuireport82536194fb35.pdf
Historical state-owned floor space data	Office of Financial Management. 2013. Facilities Inventory System. http://www.ofm.wa.gov/budget/facilities/fis.asp
Floor space by building type for State-owned buildings (except K-12 schools)	Office of Financial Management. 2012. 2012 Facilities Inventory System Report. http://www.ofm.wa.gov/budget/facilities/documents/FacilitiesInventorySystemReport2012.pdf
K-12 floor space forecast	NWCC. 2010. Sixth Northwest Conservation and Electric Power Plan: Conservation Supply Curve Files (Floor Area and Population Forecast) (http://www.nwcouncil.org/energy/powerplan/6/supply-curves)
Electricity CO_2e emission factor for NWPP	EPA. 2012. eGRID2012 year 2009 Summary Tables http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf
Natural gas CO_2, CH_4, and N_2O emission factors	The Climate Registry. 2013. The Climate Registry's 2013 Default Emission Factors (http://www.theclimateregistry.org/downloads/2013/01/2013-Climate-Registry-Default-Emissions-Factors.pdf)
Global Warming Potential for CO_2, CH_4, and N_2O	IPCC. 1995. IPCC Second Assessment Report: Climate Change 1995 (SAR) (https://docs.google.com/uc?export=download&confirm=no_antivirus&id=0B1gFp6Ioo3aka3NsaFQ3YlE3XzA)

6.5 Results

This analysis assumes new and remodeled floor space is 10 percent more efficient than effective energy code. As a result, savings are determined as the difference between "business-as-usual" scenario in which new floor space is constructed according to the effective energy code in each year and the high-performance scenario in which new floor space achieves 10 percent savings relative to the effective energy code in each year. This assumption requires that high-performance standards are continuously updated to the latest green building standards in order to outpace energy code improvements.

Table 22. Emissions reductions associated with the higher performance public buildings programs.

Target Year	Annual Energy Savings (mmBtu)			Annual Emissions Reduction (mtCO2e)
	Electricity	Natural Gas	Total Energy	
2020	220,000	160,000	380,000	30,000
2035	290,000	210,000	500,000	40,000
2050	340,000	240,000	580,000	44,000

Note: Not all numbers presented in table are significant figures.

Emission reductions from High-Performance Buildings Standards are relatively insignificant compared to other policies analyzed. These standards have a marginal impact on new construction and do little to impact existing buildings. This is to be expected since this policy is primarily a leadership, market transformation, and capacity building effort that introduces new methods and products to the market place.

7 Conversion of Public Fleet to Clean Fuels

7.1 Policy Summary

The Washington legislature has implemented several strategies aimed at reducing GHG emissions at the state agency level. To help reduce emissions from transportation by state agencies the legislature has implemented a strategy to convert public fleet vehicles to clean fuels. Under RCW 43.19.648, all state agencies and local governments are required to satisfy 40 percent of their fuel usage for publicly owned vessels, vehicles, and construction equipment with electricity or biofuel effective June 1, 2013, to the extent practicable. By June 1, 2015, 100 percent of these fuel needs are to be met by electricity or biofuel, to the extent practicable.[87] Transit agencies using compressed natural gas on June 1, 2018, are exempt from this requirement. Compressed natural gas, liquefied natural gas, or propane may be substituted for electricity or biofuel if the Department of Commerce determines that electricity and biofuel are not reasonably available. The state must also install electrical outlets capable of charging electric vehicles in each of the state's fleet parking and maintenance facilities, to the extent practicable, by the end of 2015.[88]

Under the legislation, all state agencies are required to transition all vehicles, vessels, and construction equipment to electricity and biofuels *to the extent practicable*. Washington Administrative Code (WAC) 194-28 (April 2013) defines practicability and clarifies how state agencies will be evaluated in determining whether they have met the goals set forth in RCW 43.19.648.[89] Table 1 shows the criteria considered when determining practicability for the various fuels used to meet the goals.[90]

[87] RCW 43.19.648. http://apps.leg.wa.gov/rcw/default.aspx?cite=43.19.648
[88] RCW 43.19.648 section 5. http://apps.leg.wa.gov/rcw/default.aspx?cite=43.19.648
[89] WAC 194-28. http://apps.leg.wa.gov/wac/default.aspx?cite=194-28&full=true
[90] WAC 194-28-070 Compliance Evaluation. http://apps.leg.wa.gov/wac/default.aspx?cite=194-28&full=true#194-28-070

Table 23. Practicability Criteria for Compliance Evaluation

Fuel Used to Meet Goal	Practicability Criteria (WAC 194-28)
Vehicle Electrification	It is considered practicable to procure a PHEV and PEV light-duty vehicle, light-duty truck, or medium-duty passenger vehicle when the following criteria are met: • The vehicle is due for replacement, • The anticipated driving range or use would not require battery charging in the field on a routine basis; and • The lifecycle cost is within five percent of an equivalent HEV based on anticipated length of service.
Biodiesel	It is considered practicable for agencies to: • Use a minimum of twenty percent biodiesel-blend fuel (B20) on an annualized basis when purchasing fuel through the state procurement system. • Make good faith efforts to identify sources and procure a minimum of B20 when purchasing fuel on a retail basis.
Ethanol	It is considered practicable for agencies with "flex-fuel" vehicles capable of using either high-blend ethanol fuel (E85) or regular gasoline to make good faith efforts to identify sources and procure E85 when purchasing fuel on a retail basis if the price of E85 is at least twenty percent less than regular gasoline.
Renewable Natural Gas	It is considered practicable for agencies considering acquisition of natural gas-fueled vehicles to actively assess opportunities to procure renewable natural gas as the primary fuel.
Alternate Fuels	Compressed natural gas, liquefied natural gas, or propane may be substituted for electricity or biofuel if the department determines that electricity and biofuel are not reasonably available.

Source: WAC 194-28-070 Compliance Evaluation.

State owned vehicles emitted about 277 thousand MTCO2e in 2011.[91] Five state agencies accounted for 89 percent of these emissions. Figure 1 shows the percentage of emissions from state agency vehicles, by agency, in 2011.[92]

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[91] Department of Ecology. Reducing Greenhouse Gas Emissions in Washington State Government. Second Biennial Progress Report Required under RCW 70.235.060. December 2012. https://fortress.wa.gov/ecy/publications/publications/1201019.pdf

[92] Ibid.

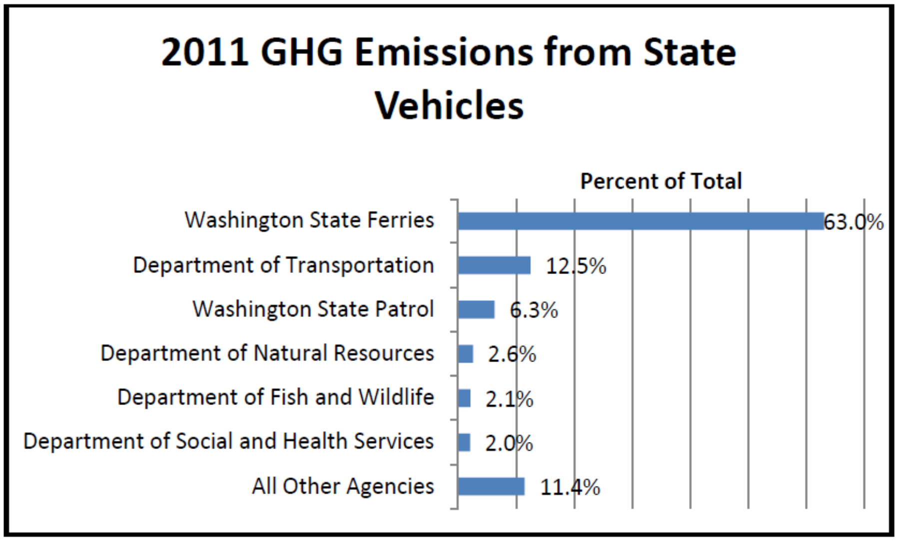

Figure 3. Share of Emissions from State Agency Vehicles, by Agency.

Gasoline and diesel fuel comprise the majority of fossil fuel consumed by state agency fleet vehicles and are the principal source of emissions. Agencies consumed 5.6 million gallons of gasoline in 2011. The largest consumer of gasoline among state agencies is the Washington State Patrol (WSP), which consumed 2.07 million gallons in 2011, accounting for about 37 percent of total agency gasoline consumption.[93] State agencies are already taking steps to reduce emissions from gasoline vehicles through the use of ethanol blends and hybrid electric vehicles. The state estimates that ethanol currently accounts for about 10 percent of agency gasoline consumption and that about half of the current agency vehicle fleet consists of first generation hybrid-electric vehicles (HEVs).[94] The share of electric vehicles, including HEVs, plug-in hybrid-electric vehicles (PHEVs), and all electric vehicles (EVs) in the agency fleet is expected to increase as the technology develops.[95]

Agencies consumed a total of 20.4 million gallons of diesel in 2011.[96] The large majority of diesel fuel is consumed by the Washington State Ferry (WSF) fleet operated by the Washington Department of Transportation (WSDOT). The WSF fleet consumed over 17.5 million gallons of diesel in 2011, accounting for 86 percent of total state agency diesel consumption.[97] As a major

93 Personal communication with Hedia Adelsman, Department of Ecology, August 23, 2013.
94 Email correspondence with Peter Moulton, Department of Commerce, July 15, 2013.
95 Email correspondence with Bryan Bazard, Department of Enterprise Services, August 23, 2013.
96 Washington State Department of Enterprise Services. Biodiesel Reports.
http://www.des.wa.gov/about/FormsPubs/Pages/Publications.aspx
97 Ibid.

consumer of diesel fuel in Washington, the WSF fleet is the focus of several current strategies to reduce fuel consumption and emissions, including:[98]

- Using biodiesel blends to reduce diesel consumption
- Retrofitting ferries to use LNG to replace biodiesel
- Profiling routes to identify optimum speeds to reduce fuel consumption
- Reducing the number of engines operating on certain vessel classes to reduce fuel consumption
- Reducing on-board fuel storage to minimize weight load and save fuel
- Installing heat-recovery systems that re-use heat from the engines to heat passenger areas

Engrossed Substitute Senate Bill 5024 requires WSDOT to pursue initiatives to reduce fuel consumption by WSF.[99] WSDOT is to develop a fuel reduction plan that includes fuel saving proposals, such as vessel modifications, vessel speed reductions, and changes to operating procedures, and provides anticipated fuel saving estimates.[100] The Department is also investigating the use of liquefied natural gas (LNG) for Issaquah Class ferries. The 7 Issaquah Class ferries account for about 22 percent of total WSF fuel use.[101] Conversion of these vessels to LNG would reduce diesel consumption by almost 4 million gallons per year based on WSF fuel consumption reported to the Department of Enterprise Services. The department will also install a power management system and more efficient propulsion systems on Hyak super class vessels which are expected to reduce fuel consumption by 20 percent and reduce maintenance costs.[102] In 2012, the Washington State Department of Transportation's Ferries Division won the President's Transportation Award for water transportation and was recognized for fuel savings on the Edmonds/Kingston ferry route, one of the most travelled routes in the system. The program reduced diesel fuel consumption by 180,000 gallons per year, the equivalent of about two thousand metric tons of CO2e per year. The state is also looking into a potential fuel saving project that will allow WSF vessels to be secured in dock for loading and unloading operations using reduced engine power.

ESSB 5024 requires Washington State ferries to use a minimum of five percent biodiesel blend (B5) during the 2011-2013 and 2013-2015 fiscal biennia, as long as the price of B5 does not

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[98] Department of Ecology. Reducing Greenhouse Gas Emissions in Washington State Government. Second Biennial Progress Report Required under RCW 70.235.060. December 2012. https://fortress.wa.gov/ecy/publications/publications/1201019.pdf
[99] Engrossed Substitute Senate Bill 5024. http://apps.leg.wa.gov/documents/billdocs/2013-14/Pdf/Bills/Session%20Laws/Senate/5024-S.SL.pdf
[100] ESSB 5024 Sec 221 (4)
[101] Source: Evaluating the Use of Liquefied Natural Gas in Washington State Ferries. Cedar River Group. January 2012. http://www.leg.wa.gov/JTC/Meetings/Documents/Agendas/2012 Agendas/JTC_010412/LNGDraftFinalReport_010412.pdf
[102] ESSB 5024 Sec 221 (4)

exceed the price of conventional diesel fuel by more than five percent.[103] Provisions of the state bulk fuel contract related to biodiesel also require that contractors provide state agencies with biodiesel made from at least 51 percent in-state feedstock and/or biodiesel produced in-state.[104] As of February 2013, all WSF vessels were using B5[105] and the Department is continuing to explore the use of biodiesel blends up to B20 in the future. Biodiesel use by the state agency land based fleet has increased significantly in recent years and accounted for over 12 percent of total non-WSF diesel consumption in the first half of 2012.[106]

7.2 Methodology

To estimate the baseline, biannual diesel and biodiesel consumption from January 2009 through June 2012 was obtained from biodiesel use reports submitted to the Department of Commerce by state agencies. This data show that total diesel consumption (sum of conventional diesel and biodiesel) by WSF and the land use sector has remained relatively flat through this time period, with only modest increases, as shown in Figure 2.

