Economic and Environmental Impacts of the Carbon Pollution Accountability Act in Washington State

Prepared for the

Washington Climate Collaborative

February 2015

Acknowledgements

The analysis presented in this report was prepared by Energy Strategies, LLC, under contract to the Washington Climate Collaborative. Jeff Burks was the principal lead on this project for Energy Strategies. Questions regarding this report should be directed to him at jburks@energystrat.com. Mr. Burks was assisted by Caitlin Liotiris and Don Hendrickson of Energy Strategies, who were responsible for developing the CTAM energy price forecasts and the assessment of projections of GHG emissions. Hollie Hohlfelder provided research and analysis on GHG emission trends and was the technical editor in preparing this report.

Energy Strategies assembled a team of research economists to conduct the economic modeling in this report, led by Steven Peterson, Research Economist and faculty member in the College of Business and Economics at the University of Idaho, and Timothy Nadreau, a consultant with nine years of experience in impact and investment analysis.

This report represents the analysis and conclusions of Energy Strategies and Steven Peterson, and does not necessarily represent the University of Idaho or any other organizations or individuals.

energy strategies

Power Through Ideas

Energy Strategies, LLC
215 S. State Street, Suite 200
Salt Lake City, Utah 84111
(801) 355-4365

Table of Contents

Executive Summary

The Carbon Pollution Accountability Act is an economy-wide cap-and-trade proposal, similar to California's existing program. Washington has carbon reduction goals for 2020, 2035, and 2050. While recent trends in emissions are encouraging and may even point to achieving the 2020 goal with no new policies, the 2035 and 2050 goals will be more difficult to achieve.

To analyze the potential economic and environmental impact of the Carbon Pollution Accountability Act, Energy Strategies began with the same assumptions that the Washington Office of Financial Management used for carbon allowance prices and energy prices (e.g., the price of gasoline, natural gas, electricity) and the amount and speed with which they will rise as a result of the Act. Of course, as with all cap-and-trade programs, the market will actually determine the cost of compliance. Energy Strategies then used these forecast energy prices in a different model than the Office of Financial Management chose. Combining a rational-expectations price model with the 2013 IMPLAN input-output economic model, Energy Strategies found that adoption of the Act would result in an average annual reduction in gross state product of approximately $5.7 billion, or 1.43% of Washington's gross state product. The net annual jobs impacts range from a loss of 42,537 jobs in 2016 to a loss of 75,278 jobs in later years, averaging a loss of 55,538 per year against the baseline projection.

The potential environmental impact of the Carbon Pollution Accountability Act is more difficult to analyze. The legislation would require the Washington Department of Ecology to set the emission caps such that Washington would meet its carbon reduction goals. Using the Office of Financial Management assumptions for carbon allowance prices and energy prices, however, the model's estimated emissions reductions, combined with the most up-to-date forecast, do not show Washington achieving its 2020 or 2035 goals. This may be a result of overly high projections and an underestimate of emissions reductions. These modeling results also point to the likely underestimate by this analysis of the market-based carbon prices that will be experienced in Washington in order to achieve the carbon limits. Higher allowance prices than what was modeled would indicate higher energy prices, and more significant job losses against the baseline.

1. Introduction

In December 2014, Governor Inslee announced he would propose legislation to help Washington meet the carbon pollution limits adopted by the legislature in 2008. The carbon limits (per RCW 70.235.020) require Washington to reduce overall greenhouse gas (GHG) emissions:

- to 1990 levels by 2020,
- to 25% below 1990 levels by 2035, and
- to 50% below 1990 levels (or 70% below expected emissions) by 2050.

The primary legislation that would seek to achieve these carbon-limit goals is the Carbon Pollution Accountability Act (CPAA; House Bill 1314, Senate Bill 5283). This legislation would create a cap-and-trade program for GHG emissions in Washington similar to California's GHG cap-and-trade program.

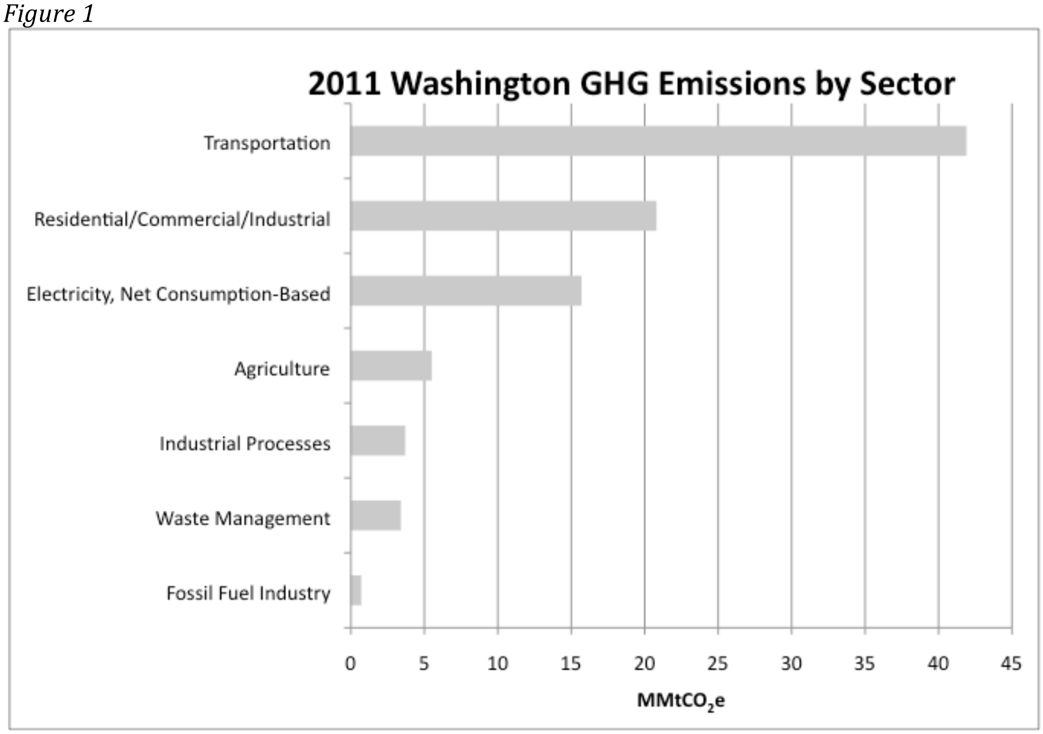
Cap and trade is a market-based environmental policy tool to reduce carbon emissions. An annual cap is set on total emissions, and allowances that represent a permit to emit one metric ton of carbon dioxide are made available to covered entities up to the level of the cap. Each year the cap ratchets down, with fewer allowances available. Participants (including emitting facilities, electricity providers, and/or fuel suppliers) must hold enough allowances to cover the emissions associated with their facility, the generation of the electricity they sell, or the combustion of the natural gas, motor gasoline, or other fuel that they distribute to end users. The allowances may be traded among participants. This allows companies to determine whether purchasing allowances in the market or reducing emissions on-site is the more cost effective means of complying with the regulation. While cap-and-trade programs set the emissions limit, it is the market that determines the cost of compliance (i.e., the cost of allowances). Cap and trade is often viewed as an alternative to carbon-tax programs, which set the price to emit, but do not set a limit on emissions.

The governor's cap-and-trade proposal is an economy-wide program, meaning it will cover greenhouse gasses emitted from the generation of electricity, the emissions of non-carbon GHG associated with some industrial processes, and the combustion of fossil fuels by the residential, commercial, and industrial sectors of the economy. The legislation requires all covered entities to purchase allowances in a sealed-bid auction; no allowances would be distributed for free (as occurred in California). The draft legislation would apply the compliance obligation to electricity that is imported to the state. The Washington Department of Ecology (WDOE) will house the program and be responsible for associated rulemaking. The proposed legislation requires WDOE to seek linkages with other jurisdictions, in order to establish a program that allows for regional trading (and eventually, national or international trading). The most logical first linkage for expanded trading would be to California's program.

2. Washington's Greenhouse Gas Profile

Washington's GHG emissions are primarily derived from the combustion of fossil fuels. The transportation sector is by far the largest single source of emissions. Based on the most recent Washington State GHG Emissions Inventory (for 2011, published in December 2014), the transportation sector was responsible for 41.9 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) and accounted for nearly 46% of the state's total reported GHG emissions. Emissions associated with the on-site combustion of fossil fuels in the residential/commercial/industrial sector represented the second-largest source of GHG emission in 2011. This sector emitted 20.8 $MMtCO_2e$ and was responsible for 23% of Washington's total GHG emissions. The third-largest source of emissions, 15.7 $MMtCO_2e$, is attributable to the electricity sector and accounts for the GHG emissions associated with generation of electricity delivered to Washington consumers from both in-state and out-of-state generators. Combined, emissions associated with the consumption of energy in these three sectors accounts for nearly 86% of the total 2011 GHG emissions in Washington.

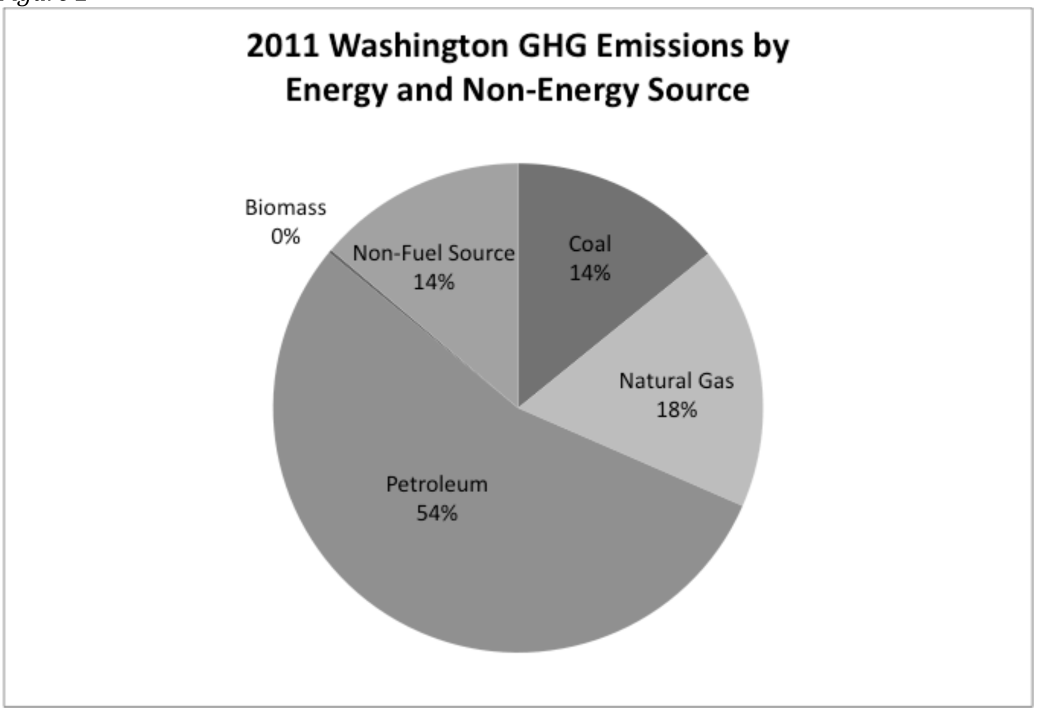
Figure 1



The remaining 14% of Washington's 2011 GHG emissions are associated with the release of fugitive greenhouse gases attributable to production, processing, and other activities of fossil-fuel production and transmission, waste management, industrial process, and agricultural sectors. Figure 1 shows the emissions by sector.

Figure 2 illustrates the 2011 Washington GHG emissions by energy and non-energy source, showing the large role petroleum products have in Washington's GHG profile.

