# Task 3 – Evaluation of Federal Policies

Summary of Federal Policies and Their Contributions to Washington's GHG Emission Reduction Targets

**September 20, 2013**

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## Acronyms

| | |
|---|---|
| **BACT** | Best Available Control Technology |
| **BAU** | Business-as-Usual |
| **BCG** | Boston Consulting Group |
| **Btu** | British Thermal Units |
| **CAFE** | Corporate Average Fuel Economy |
| **CAIR** | Clean Air Interstate Rule |
| **CARB** | California Air Resources Board |
| **CD** | Census Division |
| **CEA** | Consumer Energy Alliance |
| **CEQA** | California Environmental Quality Act |
| **CLEW** | Climate Legislative and Executive Workgroup |
| **$CO_2$** | Carbon Dioxide |
| **CRS** | Congressional Research Service |
| **CSAPR** | Cross-state Air Pollution Rule |
| **D.C.** | District of Columbia |
| **DOE** | U.S. Department of Energy |
| **EIA** | U.S. Energy Information Administration |
| **EISA** | Energy Independence and Security Act |
| **EPA** | U.S. Environmental Protection Agency |
| **EPACT** | Energy Policy Act |
| **FERC** | Federal Energy Regulatory Commission |
| **GDP** | Gross Domestic Product |
| **GHG** | Greenhouse Gas |
| **IPM** | Integrated Planning Mode |
| **IRS** | Internal Revenue Service |
| **ITC** | Investment Tax Credit |
| **LCFS** | Low Carbon Fuel Standard |
| **LNG** | Liquefied Natural Gas |
| **MATS** | Mercury and Air Toxic Standards |
| **MLP** | Master Limited Partnership |
| **MPG** | Miles Per Gallon |
| **NEMS** | National Energy Modeling System |
| **NESCAUM** | Northeast States for Coordinated Air Use Management |
| **NHTSA** | National Highway Transportation Administration |
| **NOx** | Nitrogen Oxides |
| **NREL** | National Renewable Energy Laboratory |
| **NSPS** | New Source Performance Standards |

| | |
|---|---|
| **OFM** | Office of Financial Management |
| **PSD** | Prevention of Significant Deterioration |
| **PTC** | Production Tax Credit |
| **PV** | Photovoltaic |
| **REITs** | Real Estate Investment Trusts |
| **RFS** | Renewable Fuels Standards |
| **RIN** | Renewable Identification Number |
| **RVO** | Renewable Volume Obligation |
| **SAIC** | Science Applications International Corporation |
| **SEDS** | State Energy Data System |
| **SMU** | Southern Methodist University |
| **U.S.** | United States |
| **WA** | Washington |
| **WECC/NWPP** | Western Electricity Coordinating Council / Northwest Power Pool |
| **WSPA** | Western States Petroleum Association |

## 1 Overview

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 examining and summarizing federal policies that could potentially contribute to meeting the state's greenhouse gas (GHG) emission targets for 2020, 2035, and 2050. On July 26, 2013, SAIC submitted a draft document in fulfillment of those objectives. After receiving comments from the State, SAIC provided an updated document on August 23, 2013 that responded to comments provided by the State and further quantified the potential amount of future GHG emission reductions in Washington State that could be attributable to existing and anticipated federal policies. This document provides additional response to further comments provided by the State and adds greater detail on GHG emission reductions in Washington that are forecast to occur through 2035 due to the impacts of federal policies.