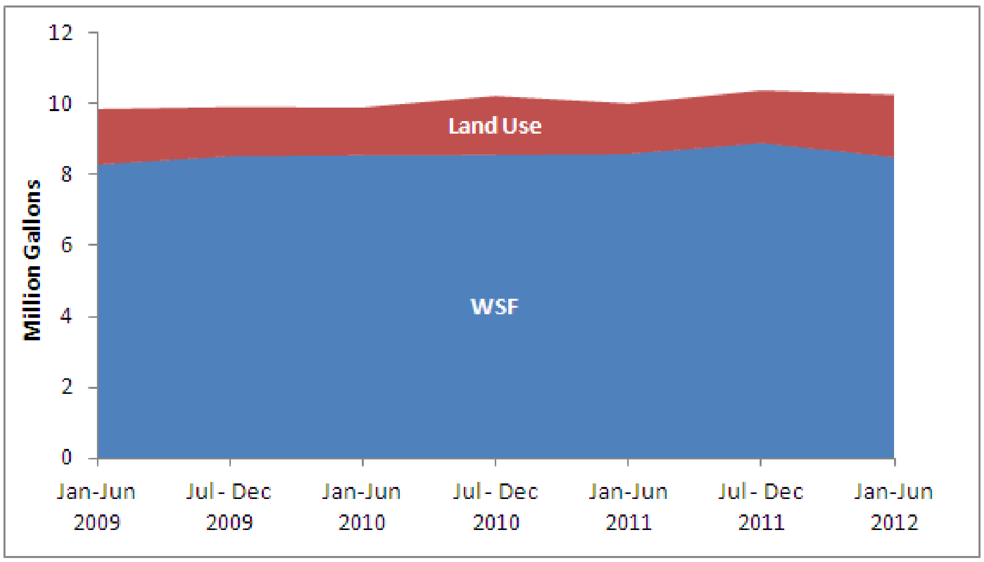

Figure 4. Total state agency diesel consumption, biannual, Jan 2009 – Jun 2012.

Although WSF diesel consumption is expected to increase marginally with the addition of three new Olympic Class vessels, this increase is assumed to be offset by existing and future WSF fuel

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[103] ESSB 5024 Sec 701 (5)

[104] Washington State Department of Enterprise Services. Biodiesel Use by Washington State Agencies. http://www.des.wa.gov/SiteCollectionDocuments/About/FormsnPublications/Reports/BiodieselUseReport20121231.pdf

[105] Washington State Department of Transportation. Washington State Ferries Environmental Program Website http://www.wsdot.wa.gov/Ferries/Environment/default.htm

[106] Department of Ecology. Reducing Greenhouse Gas Emissions in Washington State Government. Second Biennial Progress Report Required under RCW 70.235.060. December 2012. https://fortress.wa.gov/ecy/publications/publications/1201019.pdf

reduction initiatives.[107] Any marginal increases in diesel consumption by land use vehicles are also assumed to be offset by efficiency increases.[108] Therefore, to develop a total diesel demand baseline projection, the analysis assumes that annual diesel consumption will be equivalent to the average consumption from January 2009 to June 2012 and will remain relatively flat at this volume through the target years. To develop an estimate of the share of biodiesel of total diesel consumption in the target years, it was assumed that all vehicles and vessels that consume diesel, including the WSF fleet, meet but do not exceed a biodiesel blend of B20 by 2020. The biodiesel blend is assumed to remain flat at B20 through the target years. The average carbon intensity for biodiesel for each target year was developed based on a blend of feedstocks likely to be consumed in Washington which changes over time as technology improves and more advanced feedstocks become available to the market. Table 2 shows the share of biodiesel feedstocks in the target years.[109] It is assumed that all Issaquah Class vessels are converted to LNG by 2035 which will displace 22 percent of WSF diesel consumption. The LNG carbon intensity was derived from the California Low Carbon Fuel Standard using the average carbon intensity for North American LNG delivered via pipeline and overseas sourced LNG.[110]

Table 24. Share of Biodiesel Feedstocks in Target Years

	Current Share	**Share of Biodiesel Feedstocks in Target Years**		
Biodiesel Feedstock	**2013**	**2020**	**2035**	**2050**
Biodiesel, MW Soybeans	0.50	0.35	0.20	0.15
Biodiesel, NW Canola	0.25	0.30	0.35	0.40
Biodiesel, Waste Grease	0.25	0.30	0.35	0.35
Biodiesel, Corn Oil	0.00	0.05	0.10	0.10

The gasoline demand baseline projection is based on the average total gasoline consumption by state agencies from 2009 to 2011 and is assumed to remain flat through the target years as the impact of vehicle efficiency increases offsets demand growth.[111] Ethanol consumption is not expected to increase significantly from current levels, therefore, the share of ethanol in gasoline vehicles is assumed to remain at 10 percent (E10) through the target years. Note that no reductions are associated with ethanol because there is no increase in ethanol consumption relative to the baseline. However, the share of electric vehicles is assumed to increase. A general growth in electric vehicles of all types was assumed through the target years. The EIA Annual Energy Outlook projects that electric vehicles (total of EV, PHEV, and HEV) will

[107] Based on comments submitted by WSF staff in the draft version of this report delivered August 1, 2013.
[108] Based on trend of land based diesel consumption from 2009 to 2012.
[109] Developed through consultation with Peter Moulton, Department of Commerce, August 21, 2013.
[110] California LCFS lookup tables. www.arb.ca.gov/fuels/lcfs/121409lcfs_lutables.pdf
[111] Assumption based on fuel consumption data and personal communication with staff from the Departments of Commerce, Ecology, and Enterprise Services.

account for 4 percent of total vehicle sales in the Pacific Region in 2020 and 8 percent in 2035.[112] It was assumed that state agencies would adopt electric vehicles at a faster rate than the region as a whole and assumed that electric vehicles would account for 60 percent of agency gasoline vehicles in 2020, 75 percent in 2035, and 85 percent in 2050.[113] As a simplifying assumption, each electric vehicle type (HEVs, PHEVs, and EVs) was assumed to represent an equal share of electric vehicle growth. The average electric vehicle carbon intensity was developed based on the relative carbon intensity of each electric vehicle type to a gasoline vehicle using the grid electricity mix in Washington. Compressed natural gas (CNG) is assumed to displace 10 percent of gasoline consumption after 2020.[114] Table 3 shows the carbon intensities used in this analysis.[115]

Table 25. Carbon Intensities for Baseline Fuels and Replacement Fuels

Fuel	Carbon Intensity (gCO2e/MJ)
Baseline Gasoline	92.3
Baseline Diesel	91.5
Biodiesel, MW Soybeans	68.0
Biodiesel, NW Canola	26.0
Biodiesel, Waste Grease	20.0
Biodiesel, Corn Oil	4.0
CNG, pipeline NG	69.0
LNG	82.0
Electric Vehicles, average HEV, PHEV, EV	47.1

Baseline GHG emissions were calculated by multiplying the gallons of gasoline and diesel projected to be consumed in the target years by the CO2 emission factor for each fuel. The amounts of ethanol, biodiesel, electricity, CNG, and LNG assumed to replace the gasoline and diesel were multiplied by their respective CO2 emission factors to account for the emissions associated with their use. These emissions were subtracted from the fossil fuel emissions to determine total reductions.

[112] EIA Annual Energy Outlook 2013. Table 39.9. http://www.eia.gov/forecasts/aeo/data.cfm#transdemsec
[113] Note that projections of electric vehicles adoption rates were not available. This general assumption is included to show the increasing share of EVs in the agency fleet, and was developed in consultation with State Agency staff.
[114] Projections of CNG adoption rates were not available. This is a general assumption to reflect that at least a small portion of gasoline vehicles may be replaced with CNG in the future.
[115] Carbon intensities are well-to-wheel (WTW). Intensities for Gasoline, Diesel, Biodiesel feedstocks, and CNG are taken from the report *A Low Carbon Fuel Standard in Washington: Informing the Decision*. TIAX LLC. February 2011. http://www.ecy.wa.gov/climatechange/docs/fuelstandards_finalreport_02182011.pdf. LNG carbon intensity from California LCFS. http://www.arb.ca.gov/fuels/lcfs/121409lcfs_lutables.pdf. Electric Vehicle carbon intensity derived from DOE Alternative Fuel Data Center. http://www.afdc.energy.gov/vehicles/electric_emissions.php

7.3 Assumptions

The GHG emission reductions associated with the conversion of public vehicles to clean fuels were projected for the target years utilizing the following assumptions:

- Gasoline and diesel consumption remain relatively flat through the target years as increased efficiency offsets growth in demand
- All vehicles and vessels that consume diesel, including the WSF fleet, meet but do not exceed a biodiesel blend of B20 by 2020
- The share of ethanol in gasoline remains flat at current levels (10 percent) through the target years
- All Issaquah Class vessels are converted to LNG by 2035
- The amount of lower carbon feedstocks used to produce biodiesel consumed in Washington increases through the target years.
- Electric vehicles account for an increasing share of agency vehicles through the target years. Electric vehicles are assumed to replace 60 percent of agency gasoline vehicles in 2020, 75 percent in 2035, and 85 percent in 2050.
- CNG displaces 10 percent of gasoline consumption after 2020.

7.4 Data Sources

The following data sources where used for this analysis:

- Fuel Consumption estimates: Washington State Department of Enterprise Services. Biodiesel Reports. http://www.des.wa.gov/about/FormsPubs/Pages/Publications.aspx
- Fuel energy content: California Air Resources Board (ARB), Low Carbon Fuel Standard. Look up Tables. http://www.arb.ca.gov/fuels/lcfs/lu_tables_11282012.pdf
- Fuel carbon intensities: A Low Carbon Fuel Standard in Washington: Informing the Decision. TIAX LLC. February 2011. http://www.ecy.wa.gov/climatechange/docs/fuelstandards_finalreport_02182011.pdf
- Reducing Greenhouse Gas Emissions in Washington State Government. Second Biennial Progress Report Required under RCW 70.235.060. https://fortress.wa.gov/ecy/publications/SummaryPages/1201019.html
- EV factors: Derived from US DOE. Alternative Fuels Data Center. (http://www.afdc.energy.gov/vehicles/electric_emissions_sources.html)

7.5 Results

Based on the method outlined above, total projected gasoline and diesel consumption avoided through the use of clean fuels and EVs in 2020, 2035, and 2050 are shown in the tables below. The following tables show: the baseline emissions and reductions from replacing gasoline with CNG and electricity; the baseline emissions and reductions from replacing diesel with biodiesel and LNG; and the total reductions resulting from the policy. Note: Note: Not all numbers presented in tables are significant figures.

Table 26. GHG reductions for state agencies from replacing gasoline with electricity and CNG.

Electric Vehicles				CNG			
Gasoline Displaced	Gasoline Emissions Avoided	Electric Vehicle Emissions	Electric Vehicle Emission Reductions	Gasoline Displaced	Gasoline Emissions Avoided	CNG Vehicle Emissions	CNG Vehicle Emission Reductions
MJ	MT CO2e	MT CO2e	MT CO2e	MJ	MT CO2e	MT CO2e	MT CO2e
395,907,266	36,423	18,666	17,758	0	0	0	0
494,884,083	45,529	23,332	22,197	65,984,544	6,071	4,553	1,518
560,868,627	51,600	26,443	25,157	65,984,544	6,071	4,553	1,518

Table 27. GHG reductions for state agencies from replacing diesel with biodiesel and LNG.

Biodiesel				LNG			
Gallons Diesel Avoided	Diesel Emissions Avoided	Biodiesel Emissions	Biodiesel Emission Reductions	Gallons Diesel Avoided	Diesel Emissions Avoided	LNG Emissions	LNG Emission Reductions
Gallons	MT CO2e	MT CO2e	MT CO2e	Gallons	MT CO2e	MT CO2e	MT CO2e
3,432,231	42,461	17,446	25,015	0	0	0	0
3,432,231	42,461	13,892	28,569	3,775,455	46,707	41,630	5,077
3,432,231	42,461	12,923	29,538	3,775,455	46,707	41,630	5,077

Table 28. Total GHG reductions from replacing gasoline and ethanol with biofuels and electricity.