Figure 2

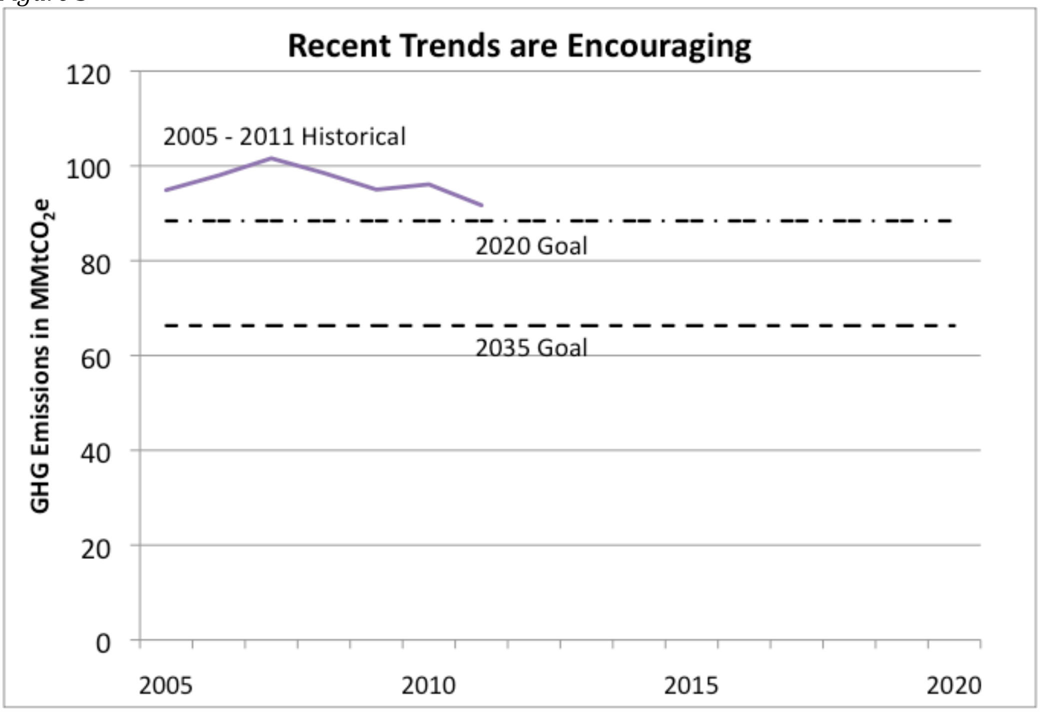


2.1 Analysis of Historic Trends

Washington has been preparing inventories of its carbon emissions for many years. The first of these efforts was in 2007, and it provided an inventory for the years 1990, 2000, and 2005. Biennial state GHG inventories are required by law, and in subsequent reports, some updates have been provided and emissions from the years 2006 – 2011 now have been inventoried.

Using the latest information available (December 2014), Washington's GHG emissions were 91.7 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) in 2011. This compares to 6,753 $MMtCO_2e$ for the United States in 2011. Largely due to the hydropower component of Washington's electricity supply, Washington's per capita emissions are much lower than average United States' emissions per capita (14.2 vs. 22.1 metric tons CO_2e in 2010). In Washington, as noted earlier, the transportation sector is the sector with the highest GHG emissions. The general trend in total GHG emissions in Washington from 1990 to 2010 has been a slight increase (from 88.4 $MMtCO_2e$ to 96.1 $MMtCO_2e$ over this twenty-year period), with a compound annual average growth rate (CAGR) of 0.4% during this time. The more recent trend, from 2005 – 2011, is a slight *decrease*, with a CAGR rate of -0.5% (see Figure 3). This is despite the increase in population that occurred during this time, with a 1% CAGR as Washington's population grew from 6.3 million people to 6.8 million. In fact, 2011's inventory showed GHG emissions were at the lowest amount inventoried since the 1990 baseline. Washington's total GHG emissions in 2011 were within 3.3 $MMtCO_2e$ (3.4%) of the state's statutory 2020 emissions target of 88.4 $MMtCO_2e$.

Figure 3



As noted, the transportation sector consistently contributes the largest portion of Washington's total GHG emissions. Notably, the transportation sector's emissions are declining at a faster rate than total emissions for the period 2005 – 2011, with a CAGR of -0.7%.

2.2 Existing Policies

The state's achievement in reducing its GHG emissions over the period 2005-2011 has been the result of a combination of factors. These include structural changes in the economy, federal actions, and state policies and regulatory initiatives specifically targeting GHG emissions that have been adopted in the past ten years. The state policies include:

- a statewide renewable fuel standard setting minimum purchases of sales percentages of ethanol and biodiesel;
- adoption of a state-owned fleet requirement to use less carbon-intensive, cleaner fuels;
- carbon dioxide emissions standards for new vehicles;
- renewable portfolio standards for utilities;
- a requirement that utilities pursue all energy efficiency investments that are cost-effective and feasible;

- updates increasing building energy efficiency performance under the Washington State Energy Code; and
- a GHG emissions performance standard for electric generation facilities.

The largest GHG emissions reductions from these policies will come from policies targeting GHG emissions in the three largest emitting sectors: transportation, residential/commercial/industrial (RCI) and electricity.

Addressing the largest source of GHG emissions (transportation), the 2005 Washington State Legislature passed legislation requiring the state to adopt California's GHG emissions standards for light-duty vehicles. Currently, California's Low Emissions Vehicle standard covers light-duty vehicle model years 2009-2016 and 2017-2025. These standards will dramatically decrease greenhouse gas emissions from cars and light trucks, which are the single largest class of emitters of GHG emissions in the state. In 2016, new vehicles will be required to meet a combined average fleet level of 250 grams carbon dioxide equivalent (gCO_2e) per mile. By model year 2025, that level drops to 163 gCO_2e per mile, resulting in a 45% reduction in the gCO_2e emissions from new vehicles.

After transportation, energy use in residential and commercial buildings and by industry is the next largest GHG emitting source in Washington (the residential/ commercial/industrial sector, or RCI sector). Energy consumption in the residential and commercial buildings sector accounted for 9.4 $MMtCO_2e$ or 45% of GHG emissions from the RCI sector in 2011. To address buildings, the Washington State Energy Code has been updated twice since 2006 – in 2009 and 2012. In 2009, Senate Bill 5854 (codified as RCW 19.27A.160) was passed by the Washington State Legislature and specified energy consumption reduction targets to be achieved through adoption of improved building energy codes. The Washington State Building Code Council was directed to develop energy codes that achieve a 70% reduction in building energy use by 2030, compared to the 2006 Washington State Energy Code.

To reduce the use of fossil-generated electricity and GHG emissions in the electricity sector, in 2006 Washington voters enacted Initiative 937, known as the Energy Independence Act. This law requires utilities serving at least 25,000 retail customers in Washington (a threshold that covers about 81% of the retail load served) to meet demand for electricity through renewable energy and energy efficiency. The EIA establishes a renewable portfolio standard (RPS) with renewable energy targets as a percentage of customer load. The targets increase over time: from 3% in 2012 to 9% in 2016, to 15% in 2020.

Another state policy that will contribute to the reduction of future emissions in the electricity sector is GHG emissions performance standard for base load electricity plants, enacted with passage of SB 6001 in 2007. The performance standard covers electricity generated within the state or delivered from outside the state. In March 2013, the Washington Department of Commerce issued a new rule, effective April 6, 2013, lowering the emissions performance standard from 1,100 pounds to 970 pounds of carbon dioxide per megawatt-hour.

Finally, passage of SB 5769 in 2011 requires Washington's only coal plant, TransAlta's 1,376 MW Centralia power plant, to be shut down by 2025. Centralia Unit 1 will be retired in 2020 and Unit 2 will be retired in 2025. Emissions reductions from the retirement of Centralia will be significant. In 2013, the Centralia plant was responsible for over 8.3 million $MMtCO_2e$ of GHG emissions.

As part of the 2013 Washington State Climate Legislative and Executive Workgroup (CLEW) process, the state of Washington hired Leidos to prepare an evaluation of the contribution these policies and other current state and federal GHG emissions reduction programs could potentially make towards achieving the state's GHG emissions targets.

Leidos evaluated eight existing state policies and five categories of federal policies that have the potential to contribute to meeting the state's GHG emissions targets. Figure 4 lists these policies.

Figure 4

Federal and State Policies Evaluated for Impacts on GHG Emissions

State Policy	Federal Policy
Renewable Fuel Standard	Renewable Fuel Standards
Washington State Energy Code	Tax Incentives for Renewable Energy
GHG Emissions Performance Standard for Power Plants	GHG Emissions Standards for New Vehicles
Appliance Standards	CAFE fuel economy standards
Energy Independence Act (I-937)	Future Clean Air Act Requirements (excluding GHG)
Energy Efficiency in Public Buildings	
Public Fleet Conversion to Clean Fuels	
GHG Emissions Standards for New Vehicles	
Growth Management Act	

Most importantly, Leidos did not evaluate the impact of pending Environmental Protection Agency (EPA) regulations covering existing power plants under Section 111(d) of the Clean Air Act (the Clean Power Plan). This was despite stakeholder comments provided to CLEW that recommended Leidos evaluate the significant impacts this emerging regulation would have on GHG emissions from the state's electricity sector, as well as the electricity sector in other states, which would impact imported electricity.

The GHG emissions trends seen in Washington are very encouraging, and there are numerous state and federal policies that will reduce Washington's GHG emissions going forward.

3. Economic Impact of the CPAA

In order to evaluate the economic impact of the governor's proposed cap-and-trade program, economic modeling was used to predict the differences that might be seen in energy prices, in economic productivity, and jobs. These and other economic indicators are measured against a baseline forecast for the period from 2016 to 2035. An overview of the modeling framework precedes a discussion of the economic analysis and modeling results.

3.1 Modeling Framework to Evaluate the CPAA

The methodology used to evaluate the CPAA centers around the combined use of three models: an energy price model, an economy-wide price model, and an input-output model. The flow of analyses conducted in this study is outlined below.

Energy Price Model: Energy Strategies used the Carbon Tax Analysis Model (CTAM) for its energy price model. CTAM was used to analyze the impact of the governor's proposed cap-and-trade policy on energy prices, that is, the amount of price increase that could be expected versus baseline price forecasts for natural gas, electricity, diesel, and gasoline.

Price Model: The energy price increases were entered into an iterative price model developed to analyze the ability of firms to pass their increased energy costs onto their consumers. Such models are often referred to as rational expectation models. The resulting reduction in outputs by industrial sector were calculated and entered into an IMPLAN input-output model.

Input-Output Model: The IMPLAN (IMpact analysis for PLANning) model calculated the effects of sectorial output reductions from rising energy prices on gross state product, total compensation (gross payrolls), jobs, and indirect taxes (sales taxes, property taxes, and excise taxes).

The three models and the methodological assumptions are described in more detail in the following sections.

3.1.1 Carbon Tax Analysis Model: The Energy Price Model

CTAM was developed by Keibun Mori of the University of Washington and is currently maintained by the Washington State Department of Commerce, which shared the latest version of CTAM (v2.8a) with Energy Strategies. CTAM output has been used in combination with Regional Economic Models, Inc. (REMI) models by the Washington State Office of Financial Management (OFM) to study the impacts of the proposed CPAA. The shared version is the same version that was utilized by the OFM in developing its December 23, 2014 estimates of the economic impacts of the CPAA.

Although the model was developed to evaluate a carbon tax, it can be used to evaluate cap-and-trade programs, such as the CPAA, by making assumptions about allowance prices. The model is based on three primary elements: the carbon tax rates (or, for cap and trade, the assumed allowance prices), the Energy Information Administration's (EIA's) energy price and consumption forecasts, and price elasticities of demand (that is, how consumer demand changes when prices increase).

Energy Strategies employed some of the assumptions and calculations from CTAM in the analysis of the economic impacts of the CPAA. CTAM was used to calculate impacts on energy prices resulting from the CPAA and estimate revenues from the CPAA. In addition, the demand elasticities cited in CTAM were used in the Price Model. The assumptions within CTAM were left "as is" and were not modified from the model that was shared by the Department of Commerce.