There are a virtually unlimited number of federal policies that can affect national and individual state GHG emission levels. The Kaya identity (eq.1 below) expresses carbon dioxide emissions as a function of: 1) Total economic activity; 2) the energy intensity of economic activity; and 3) the carbon intensity of energy consumed.[1]

$$CO_2 \text{ Emissions} = \text{Population} \times (\text{GDP}/\text{Population}) \times (\text{Energy}/\text{GDP}) \times (CO_2/\text{Energy}) \quad \text{(equation 1)}$$

Thus, virtually any policy that will affect economic activity, from the Patient Protection and Affordable Care Act to the quantitative easing by the Federal Reserve will affect GHG emissions. However, it is rare that the GHG consequences of such policies have been examined and to do so would require a scope and resources far beyond that of this study. Instead, we will focus on those policies that can be more reasonably expected to impact the last two variables of the Kaya identity, the energy intensity of the economy and the carbon intensity of energy consumed. That said, such policies themselves, will have an impact on economic activity that can be of great consequence, and which we will try to consider in this study.

Although this analysis has been largely limited to existing federal policies, or proposed federal policies that can be plausibly expected to be implemented in the near- or mid-term, a special exception has been made for the inclusion of state-level policies implemented within Washington's region but outside of its borders such as California's Low Carbon Fuel Standard and the Renewable Portfolio Standards in place across the region. A summary of each policy

[1] Kaya, Y., *Impact of Carbon Dioxide Emission Control on GNP Growth: Interpretation of Proposed Scenarios*, paper presented to the IPCC Energy and Industry Subgroup, Response Strategies Working Group, Paris, France, 1990.

analyzed appears directly below accompanied by a brief literature review. The U.S. Energy Information Administration's (EIA) National Energy Modeling System (NEMS) has been employed to perform a forecast of the impacts of these policies on future greenhouse gas emission levels. NEMS performs its analysis at the national and regional levels. Preliminary results provided in Section 4 below include forecasts of impacts on national emissions levels and forecasts of impacts on Census Division 9, which includes California, Oregon, Hawaii, Alaska and Washington and in the case of electricity[2], the Western Electricity Coordinating Council / Northwest Power Pool[3]. SAIC will employ post processing techniques to apply relevant policies specifically to Washington state. Specifically, post processing will multiply Washington's average historic share of fuel, energy, or emissions, as appropriate, by regional NEMS projections to estimate state-level impacts for each policy. Historic data for Washington was obtained from the State Energy Data System (SEDS) and State $CO_2$ Emissions database maintained by the Energy Information Administration. These values were averaged for 2006 through 2010 to estimate Washington State's typical share or weight in the region. Additional details on state-level calculation methods are provided in Appendix C.

## 2 Summary of Federal Policies to be Examined

The CLEW has identified five categories of federal policies that may contribute to meeting the states greenhouse gas emissions targets. They are:

- Renewable fuel standards;
- Tax incentives for renewable energy;
- Tailpipe emission standards for vehicles;
- Corporate average fuel economy (CAFE) standards for cars and light trucks; and
- Clean Air Act requirements for emissions from stationary sources and fossil-fueled electric generating units.

This study defines the renewable fuels standards as RFS-1 and RFS-2 as required under the Energy Policy Act (EPACT) of 2005 and Energy Independence and Security Act (EISA) of 2007, respectively. Tax incentives for renewable energy are defined as the Production Tax Credit for Renewable Resources and its subordinate element, the Investment Tax Credit. The CAFE standards are defined as the more stringent requirements implemented subsequent to EISA 2007. The tailpipe emissions standard for carbon dioxide and the most recent update to the CAFE standards are inextricably bound, both via regulation and in the NEMS model and thus are treated jointly. In response to the CLEW mandate to evaluate the impact of applicable emission standards for stationary source and fossil fueled electric generation under the Clean Air Act, this

[2] See Appendix A for a map of U.S. Census divisions.
[3] See Appendix B for a map of NEMS Electricity Market Module regions.

study examines the Mercury and Air Toxic Standards, the Clean Air Interstate Regulations, and the Cross-state Air Pollution Rule which constrain emissions of sulfur dioxide and oxides of nitrogen.