	Reductions from Replacing Gasoline with CNG and EV	Reductions from Replacing Diesel with Biodiesel and LNG	TOTAL REDUCTIONS
Target Year	MT CO2e	MT CO2e	MT CO2e
2020	2,960	25,015	27,975
2035	7,437	33,646	41,083
2050	13,356	34,615	47,971

8 Purchasing of Clean Cars

8.1 Policy Summary

The Clean Car Law was passed by the Washington State Legislature in 2005. It states that, starting with 2009 models, new vehicles must meet strict clean air standards to be registered, leased, rented, licensed, or sold for use in Washington. This mandate includes cars, light duty trucks, and passenger vehicles (SUVs and passenger vans). New vehicles that do not meet clean car standards cannot be registered, licensed, rented, or sold for use in Washington.[116]

Washington recently adopted California Standards[117] through RCW 70.120A.010 so as to not create another standard on top of federal and the stricter California standards. These California motor vehicle emission standards are for passenger cars, light duty trucks, and medium duty passenger vehicles based on Title 13 of the California Code of Regulations. The Washington standard will be amended from time to time to maintain consistency with the California motor vehicle emission standards.

8.1.1 Discussion on California Clean Car Standards

The California Air Resources Board (CARB) adopted Low Emissions Vehicle (LEV) standards in 1990 (effective from 1994-2003) to control smog-causing pollutants from tailpipe emissions. LEV II amendments built upon these standards to further improve pollutant emissions reductions became operational in 1999 (effective from 2004-2010).[118] In 2002, the governor signed California Bill AB 1493 (Pavley Regulations) for the reduction of GHG emissions. The California Pavley Regulation was fully adopted in 2005, and became effective for 2009 model year cars. AB 1493 directed CARB to adopt the maximum feasible and cost-effective reductions in GHG emissions from light-duty vehicles. Vehicle GHG emissions included carbon dioxide, methane, and nitrous oxide emitted from the tailpipe, along with emissions of HFC134a.[119] California has recently adopted a new set of amendments called the Cal Low Emission Vehicle III (LEV III) amendments, also known as the Advanced Clean Cars Program. These amendments control emissions from cars and light duty trucks by combining the standard for smog-causing pollutants and GHG emissions into a single coordinated package.[120]

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116 http://www.ecy.wa.gov/programs/air/cleancars.htm

117 California Environmental Protection Agency. Air Resources Board. Low-Emission Vehicle Program. http://www.arb.ca.gov/msprog/levprog/levprog.htm

118 California Air Resources Board. 2012. Low Emission Vehicle Program. Online at: http://www.arb.ca.gov/msprog/levprog/levprog.htm

119 California Air Resources Board. February 25, 2008. Comparison of Greenhouse Gas Reductions for the United States and Canada under ARB GHG Regulations and Proposed Federal 2011-2015 Model Year Fuel Economy Standards, p. vi. Online at: http://www.arb.ca.gov/cc/ccms/reports/pavleycafe_reportfeb25_08.pdf

120 California Air Resources Board. 2011. Facts about the Advanced Clean Cars Program. Online at: http://www.arb.ca.gov/msprog/zevprog/factsheets/advanced_clean_cars_eng.pdf

The Cal LEV III amendments include proposed changes to the LEV II standards. The changes include updated emission standards for criteria pollutant emissions for vehicle model years 2015-2025 and GHG emission standards for vehicle model years 2017-2025. The changes will be phased-in through 2025. The proposed changes were approved by the CARB in 2012. The GHG standards expand on the current Pavley emission standards set for model year 2009-2016 vehicles. The new standard establishes a 'footprint' curve where GHG reduction targets are set based on the overall size of the vehicle. By basing the GHG reduction targets on vehicle size, the level of difficulty in meeting the standard is the same for smaller and larger vehicles. This will allow manufacturers to have the flexibility needed in determining how their fleet will meet the new requirements.

The CARB calculated the GHG reduction potential of the new LEV III standards. The potential reductions include:

- GHG emissions from new cars will be cut 34 percent from 2016 levels.
- By 2025, GHGs will be reduced by 42 million tons, the equivalent of taking 10 million cars off the road for a year.
- A cumulative reduction of more than 870 million metric tons of greenhouse gases through 2050.[121]

California has estimated that the average new vehicle purchase costs will increase by about $1,900 when the more stringent requirements take effect. However, these increased purchase costs are expected to be offset by reduced operating costs, ultimately resulting in a net savings of up to $4,000 over the lifetime of the vehicles.[122]

8.2 Methodology

8.2.1 California Air Resources Board Pavley Regulations Analysis Methods for Washington

In 2008, CARB conducted an analysis[123] to compare the GHG emission reduction benefits expected from California's Pavley rules for 2009 – 2016 model year vehicles with proposed federal fuel economy standards for 2011 through 2015 model years. For this analysis, CARB also calculated the emissions benefits for each of the 50 states assuming the Pavely standards

[121] California Air Resources Board. 2011. *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Public Hearing to Consider the "LEV III" Amendments to the California Greenhouse Gas and Criteria Pollutant Exhaust and Evaporative Emission Standards,* p. 175. Online at: http://www.arb.ca.gov/regact/2012/leviiighg2012/levisor.pdf

[122] Ibid, p. 209.

[123] California Air Resources Board. May 8, 2008. Comparison of Greenhouse Gas Reductions for the United States and Canada under ARB GHG Regulations and Proposed Federal 2011-2015 Model Year Fuel Economy Standards: Addendum to the February 25 Technical Assessment. Online at: http://www.arb.ca.gov/cc/ccms/reports/final_pavleyaddendum.pdf

were applied to each individual state. CARB analysis included an estimate of the expected GHG emissions reductions in Washington State in 2016 and 2020 as a result of implementing the Pavley standards.[124] The following table outlines GHG the emissions requirements for cars and trucks for the Pavley Standard.

Table 29. California Pavley Regulation emissions standards for passenger cars and light duty trucks.[125]

Model Year	Cars (g CO_2e /mi)	Trucks (g CO_2e /mi)
2002 (Base Year)	312	443
2009	323	439
2010	301	420
2011	267	390
2012	233	361
2013	227	355
2014	222	350
2015	213	341
2016	205	332
2017	195	310
2018	185	285
2019	180	270
2020	175	265

CARB calculated the tons of greenhouse gases reduced in California under the federal CAFE standards compared to those that occur under the Pavley rules by applying the new vehicle model year-specific GHG reductions to the carbon dioxide tons per day emission estimates output from the EMFAC[126] on-road emissions inventory model .[127] In this 2008 study, the EMFAC model accounted for the 2008 and projected vehicle fleet in California based on data from the Department of Motor Vehicles, the Smog Check inspection and maintenance program, and local and regional transportation planning agencies. Emissions rates were derived from in-use vehicle tests. To translate these calculations to other states such as Washington, CARB used

[124] Data received from personal communication with Brett Rude at the Washington Department of Ecology on August 7, 2013.
[125] Table adapted from: CARB February 2008 Technical Assessment, Table 4 on p. 8. Note that CO_2 equivalents account for all GHGs (CO_2, N_2O, CH_4, and HFCs).
[126] For the CARB report, EMFAC was the U.S.EPA approved model used by California to assess the effectiveness of its vehicular emission control rules. See e.g. 73 FR 3464 (January 18, 2008).
[127] CARB February 2008 Technical Assessment, p. 3.

Washington-specific gasoline consumption data as a proxy for scaling emissions reductions in the EMFAC model.[128,129]

8.2.2 California Air Resources Board LEV III Analysis Methods

The California Air Resources Board (CARB) Advanced Clean Cars Staff Report[130] was used as a model to illustrate the potential benefits of Washington's Clean Car Law. The following text summarizes the methods used by CARB to calculate GHG emissions reductions from the Advanced Clean Car program.

CARB used the EMFAC 2011 model to estimate the environmental benefits of the Advanced Clean Cars program, specifically focusing on on-road passenger vehicles. The EMFAC light-duty vehicle (LDV) module accounts for passenger cars, light-duty truck, and medium-duty trucks, and is informed by the most recent available Department of Motor Vehicles registration data and estimates on vehicle miles traveled (VMT) from regional transportation planning agencies. EMFAC calculates emissions as the product of the population of vehicles, the number of VMTs[131], and the emissions rates for each vehicle per mile[132]:

Emissions = Vehicle Population[133] *x Technology Fraction*[134] *x Annual VMT x Emission Factor*

The baseline scenario in EMFAC was adjusted to account for the most recent assessment of baseline technology penetration and updated emissions factors. The policy scenario takes into account the GHG standards for new vehicles in California that are outlined in the following table:

Table 30. GHG standards for New Vehicles in California as run in the policy scenario of the EMFAC model for the LEV III standards.[135]

Model Year	Cars (g/mi CO2e)	Trucks (g/mi CO2e)	Fleet Average (g/mi CO2e)
2008 (Base Year)	291	396	336
2017	213	290	243

[128] Ibid, p. 3.
[129] CARB May 2008 Addendum, p. 3.
[130] CARB 2011, 272 pp.
[131] It is important to note that EMFAC does not model VMT past 2035. In order to forecast VMT and emissions from 2035 to 2050, CARB applied an annual population growth rate from the last year (2034-2035) to years through 2050. This population projection combined with default survival rates and annual VMT accrual data contributed to calculating total annual VMT from 2035 to 2050.
[132] CARB 2011, p. 172.
[133] Vehicle Population refers to the population of a vehicle of a given vehicle type and model year.
[134] Technology Fraction refers to the fraction of vehicles that meet the different emission exhaust standard categories (e.g., super-ultra-low-emission-vehicle and ultra-low-emission-vehicle).
[135] Table adapted from: CARB 2011 Appendix T, p. T-40. Online at: http://www.arb.ca.gov/regact/2012/leviiighg2012/levappt.pdf

2018	203	280	233
2019	192	273	224
2020	183	264	215
2021	173	245	201
2022	165	233	192
2023	158	221	183
2024	151	210	174
2025	144	200	166

With the policy scenario comes the impacts from rebound effects. A rebound effect is where customers use some fraction of the energy savings from the newly introduced technology to utilize a greater amount of a particular good. In this case, the rebound effect would be that driving may increase slightly if operating costs for vehicles decrease with the Advanced Clean Car regulation. Depending on the year and scenario, CARB used a state-specific rebound of 3 to 6 percent for both the baseline and policy scenarios.[136] With the rebound effect included, CARB calculated the benefits of the Advanced Clean Car Program by taking the difference between the adjusted baseline emissions inventory and the policy scenario inventory.

8.3 Assumptions

8.3.1 California Air Resources Board Pavley Regulations Analysis Results for Washington

CARB projected the GHG emission reductions associated with the implementation of the Pavley Regulations for the 2016 and 2020 target years utilizing the following major assumptions:

- CARB assumed the Washington fleet mix to be 55 percent passenger cars and 45 percent light duty trucks.
- For this project, to translate the CARB estimate for California to Washington, the same percentage was applied as was previously used by CARB to estimate Washington emission reductions from the Pavely standards.

8.3.2 California Air Resources Board LEV III Analysis Assumptions

CARB projected the GHG emission reductions associated with the implementation of the Advanced Clean Car regulations for the target years utilizing the following major assumptions:

- No further tightening of standards after 2025.
- Rebound effect of 3 to 6 percent depending on year and scenario.

[136] It is important to note that federal agencies usually apply a general 10 percent rebound for their analyses, but CARB used what they considered to be a more state-specific rebound estimate from 2010 peer review literature by Hymel, Small, and Van Dender. Note, for the purposes of this analysis, CARB assumptions were adopted in absence of detailed data for Washington.

- EMFAC 2011 does not account for the reductions and benefits from the Pavley standard[137] or the Low Carbon Fuel Standard. These adjustments to the baseline are made in a separate Advanced Clean Car mobile source emissions inventory database tool.