CTAM provides both a baseline estimate of fuel prices and an estimate of fuel prices under an assumed set of carbon prices. CTAM utilizes projections from the EIA's Annual Energy Outlook (AEO) to develop a baseline of expected prices and consumption for various energy types. The version maintained by the Department of Commerce makes modifications to the AEO’s "Pacific Region" consumption and price estimates to reflect Washington’s energy consumption and prices.

After developing a baseline projection for Washington State, CTAM then compares the baseline prices to a scenario in which there is a price on carbon (which is referred to as the CPAA scenario). CTAM calculates the energy prices in the CPAA scenario using two primary assumptions: the carbon content of the energy type and the cost of carbon emissions. Therefore, assumptions must be developed for the carbon content of various fuels and the price of carbon over the study timeframe. The assumptions for carbon content and the price of carbon are discussed in a later section.

CTAM estimates the impacts on future energy consumption due to the higher prices imposed by a carbon tax by applying a price elasticity of demand. CTAM applies price elasticities of demand to the price increases that are expected from a cap-and-trade program to predict the adjusted demand under higher prices. This report did not directly use this output from CTAM, since it does not capture any secondary impacts associated with changes in price. However, CTAM includes a number of cited price elasticities of demand that were incorporated into the Price Model. The Price Model provides a more holistic view of additional price changes that will result from high energy prices.

CTAM calculates estimated revenues from the carbon tax (or cap-and-trade allowance auctions) by multiplying the carbon cost by the adjusted GHG emissions projections for the state. The carbon cost is an input (the assumptions used for this paper are reviewed in a later section), and the adjusted GHG emissions are calculated by CTAM based on the adjusted demand values (as described above). This analysis utilizes the revenues estimated by CTAM.

3.1.2 The Price Model

A price model was developed to calculate the effect of rising energy prices on each sector of the Washington State economy. The price model was developed because input-output models assume constant prices in their analyses. The model was built from parameters obtained from the 2013 IMPLAN data for Washington State. Employing an iterative analysis, the price model calculated the following three tiers of effects on the Washington State economy:

- *First Tier:* The model estimated the economic impacts of increased energy prices (electricity, gasoline, diesel, natural gas, others) on business and consumer spending in Washington State. This tier shows the increased expenditures that would be required for energy producers and distributors to maintain output levels at an increased price.
- *Second Tier:* The indirect effects on business production and consumer spending from the increase in the prices of all other goods and services as a result of the CPAA. This tier shows the increased prices secondary consumers of energy would have to pay if the increased production costs were fully passed on and borne by consumers of energy.
- *Third Tier:* The effects on all the prices of goods and services produced in Washington including the goods and services exported from Washington State. The analysis includes the changes in the competitiveness of Washington State products exported to the rest of the U.S. and abroad. This final tier shows the increased costs to consumers of products produced in the second tier, that is, tertiary consumers of energy.

The price model represents a comprehensive approach of estimating the flow of energy price increases as they ripple throughout the Washington State economy. The model illustrates that rising energy prices affects virtually every consumer and every producer in Washington State, even business and consumers who consume little direct energy.

The three tiers can be best explained using the example of steel manufacturing and fabrication. The first tier calculates the effects of rising energy prices on steel companies (as well as their employees and all other energy consumers). The second tier calculates the effects of rising steel prices into the production of all goods requiring steel inputs. The third tier calculates the price increases of all final finished products containing steel, including new buildings and machinery, and the exports of steel to the rest of the U.S. and abroad.

3.1.3 IMPLAN: The Input-Output Model

The Energy Strategies team utilized the input-output model IMPLAN to develop the economic impacts estimates presented in this report. IMPLAN is the most widely used input-output software in the world and is employed in a large array of public and private sector project analyses. The IMPLAN model allows the user to calculate the effect of an initial change on the economy and through the inter-sectorial linkages, estimate the total impact on the economy as a whole. A key feature of IMPLAN is the transparency of its data and algorithms.

This analysis employed a 2013 model of the Washington State economy. In 2013 IMPLAN expanded its sectorial detail from 440 sectors to 536 sectors.

Three levels of economic impacts are reported. The first is the direct impact of the sectorial reduction of output in the state's economy from rising energy prices (with data provided from the price model). The second, indirect impact, is the effect of reduced downstream spending from other regional businesses that provide goods or services to the firms impacted by rising energy prices. These backward linkages reflect the reduced spending from producers on their suppliers, and by those suppliers on their suppliers further downstream, and so forth.

The third effect, induced impacts, arises from the reduction of employee and consumer spending as these "ripple" throughout the economy. The total effect on the economy therefore includes the direct, indirect, and induced impacts. The ripple effects or multiplier effects arise from the indirect and induced impacts, with the direct impacts stemming from the previously described price model.

The magnitude of the economic impacts is determined by the size of the direct effect on each sector by rising energy prices, the degree of backward linkages in the state's economy, and by the size of the "leakages" from imports and taxes.

The IMPLAN model reports economic impacts by several metrics.

- *Sales:* The broadest metric is sales transactions, which represent the total "raw" transactions in dollars from the direct, indirect, and induced impacts from reduced sectorial output by rising energy prices. This measure of economic activity includes some "double counting" so it is less accurate than other measures of outputs.

- *Gross State Product (value-added):* Gross state product is defined as the total dollar value of all final goods and services produced in the state's economy. It is a net measure, and so eliminates the double counting that occurs in sales transactions. It is the summation of employee compensation, proprietor's income, other property income, and indirect business taxes less subsidies.
- *Employee Compensation and Proprietors' Income (Total Compensation):* Gross wage and salary earnings paid to individual workers. It includes supplements and fringe benefits (retirement benefits, health insurance, etc.) from employers. Proprietors' income represents the income that accrues to self-employed workers and business owners. Employee compensation is a component of gross state product.
- *Employment:* The total employment (full-time and part-time workers) resulting from a change in economic activity caused by rising energy prices.
- *Indirect Taxes (Tax on Production and Imports):* All taxes generated from economic activity excluding personal and corporate income taxes. These consist of mostly sales taxes, property taxes, and excise taxes. Indirect taxes are a component of gross state product.

Input-output models are static, fixed at a point in time. The IMPLAN model represents the Washington State economy in 2013. All reported outputs are in constant 2013 dollars. The fundamental economic relationships are explicitly assumed to remain constant over the 2016 – 2035 time horizon. Generally, input-output models do not incorporate new business creation or business exit. They also do not allow for input substitution, technological innovation and change. The price model (described above) does allow for some substitution of inputs within each production function (away from the inputs affected by the increasing energy costs), but only after the first three iterations of the model.

There are costs and benefits to using a static model. The chief benefit of a static model is that it does not include future forecasting errors that often occur in forecasts of large complex macro economies. A static model provides a consistent benchmark for comparing changes.

Businesses and consumers respond to increasing energy prices by reducing their quantities demanded of energy inputs and products. In economic terms, this is defined as the price elasticity of demand. In the short-run, business and consumers are relatively insensitive to energy prices due to the limited options for substitution (i.e. energy is said to be price inelastic). Over time business and consumers are more able to substitute away from the high energy prices and they become more sensitive. Innovation will also occur over time reducing, the quantity demanded of energy intensive products.

More formally, price elasticity is defined as the percentage change in quantity demanded divided by the percentage change in price. If the price elasticity measures

-1.0, for example, it means that a 1% increase in price will lead to a 1% decrease in quantity demanded.

This analysis incorporated a weighted average of the CTAM model's long-term price elasticities for *each* of the primary energy sectors, which averaged approximately -0.55 collectively. For all other goods and services consumed in Washington State, a unitary elasticity (i.e., -1.0) was adopted. For domestic and foreign exports, an elasticity of -1.5 was assumed. Export markets are highly competitive markets, and the higher price elasticity reflects the vulnerability Washington exports will face to lower-priced products from competitors who do not face elevated energy and product prices caused by cap-and-trade regulation.

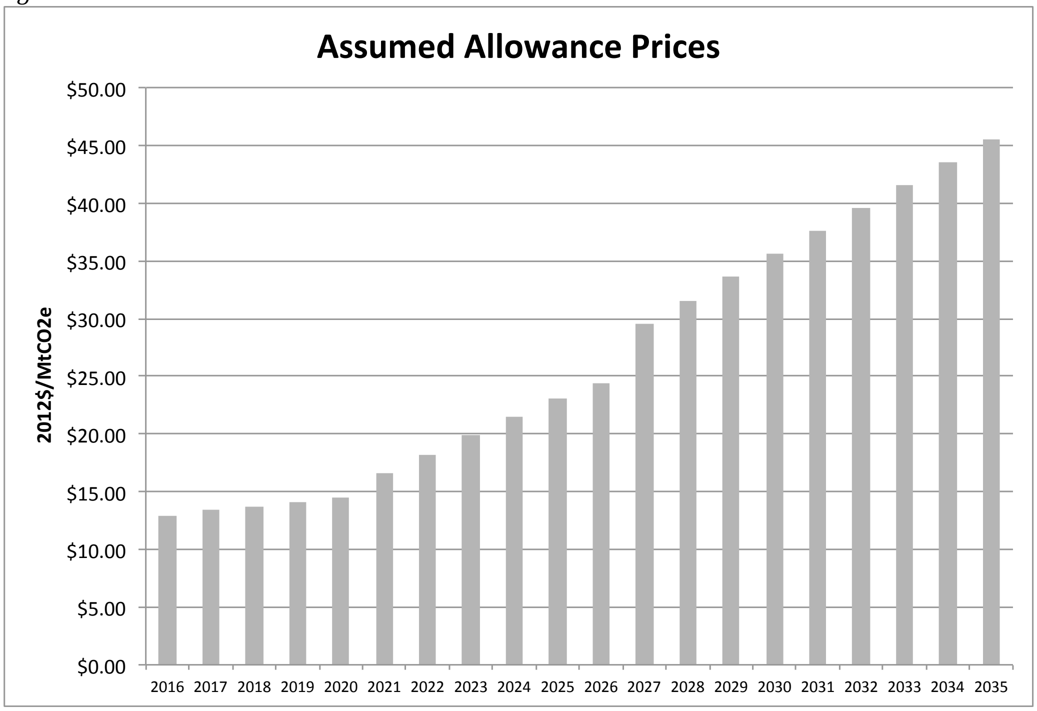
3.2 Modeling Output: Energy Price Impacts

The first significant modeling output from this analysis is the impact of the CPAA on energy prices. This output is used as an input for later stages in the modeling. As noted earlier, the CPAA imposes an economy-wide environmental regulation, and both OFM and Energy Strategies assume that while the point of regulation is the largest emitters/fuel suppliers, the cost of purchasing allowances to comply with the standard will primarily be passed through to all consumers in the form of higher energy prices. Energy Strategies used CTAM for its energy price impact estimates. CTAM calculates the energy prices in the CPAA scenario using two primary assumptions: the cost of carbon emissions and the carbon content of the energy type. Before reviewing the energy price impacts, these two assumptions are discussed.

3.2.1 Carbon Price Assumptions

The primary case employed in this study utilizes the carbon pricing assumptions employed by the Washington State Office of Financial Management (OFM). This scenario assumes all allowances are auctioned (i.e. no allowances will be given to businesses free of charge). This scenario also assumes carbon prices start at $12.94/metric ton in 2016 and increase at a rate of about $0.40/metric ton per year from 2017 to 2020, and about $2.00/metric ton from 2021 to 2035, reaching a price of $45.60/metric ton in 2035. Figure 5 illustrates these prices.

Figure 5



In the proposed CPAA, the price of purchasing an allowance is not known, but will be determined by the market. Therefore, assumptions must be made regarding the market's future behavior.