There are several other policies in place, that while not emanating from the federal government, have critical impacts across state borders and in particular, that may affect Washington's ability to meet its GHG emissions targets. Most notable among these are the California Low Carbon Fuel Standard, and state-level renewable portfolio standards. While it is unlikely that the Federal government will pass a renewable portfolio standard in the foreseeable future, we will conduct a regional analysis that captures the impact of surrounding states on the Washington electricity market.

In addition to existing policies, SAIC will also examine several prospective policies that we believe have a reasonable chance of becoming law in the near future and affecting the curve of Washington's future emissions profile.[4] Three of these were identified in President Obama's Climate Action Plan, released on June 25, 2013. They include EPA regulation, under the Clean Air Act, of GHG emissions from current and future electric generation stations, new incentives for renewable power generation on federal lands, and a reduction of tax expenditures for fossil fuels, which SAIC has interpreted as a repeal of the oil and gas depletion allowance.

In addition to those policies proposed by President Obama there are several being considered in Congress and lower down in the executive branch which also may have important impacts. The first is to grant renewable generation projects Master Limited Partnership (MLP) parity with fossil fuel projects as well as to allow renewable energy projects the same tax benefits from Real Estate Investment Trusts (REITs) that fossil-based projects now receive. MLPs and REITs combine the tax benefits of a partnership with the liquidity of a publicly traded stock. Both MLPs and REITS are taxed based on returns to investors but are not taxed at the corporate level, eliminating the "double taxation" generally applied to corporations and their shareholders. Limited partners in an MLP may record a pro-rated share of the MLP's depreciation to reduce tax liability. To qualify for MLP status, a partnership must generate at least 90 percent of its resources from qualifying sources. To date, "inexhaustible" (renewable) energy sources have been excluded as a qualifying source. The MLP Parity Act would allow renewables to be included as a qualifying source. REITs work similarly to MLPs. REITs were initially authorized by Congress in 1960 to give retail investors a way to get into commercial real estate. They are

[4] There are a virtually limitless number of potential policies that have been proposed at the federal level that could, conceivably reduce greenhouse gases. However, given the current legislative environment, absent existing authorities in the executive branch, or inclusion in an unrelated bill such as a continuing resolution or debt ceiling adjustment the prospects for these policies are limited in the near term. For example, S. 761, the Energy Saving and Industrial Competiveness Act may have had relevant impacts on Washington's emission levels but has been subject to considerable delay in the U.S. Senate as unrelated amendments associated with the minority's effort to defund the Patient Protection and Affordable Care Act are considered. Should S.761 pass out of the senate it will be subject to a similar process in the House of Representatives.

required to pay at least 90 percent of their taxable income to shareholders. REITS are now used for funding timber, data centers, mobile phone towers, and natural gas pipelines. All that is required for renewable energy facilities to be eligible for classification as a REIT is a letter ruling by the Internal Revenue Service that renewable facilities are "real property." The IRS has issued case-specific letters ruling in support of renewable REITS, but, has not, to date, issued a generic ruling.

Although it is not a policy determined by Congressional statute or executive order, the potential expansion of Liquefied Natural Gas (LNG) exports may have important effects on domestic gas production and prices. These effects may, in turn, have implications for future GHG reductions in Washington. The Federal Energy Regulatory Commission is currently considering application for the siting and construction of 17 LNG export terminals, with an additional six in the proposal pipeline. Approval of a significant portion of these terminals will likely increase the export of natural gas with important implications for gas production and prices.