8.4 Data Sources

The following data sources were used for the analysis:

- Department of Ecology. Washington Clean Car Information. http://www.ecy.wa.gov/programs/air/cleancars.htm
- California Air Resources Board May 2008 Addendum to the February 2008 Technical Assessment for the Pavley Standards. http://www.arb.ca.gov/cc/ccms/reports/final_pavleyaddendum.pdf
- California Air Resources Board Advanced Clean Cars Staff Report. http://www.arb.ca.gov/regact/2012/leviiighg2012/levisor.pdf
- California Air Resources Board. Amendments to the Low-Emission Vehicle Program - LEV III. http://www.arb.ca.gov/msprog/levprog/leviii/leviii.htm

8.5 Results

8.5.1 California Air Resources Board Pavley Regulations Analysis Results for Washington

For Washington State, CARB estimates that there will be annual emissions reductions of 2.3 million $mtCO_2e$ in 2016 and 5 million $mtCO_2e$ in 2020.[138] The following table depicts the 2016 and 2020 annual and cumulative emissions reductions from adopting the California Pavley Standards in Washington.

Table 31. Washington State annual and cumulative CO2e emissions reductions achieved by adopting the California Pavley Regulation.[139]

Year	Annual GHG Reductions from Pavley Standards (Million MtCO2e)	Cumulative GHG Reductions from Pavley Standards (Million MtCO2e)[140]
2016	2.3	7.9

[137] The Pavely standard refers to California Bill AB 1493 that was signed by the governor in 2002. AB 1493 directed CARB to adopt the maximum feasible and cost-effective reductions in GHG emissions from light-duty vehicles. Vehicle GHG emissions included carbon dioxide, methane, and nitrous oxide emitted from the tailpipe, along with emissions of HFC134a.
[138] Ibid, Table 2 on p. 6.
[139] Table adapted from: Washington values in the CARB May 2008 Addendum, Table 3 on p. 7.
[140] Note that the annual and cumulative reductions are based on a federal fleet mix assumption that CARB used for other states that they modeled (approximately 55 percent passenger car/light duty truck 1 & 45 percent light duty truck 2. Thus, benefits for Washington may be slightly underestimated as the State's fleet mix may be different.

2020	5.0	24.8

8.5.2 California Air Resources Board LEV III Analysis Results

CARB calculated the CO2-Equivalent (CO2e) emission benefits from Advanced Clean Car regulations in California, shown in Table 24. CARB's analysis concluded that because the operating costs of vehicles meeting the GHG standards will decrease, vehicle use may increase (the Rebound Effect). When rebound rates were included in the inventory, there were negligibly (approximately one to two percent) fewer emission reductions compared to the substantial overall emission reductions expected from the Advanced Clean Car regulations package. It is important to note that the full benefits of the policy will more likely be seen over 20 years into the future when the California fleet completely consists of the policy-compliant vehicles. Washington would likely see similar reductions proportional to the state's vehicle mix and VMT.

Table 32. Emissions and emissions reductions from the Advanced Clean Car regulations in California.[141]

California Statewide CO_2e Emissions (Million Metric Tons/Year)				
Calendar Year	Adjusted Baseline with Rebound	Proposed Regulation with Rebound	Reductions	Percent Reduction
2020	111.2	108.1	3.1	3%
2025	109.9	96.3	13.6	12%
2035	114.8	83.2	31.6	28%
2050	131	88.3	42.7	33%

8.5.3 California Air Resources Board LEV III Analysis Results for Washington

To estimate the impact of the LEV-III standards in Washington, a simplified method based on the results of the 2008 CARB Pavely analysis described above was used. The CARB study calculated the annual and cumulative CO_2e reductions that would be achieved for each of the 50 states if the Pavely standards were in place, applying a percent to adjust the California estimate to each state. The ratio between California and Washington was applied to the California LEV-III reductions to estimate the reductions from LEV-III that WA would achieve. Table 33 shows the estimated reductions from the LEV-III standards in Washington in 2020, 2035, and 2050 based on this simplified translation.

[141] This table was adapted from page 176 of the CARB *Staff Report: Initial Statement of Reasons for Proposed Rulemaking, Public Hearing to Consider the "LEV III" Amendments to the California Greenhouse Gas and Criteria Pollutant Exhaust and Evaporative Emission Standards.* http://www.arb.ca.gov/regact/2012/leviiighg2012/levisor.pdf

Table 33. Estimated Washington State Reductions from LEV-III

Washington Statewide CO_2e Emissions Reductions – LEV-III (Million Mt/Year)		Washington Statewide GHG Reductions from Pavley Standards (Million MtCO2e/Year)*	Washington Statewide GHG Reductions from Clean Cars Standards (Million MtCO2e/Year)
Calendar Year	**Reductions**		
2020	0.5	5	5.5
2035	5.0	5	10
2050	6.7	5	11.7

Note: it is assumed that the 5 MMtCO2e/year achieved by Pavely is constant for each year and therefore added to the LEV III Reductions. Not all numbers presented in table are significant figures.

9 Policies and Programs under the Growth Management Act

9.1 Policy Summary

Patterns of land use development have a direct impact on transportation sector GHG emissions, which accounted for over 44 percent of total GHG emission in Washington state in 2010.[142] Land use planning and transportation strategies that encourage compact and mixed use development lead to fewer VMT resulting in reduced consumption of transportation fuel and GHG emissions.[143] The Washington State Legislature passed the Growth Management Act (GMA) in 1990 creating a framework for comprehensive land use planning. Reducing urban sprawl and encouraging efficient multimodal transportation systems are among the comprehensive planning goals,[144] which in turn, address VMT and other concerns. To address uncoordinated and unplanned growth, the GMA requires state and local governments (i.e., counties of a certain size and growth rate, and the cities within them[145]) to manage growth by identifying and protecting critical areas and natural resource lands, designating urban growth

[142] SAIC, Evaluation of Approaches to Reduce Greenhouse Gas Emissions in Washington State, Task 1.a – Analyze Washington State's total consumption and expenditures for energy, Draft, August 2013.
[143] Reid Ewing, et al., Growing Cooler: The Evidence on Urban Development and Climate Change, , Urban Land Institute, 2008. http://postcarboncities.net/files/SGA_GrowingCooler9-18-07small.pdf
[144] RCW 36.70a. http://apps.leg.wa.gov/rcw/default.aspx?cite=36.70a
[145] State of Washington, About the Growth Management Act, Accessed August 2013 at http://www.gmhb.wa.gov/Reader.aspx?pg=About.htm

areas, preparing comprehensive plans and implementing them through capital investments and development regulations.[146]

In 2008, the Legislature enacted Senate Bill 6580 to support State and local agencies in meeting the GHG emission limits codified in E2SSHB 2815, and specifically to address mitigation of GHG emissions through land use and transportation planning processes under the GMA. The legislation recognized that patterns of land use development influence transportation-sector GHG emissions and the state's dependence on foreign oil.[147] Senate Bill 6580 directed the Washington State Department of Commerce to produce a report identifying potential amendments to the GMA and related statutes, that would better enable state and local governments to address climate change issues through land use and transportation planning. The report found that compact urban development is the most important and effective land use planning action the State can take to make progress towards reducing emissions, citing the study *Growing Cooler*, which claimed that increasing the percentage of new development that occurs in compact, urban patterns can result in a 20-40 percent reduction in per capita VMT and a 7-10 percent reduction in associated GHG emissions in the United States by 2050.[148]

The Transportation Implementation Working Group (IWG) was formed under the Climate Action Team (CAT) to address the E2SSHB 2815 requirements regarding "most promising" GHG reduction strategies, including VMT reduction approaches for transportation. In 2008, the Transportation IWG worked to document approaches to reduce emissions from transportation and highlighted Compact and Transit Oriented Development (CTOD) as an "integral part" of its transportation recommendations, because it provides for necessary density, infrastructure, and features that support and enable the use of alternatives to single occupancy vehicle (SOV) trips. The IWG reports that Washington's GMA "already enables, but does not require, local government planning to promote centers or CTODs."

The recommended CTOD elements, which reportedly represent the most promising opportunities to reduce VMT and can be adopted under the GMA include the following:[149]

- Promote and Support Housing and Employment Density
- Develop and Provide Parking Incentives and Management
- Encourage Bicycle and Pedestrian Accessibility
- Encourage Urban Brownfield Redevelopment

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[146] Chapter 36.70A RCW. http://apps.leg.wa.gov/RCW/default.aspx?cite=36.70A
[147] RCW 36.70A.280. http://apps.leg.wa.gov/rcw/default.aspx?cite=36.70A.280
[148] Reid Ewing, et al., Growing Cooler: The Evidence on Urban Development and Climate Change, , Urban Land Institute, 2008. http://postcarboncities.net/files/SGA_GrowingCooler9-18-07small.pdf
[149] Washington 2008 Climate Action Team, Transportation Implementation Working Group. Appendix 4: Reducing Greenhouse Gas Emissions and Increasing Transportation Choices for the Future. Accessed August 2013 at http://www.ecy.wa.gov/climatechange/2008CATdocs/IWG/tran/110508_transportation_iwg_final_report.pdf

- Transportation concurrency

The various transportation and land use policies under the GMA, such as bicycle accessibility and parking management, interact closely with each other, and other existing policies, both synergistically and competitively. Due to the complexity of these interactions, a transportation and land use planning modeling effort would need to be undertaken to quantify the impact of these interactions on GHG emission reductions. While such modeling efforts are outside the scope of this analysis, a separate section of this project – the Task 4 Report addresses the key interactions of different policies across sectors and levels of government.

9.2 Methodology

For the purpose of this analysis, a simplified methodology was employed to quantify GHG emissions resulting from GMA transportation and urban development policies, notably:

- Identify prior GHG quantification approaches and reduction estimates that have a relationship to GMA transportation and urban development policies;
- For each estimate identified, review the scope of the strategy and its relationship to GMA; and
- Select the most representative estimate and extrapolate to 2050 by applying a reasonable growth rate assumption.

To this end, several studies aimed at estimating GHG emission reductions were examined, and key results are presented in the paragraphs and tables below. Among all of the related GHG quantification efforts previously undertaken for each identified policy bundle, the quantified policy assumed to be the most representative of the GMA policy is the CAT IWG estimate for 2020 GHG reductions statewide from the CTOD Strategy.[150] For the purposes of this project, the CTOD 2020 estimate is adopted for the current 2020 estimate for GMA. The following paragraphs and tables in this section summarize the literature reviewed and estimates previously prepared for potentially relevant policy approaches.

There are multiple approaches, methodologies and tools to quantify and estimate GHG emission impacts of transportation and land-use policies; each at various stages of development and refinement, and applicable at difference geographic scales. In addition, there are a vast number of possible indicators that could be tracked to gauge progress toward sustainable transportation goals associated with growth management, from VMT reductions and transit ridership to

[150] Washington 2008 Climate Action Team, Transportation Implementation Working Group. Appendix 4: Reducing Greenhouse Gas Emissions and Increasing Transportation Choices for the Future. Accessed August 2013 at http://www.ecy.wa.gov/climatechange/2008CATdocs/IWG/tran/110508_transportation_iwg_final_report.pdf

quantity and density of development.[151] The most robust approach is a complex regional transportation land-use modeling effort, but few medium- and small-sized cities outside the Puget Sound Region have had sufficient resources to employ this approach. Separately, in March 2013 the Washington State Department of Transportation published *Guidance for Project-Level Climate Change Evaluations*, and provides other resources to support decision-making on a project level. Additionally, guidance and tools are available and underway to estimate GHG impacts of certain strategies that make up growth management, including the land-use component of transit.[152] The Table below provides some valuable insights into GHG reduction estimates for a range of policy bundles that are potentially relevant to GMA.