As a proxy for market prices, Energy Strategies adopted the first-year auction price of $12.94/metric ton and the price escalation rate assumed by OFM in its analysis. We expect that Governor Inslee will seek to link Washington's proposed cap-and-trade program to California's program, and the existing allowances prices in California, which recently settled at $12.01/metric ton, are a reasonable proxy for the floor price WDOE may initially set for allowances in Washington. While there are notable differences between California's existing cap-and-trade program and the one proposed in Washington, the expectation that the two programs would link and allow trading between them provides justification for using California's market as a proxy for prices that may be experienced in a Washington cap-and-trade program.

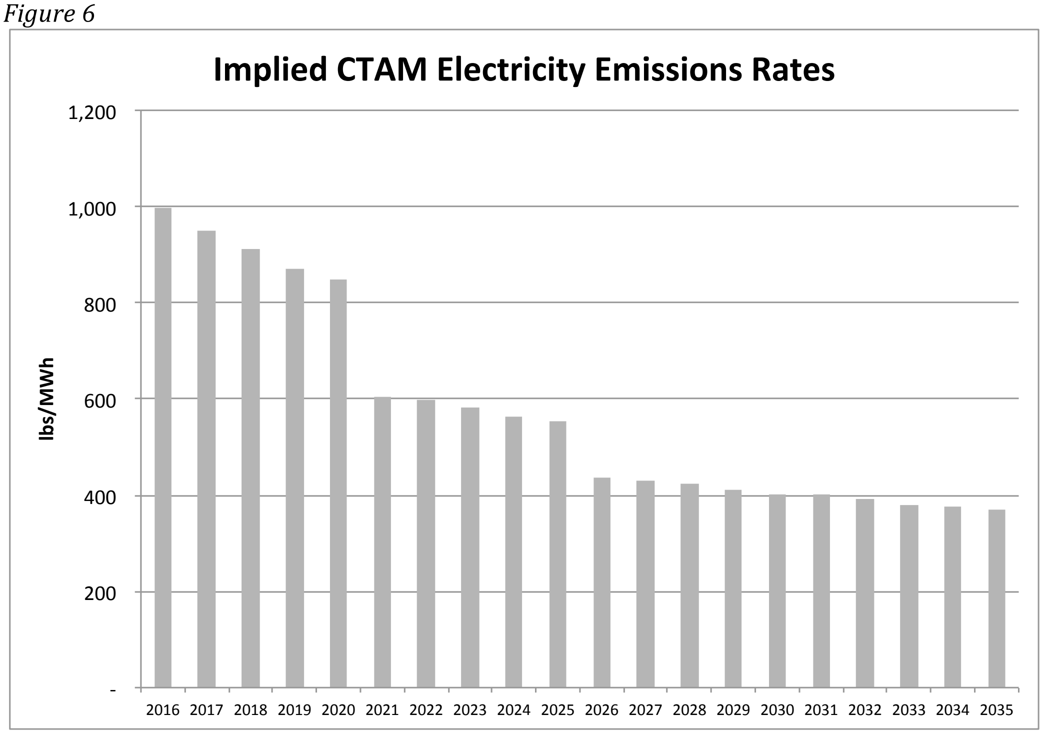
3.2.2 Carbon Content Assumptions

The carbon content for most fuels (natural gas, gasoline, diesel, etc.) remains relatively constant over time and the assumptions for carbon content of these fuels is straightforward and fairly easy to predict. Thus, CTAM's assumptions for the carbon content of all fuels except electricity were accepted without much review.

The carbon content assumptions in CTAM for electricity were more closely reviewed for reasonability, however. The carbon content of a unit of electricity varies substantially over time, as the generation resources used to produce electricity vary.

For instance, as renewable resources provide more electricity, the carbon content of one unit of electricity decreases. It is also true that as coal-fired resources, such as Centralia, are retired, the carbon content of electricity will decrease as the coal is replaced with lower carbon-emitting resources such as natural gas, wind, and solar. CTAM estimates the carbon content of electricity over the 2016 – 2035 timeframe that we studied. The most recent version of CTAM was updated to include the emissions associated with electricity generation that is located outside of Washington State, but is imported into the state and used to serve electricity consumers in Washington. This approach is consistent with the structure of the proposed CPAA and would include the emissions (and associated costs of purchasing allowances for emissions) from out-of-state coal-fired resources such as Colstrip. Figure 6 below illustrates the carbon content of electricity assumed in CTAM. Due to the lack of an easily identifiable emission rates for electricity in CTAM, these values are the implied carbon-content values based on the percentage price increases in electricity under the CPAA produced by CTAM.

Figure 6



The carbon content of electricity delivered to Washington State implied in CTAM seems high when compared to other sources. For instance, the Washington Department of Commerce's 2012 Fuel Mix Report estimates an emissions rate of about 370 lbs/MWh in 2012. This rate is for 2012, but going forward, it would be expected to drop further when Centralia retires and as more renewable resources are added to Washington's electricity fuel mix. Furthermore, we expect emissions rates for electricity to continue to drop due to possible retirement of out-of-state coal resources and additional pressure on emission rates from policies such as the

Clean Power Plan. Therefore, we would anticipate lower GHG emissions (and lower price impacts) from the CPAA in the electricity sector than are included in CTAM.

Based on the assumptions described above, CTAM calculated the following price impacts as a result of implementing the CPAA, as summarized in Figure 7. For natural gas and electricity, the prices are weighted averages across the various sectors (e.g., residential, industrial).

Figure 7

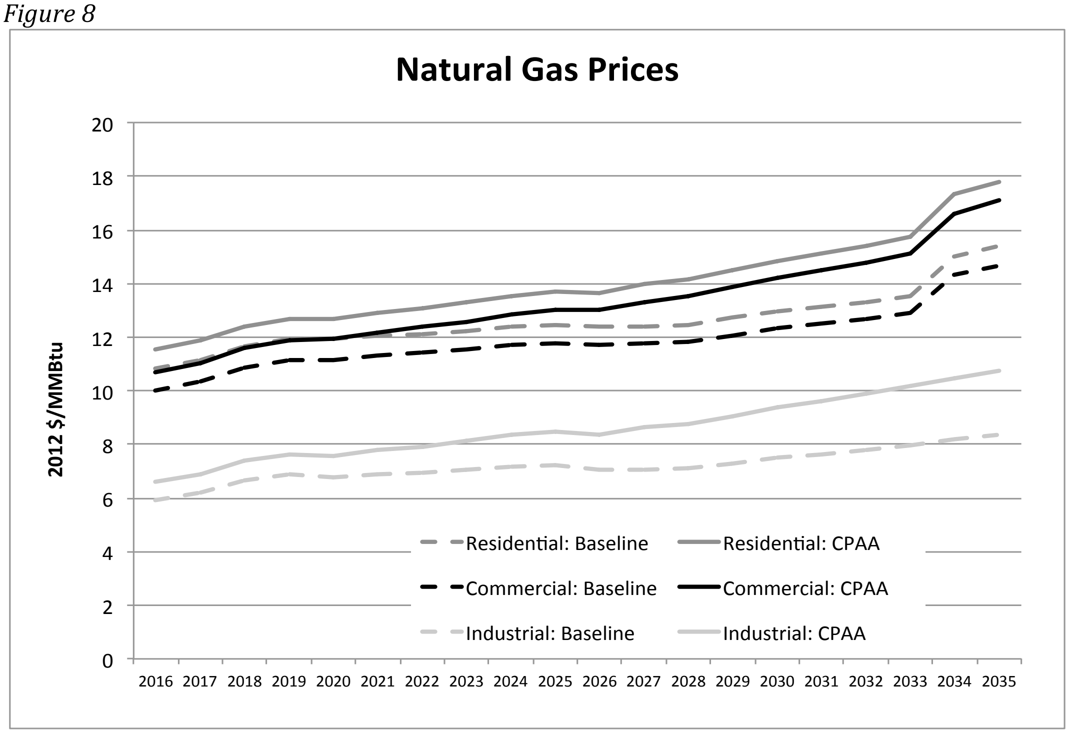
CPAA Energy Price Impacts: Baseline and CPAA

	Natural Gas Prices (Weighted Average Across Sectors, in 2012 $/MMBtu)		Electricity Prices (Weighted Average Across Sectors, in 2012 cents/kWh)		Gasoline Prices (in 2012 $/gallon)		Diesel Prices (in 2012 $/gallon)	
Year	Baseline	CPAA	Baseline	CPAA	Baseline	CPAA	Baseline	CPAA
2016	$6.73	$7.34	7.42	8.00	$3.27	$3.38	$3.83	$3.96
2017	$7.05	$7.69	7.35	7.92	$3.23	$3.34	$3.84	$3.97
2018	$7.47	$8.11	7.28	7.84	$3.23	$3.34	$3.88	$4.02
2019	$7.69	$8.36	7.21	7.76	$3.24	$3.37	$3.97	$4.11
2020	$7.62	$8.31	7.11	7.67	$3.30	$3.42	$4.03	$4.18
2021	$7.52	$8.28	7.00	7.46	$3.35	$3.49	$4.10	$4.26
2022	$7.54	$8.38	6.95	7.45	$3.40	$3.56	$4.17	$4.36
2023	$7.63	$8.55	6.90	7.42	$3.46	$3.63	$4.23	$4.43
2024	$7.78	$8.77	6.85	7.40	$3.50	$3.69	$4.29	$4.51
2025	$7.83	$8.90	6.84	7.42	$3.54	$3.74	$4.35	$4.58
2026	$7.57	$8.68	6.79	7.28	$3.57	$3.78	$4.40	$4.65
2027	$7.59	$8.93	6.80	7.38	$3.61	$3.86	$4.46	$4.76
2028	$7.66	$9.09	6.82	7.43	$3.62	$3.89	$4.49	$4.81
2029	$7.88	$9.42	6.82	7.45	$3.66	$3.94	$4.54	$4.88
2030	$8.13	$9.77	6.85	7.50	$3.69	$3.99	$4.58	$4.94
2031	$8.29	$10.02	7.00	7.68	$3.73	$4.05	$4.63	$5.01
2032	$8.48	$10.32	7.05	7.76	$3.77	$4.11	$4.68	$5.08
2033	$8.72	$10.65	7.03	7.75	$3.81	$4.17	$4.73	$5.15
2034	$9.22	$11.26	7.09	7.83	$4.06	$4.43	$4.97	$5.41
2035	$9.48	$11.63	7.17	7.94	$4.10	$4.49	$5.02	$5.48
2035 % change Baseline to CPAA		*22.6%*		*10.7%*		*9.5%*		*9.2%*

3.2.3 Natural Gas Price Impacts

The price of natural gas across all sectors is expected to be 22.6%, or $2.15/MMBtu, higher in 2035 under the CPAA than it would be absent the CPAA. Figure 8 illustrates the expected prices for natural gas across the residential, commercial, and industrial sectors.