## 2.1 Existing Policies

### Renewable Fuels Standards (RFS-1 and RFS-2)

***Program Summary:*** The Renewable Fuels Standard (RFS) was created under EPACT 2005. EPACT required that 7.5 billion gallons of renewable fuels be blended into motor gasoline by 2012. Administered by EPA, the original RFS is often referred to as RFS-1. The Program was expanded under EISA 2007. In addition to motor gasoline, it now includes diesel fuels. The target for renewable fuel to be blended into transportation fuels was raised to 36 billion gallons by 2022. EISA established new categories of renewable fuels including biomass-based diesel, non-cellulosic advanced and cellulosic biofuel, each with its own target within the larger overall target. Together, these advanced biofuels were equal to 21 billion of the overall 36 billion gallons targeted in 2022. EISA also set thresholds for the life-cycle GHG emissions of each of these fuels. To qualify under the program, traditional renewable fuels would need to have life-cycle emissions that are 20 percent lower than the fuel being displaced, advanced biofuel and biomass-based diesel would need to have lifecycle emissions 50 percent below the fuel being displaced, and cellulosic biofuel would need to have life-cycle GHG emissions 60 percent below the gasoline or diesel fuel it displaces. Under this Program (now referred to as RFS-2) the EPA assigns refiners and importers of petroleum-based transportation fuels a Renewable Volume Obligation (RVO). These regulated entities may meet these obligations with Renewable Identification Numbers (RIN), an alphanumeric code assigned to each gallon of renewable fuel either produced or imported into the United States. RINs may be traded so that obligations can be met at least cost.

***Results of Preliminary Literature Review:*** The EPA estimated that RFS-2 will displace approximately 13.6 billion gallons of motor gasoline and diesel fuel in 2022, reducing greenhouse gas emissions by 138 million metric tons, and decreasing the cost of oil imports by

$41.5 billion. At the same time, the program will increase farm income by $13 billion dollars in 2022, but will also increase the annual cost of food by $10 per person in the U.S.[5] In 2011 and 2012, the American Petroleum Institute commissioned a two-phase study to look at the economic impacts of RFS-2. In phase one, Charles River Associates used the NEMS version from *Annual Energy Outlook 2011* to evaluate the market's ability to absorb ethanol into petroleum based fuels. They estimated that by 2013 the U.S. market would no longer be able to absorb the requisite volume of ethanol and would have to begin either reducing production of petroleum based fuels or increasing the portion of production that was exported.[6] Further, Charles River found that by 2015, implementation of the rule would be impossible. In phase two, NERA economic consulting looked at the economic effects of hitting this "blend wall," and concluded thatit would result in a $770 billion decline in GDP in 2015, and a diminution of household consumption of $2,700.[7]

What these studies fail to emphasize is that under EISA, the EPA has considerable discretion to alter the individual standards or provide waivers to fuel producers and exporters. In his June 26, 2013 testimony to the House Committee on Energy and Commerce, Subcommittee on Energy and Power, EIA Administrator Adam Sieminski stated that "the RFS program is not projected to come close to the achievement of the legislative target that calls for 36 billion gallons of renewable motor fuels use by 2022." He went on to state, "EPA will need to decide how to apply its regulatory discretion regarding the advanced and total RFS targets as allowed by law." The U.S. EPA did reduce compliance levels for cellulosic ethanol in 2012 and 2013, setting the 2013 target at 6 million gallons, less than half of the level in February 2013 proposed rulemaking and well below the one billion gallons foreseen in EISA. The final 2013 rulemaking did maintain the advanced biofuel target at statutory levels, with the total renewable fuels target at 16.55 billion gallons. The final does project however, that EPA will need to adjust the total target below the 18.15 billion gallons contained in EISA.[8] The EIA points out that the expectation that cellulosic and advance biofuels could be available in significant volumes at reasonable costs has not been realized and that the general reduction in fuel volumes consumed places additional pressure on biofuel volumes targets.[9]

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[5] U.S. EPA, *EPA Finalizes Regulation for the National Renewable Fuel Standard Program for 2010 and Beyond*, Office of Transportation and Air Quality, EPA-420-F-10-007, February 2010.