[151] For more information on indicators or performance measures for sustainable transportation, see research by the Transportation Research Board (TRB) Subcommittee on Indicators (ADD40-1) and related work by Todd Litman, of the Victoria Transport Policy Institute.
152 For example, a two-year project of the TRB currently underway, TCRP H-46, Quantifying Transit's Impact on GHG Emissions and Energy Use: The Land Use Component, Accessed July 2013. http://apps.trb.org/cmsfeed/trbnetprojectdisplay.asp?projectid=3092

Table 34. Transportation VMT and Emission Reduction Strategies and Associated GHG Reduction Estimates.[153]

Strategy	GHG Reduction Range	Notes
Land Use-Based VMT Reduction Strategies		
Transit Oriented Development	5-44%	Reduction compared to business-as-usual development. Greater reduction associated with higher-density projects next to high quality transit service. Source: (1)
Mixed-use Development	5-35%	Reduction compared to business-as-usual development. Greater reduction associated with higher densities, better mix of land use, and a central location. Source: (1)
Improved Jobs/Housing Balance	2-15%	Reduction compared to business-as-usual development. Source: (2)
Transportation-Based VMT Reduction Strategies		
Improved Bicycle and Pedestrian Design	0-6%	Reduction compared to typical suburban street. Source: (2)
Transit System Enhancements and Expansion	2-10%	Reduction assuming a doubling in transit revenue-miles. Source: (1)
Parking Management Districts	2-20%	Greater reduction associated with combination of parking strategies and higher fees. Source (3,4)
Transportation System Operations Improvement Strategies		
Traffic Control Optimization	5-15%	Reduction based on a 5 mile per hour increase in average speed (assuming congested conditions with speeds less than 45 MPH). See **Appendix** C for detailed calculations. Source (5)
Congestion Management	5-20%	Reductions based on a 5 MPH improvement in freeway and arterial speeds when compared to the minimal emissions generated at 45 MPH. Freeway speed assumed to decrease by 5 MPH and arterial speed assumed to increase by 5 MPH (assuming arterial speeds less than 45 MPH). Source (5)
Roadway Tolling Strategies		
HOT Lanes	0-6%	Greater benefit with larger-scale implementation. Toll must be set to discourage induced travel. Source (3)
Cordon Tolls	5-25%	Greater benefit with larger-scale implementation. Source (3)

Sources:

(1) Ewing, R., et al. *Growing Cooler*. Washington D.C. Urban Land Institute, 2008.
(2) U.S. EPA. "Index 4D Method: A Quick Response Method of Estimating Travel Impacts from Land Use Changes." Washington D.C., 2001.
(3) California Air Resources Board. "Can Transportation Pricing Strategies Be Used for Reducing Emissions?" June 1998. http://www.arb.ca.gov/research/resnotes/notes/98-1.htm
(4) Puget Sound Regional Council. "Congestion Management Strategies." http://psrc.org/projects/cms/strategies/strategies-p4.htm
(5) Calculations performed by Fehr & Peers; Emissions Factors from EMFAC 2007, V2.3 November 1, 2006. Provided by Jeff Long, California Air Resources Board, April 2007.

The Tables below present GHG reduction estimates for various transportation policies at the state and regional level. In November 2008, CAT published *Leading the Way: Implementing Practical Solutions to the Climate Change Challenge* outlining the "most promising" strategies and opportunities to reduce GHG emissions. As part of that effort, the IWG identified and recommended tools and best practices to achieve the VMT reduction benchmarks. Table 2 below summarizes annual GHG reduction estimates for 2020 if the recommended transportation and urban development policies were to be implemented.

[153] Table reproduced from Fehr and Peers 2009. Accessed August 2013 online at: http://www.fehrandpeers.com/wp-content/uploads/2011/09/GHGAnalysisTools.pdf

Table 35. Annual GHG reduction estimates for transportation and urban development policies for 2020.

GHG Reductions (MMTCO2e) [154]	Policy	Assumptions	Comments
2.58	Transit, Rideshare and Commuter Choices	• GHG estimates based on anticipated reduction in automobile travel, increase in public transportation and rideshare travel • Transit dramatically increased in all areas, particularly in areas that can best support transit • Population is concentrated in areas that are more supportive of transit • Series of rideshare supply- and demand-side actions	Cumulative Reductions (2008-2020): 15.5 MMTCO2e
1.6	Compact and Transit Oriented Development (CTOD) Strategy	7% VMT reduction was based on the Puget Sound regional Council's Vision 2040, "which modeled 'Metropolitan Cities Alternative,' as well as from land use scenario modeling in other metropolitan areas, and from the judgment of several travel modeling experts who have worked in the Pacific Northwest region."	

Source: Climate Action Team. (2008). ***Leading the Way: Implementing Practical Solutions to the Climate Change Challenge - Appendix 4: Transportation Implementation Working Group - Reducing Greenhouse Gas Emissions and Increasing Transportation Choices for the Future*** **.**

In early 2009, the Washington State Department of Transportation evaluated progress of the Growth and Transportation Efficiency Center (GTEC) program which was designed to work with businesses, schools, and neighborhoods to find new ways to encourage commuters to ride transit, vanpool, carpool, walk, bike, work from home, and use other commute options besides driving alone. The collective goal of GTEC programs is to reduce 13,000 drive-alone vehicle trips and 103 million annual vehicle miles traveled by 2011. Table 3 below outlines GHG reduction estimates of seven GTEC programs.

Table 36. GTEC Program GHG reduction estimates.

AnnualGHG Reductions in year 2012[155] (Tons)	Assumptions – Program Goals	Geographic Region
8,917	GHG reductions achieved if GTEC program achieves its goals	Bellevue, WA

[154] **Estimates are for 2020, and represent total annual statewide reductions for the given policy.**

[155] Target year is assumed to be 2012 as program goals are to reduce drive alone trips and VMT by 2011.

	of 10% reduction drive alone trips ; 13% reduction VMT	
1,675	GHG reductions achieved if GTEC program achieves its goals of 10% reduction drive alone trips ; 13% reduction VMT	Olympia, WA
494	GHG reductions achieved if GTEC program achieves its goals of 11% reduction drive alone trips ; 14% reduction VMT	Redmond, WA
18,041	GHG reductions achieved if GTEC program achieves its goals of 10% reduction drive alone trips ; 13% reduction VMT	Seattle, WA
4,304	GHG reductions achieved if GTEC program achieves its goals of 10% reduction drive alone trips ; 13% reduction VMT	Spokane, WA
9,934	GHG reductions achieved if GTEC program achieves its goals of 10% reduction drive alone trips ; 13% reduction VMT	Tacoma, WA
3,641	GHG reductions achieved if GTEC program achieves its goals of 14% reduction drive alone trips ; 16% reduction VMT	Vancouver, WA

Source: Washington State Department of Transportation. (March 2009) ***Growth and Transportation Efficiency Center Program: 2009 Report to the Legislature.***

To date, a methodology and associated tools have not yet been applied to a Washington State-wide assessment of GHG emissions associated with GMA. One approach that has been applied for prior State-level compact development / transportation and land-use policy analysis in Maryland to support analyses pursuant to Maryland's Greenhouse Gas Emissions Reduction Act of 2009[156], and California for CARB to validate a GHG estimate for inclusion in the Draft AB 32 Scoping Plan[157] is based on two key metrics: density of the State's built environment, and relative amount of growth. The 2008 CAT efforts applied this approach with some California-specific inputs to validate its 2020 estimate for CTOD and determined it was reasonable based on the relative similarity of the estimates using different approaches.

156 SAIC, Appendix B – Greenhouse Gas Quantification: Final Report, Analysis of Greenhouse Gas Emission Reductions, Prepared for Maryland Department of the Environment, June 22, 2011. Accessed July 2013, http://www.mde.state.md.us/programs/Air/ClimateChange/Documents/2011%20Draft%20Plan/B_GHG_Quantification.pdf.
157 Reid Ewing and Arthur C. Nelson, "CO2 Reductions Attributable to Smart Growth in California," National Center for Smart Growth, University of Maryland, and Metropolitan Research, University of Utah, January 7, 2010, http://metroresearch.utah.edu/products/11-CO2-Reductions-Attributable-to-Smart-Growth-in-California.

9.3 Assumptions

In reviewing estimates outlined in the tables above, the CAT IWG estimate for 2020 GHG reductions statewide from the CTOD Strategy[158] is assumed to be the most representative of the GMA policy of the related GHG quantification efforts previously undertaken, and is assumed for the 2020 estimate for GMA. The reasons for selecting this estimate as most representative include its coverage in terms of geography (statewide) and policy focus (land use planning rather than public transportation infrastructure investment or technology focus). The emission reduction calculation method for 2020, 2035, and 2050 reflect the assumption that the implementation of activities on which the GMA reductions are dependent (i.e., CTOD center development, pedestrian and bicycle infrastructure construction, technical assistance availability for incorporating multimodal improvements within GMA Concurrency), will not be completed on a linear timescale. Rather, we assume that the developments may be in various phases of planning and construction between the present and 2020, and many are not completed until just before 2020.[159] Some VMT reductions will not begin until the completion or implementation of the dependent strategies. Further, we assume that there will be a ramp-up in use of alternative modes, such as bike trails and transit. As a result, the GHG reductions that are dependent upon the VMT reductions will be slow to be realized within the first half of the timeframe and level off in the second half.

The assumed growth rate of the GHG reductions achieved per year gradually decreases from approximately three percent to one percent per year between 2020 and 2050 to result in a leveling off of the curve (as illustrated in Figure 1 below).[160] We believe that this is a reasonable curve. It is unreasonable to assume that the annual reductions will continue to increase; rather they will level off once the desired density and development is achieved.

[158] Washington 2008 Climate Action Team, Transportation Implementation Working Group. Appendix 4: Reducing Greenhouse Gas Emissions and Increasing Transportation Choices for the Future. Accessed August 2013 at http://www.ecy.wa.gov/climatechange/2008CATdocs/IWG/tran/110508_transportation_iwg_final_report.pdf

[159] This assumption of non-linear growth in emission reductions, which accelerate in an exponential growth curve just prior to 2020, is consistent with the approach developed for the transportation and land-use policy quantification supporting the State of Maryland GHG strategy, accessed in August 2013 at http://www.mde.state.md.us/programs/Air/ClimateChange/Documents/2011%20Draft%20Plan/B_GHG_Quantification.pdf

[160] The declining rates of growth of 3, 2, and 1% over the future years illustrated in Figure 1 are based on authors' judgment and simplified curve fitting analysis.

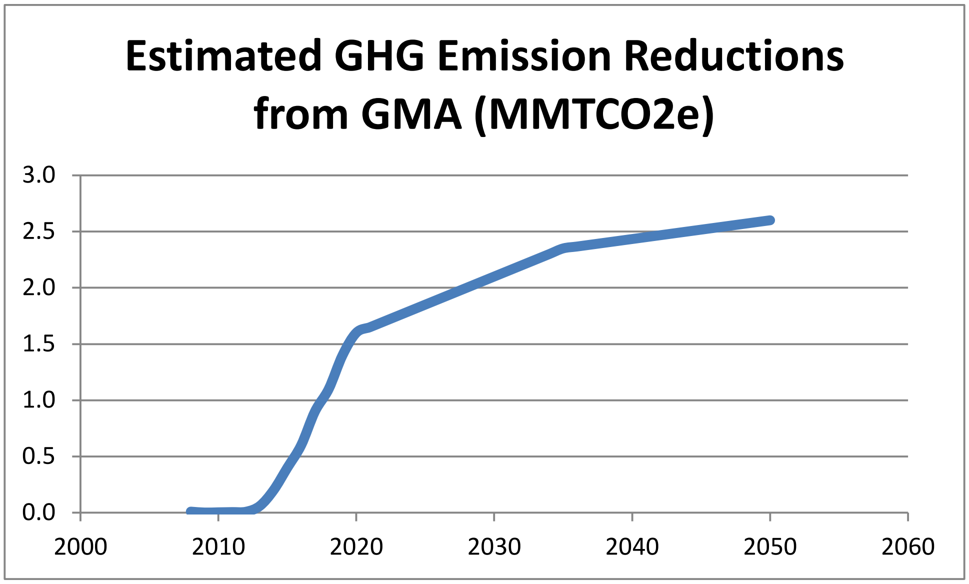

Figure 5. Estimated GHG emission reductions from GMA policies and programs.

9.4 Data Sources

The key data sources used for quantification include:

- CAT IWG estimate for 2020 GHG reductions statewide from the CTOD Strategy: Washington 2008 Climate Action Team, Transportation Implementation Working Group. Appendix 4: Reducing Greenhouse Gas Emissions and Increasing Transportation Choices for the Future. Accessed August 2013 at http://www.ecy.wa.gov/climatechange/2008CATdocs/IWG/tran/110508_transportation_iwg_final_report.pdf
- Non-linear growth curve representing the percent of reductions achieved in target years: Transportation and land-use (TLU) policy quantification supporting the State of Maryland GHG strategy, accessed in August 2013 at http://www.mde.state.md.us/programs/Air/ClimateChange/Documents/2011%20Draft%20Plan/B_GHG_Quantification.pdf

9.5 Results

Estimated GHG emission reductions from GMA policies and programs in 2020 are assumed to be 1.6 MMTCO2e, as reported by the IWG of the 2008 CAT effort. A Rough Order of Magnitude (ROM) forecast for 2035 and 2050 resulted in the GHG reductions presented in Table 4, and illustrated in Figure 1. The curve of the graph represents the changing pace of reductions achieved, which began slowly, accelerated after 2014 as supporting infrastructure, planning efforts and GMA-related programs are completed and implemented, and then experienced a leveling off as the policy matures and approaches full potential. The forecast for 2035 and 2050 are highly speculative and based on an extrapolation of the 2020 estimate, which is taken from the IWG of the 2008 CAT effort.

Table 37. ROM GHG emission reductions for GMA in Target Years.