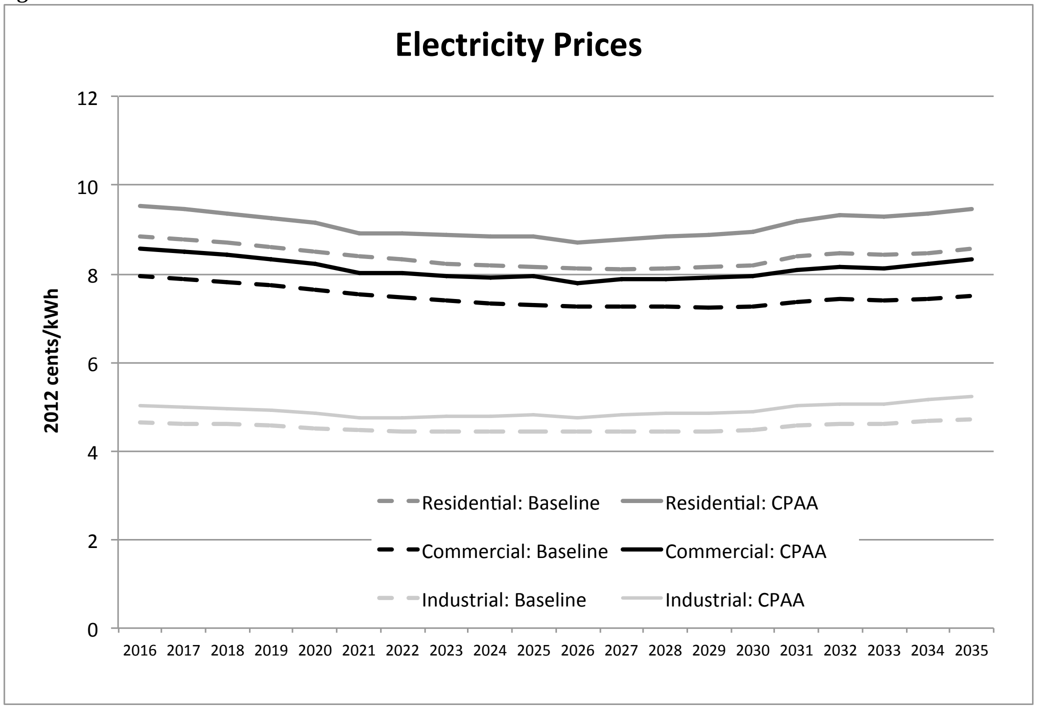
Figure 8



3.2.4 Electricity Price Impacts

Electricity prices are expected to remain fairly flat, and even decline in the Baseline projections within CTAM. Based on the assumptions contained in CTAM, the weighted average price of electricity across all sectors is expected to be 10.7%, or $0.76/kWh, higher in 2035 under the CPAA. Figure 9 illustrates the expected prices.

Figure 9



3.2.5 Transportation Fuels Price Impacts

Baseline gasoline and diesel prices in CTAM are based on the EIA's 2014 AEO. While these prices may seem somewhat high in comparison to today's lower street price for transportation fuels, this analysis leaves the EIA's figures unchanged. Based on the assumptions contained in CTAM, by 2035 with the CPAA in place, the price of gasoline and diesel are expected to be 9.5% and 9.2% or $0.39/gallon and $0.46/gallon higher, respectively, than they would be absent the CPAA. Figures 10 and 11 illustrate the expected gasoline and diesel prices, respectively.

Figure 10

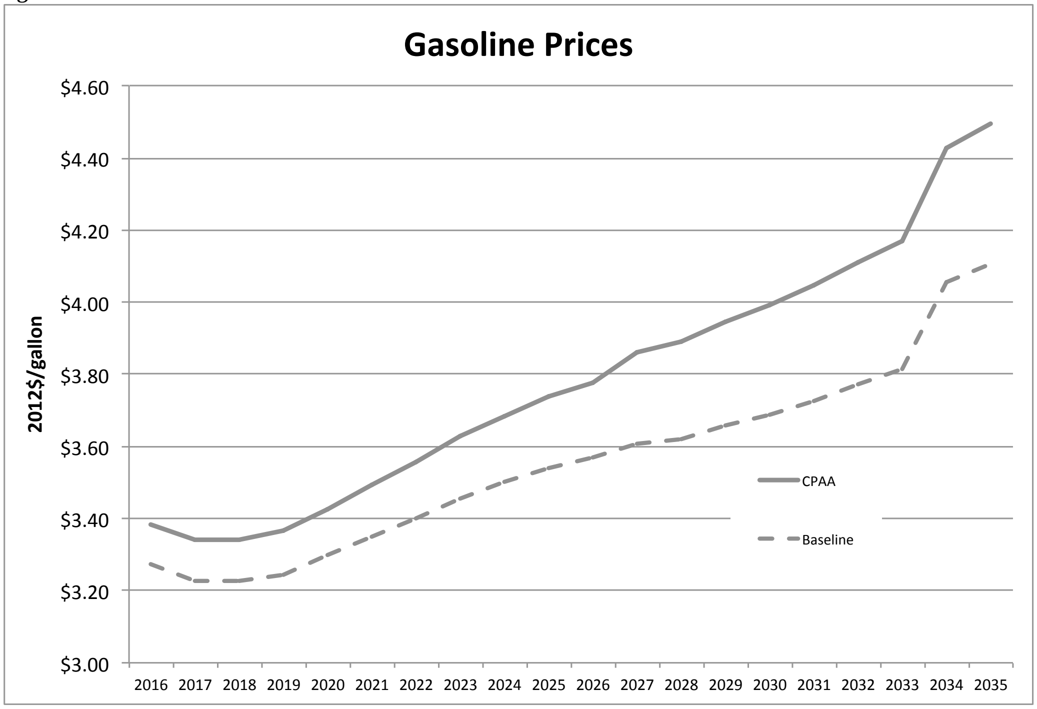
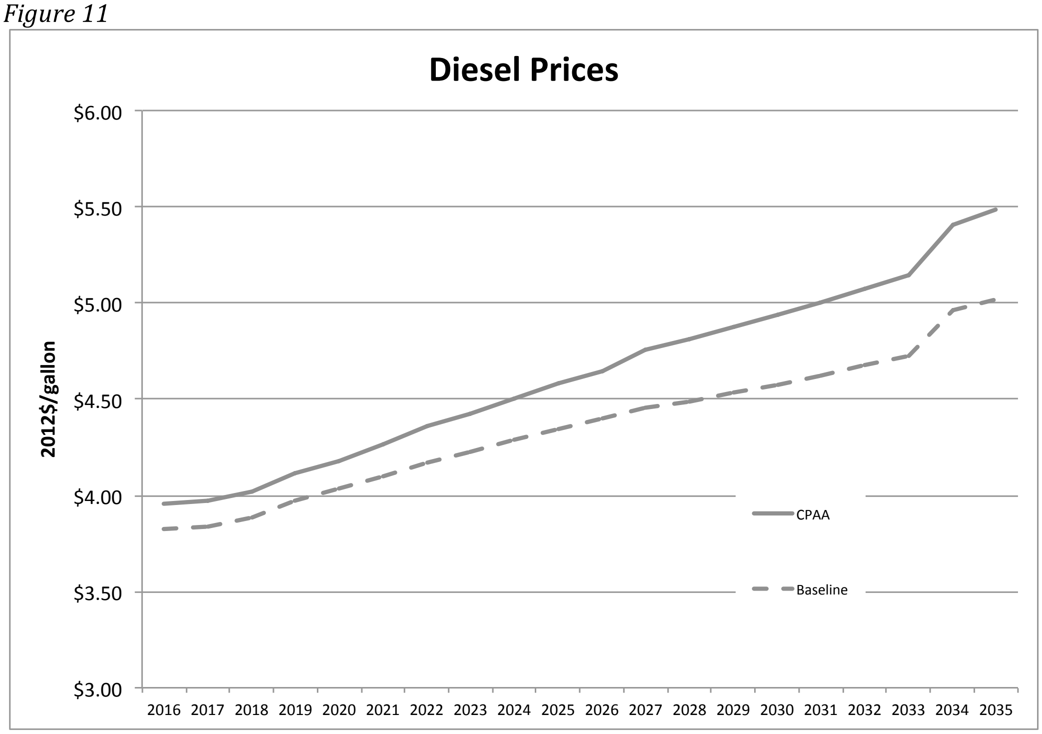


Figure 11



3.2.6 Impact to Average Household: Direct Effects Only

Figure 12 illustrates the direct impact of the expected energy price increases in 2035 on an average household's electricity, natural gas and gasoline bills. The average price increase for electricity, natural gas, and gasoline in 2035 would raise a typical residential customer's bills by $55.91/month. These are only the direct effects of the increased energy prices that would result from the CPAA and do not include other secondary impacts that would be caused as businesses raise prices to help recover the increased energy prices they would experience.

Figure 12

Impact to Average Household; Direct Effects Only

Average 2012 Consumer	Average Monthly Expense*	CPAA Price Increase**	Impact to Average Customer per Month
Electricity	$88	10.6%	$9.37
Natural Gas	$72	22.6%	$16.30
Gasoline for 2 Average WA Drivers	$318	9.5%	$30.24
Total			**$55.91**

* Based on EIA Data for Average Residential Customers

** Percent increases are the average price increase from the baseline across all sectors in 2035.

3.3 Modeling Output: Allowance Revenues (Recycling)

Another significant modeling output available from CTAM is the estimate of allowance revenues that will be available as new revenue for the state of Washington from the CPAA. This output, allowance revenues, can then be used as an input by the IMPLAN model, as the generated revenue is recycled through the economy through new government spending and/or tax credits, which allow consumers and businesses to spend more. Energy Strategies used CTAM for its year-by-year estimates of allowance revenues from the CPAA. As noted earlier, CTAM calculates the revenues by multiplying the carbon cost by the adjusted GHG emissions projections for the state. Because CTAM was designed for the analysis of carbon taxes, not cap-and-trade, there is no ability to place a cap on the emissions.

The output from CTAM for allowance revenues is summarized in Figure 13 below.

Figure 13

Annual Allowance Revenues from CTAM

in millions 2012$	2016	2020	2025	2030	2035
Total Revenues	$800	$887	$1,337	$2,022	$2,541

The governor's estimate for CPAA revenues is based on an estimate of $947 million in 2017. The actual amount collected under the CPAA will vary substantially based on a number of factors, including the price of allowances in the market. Over time, if allowance prices increase, revenues will also increase significantly.

Energy Strategies then used the governor's proposal as the basis for allocating the new revenue back through the economy. The revenues were redistributed to each area the governor outlined in his plan using the same percentages as seen in the governor's 2017/$947 million proposal. The revenue that is generated by the CPAA and recycled through the governor's reinvestment plan serves to help offset any negative economic and jobs impacts that result from the increased prices associated with the CPAA. IMPLAN was used to estimate the effects of the estimated revenue recycling generated from the governor's proposal on the Washington State economy. These impacts are reported as (partial) offsets to the energy price increases.

The governor's plan, which provided detail only for fiscal year 2017, calls for $819 million to be spent by government on programs (86%), while $128 million would be returned via tax rebates/credits (14%). The revenue recycling dollars as calculated by CTAM ranged from $800 million in 2016 to $2.5 billion in 2035. The average annual recycling dollars was $1.52 billion and was allocated:

- $322 million in new highway construction,
- $322 million in highway maintenance,
- $613 million in K-12 education,
- $25 million in low cost housing,
- $32 million in agricultural and forestry support services for rural economic development,
- $5.7 million for administrative costs, and
- $207 million in household income rebates.

In keeping with the governor's plan as outlined for 2017, approximately 86% of the revenue recycling across all modeled years (2016 to 2035) goes for new government spending and 14% for income rebates. Of the 86% of new government spending, approximately 43% goes directly into government operations, mostly education.

3.4 Modeling Output: Economic Impacts

The economic modeling results from IMPLAN input-output model are considered by the authors to be the core of this analysis and report. The economic impacts were calculated for each year of the energy price forecast of the governor's cap-and-trade policy, 2016 to 2035 (20 years). In addition, sectorial detail was provided in the report of the annual average impacts. This section begins with a summary of the net average annual economic impacts before turning to time-series reviews of the impact on employment and gross state product. The section concludes with a closer look at the impact on tax revenues.

3.4.1 Net Average Annual Economic Impacts: Summary

Figure 14 presents the net average annual economic impacts from the governor's proposed cap-and-trade policy, which includes the effects of revenue recycling. The impacts include the direct, indirect, and induced impacts (i.e. they include the multiplier effects). The analysis reports the impacts in all 536 IMPLAN industrial sectors, which have been aggregated into 10 sectors for this report. The table represents changes against the baseline projection under a CPAA scenario.

The average annual reduction in gross state product was approximately $5.7 billion or 1.43% of Washington State's gross state product. The loss of jobs averaged approximately 56,000 per year (1.43% of all jobs) and the decline in sales, excise, and property taxes of approximately $658 million per year. In terms of industries hardest hit, utilities fell by 10.7% (gross state product), mining declined 6.7%, and transportation fell 6.0%.