[6] Charles River Associates, *Impact of the Blend Wall Constraint in Complying with the Renewable Fuel Standard*, H. Foster, R. Baron, P. Bernstein, November 2, 2011, http://www.api.org/news-and-media/news/newsitems/2013/march-2013/~/media/Files/Policy/Alternatives/13-March-RFS/CRA_RSF2_BlendwallConstraints_Final_Report.pdf

[7] http://www.api.org/~/media/Files/Policy/Alternatives/13-March-RFS/NERA_EconomicImpactsResultingfromRFS2Implementation.pdf

[8] U.S. Energy Information Administration, *EPA Finalizes Renewable Standard for 2013; Additional Adjustments Expected in 2014*, August 14, 2103, http://www.eia.gov/todayinenergy/detail.cfm?id=12531

[9] Energy Information Administration, U.S. Department of Energy, statement of Adam Sieminski, Administrator, before the Subcommittee on Energy and Power, Committee on Energy and Commerce, U.S. House of Representatives, June 26, 2013, http://www.eia.gov/pressroom/testimonies/sieminski_06262013.pdf

## CAFE Standards and Tailpipe Emission Standards for Carbon Dioxide

***Program Summary:*** The Corporate Average Fuel Economy (CAFE) Standards were first enacted into law by the U.S. Congress in 1975, in response to the 1973 Arab Oil Embargo. The law required a doubling of passenger vehicle fuel efficiency to 27.5 miles per gallon (mpg) by 1985. Fuel efficiency was defined as the sales weighted mean fuel economy expressed as mpg for a manufacturer's fleet of vehicles with a gross vehicle weight less than 8,501 pounds. For every 0.1 mpg that a manufacturer's annual fleet missed the goal, it was required to pay a penalty of $5.50 multiplied by the manufacturer's total vehicle production. The National Highway Transportation Administration (NHTSA) was also authorized to set a separate standard for light trucks, which rose from 11.6 mpg in 1975 to 19.5 mpg in 1985. Between 1986 and 1988, the CAFE standard was lowered to 26 mpg and the light-truck standard stood at 20.5 mpg. In 1989, NHTSA restored the passenger-vehicle standard to 27.5 mpg and lowered the truck standard to 20 mpg. CAFE standards stood unchanged until 2006, when the light truck standard was raised to 24 mpg by 2011. In EISA 2007 Congress raised CAFE standards for cars and light duty trucks significantly, reaching 35 mpg by 2020. In April 2009, NHTSA, together with the U.S. EPA announced plans to accelerate this increase, reaching a combined average of 35.5 mpg by model year 2016, based on passenger cars reaching 39 mpg and light duty trucks meeting a 35 mpg target. EISA 2007 also required fuel efficiency standards for medium- and heavy-duty trucks for the first time. These standards were proposed jointly by NHTSA and EPA in October of 2010 and finalized as the Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles in August 2011.[10] EPA issued minor amendments to this rule in May and August of this year.[11]

On October 15, 2012, NHTSA and EPA jointly issued a final rule for CAFE standards and tailpipe emissions of carbon dioxide for light duty vehicle model years 2017 and beyond. Under the rule, each manufacturer faces a unique combination of carbon dioxide emissions and CAFE standards depending on the numbers of vehicles produced and the footprint of those vehicles. The latter is a change from earlier versions of the CAFE standards that focused on a weight threshold and had a single mpg target above and below that threshold. Instead, the footprint of a vehicle is defined as its wheelbase size (the distance from middle of front axle to middle of rear axle) multiplied by its track width (the distance between the center lines of its tires). The EPA tailpipe emissions standard of 163 grams of carbon dioxide per mile for light-duty vehicles would suggest a fleet wide average of 54.5 mpg in 2025 if the tailpipe emissions standard was reached through fuel economy alone. However, there are other mechanisms that may be used to reach that tailpipe standard. NHTSA has set a minimum CAFE standard for passenger cars of 50.9 mpg by 2025. NHTSA does allow manufacturers some flexibility, including the option to

[10] The Pew Environment Group, *History of Fuel Economy*, April 4, 2011, http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Fact_Sheet/History%20of%20Fuel%20Economy%20Clean%20Energy%20Factsheet.pdf