	Total GHG Emission Reductions in Target Years (MMTCO2e)		
Existing Policy	**2020**	**2035**	**2050**
GMA	1.6	2.4	2.6

Note: Not all numbers presented in table are significant figures.

Policy Interactions

The preceding sections present and document estimates of the GHG emission reductions that can be expected to be generated by nine of the policies currently in place in Washington. In developing these emission reduction estimates, each policy was treated as independent of all other policies. The purpose of this chapter is to provide a qualitative discussion of the types of interactions that can occur between these policies.

Policy overlap is particularly apparent in policies that focus on the electricity and RCI sectors, primarily because electricity sector policies tend to target electricity supply, while RCI policies target electricity demand. In general, any policy that reduces electricity consumption will overlap with any policy that reduces emissions from the generation of electricity. Therefore, each of the RCI policies overlaps with each of the electricity policies; e.g., appliance standards and the Energy Codes policy interact with both the Energy Independence Act and the emission performance standards. Suppose, for example, that a demand side (RCI) program has the effect of reducing electricity consumption by 100 MWh. If the marginal emission factor for the grid is 0.5 metric tons CO2e per MWh prior to any supply-side (electricity) programs, then the demand side program, considered in isolation, will reduce emissions by (100 x 0.5 =) 50 metric tons CO2e. If, however, an RPS is implemented which reduces the average marginal emission factor to 0.4 metric tons CO2e per MWh, the impact of the demand side program will be reduced from 50 to 40 metric tons CO2e. In this hypothetical example the overlap between the RCI and electricity policy would be 10 metric tons CO2e.

The emission performance standard policy will likely overlap with the Energy Independence Act for a portion the 15 percent of load covered by the latter, assuming that at least some of this load would have been met by baseload fossil fuel plants absent the renewables plants. As an example, suppose that absent these two policies at least a portion the 15 percent of load would be met by baseload power plants with an average emission factor of 1100 lbs CO2e/MWh. In this case, the emission performance standard, considered independently of all other policies, would reduce emissions of these plants by (1100-970=) 130 lbs CO2e/MWh. The Energy Independence Act, considered separately from all other policies, would reduce emissions of these plants by (1100-0=) 1100 lbs CO2e/MWh. The simple sum of these emissions reduction estimates would be 1230 lbs CO2e/MWh. However, the actual reductions achievable by both policies combined cannot exceed 1100 lbs CO2e/MWh. In this hypothetical example, the overlap between the two policies would therefore be equal to 130 lbs CO2e/MWh.

In the RCI sector, the Energy Code policy will interact with the public buildings policy for those buildings covered by both policies. These two policies are examples of policies that target the same emissions sources, and that therefore compete to reduce the same emissions. For example, to the extent that each of these policies aims to reduce energy consumed by a building's HVAC system, they will compete for the same energy and emissions reductions. The combined emissions effect of the policies will be less than the simple sum of their emission reductions calculated independently (although, unlike for the interactions discussed above, estimating the overlap in this case is complex and site-specific). Given that the current Washington appliance standards focus on a handful of various appliances not covered under national standards, such as residential wine chillers and bottle-type water dispensers, there will most likely be little significant interaction with other Washington RCI policies.

The interactions among transportation and land use policy decisions are many in number and complex in character. State and local governments and organizations nationwide have begun to recognize the importance of system-wide transportation and land-use modeling and analysis. Such modeling is outside the scope of this project, but key interactions can be summarized qualitatively for transportation and land use policies such as those in place under the Growth Management Act (GMA). Transportation and land use strategies have significant interactions with each other, primarily synergistic, however there is the possibility of conflicting and overlapping effects.

Some TLU policies may achieve little reductions on their own, but with the implementation of other policies under the GMA, they can have large impacts. For example, transit service is not feasible in low-density areas where parking is plentiful, as high density development is a prerequisite for cost-effective transit system deployment. Therefore, certain transit strategies alone would not achieve reductions without compact development in place. However, transit enhancements in combination with smart growth strategies and pricing incentives can provide significant VMT and GHG reductions. This is an example of synergies between policies.

Local Government GHG Reduction Initiatives

The Climate Legislative and Executive Workgroup (CLEW) through the Office of Financial Management (OFM), as part of its Evaluation of Approaches to Reduce Greenhouse Gas Emissions in Washington State, asked the Washington Association of Cities and the Washington Association of Counties to provide information about how cities and counties respectively work to reduce GHG emissions and to provide examples of significant GHG emission reduction programs undertaken. This section presents a summary of the local initiatives reported by the cities and counties.

Efforts are underway at both the county and city level to assist the State in reaching its aggressive GHG reduction targets as well as additional jurisdictional-level goals. Initiatives range from passing ordinances pursuant to state-level policy to creating climate action plans and associated greenhouse gas inventories. Efforts abount in urban areas, such as King County and the City of Seattle, but also are being implemented in many of the rural counties in the State, and have already resulted in GHG emission reductions and cost savings. In addition to fuel savings, other drivers of local initiatives include relevant state-level policies, such as the February 2007Executive Order 07-02 that Governor Christine Gregoire issued to outline the State's commitment to address climate change by reducing greenhouse gas (GHG) emissions, and the Washington Commute Trip Reduction (CTR) Efficiency Act in 2006.

County GHG reduction efforts can be organized into several general categories:

1) Completing GHG inventories and creating Climate Action Plans (CAP) that outline specific GHG reduction targets;
2) Developing and reporting on sustainability goals through Sustainability Reports;
3) Incorporating climate change adaptation policies into local Growth Management Act (GMA) Comprehensive Plans, land use strategies, and building codes;
4) Decreasing fuel emissions and vehicle miles traveled (VMT) through improved traffic management, modernizing county fleets, and participating in Commute Trip Reduction programs;
5) Creating more energy efficient buildings and homes by offering low-income weatherization programs, participating in the Community Energy Challenge, retrofitting county buildings, and educating employees on energy use;
6) Reducing waste through composting and recycling programs, and reducing overall resource use;
7) Purchasing more environmentally-friendly products;
8) Dedicating staff to sustainability efforts;

9) Making data on sustainability efforts available to the public and reporting on progress towards sustainability goals both internally and externally; and
10) Joining pro-environment clubs and programs such as the Responsible Purchasing Network and the Cool Counties Climate Stabilization Initiative.

Through a survey administered by the Washington State Association of Counties, sixteen counties provided information about current local initiatives to reduce GHG emissions. Some counties are doing the bare minimum and offering resolutions without explicit reduction goals while others have extensive efforts underway. For example, Clallam County, along with eight other Washington counties and twenty-three cities, is a member of the International Council for Local Environmental Initiatives (ICLEI) which assists local governments with adopting policies and implementing actions to reduce local GHG emissions. Clallam County completed a comprehensive GHG inventory of its operations in 2008, which resulted in a CAP with a target of reducing GHG emissions 80% below 2006 levels by 2050. Whatcom County purchases 100% of its electricity from green sources. It additionally staffs Employee Transportation Coordinators, who provide information to assist employees in finding alternative commutes to and from work. Chelan County has invested in electric vehicle (EV) tourism by installing over a dozen EV charging stations on the Stevens Pass Scenic Byway between Seattle and Wenatchee. Spokane County published a Sustainability Report that focuses on renewable energy, clean mobility, land use, conserving water, energy efficiency, and emergency preparedness.

Table 1.1 summarizes the programs that have been undertaken by the sixteen counties, as well as the City of Seattle and King County, based on the information provided by County representatives (see Appendix A for details on the programs offered in each county).

Within the range of programs described, there exist several links to Washington State and federal policies regarding GHG reduction. The Washington State Legislature passed the CTR Efficiency Act in 2006 requiring all state agencies to aggressively develop programs to reduce commuting by state employees, through telecommuting, biking, walking, and using public transit. This program has trickled down into the majority of counties in Washington State. Other state laws that have encouraged GHG reduction efforts or have spread to local governments include RCW 70.235.070 which requires state agencies to consider local governments' GHG emissions and goals when distributing capital funds; Senate Bills 6001 and 6580 which set output-based carbon dioxide (CO_2) emission limits on all new, base-load electric generation and incentives for renewable energy production; and House Bills 3141, 1397, and 6508 which establish CO_2 mitigation requirements for fossil fueled thermal power plants, adopt California motor vehicle emission standards, and list requirements for minimum renewable fuel content, respectively.

In terms of federal legislation, counties cited the following as reasons for adopting GHG reduction policies: Presidential Executive Order 13514, which directs federal agencies to increase their energy efficiency by reporting on GHG emissions, protecting water resources, reducing waste, purchasing environmentally friendly products, and improving energy efficiency in government buildings; Executive Order 13423 which sets goals in energy efficiency, acquisition, renewable energy, toxic chemical reduction, recycling, sustainable buildings, electronic stewardship, fleets, and water conservation; and U.S. Department of Energy (DOE) Order 430.2B outlining the requirements and responsibilities for managing DOE's energy use, buildings, and fleets.

Some of the local initiatives reported by each county are a response to climate change, however, some initiatives were adopted in order to address other issues, such as reducing operating costs or increasing economic opportunities, with climate change mitigation as a secondary benefit. For example, many of the energy efficiency and waste reduction projects have economic benefits and result in significant cost savings, such as Klickitat County's Energy Overlay Zone ordinance that encourages responsible development of commercial-scale renewable energy facilities, particularly wind and solar. Pierce County's Energy Conservation Policy outlines several ways for County employees to reduce their energy use, decreasing costs for the County as a whole, as well as reducing GHG emissions. Additionally, Skagit County's Zero Waste events have saved the County from paying disposal fees for 34 events over a two-year time period.

The examples above do not cover all the efforts currently being implemented throughout Washington State and are meant to highlight the existing programs from different counties. Through these examples, however, it is apparent that a number of counties have undertaken significant GHG emission reduction policies to help support State goals as well as improve operating efficiencies.

Table – Summary of Washington State Counties' and the City of Seattle's GHG Reduction Initiatives – Data Call Results

	CAP	GHG Inventory	Sustainability Report	Land use strategies	Traffic Mgmt.	Alt. fuel/ EVs	CTR	Weather-ization	Energy Eff.	Green Purchasing	Waste Red.	Ded. Staff	Member-ships	Data Available/ Reporting
Benton/ Franklin					✓	✓	✓	✓						
Clallam	✓	✓		✓		✓		✓	✓		✓	✓	✓	
Clark		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Cowlitz								✓	✓					
Island	✓	✓			✓	✓	✓	✓	✓				✓	
King	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Kitsap							✓	✓				✓		
Klickitat				✓				✓	✓					✓
Pacific				✓	✓	✓	✓	✓	✓	✓	✓			
Pierce		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
San Juan				✓	✓	✓	✓	✓	✓	✓	✓			✓
Seattle	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Skagit	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Snohomish	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Stevens				✓			✓	✓	✓		✓			

Thurston	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Walla Walla				✓	✓		✓	✓	✓	✓				
Whatcom	✓	✓			✓	✓	✓	✓	✓		✓		✓	✓

This Table summarizes the local GHG reduction initiatives currently underway in Washington State Counties as well as the City of Seattle. More information about the specific programs undertaken by each County can be found in Appendix A. Please note that this is not an exhaustive list of current initiatives and the information illustrated in Table 1.1 and Appendix A is based on the information provided by County representatives and information available on the County webpage.
Note: an unabridged version of city and county data collected is available separately.

APPENDIX to Local Government Initiatives, Task 1d

Specific City Actions, Categorized by County

The Climate Legislative and Executive Workgroup (CLEW) through the Office of Financial Management (OFM), as part of its Evaluation of Approaches to Reduce Greenhouse Gas Emissions in Washington State, asked the Washington Association of Cities and the Washington Association of Counties to provide information about how cities and counties respectively work to reduce GHG emissions and to provide examples of significant GHG emission reduction programs undertaken. This section presents a summary of the local initiatives reported by the cities and counties in August 2013.