Figure 14

Net Average Annual Economic Impacts of Proposed Carbon Policy

Industry	Change in Gross State Product (in millions)	Percent Change in GSP by Industry	Change in Jobs	Percent Change in Jobs by Industry	Change in Sales, Excise and Property Taxes (in millions)
Ag. & Forestry	($145)	-1.8%	(2,255)	-1.6%	($1)
Mining	($149)	-6.7%	(322)	-5.2%	($1)
Utilities	($375)	-10.7%	(510)	-9.8%	($129)
Construction	($85)	-0.6%	(1,193)	-0.6%	($4)
Manufacturing	($851)	-1.7%	(5,814)	-1.9%	($34)
Transportation	($534)	-6.0%	(6,373)	-5.7%	($49)
Trade	($925)	-1.9%	(10,418)	-2.0%	($242)
Services	($2,936)	-1.4%	(35,423)	-1.7%	($228)
Government	$176	0.3%	5,066	0.8%	$12
Consumption/Rebates	$146	-	1,703	-	$17
Total	**($5,679)**	**-1.43%**	**(55,538)**	**-1.38%**	**($658)**

Note: Table does not sum due to rounding.

The results in Figure 14 are net of revenue recycling. The average annual results excluding revenue recycling would be a loss of $7.3 billion in gross state product, and a loss of 78,109 jobs. The positive offset in gross state product from revenue recycling averages $1.7 billion. The jobs created from the offsets of revenue recycling ranged from 11,811 in 2016 to 37,526 in 2035, averaging 22,572 jobs.

The effects of the increasing energy prices are widely diffused throughout the Washington State economy, but there are inter-industry variations on the magnitude of the impacts. Note that in Figure 14, the government sector is the only aggregated sector to experience an increase in both gross state product and jobs. The hardest-hit sector in relative magnitude was the utility industry, with a 10.7% decline in gross state product from the baseline and 9.8% reduction in jobs (including the multiplier effects). The second hardest-hit sector was transportation, with a 6% decline in gross state product and a 5.7% loss in jobs. Manufacturing had a 1.7% decline in gross state product and a 1.9% loss of jobs.

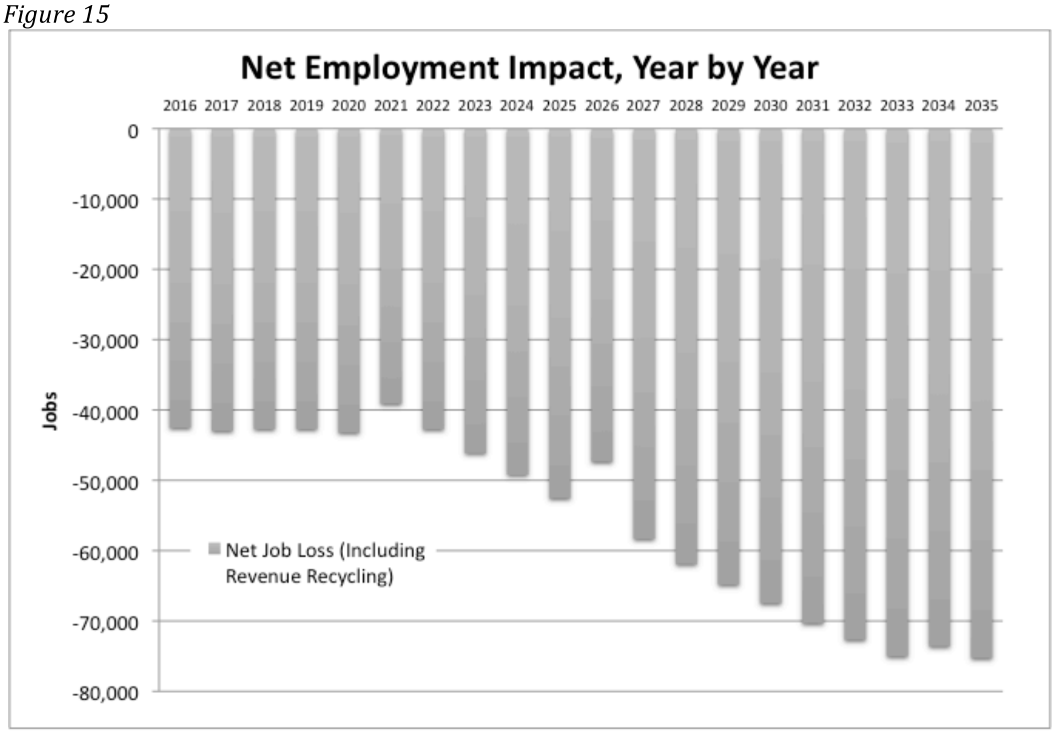
In absolute numbers, the greatest loss of gross state product was services, at $2.9 billion and a 35,423 reduction in jobs. This result occurs because of the overall magnitude of the service sector and the widespread dispersed effects of the energy prices on the state's economy.

3.4.2 Time-Series Reviews of the Economic Impact

While the net average annual data provides an overview of the economic impacts of the CPAA, it can also be informative to look at the economic impacts year by year. The following discussion and charts show year-by-year impacts against the baseline. The economic impacts shown in this section are static illustrations of the very dynamic reality of how jobs are created and gross state product grows over time. Thus, the annual net employment impacts in these graphs should be thought of as reductions in future job growth, and the gross state product impacts as reflecting reduction in future gross state product. As noted earlier, the IMPLAN model is static and reflects Washington State in 2013; there are no macroeconomic predictions about innovation, technology, or shifts in the roles of various industries embedded in this analysis.

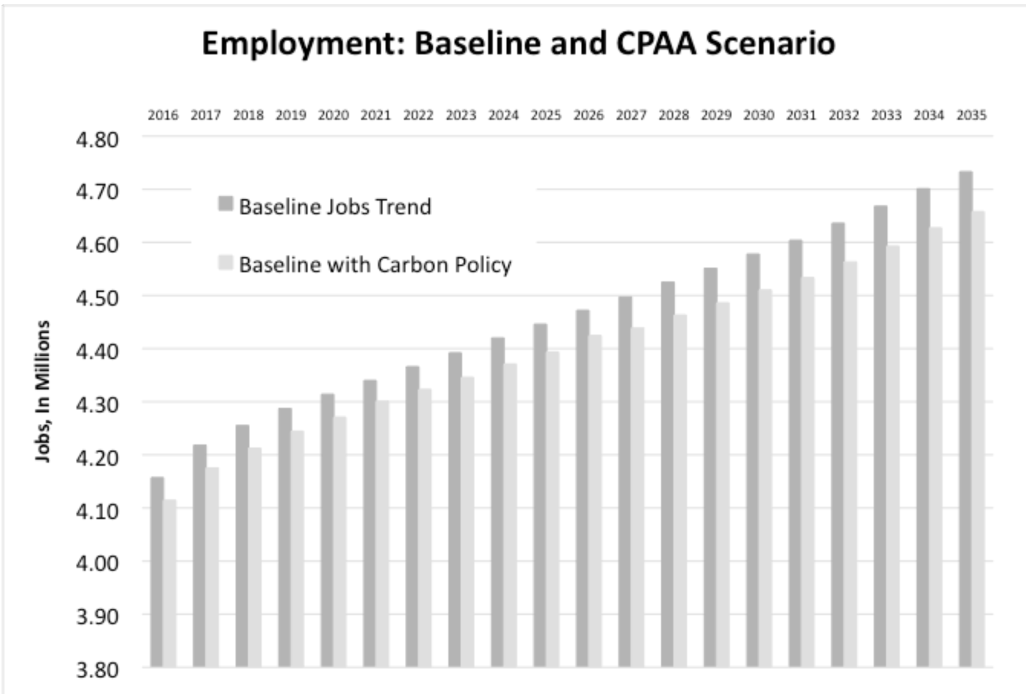
The job impact year by year can be seen in Figure 15. These results are net of revenue recycling. The net annual jobs impacts range from losses of 42,537 to 75,278 jobs, averaging 55,538 lost jobs per year.

Figure 15



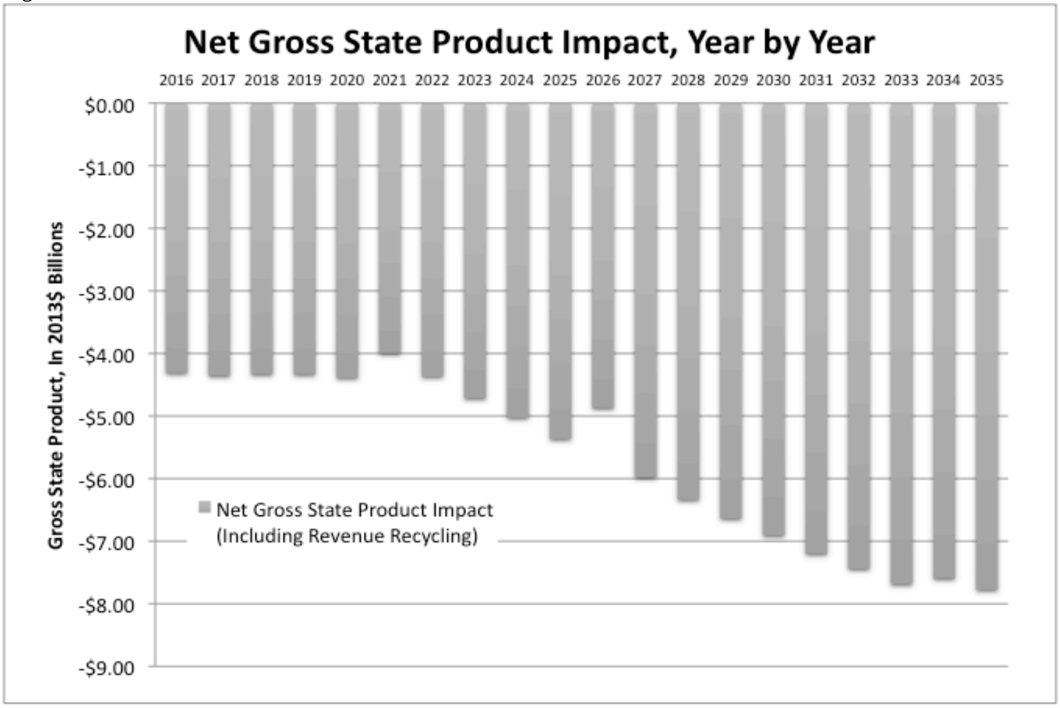
Baseline employment trends were obtained from OFM's September 23rd presentation to the Carbon Emissions Reduction Task Force. The annual estimated economic impacts are netted from the OFM forecast and can be seen in Figure 16. The graph illustrates the general conclusions of this analysis, that the governor's proposed cap-and-trade policies could have substantial negative net economic impacts on the Washington State economy.

Figure 16



The net decline in gross state product ranges from $4.3 billion in 2016 to $7.8 billion in 2035 (in constant 2013 dollars), averaging $5.7 billion per year (Figure 17).

Figure 17



3.4.3 Tax Revenue Impacts

The IMPLAN system has a fiscal module that estimates the tax impacts from changes in economic activity. The tax module was run for each year of the energy price scenarios. The average annual tax impacts are reported in Figure 18.

Figure 18

State Tax Impacts from Carbon Policy; Annual Average 2016 – 2035

Category (in millions)	Total	Sales	Property	Excise	Federal Excise
Taxes Lost from Output Reduction	($757)	($428)	($200)	($48)	($82)
Taxes Gained from Revenue Recycling	$99	$56	$26	$6	$11
Net Tax Impacts	**($658)**	**($372)**	**($174)**	**($41)**	**($71)**

Note: Table does not sum due to rounding.

The first line shows gross taxes lost from the reduction in economic output. Tax revenues are tied directly and indirectly to the economic activity that generates them. A reduction of the economy or future economic growth will cause a reduction of tax revenues. There will then be offsetting positive revenues (taxes gained) from revenue recycling. For example, schoolteachers and construction companies supported from the revenue recycling pay a wide array of state and federal taxes. The last line shows the net impact of these two offsetting forces.

Figure 18 does not reflect the influx of new revenues from the allowance auctions. The annual average of this new source of revenue as estimated by CTAM is roughly

$1.5 billion. Adding this amount to the calculation results in the net state tax impacts from the CPAA, as summarized in Figure 19.

Figure 19
Net State Tax Impacts from Carbon Policy; Annual Average 2016 – 2035

in millions	
Revenue recycling (offsets)	$1,529
Taxes lost from output reduction	($757)
Taxes gained from revenue recycling	$99
Net tax impacts	**$870**

Note: Table does not sum due to rounding.

The OFM estimates of new revenues created from the governor's cap-and-trade proposal do not consider the reduction of tax revenues that will result from the reduction of output that will likely occur from increasing energy prices and their effects on the broader economy. Our analysis shows that *net* tax revenues generated will on average be only a little more than half of the projected gross new revenues from allowance auctions due to the reduction of economic output from the policy.

3.4.4 Impact to Average Household: Direct and Indirect Effects

In section 3.2.6, the impacts on an average household were summarized, using the direct effects of higher gasoline, natural gas, and electricity prices only. When factoring in the economy-wide impacts, the reduction of household income is much greater than the average increase in energy bills.

Total household income as measured by employee compensation, proprietor's income, and employer supplements was reduced by a $3.1 billion dollars on average in the primary energy scenario, including the multiplier effects. Averaging this number across the total Washington State households (2,629,126) yields a loss of income of $1,194 per household.

3.5 High-Allowance-Price Scenario

As noted earlier, because CTAM was designed for the analysis of carbon taxes, not cap-and-trade, there is no ability to place a cap on the emissions. When the OFM's assumptions on carbon prices were used, the adjusted GHG emissions projections for the state as predicted by CTAM would not achieve Washington's 2020 and 2035 carbon limits as established by the legislature in 2008. Despite this counter-intuitive outcome, Energy Strategies feels the carbon-price scenario based on OFM's carbon allowance prices (ending at $45.60 in 2035), which has been discussed at length in prior sections, is a reasonable price scenario.

It is possible to calculate the allowance price levels that would result in CTAM predicting that Washington would achieve its GHG reduction goals. Therefore, a high-allowance-price scenario was created and evaluated, in which allowance prices are set high enough for the emissions reductions projected in the CTAM model to achieve the economy-wide 2020 and 3035 GHG emission reductions goals. Note this is a CTAM prediction, based on adjusted GHG emissions solely from direct energy price impacts.

This high-allowance-price scenario begins with the same starting allowance price of $12.94/ton in 2016, but rather than increasing at about $0.40/year 2017 – 2020 and about $2.00/year thereafter, the allowance price rises $12.00/year from 2017 – 2020 and $4.00/year per metric ton thereafter, reaching $120.94/metric ton in 2035.

The market of course will determine the cost of allowances, and there could certainly be some volatility. The cost of allowances will almost certainly not follow the exact path outlined in the primary scenario previously discussed. However, Energy Strategies feels the high-allowance-price scenario is much less likely to approximate reality for a variety of reasons. First, the higher allowance prices will lead to greater substitution away from carbon-intense activities. Secondly, higher price increases in energy will lead to greater innovation. CTAM does not account for substitution and innovation; it simply reflects reduction in demand from the higher price (that is, it assumes people drive less, turn the thermostat down, etc.). Thirdly, as noted before, CTAM-derived forecasts are based solely on adjusted demand from direct energy prices and do not reflect adjusted demand arising from the indirect effects of rising energy prices. In reality, as higher energy prices ripple through the economy, increasing the costs of all goods and services, demand will fall earlier than if only the direct effects are considered. Therefore, the emissions reductions targets would likely be achieved before these high prices were reached.

In order to force CTAM to produce the emission reductions necessary to achieve the economy-wide GHG reduction goals, the allowance prices required are very high and would result in substantial increases to the price of energy such as electricity, natural gas and gasoline. Under this scenario, energy prices would be 24% to 60% higher in 2035 than they would be without the CPAA.

Figure 20

Fuel Price Impacts Under a High-Allowance-Price CPAA

Fuel Type	Unit	2035 Baseline	2035 High-Price CPAA	High-Price CPAA % Increase in 2035
Gasoline	$/gallon	$4.10	$5.14	25%
Diesel	$/gallon	$5.02	$6.24	24%
Electricity	cents/kWh	7.41	9.50	28%
Natural Gas	$/MMBtu	$9.48	$15.17	60%

Because the allowances prices in the high-allowance-price scenario approach much higher levels than under the primary CPAA scenario, the revenues associated with the CPAA would also be much higher. As illustrated in Figure 21, in this scenario CTAM estimates revenues would reach more than $5.2 billion by 2035. For this scenario, we have continued to assume these higher revenues would be recycled according to the same proportions proposed by the governor for the expected $947 million in 2017. While this assumption parallels the primary CPAA case analysis, note that a $5.2 billion annual increase in tax revenue would be dramatic: for Washington's 2011 – 2013 *two-year* spending period, the estimated collection of taxes from its citizens and businesses through the sales tax, property tax, and Business and Occupation tax was $32.8 billion.

Figure 21

Annual Allowance Revenues from CTAM: High-Allowance-Price Scenario

in millions 2012$	2016	2020	2025	2030	2035
Total Revenues	$800	$3,445	$3,988	$4,720	$5,216

The results from IMPLAN are summarized below in Figure 22. In this scenario, the net average loss of gross state product is $23.7 billion (5.97% of GSP) and the net average loss of jobs against the baseline is 242,141 (-6.02% of employment). However, there is an important caveat that must be applied to these results. IMPLAN does not account for substitution or innovation. We expect the energy prices assumed in this high price scenario will lead to greater innovation and substitution away from high-cost energy inputs in the production processes of the economy. Accordingly, it is *very unlikely* the economic impacts reported in Figure 22 will be realized and sustained in the long run.

Figure 22

Net Average Annual Economic Impacts; High-Allowance-Price Scenario

Industry	Change in Gross State Product (in millions)	Percent Change in GSP by Industry	Change in Jobs	Percent Change in Jobs by Industry	Change in Sales, Excise and Property Taxes (in millions)
Ag. & Forestry	($593)	-7.3%	(9,602)	-6.6%	($6)
Mining	($545)	-24.7%	(1,262)	-20.5%	($3)
Utilities	($1,353)	-38.6%	(1,842)	-35.3%	($467)
Construction	($630)	-4.3%	(8,421)	-4.4%	($27)
Manufacturing	($3,285)	-6.4%	(23,624)	-7.7%	($126)
Transportation	($1,883)	-21.2%	(21,689)	-19.5%	($138)
Trade	($3,827)	-7.9%	(44,240)	-8.4%	($1,011)
Services	($11,889)	-5.9%	(143,973)	-6.8%	($939)
Government	($44)	-0.1%	8,206	1.3%	$60
Consumption/Rebates	$370		4,307		$5
Total	**($23,680)**	**-5.97%**	**(242,141)**	-6.02%	($2,651)

Note: Table does not sum due to rounding.

4. Projections of GHG Emissions

As part of this analysis, the environmental impact of the CPAA was analyzed as well as its potential economic impact.

Under the draft legislation, Washington's Department of Ecology must set annual allowance budgets that decrease each year and will lead to Washington achieving its GHG targets. While the emissions trajectory will be designed to meet the 2020, 2035, and 2050 goals, we cannot predict with any accuracy the market price of allowances.

We do know, based on the CTAM analysis, that the price assumptions used by OFM and in this analysis are not high enough to result in a reduction in GHG emissions that would enable the state of Washington to meet its 2020 and 2035 goals. In order to show an emissions reduction that would meet Washington's goals, the model requires allowance prices that are three to four times higher than the current OFM assumptions.

Given that background, a review of the current projections that exist for Washington for 2035 (and, to a lesser extent, 2050) follows, with a potential projection under the CPAA using the OFM allowance-price assumptions.

4.1 Department of Ecology Projections

The Washington Department of Ecology produces projections of GHG emissions for Washington. The first projections were provided in December 2007, and reported projections for 2010 and 2020. In December 2010, WDOE lowered its projections for 2020 and released a new GHG emissions projection for 2035. In September 2013, the 2020 and 2035 projections were both revised downward and a new projection for 2050 was issued. During the CLEW process, some of the WDOE model assumptions were revised. This resulted in yet another set of new projections for 2020, 2035, and 2050 that were again lower than previous WDOE projections. The WDOE has been consistent in overestimating GHG emissions in its projections and every subsequent update has resulted in lowering projected total GHG emissions. Figure 23 summarizes the numbers and the dates they were released.

Figure 23

Total Gross Washington GHG Emissions in MMtCO$_2$e, Projected

	December 2007 Projection Estimates	December 2010 Projection Estimates	September 2013 Projection Estimates	October 2013 Projection Estimates
2010	103.0	N/A	N/A	N/A
2020	121.9	104.0	101.3	99.6
2035	Not Developed	114.2	111.7	104.9
2050	Not Developed	Not Developed	135.0	115.0

It is also recognized that it is extraordinarily difficult to model economy-wide emissions far into the future, and revisions and improvements to the model can be expected in the future. The trend toward lower projected emissions upon updating, however, reveals a bias toward overstatement of GHG emissions. This same bias may also be evident in the comparison of projected results against actual results, which is (to date) only possible for 2010. While the 2010 GHG emissions inventory was forecast to be 103.0 $MMtCO_2e$ as part of the work released in December 2007, when the historical inventory was released in September 2013, the actual GHG emissions were 96.1 $MMtCO_2e$. That is, the work projecting emissions less than three years in the future resulted in a forecast that was 7% too high.

As noted earlier, the short-term (7-year) recent trend for Washington's GHG emissions is downward. WDOE's currently projections reflect the longer-term (20-year) trend, projecting a slight increase.

4.2 Leidos Adjustments to the WDOE Projections

As part of the CLEW process, Leidos was hired to conduct a number of analyses around GHG emissions in Washington and expected impacts from a cap-and-trade or carbon tax in the state. One of the deliverables from Leidos was a projection of future GHG emissions in Washington State, including a quantification of the expected GHG reductions from existing state and federal policies. Leidos estimated that, with most currently enacted policies accounted for, the state's GHG emissions would reach 97.9 $MMtCO_2e$ in 2020. By 2035, Leidos estimated the state's GHG emissions would be 97.5 $MMtCO_2e$. While these projections certainly show a flattening of the state's emissions, they do not indicate the state would meet the 2020 or 2035 GHG emission goals.

There are a number of reasons why the Leidos' projections may actually overstate the emissions that would be expected in 2020 and 2035. These include:

- A very conservative approach to estimating GHG reductions associated with the retirement of Centralia. Under a consumption-based accounting system, Washington is not given full credit for the retirement of units of the Centralia power plant in 2020 and 2025.
- Failure to account for the likely retirement of Colstrip units one and two in the 2035 timeframe, and
- WDOE's calculations of the future mix of electricity consumed in Washington assumes annual increases in the amount of coal-fired generation when there are no plans to add new coal resources in Washington or the region.

Projections by WDOE and Leidos do not include GHG emissions reductions required of existing power plants under EPA's Clean Power Plan rule. Despite these limitations, the Leidos projections represent the most comprehensive and up-to-date estimate of future GHG emissions in Washington State. Figure 24 summarizes the Leidos adjustments and projections as well as the Washington Department of Ecology projections.