Chelan County

City of Leavenworth

- Part of the West Coast Green Highway (1 EV charging station)

City of Wenatchee

- Part of the West Coast Green Highway (1 EV charging station)

Clark County

City of Battle Ground

- Signed the US Conference of Mayors Climate Protection Agreement

City of Camas

- Signed the US Conference of Mayors Climate Protection Agreement

City of Ridgefield

- Part of the West Coast Green Highway (1 EV charging station)

City of Vancouver

- Signed the US Conference of Mayors Climate Protection Agreement
- Completed GHG inventory in 2008
- Adopted a sustainability policy/plan
- Enhanced the city's tree canopy through the Urban Forestry Program
- Expanded trails and transportation networks to encourage biking/walking
- Switched to LED lights in traffic signals and T-8 fluorescent bulbs in city facilities
- Adopted new policy to ensure facilities will meet LEED standards
- Part of the West Coast Green Highway (1 EV charging station)

City of Washougal

- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- Performed a recycling and GHG inventory
- Uses hybrid vehicles were feasible
- Created a standing sustainability committee

Cowlitz County

City of Castle Rock

- Part of the West Coast Green Highway (1 EV charging station)

Island County

City of Coupeville

- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- CAP -- 20% reduction goal below 2000 levels by 2020 (Kyoto Protocol goal)

City of Langley

- ICLEI member

- Completed GHG inventory in 2000 and has a CAP
- Focused on improving efficiency in new and existing buildings, promoting local, distributed generation and solar hot water heat, and promoting awareness of and reduction in its eco-footprint

City of Oak Harbor

- ICLEI member
- Completed GHG inventory and has a CAP

Jefferson County

City of Port Townsend

- ICLEI member
- Completed GHG inventory and has a CAP

King County

City of Auburn

- Signatory on the Puget Sound Green Fleet Initiative
- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member

City of Bellevue

- Signatory on the Puget Sound Green Fleet Initiative
- Installed adaptive signal control technology
- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- Completed a GHG emissions report and is drafting a plan for community emissions and for municipal emissions (striving to reach Kyoto Protocol levels)
- Expanded its recycling programs to include all community and beach parks and school ball fields managed by the City
- Assessed current tree canopy
- Adopted natural drainage practice standards
- Encourages LID
- Formulated a comprehensive communication plan to keep public up-to-date on environmental actions

City of Bothell

- Signatory on the Puget Sound Green Fleet Initiative
- Carbon Reduction Plan (includes motion sensors, LED Christmas lighting, green building incentives, CTR, green fleets, recycling, equipment reuse, paper reduction, composting, recycling in parks, and more)
- ICLEI member

City of Carnation

- Signed the US Conference of Mayors Climate Protection Agreement

City of Clyde Hill

- Signed the US Conference of Mayors Climate Protection Agreement

City of Des Moines

- Signatory on the Puget Sound Green Fleet Initiative

City of Federal Way

- Signatory on the Puget Sound Green Fleet Initiative

City of Issaquah

- Signatory on the Puget Sound Green Fleet Initiative
- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- Zero Energy Demonstration Project (housing community in Issaquah Highlands)
- Promotes sustainable building practices
- Supports tree planting and restoration projects
- Incorporated hybrid vehicles into its fleet
- "Central Issaquah Plan"; working to minimize sprawl and protect open spaces
- King County Cities Climate Collaboration (coordinate and enhance effectiveness of local government climate and sustainability efforts)

City of Kenmore

- Signatory on the Puget Sound Green Fleet Initiative

City of Kent

- Signatory on the Puget Sound Green Fleet Initiative
- LEED certified events center
- Promotes trees plantings
- Provides environmental tips to residents

City of Kirkland

- Signatory on the Puget Sound Green Fleet Initiative
- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- Completed a GHG and has a CAP
- CTR program
- Replaced street lights with LEDs
- Purchases Energy Star electronics
- Purchased hybrid vehicles and ultra-low sulfur diesel vehicles
- Manages an active tree preservation program
- Lawnmowers run on biodiesel
- Natural Resource Management Plan
- Runs a regional recycling center
- King County Cities Climate Collaboration

City of Lake Forest Park

- Signatory on the Puget Sound Green Fleet Initiative
- Signed the US Conference of Mayors Climate Protection Agreement
- Urban Forest Task Force

City of Mercer Island

- Signatory on the Puget Sound Green Fleet Initiative
- ICLEI member
- King County Cities Climate Collaboration

City of Newcastle

- Signatory on the Puget Sound Green Fleet Initiative

City of Normandy Park

- Signatory on the Puget Sound Green Fleet Initiative

City of Redmond

- Signatory on the Puget Sound Green Fleet Initiative
- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- Sustainable Agenda
- Sustainability Advisory Committee
- Retrofitted diesel vehicles
- Encourages residents not to idle
- Provides ongoing employee/community education
- Converted all traffic signals to LED lights
- Developed green building incentives
- R-Trip rewards residents who carpool
- Sustainability website
- King County Cities Climate Collaboration

City of Renton

- Signatory on the Puget Sound Green Fleet Initiative
- Installed adaptive signal control technology
- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- Uses hybrid vehicles
- Actively plants trees through the Urban and Community Forest Program
- Clean Economy Strategy
- Sunset Area Community Revitalization Area
- King County Cities Climate Collaboration

City of Sammamish

- Signed the US Conference of Mayors Climate Protection Agreement

City of SeaTac

- ICLEI member

City of Seattle

- Signatory on the Puget Sound Green Fleet Initiative
- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- King County Cities Climate Collaboration
- CAP calls for 58% reduction by 2030; 2008 baseline
- Completed GHG inventory in 2008 (local community inventories every three years; GHG inventory will be done for air travel in 2013)
- Complete Streets Ordinance (roads for cars, trucks, transit, pedestrians, and bicyclists)
- Developed RainWatch to better predict flooding
- Established Green Infrastructure target of managing 500 million gallons of stormwater on average a year with GSI approaches by 2025
- Seattle 2030 high-performance building district
- Green Building Taskforce
- Community High Road Agreement
- Use cement with a lower carbon content for transportation projects -- implemented and evaluated the impact of the carbon offset program for concrete in CPRS Projects
- Use green paving materials in the CPRS division roadway paving projects
- Ballard, Venema, Delridge Natural Drainage Systems underway (completion date 2015) -- initiated efforts to quantify impacts
- LED traffic lights
- Exploring ASCT
- Seattle's Clean & Green Fleet Plan
- Plug-In Project
- Purchased 35 EVs and 36 charging stations +15 at key publically available locations
- All-electric scooters for parking enforcement officers
- All patrol vehicles use LED lighting
- Idle-management system in all patrol vehicles is standard
- 2012 fleet expansion -- 163 capable of running biodiesel; 26 are all-electric; 7 are hybrid
- Walk Bike Ride Initiative
- Employee CTR -- vanpools; inWeb website to allow for telecommuting; bicycles are a part of eGo reservation system
- Community Power Works
- Northwest Smart Grid Demonstration Project
- Seattle City Lights has zero net GHG through conservation programs, energy efficient solutions, and carbon offsets; 2002 started receiving energy from Wind Project
- Climate Action Now (CAN) -- tools that allow residents to develop personal climate action plans

- District Energy Plan for First Hill
- Upgrade boilers and lighting systems
- Completed energy audits of 30 municipal buildings (will retrofit 14 of these buildings by 2014)
- Energy Efficiency and Conservation Block Grant -- retrofit 2000 single family homes by 2014
- All City buildings greater than 50,000 square feet, as well as libraries, have been benchmarked
- Conservation effectiveness evaluation
- Assessed bathroom paper purchasing
- Provides recycled-content product information for projects including SPU transfer station
- Composting Mandate -- requires all take-out containers to be 100% recyclable or compostable and styrofoam free as well as all single-family households to participate in composting; expanding the composting mandate to apartments, townhomes, and other multi-family dwellings
- Zero Waste Strategy (recycling 60% of all waste by 2012 and 70% by 2025)
- Saving Water Partnership (between local utilities)
- Assess Waste Stream Analysis Cost
- SPU's Solid Waste Management Plan waste diversion goals
- Green Ribbon Commission on Climate Change
- Office of Sustainability and Environment
- Energy & Environment Committee
- Steering Committee for new construction/ renovations
- Glacier scientist (complete inventory of North Cascades glaciers/hydrology modeling for glacier-fed streams)
- Track energy and fuel use consumed by City facilities and vehicles
- Launched the US Conference of Mayors Climate Protection Agreement in 2005**
- ICLEI member
- Seattle Climate Partnership (for businesses)
- Puget Sound Clean Cities Coalition
- Puget Sound Green Fleet Initiative
- King County Cities Climate Collaboration
- Climate COOLective

City of Shoreline

- Signatory on the Puget Sound Green Fleet Initiative
- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- Completed a GHG inventory in 2010 and has a CAP underway
- LEED Gold certified City Hall

- Founding partner of the King County Cities Climate Collaboration
- Adopted the Forevergreen Sustainability Strategy which implements sustainable practices in City operations
- Employs an interdepartmental Green Team to implement the Sustainability strategy
- Runs an Urban Forestry Assessment
- “Green street" demonstration

City of Skykomish

- Part of the West Coast Green Highway (1 EV charging station each)

City of Snoqualmie

- Signatory on the Puget Sound Green Fleet Initiative
- Signed the US Conference of Mayors Climate Protection Agreement
- King County Cities Climate Collaboration
- Sustainability Plan
- Land Preservation Initiative
- Wastewater Treatment Plan produces reclaimed water that is used to irrigate City parks and right of ways

City of Snoqualmie Pass

- Part of the West Coast Green Highway (1 EV charging station each)

City of Tukwila

- Signatory on the Puget Sound Green Fleet Initiative
- King County Cities Climate Collaboration
- Owns the first non-motorized plan which includes projects to improve streets and trails for pedestrians and bicyclists
- Green-building/mixed development in Tukwila Village

City of Yarrow Point

- Signed the US Conference of Mayors Climate Protection Agreement

Kitsap County

City of Bainbridge Island

- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member

City of Bremerton

- Signed the US Conference of Mayors Climate Protection Agreement

Kittitas County

City of Cle Elum

- Part of the West Coast Green Highway (1 EV charging station)

City of Ellensburg

- Added solar power to its system and City of Ellensburg utility customers can purchase shares of the PV array and have their share of PV production deducted from their electric bill

Lewis County

City of Centralia

- Part of the West Coast Green Highway (1 EV charging station)

Pierce County

City of Pacific

- Signed the US Conference of Mayors Climate Protection Agreement

City of Tacoma

- Signed the US Conference of Mayors Climate Protection Agreement
- Completed a greenhouse gas (GHG) inventory in 2007 and associated CAP
- ICLEI member
- Created a Green Ribbon Climate Action Task Force to develop and refine reduction goals

- Upgraded its Central Treatment Plant
- Downtown Growth & Transportation Efficiency Center
- Purchased new hybrid/low sulfur diesel fleet vehicles and added a B20 pump to the city's fueling station
- Performed lighting retrofits in traffic lights
- Retrofitted locomotives
- Currently evaluating tidal energy resources in the Tacoma Narrows

Skagit County

City of Burlington

- Part of the West Coast Green Highway (1 EV charging station)

City of Rexville

- Home to a manure anaerobic digester

Snohomish County

City of Edmonds

- Signed the US Conference of Mayors Climate Protection Agreement
- Has a staff task force to research information on energy-usage and provides the data to the Mayor and the committee
- Switching to B-20 biodiesel fuel in most City-owned vehicles
- Switching to LED lighting in traffic signals
- Retrofitting plumbing in city-owned buildings for water efficiency
- Supporting rapid transit initiatives
- Public education on recycling
- ICLEI member
- Climate Action Plan

City of Everett

- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- Completed a GHG inventory and is developing a CAP
- Offers density incentives for the development of LEED silver certified buildings downtown
- Using hybrid, fuel efficient vehicles and buses

City of Lynnwood

- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- Competed a GHG inventory

City of Monroe

- Home to a manure anaerobic digester (public/private partnership)

City of Mountlake Terrace

- Banned sale of plastic water bottles at City facilities
- No idling policy for city vehicles
- New sidewalk investments
- Strict stormwater standards
- Energy upgrades at regional swimming pool
- Sustainability Strategy

City of Sultan

- Part of the West Coast Green Highway (1 EV charging station)

Spokane County

City of Spokane

- Signed the US Conference of Mayors Climate Protection Agreement
- Completed a GHG inventory in 2007 and is looking to achieve a 7% reduction in GHG emissions from 1990 levels by 2012 (long range -- 30% reduction from 2005 by 2030)
- Invested money in public transit and has seen increased ridership
- Retrofitted buses
- Awarded a grant in 2008 to create a strategic plan to deal with rising oil prices and climate change. It also implemented adaptive signal control technology in 2013

Thurston County

City of Lacey

- Signed the US Conference of Mayors Climate Protection Agreement
- Lacey is meeting all its municipal energy needs through green power
- Urban Forest Management Plan
- ICLEI member

City of Olympia

- Signed the US Conference of Mayors Climate Protection Agreement
- Green power provides City's electrical needs for drinking water, wastewater, and storm and surface water utilities
- In 2007, the City adopted a green fleets policy and is converting its fleet to B40 biodiesel
- Retrofitted 20 heavy duty trucks with DOCs
- In 2006, adopted a Zero Waste Resolution
- ICLEI member