Figure 24

Total Gross Washington GHG Emissions in $MMtCO_2e$, Projected

in $MMtCO_2e$	2020	2035	2050
Projected GHG emissions *without* federal and state policy	115.1	128.1	138.2
Estimated reductions from existing state policies	-15.8	-29.0	-36.5
Estimated reductions from existing federal policies	-1.4	-1.6	-1.6
Leidos Projected GHG emissions *with* federal and state policies	97.9	97.5	100.1
WDOE Total Gross GHG Emissions Projections, October 2013	99.6	104.9	115.0

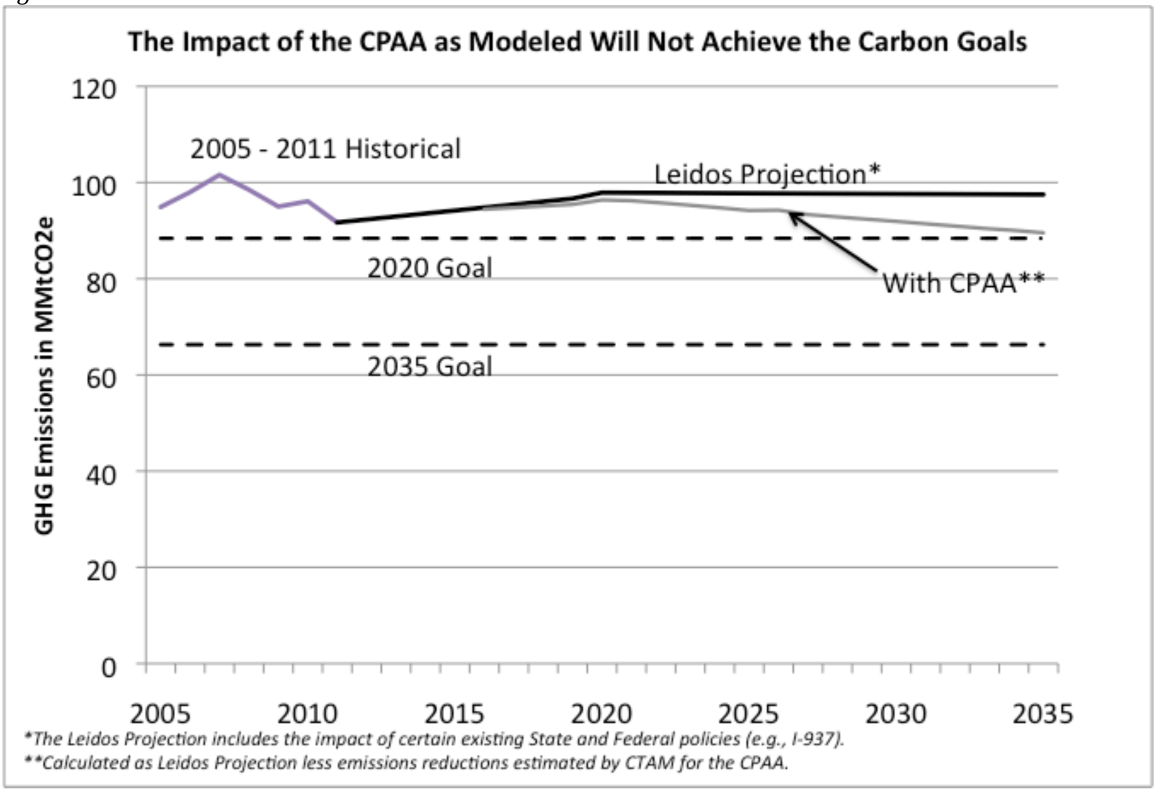
4.3 The Impact of the Clean Power Plan on Washington's GHG Emissions

As noted earlier, the evaluation of the potential impact from federal policies performed by Leidos excluded the impact from the federal regulation of GHG emissions from existing power plants. The Environmental Protection Agency's Clean Power Plan, which seeks to regulate GHG emissions under Section 111(d) of the Clean Air Act, is currently a draft rule, with a final rule expected by mid-summer 2015. While a great deal of uncertainty remains regarding the precise form of the final rule and its implementation, we do know that the federal rule only targets GHG-emitting generation sources *within* each state. That is, under the Clean Power Plan, each state will regulate existing GHG-emitting generation resources based on electricity generated within the state; it is not consumption-based regulation. This creates a potential conflict between the federal Clean Air Act and the CPPA, with the CPAA proposing to regulate electricity-sector GHG emissions under a consumption-based standard. Regardless, the Clean Power Plan could drive emissions from Washington's electricity sector even lower than the forecasts from Leidos and may serve as a means of reducing GHG emissions without the implementation of the CPAA.

4.4 Projections of GHG Emissions under the CPAA

In order to estimate the possible GHG trajectory of the state under the CPAA, Energy Strategies began with the most recent Leidos projection, which includes the existing state and federal policies that were quantified through their work for CLEW. Energy Strategies then added the emissions reductions that CTAM estimated would be caused by the CPAA. The resulting estimate of the CTAM-adjusted GHG emissions projections for 2020 and 2035 are shown in Figure 25.

Figure 25



As the graph illustrates, and as discussed in earlier sections, based on the reductions estimated in CTAM and the assumed allowance prices, the CPPA alone will not be sufficient to achieve the GHG emission targets. However, the structure of a cap-and-trade is that an emissions level (for the covered sectors) is set and the market price will adjust to ensure the required emission levels are achieved. Therefore, the CPAA will ensure emissions are driven to the level at which the cap is set, but we do not know the prices at which allowances will be traded. Emissions reductions from the CPAA may be driven by price changes causing decreased demand for energy, by incentivizing efficiency upgrades that could be achieved for less than an allowance price, by incenting innovation, motivating substation, or a number of other factors.

It should be noted that the emission reductions calculated in CTAM are likely a low-end estimate of what would be achieved with the CPAA, because CTAM only accounts for the emission reductions driven by decreased consumption from higher energy prices. CTAM does not account for other types of emission reductions that would be driven by the CPAA. Therefore, the emissions reductions in CTAM could be viewed as a low-end estimate.

CTAM has its own projections of future emissions for Washington. However, the Leidos projections appear to have much more thorough documentation and also have the benefit of including emissions from every sector of the economy. For instance, CTAM does not appear to include emissions from landfills or the agriculture sector.

5. Conclusions

The Carbon Pollution Accountability Act is an economy-wide cap-and-trade program that will economically impact *all* Washington households, businesses, and industry. The Act's regulation of greenhouse gas emissions targets millions of households and businesses, not just the 130 "worst polluters." More than fifty percent of Washington's 2011 GHG emissions covered by the Act are associated with residential and commercial businesses consumption of on-road petroleum fuels and natural gas for heating homes and businesses. While wholesale petroleum fuel distributors and retail natural gas distribution companies will be regulated by the Act, they are being regulated almost entirely on the basis of greenhouse gasses emitted by individual households and businesses.

The urgency of implementing the Act is overstated by this administration. The Washington Department of Ecology's projections have consistently overestimated the state's GHG emissions and have regularly been revised downward. These overestimates have been used to conclude the state will not meet its legislatively mandated 2020 and 2035 GHG emissions target and to justify the urgent need for cap-and-trade regulations.

GHG emissions have been on a downward trend in Washington, the result of a changing economy and economic conditions and the implementation of effective federal and state policies targeting greenhouse gasses. The most recent inventory, released in December 2014, indicates that the state's 2011 GHG emissions are at the lowest level since 1990 and within 3.3 $MMtCO_2e$ of the 2020 emissions target. This is the culmination of a trend that has seen GHG emissions *fall* by a compound annual average rate of 0.5% since 2005. This GHG emissions trend could continue in the foreseeable future, reinforced by the growing effectiveness of existing policies already adopted by the state of Washington and EPA's pending rule regulating GHG emissions from power plants. This trend points to the possibility that Washington could achieve the 2020 goal without new and costly cap-and-trade regulation.

Energy prices and expenditures of Washington households and businesses will increase as a result of implementing the Act. Using the same assumptions as Washington's Office of Financial Management, Energy Strategies estimates the following price impacts under the CPAA (versus baseline) in 2035:

- The weighted average price of electricity is projected to increase by 11% to $0.0794 per kWh,
- The weighted average price of natural gas is expected to be 22.6%, or $2.15/MMBtu, higher, and
- The price of gasoline is expected to be 9.5% or $0.39/gallon higher, and
- The price of diesel is expected to be 9.2% or $0.46/gallon higher.

Governor Inslee's Carbon Pollution Accountability Act will have a significant negative impact on the Washington State economy. Even when the recycling of allowance revenues into new government programs, tax credits, and rebates is taken into account, the net economic loss is substantial.

- The average annual reduction in gross state product is projected to be approximately $5.7 billion or 1.43% of Washington State's gross state product.
- The loss of jobs across the economy is estimated to average approximately 56,000 per year.
- Tax revenues are tied directly and indirectly to the health of the economy and a reduction in future economic growth due to the Act will result in a reduction in tax revenues. Under the CPPA the collection of sales, excise, and property taxes are all expected to decline. Our analysis shows that *net* tax revenues generated will on average be only a little more than half of the projected gross new revenues from the sale of allowances due to the reduction in economic output from the policy.

The CPAA requires the Department of Ecology to set the annual allowance cap such that the 2020, 2035, and 2050 targets will be met. Our analysis and the analysis performed by the OFM show that allowances prices starting at $12.94 and rising over time at the rates assumed will not be high enough to drive the reductions in GHG emissions needed to achieve the 2020, 2035, or 2050 emissions targets set by the Washington legislature. This may be a result of overly high projections of GHG emissions and the model's underestimate of emissions reductions. It also reflects the fact that the forecast for allowance prices used by OFM and this analysis may be too low.

A comparison of the results of the economic impact analysis in this report and those released by the Office of Financial Management December 23, 2014, indicate there is a significant difference between the two. The OFM analysis reports that a cap-and-trade program will have negligible economic impacts on Washington's economy; income, employment, and gross state product show slight improvements against the baseline over the period 2016 – 2035. Our analysis shows the opposite result.

Historical analysis of the U.S. business cycle shows the economy is sensitive to increases in energy prices, and rising energy prices have been an important component of most recent major U.S. recessions. A cap-and-trade policy will increase the cost of energy throughout the Washington economy. As higher energy costs ripple through the economy, every business and household will feel the impact.

Resources

Carbon Pollution Accountability Act
House Bill 1314: http://apps.leg.wa.gov/billinfo/summary.aspx?bill=1314&year=2015
Senate Bill 5283: http://apps.leg.wa.gov/billinfo/summary.aspx?bill=5283&year=2015
Governor Inslee's Policy Briefs: http://www.governor.wa.gov/issues/climate/waleg15.aspx

Carbon Emissions Reduction Taskforce (CERT)
Meeting materials, including OFM presentations and projection modeling updates.
http://www.governor.wa.gov/issues/climate/cert.aspx

Carbon Tax Analysis Model (CTAM)
V2-8a shared by Washington Department of Commerce on December 31, 2014
http://www.commerce.wa.gov/Programs/Energy/Office/Pages/NewEnergyReports.aspx

Climate Legislative and Executive Workgroup (CLEW)
Overview and the final Leidos report to the legislature.
http://www.governor.wa.gov/issues/economy/climateWorkgroup/
Meeting materials, including documentation on GHG inventories.
http://www.governor.wa.gov/issues/economy/climateWorkgroup/meetings.aspx

IMPLAN
http://implan.com

U.S. EPA's Trends in GHG Emissions (2014)
http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Chapter-2-Trends.pdf

U.S. EPA's Clean Power Plan
http://www2.epa.gov/carbon-pollution-standards

U.S. Energy Information Administration's Annual Energy Outlook
http://www.eia.gov/forecasts/aeo/

Washington Greenhouse Gas Inventories and Projections, and Population
Dept. of Ecology GHG: http://www.ecy.wa.gov/climatechange/ghg_inventory.htm
Washington's OFM population report: http://www.ofm.wa.gov/pop/april1/poptrends.pdf