City of Tumwater

- Signed the US Conference of Mayors Climate Protection Agreement
- Completed a GHG inventory
- ICLEI member
- Part of the West Coast Green Highway (1 EV charging station)

Whatcom County

City of Bellingham

- Signed the US Conference of Mayors Climate Protection Agreement
- ICLEI member
- Conducted a GHG inventory
- Completed a CAP in 2007
- Purchases 100% of its electricity from renewable sources through Puget Sound Energy's Green Power Program
- Part of the West Coast Green Highway (1 EV charging location)
- Resource Conservation Program and energy audits/energy reduction plan for all city-owned facilities
- Energy Resource Scarcity Peak Oil Task Force -- preparing the community to deal with decline in oil production
- 2kw solar project (PSE funded) on the roof of the Environmental Learning Center
- Community Energy Challenge
- Standardized green building codes within the City's building code system
- Growth strategy includes compact "urban villages"

City of Blaine

- Part of the West Coast Green Highway (1 EV charging location)

City of Ferndale

- Signed the US Conference of Mayors Climate Protection Agreement
- Completed GHG inventory and CAP

City of Lynden

- Home to three manure anaerobic digesters

Yakima County

City of Outlook

- Home to a manure anaerobic digester

Washington State's GHG Emissions – Historical and Projected

in Million Metric Tons of Carbon Dioxide Equivalents ($MMTCO_2e$)

Sector	Historical GHG Emissions $MMTCO_2e$				Projected GHG Emissions $MMTCO_2e$			
	1990[1]	**2000**	**2005**	**2010**	**2020 BAU**[2]	**2020**[3]	**2025**[3]	**2035**[3]
Electricity Consumption (Coal, NG, biomass/ waste, petroleum)	16.9	23.3	18.9	20.7	24.9	18.4	18.9	20.4
Residential/ Commercial/ Industrial (Coal, NG, oil, wood)	18.6	20.3	19.4	19.7	24.3	21	20.9	19.2
Transportation (on-road gasoline, diesel, marine vessels, jet fuel & aviation, rail, NG, LPG)	37.5	45.9	44.5	42.2	56.9	44.9	45.7	46.8
Fossil Fuels (methane from NG industry)	.5	.7	.9	.7	1.1	.7	.7	.7
Industrial Processing (Cement, Aluminum, Semiconductor manufacturing, electric power T&D, ozone-depleting substitutes (HFCs, PFCs…)	7	6.6	3.3	3.8	6.2	7.8	9.1	13.6
Agriculture (Manure mgt, enteric fermentation, ag. soils)	6.4	6.4	5.4	5.2	4.8	6	6.1	6.2
Waste (Solid waste and wastewater treatment)	1.5	2.2	2.4	3.8	3.6	5.2	5.8	7.3
Total	**88.4**	**105.4**	**94.8**	**96.1**	**121.8**	**104.0**	**107.2**	**114.2**

[1] The 1990 GHG emissions baseline was developed in 2007 in response to the legislative requirements stated in: RCW 80.80.020 (2)(a) "By December 31, 2007, the departments of ecology and community, trade, and economic development shall report to the appropriate committees of the senate and house of representatives the total greenhouse gases emissions for 1990 and the totals in each major sector for 1990."
http://www.ecy.wa.gov/climatechange/docs/1990GHGBaseline_Legislators.pdf

[2] 2020 BAU (business-as-usual) is a projection of WA's emissions between 2005 and 2020, based on no additional actions to reduce emissions are taken past 2005.
http://www.ecy.wa.gov/climatechange/docs/WA_GHGInventoryReferenceCaseProjections_1990-2020.pdf

[3] 2020, 2025 and 2035 GHG emissions projections account for state and federal actions in place as of 2010. These state and federal actions include: I-937 energy efficiency, I-937 renewable portfolio standards, CAFÉ standards (2007 federal fuel standards), clean car standards (additional to CAFÉ), biofuels, energy code, appliances standards, state fleet efficiency measures, and green building standards for public buildings.

2000 and 2005 historical GHG emissions are described in
http://www.ecy.wa.gov/climatechange/docs/WA_GHGInventoryReferenceCaseProjections_1990-2020.pdf

2010 historical GHG emissions can be found in: https://fortress.wa.gov/ecy/publications/publications/1202034.pdf

State of Climate Change Science: *Annotated Bibliography*

1. Intergovernmental Panel on Climate Change (IPCC), Working Group I Report, 2007

The IPCC is the leading international, scientific organization providing assessments on climate change and its projected impacts on resources and societies worldwide. The Working Group I report ("The Physical Science Basis") consists of a synthesis of the science on change in the global climate system. The fourth assessment report (AR4) was released in 2007.

Link to report	http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html
Publishing body	IPCC (Cambridge Press)
Literature included	Contributions are supported by references to peer-reviewed and internationally available literature. Unpublished material needs citation and a copy must be provided.
Review process	IPCC authors are directed to "seek the participation of reviewers encompassing the range of scientific, technical and socio-economic views, expertise, and geographical representation". The review process consists of 2 stages: 1. Review by experts from a range of scientific, technical and socio-economic views, expertise and geographical backgrounds, and 2. Review by governments and experts chosen to include "as wide a group of experts as possible". For additional details, see "IPCC principles, Appendix A: http://www.ipcc.ch/organization/organization_procedures.shtml
Geographical domain	Global, regional (continental)
Subject matter	Synthesis of the current state of climate science.
Citation	Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). (2007). *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

2. Intergovernmental Panel on Climate Change (IPCC), Working Group I Report, 2013

The IPCC is the leading international, scientific organization providing assessments on climate change and its projected impacts on resources and societies worldwide. The Working Group I report ("The Physical Science Basis") consists of a synthesis of the science on global climate change. The fifth assessment report (AR5) is scheduled for release in late September, 2013.

Link to report	Not yet available: the Working Group I Report is scheduled for release after September 26th, 2013. Updates can be viewed at http://www.ipcc.ch
Publishing body	IPCC (Cambridge Press)
Literature included	Contributions are supported by references to peer-reviewed and internationally available literature. Unpublished material needs citation and a copy must be provided.
Review process	IPCC authors are directed to "seek the participation of reviewers encompassing the range of scientific, technical and socio-economic views, expertise, and geographical representation". The review process consists of 2 stages: 1. Review by experts from a range of scientific, technical and socio-economic views, expertise and geographical backgrounds, and 2. Review by governments and experts chosen to include "as wide a group of experts as possible". For additional details, see "IPCC principles, Appendix A: http://www.ipcc.ch/organization/organization_procedures.shtml
Geographical domain	Global, regional (continental)
Subject matter	Climate science.
Citation	Not yet available.

3. IPCC, 2012: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.

The purpose of this synthesis report is to integrate expertise in climate science, disaster risk management, and adaptation to inform decisions on reducing and managing the risks of extreme events and disasters associated with climate change.

Link to report	http://ipcc-wg2.gov/SREX/
Publishing body	IPCC (Cambridge Press)
Literature included	Contributions are supported by references to peer-reviewed and internationally available literature. Unpublished material needs citation and a copy must be provided.
Review process	Authors and review editors for special report are nominated by governments and selected by the WGI and WGII bureaus. The report and summary for policymakers (SPM) undergo an expert review and an additional expert and government review. http://ipcc-wg2.gov/SREX/ipcc-process/
Geographical domain	Global, national, regional
Subject matter	Climate science, climate impacts, adaptation and vulnerability, mitigation (very broad for state-level adaptation efforts).
Citation	Field, C. B., Barros, V., Stocker, T. F., & Dahe, Q. (Eds.). (2012). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

4. US Global Change Research Program (USGCRP), Third National Climate Assessment (NCA), 2013

The NCA evaluates and summarizes current climate science from the US Global Change Research Program and other sources. The report is intended to inform national priorities for future climate science research and adaptation to climate impacts. A revised draft is scheduled for submission to USGCRP by fall 2013; the final report will be released in early 2014.

Link to report	Public comment draft available at: http://ncadac.globalchange.gov/
Publishing body	National Climate Assessment Development Advisory Committee
Literature included	Synthesis reports (e.g., IPCC), peer-reviewed literature,

	technical inputs
Review process	Input from stakeholders that was compiled into a separate Technical Input Report (TIR) for each chapter. The entire 3rd NCA draft was released for an expert review and public comment period from January to April 2013.
Geographical domain	All U.S. states and territories
Subject matter	Climate science, climate impacts, vulnerability
Citation	TBD

5. Washington State Climate Change Impacts Assessment (WACCIA), 2009

The WACCIA was produced in 2009 by the Climate Impacts Group in collaboration with researchers and Washington State University and the Pacific Northwest National Laboratory, as mandated by Washington State House Bill 1303. The report assesses climate impacts by sector, including water, energy, agriculture, and forests.

Link to report	http://cses.washington.edu/cig/res/ia/waccia.shtml
Publishing body	Climate Impacts Group, University of Washington
Literature included	Synthesis reports (e.g., IPCC), peer-reviewed literature.
Review process	Anonymous peer review: all chapters were published as a special edition in the journal *Climatic Change*.
Geographical domain	Focused on WA state, but also includes results for the full Columbia River basin.
Subject matter	Climate impacts, by sector
Citation	Climate Impacts Group (2009). *The Washington Climate Change Impacts Assessment*, M. McGuire Elsner, J. Littell, and L Whitely Binder (eds). Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Oceans, University of Washington, Seattle, Washington.

6. America's Climate Choices, 2011

America's Climate Choices is a five report series developed by the National Research Council, as requested by Congress. Developed between 2009 and 2011, the report discusses climate change adaptation and mitigation policy as well as the relevant science and technology. The report focusing on the science of climate impacts, *Advancing the Science of Climate Change*, includes impacts by sector such as freshwater resources, agriculture, public health and transportation. The report also covers adaptation options and climate change drivers in each sector.

Link to report	http://nas-sites.org/americasclimatechoices/sample-page/panel-reports/
Publishing body	National Research Council of the National Academy of Sciences
Literature included	Peer-reviewed science and other assessments such as IPCC AR4, USGCRP's *Global Climate Change Impacts in the United States* and previous NRC reports
Review process	A different authoring panel is responsible for each report in the series, with outside input received from public presentations and workshops and comments submitted on the website.
Geographical domain	U.S.
Subject matter	Climate science, adaptation and mitigation policy, technology
Citation	National Research Council (2011). *America's Climate Choices*. Washington, DC: The National Academies Press.

7. National Research Council (NRC) – Sea level rise for the coasts of California, Oregon and Washington: Past, Present and Future

Several federal and state agencies collaborated to produce this assessment of sea level rise along the West Coast of the U.S. The report reviews and synthesizes the current, published research on global and regional sea levels and applies established process-based approaches to project global sea level rise through the 21st century.

Link to report	http://www.nap.edu/catalog.php?record_id=13389
Publishing body	National Academy of Sciences
Literature included	Committee reviews and synthesizes current, published research.
Review process	The NRC appointed a Report Review Committee to select experts from a variety of backgrounds to independently review the report. The review process ensures that the report meets institutional standards of objectivity, evidence and responsiveness to the study charge. Reviewers are listed in the Acknowledgements of the report.
Geographical domain	West Coast of U.S. (California, Oregon and Washington)
Subject matter	Sea level rise, coastal impacts, vulnerability – specific to coastal systems along the U.S. West Coast.
Citation	National Research Council. *Sea-Level Rise for the Coasts of*

California, Oregon, and Washington: Past, Present, and Future. Washington, DC: The National Academies Press, 2012.

8. Mote et al., 2008. Sea level rise in the coastal waters of Washington State.

This report consists of a synthesis of findings concerning the global and local factors contributing to sea level rise along the coasts of Washington state. The report provides summaries of sea level rise projections for 3 areas in WA state: the Puget Sound basin, Central/Southern WA coast, and the NW Olympic peninsula.

Link to report	http://cses.washington.edu/db/pdf/moteetalslr579.pdf
Publishing body	Climate Impacts Group and WA Department of Ecology
Literature included	Peer-reviewed scientific journal articles
Review process	The report was reviewed by regional experts from universities, government agencies and environmental consulting groups.
Geographical domain	Washington state
Subject matter	Sea level rise
Citation	Mote, P., Petersen, A., Reeder, S., Shipman, H., Whitely Binder, L.C. (2008). *Sea level rise in the coastal waters of Washington State.* Report prepared by the Climate Impacts Group, Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Oceans, University of Washington, Seattle, Washington and the Washington Department of Ecology, Lacey, Washington.