[11] U.S. Environmental Protection Agency http://www.epa.gov/otaq/climate/regs-heavy-duty.htm

average mpg between passenger cars and light duty trucks, to bank and carry forward credits for earlier over-compliance, to trade among manufacturers, and to improve air conditioning performance to meet carbon dioxide standards.[12]

***Results of Preliminary Literature Review:*** Two primary areas of concern have been raised related to the implementation and ongoing tightening of CAFE standards. First, CAFE standards increase the purchase price of new vehicles, and second, there is ongoing concern that one of the common approaches to improving fuel efficiency, reducing the weight of vehicles, may increase traffic fatalities. The former is fairly straightforward while the latter is much less clear. The EPA estimates the cost of new vehicles will increase by $1,800 from the model year 2016 rule to the model year 2025 rule.[13] There is little controversy over this number, though some report it as $2,000 to $2,800.[14] EPA estimated a payback of these costs, through reduced gasoline consumption, to be between 3.2 and 3.4 years depending on the discount rate applied to the analysis, with total savings between $5,700 and $7,400 over the life of the vehicle.[15],[16] This analysis assumes an average gasoline price of $3.87. Some have taken issue with this price, suggesting that prices are likely to decline over time.[17] Further, even if life-cycle cost estimates promise a return-on-investment, new car buyers will typically act in response to visible sticker prices.

The concern about safety rests largely on a study completed in 1989 by Crandall and Graham that linked higher fuel economy levels to decreased weight, and declines in car weight to increased fatalities.[18] The most oft-cited reference is a 2002 National Academy of Sciences study that concluded that the fuel economy improvements from CAFE had probably resulted in

[12]CAFE standards are based on tests permed on a dynamometer in EPA labs that simulates city and highway driving based on procedures outlined in the original 1975 legislation. Estimates of real world auto fuel efficiency tend to differ and are reflected on EPA window stickers. These window stickers use a more recent methodology that takes into account hot and cold driving conditions, use of automobile air conditioners, and high speed driving among other condition. Using the more recently developed methodology the 54.5 mpg in the new CAFE standards is likely to be closer to a real world efficiency of 40 mpg.

[13] For the MY 2016 rule, NHTSA and EPA had estimated a cost increase of approximately $950 above Model Year 2011.

[14] Heritage Foundation, *CAFE Standards: Fleet-wide Regulations Costly and Unwarranted*, Diane Kurtz, November 28, 2011, http://www.heritage.org/research/reports/2011/11/cafe-standards-fleet-wide-regulations-costly-and-unwarranted

[15]U.S. EPA, *Regulatory Impact Analysis: Final Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards*, EPA-420-R-12-016, August 2012, http://www.epa.gov/otaq/climate/documents/420r12016.pdf

[16] This estimate is for the price of fuel savings only, it does not incorporate the social cost of carbon. EPA has quantified the benefits from monetizing the avoided damages from carbon dioxide emissions separately.

[17] Congressional Research Service, *Automobile and Truck Fuel Economy (CAFE) and Greenhouse Gas Standards*, B. Yacobbuci, B. Canis, and R. Lattanzio, September 11, 2012, p.7, http://www.fas.org/sgp/crs/misc/R42721.pdf

[18] *The Effect of Fuel Economy Standards on Automobile Safety*, R. Crandall, and D. Graham, Journal of Law and Economics, Vol. 32, 1989, pp. 97-118. http://www.jstor.org/discover/10.2307/725381?uid=3739936&uid=2129&uid=2&uid=70&uid=4&uid=3739256&sid=21102549651477

between 1,300 and 2,600 additional traffic fatalities in 1993,[19] based on a 1997 analysis by NHTSA. It should be noted that the report pointed out that the most important determinant of traffic fatalities was vehicle weight differential, and that a policy focused at reducing weights at the high-end of the scale would improve safety. A series of subsequent analyses have called into question whether CAFE standards decrease vehicle safety at all, some actually observing a positive correlation between higher fuel economy and vehicle safety test crash ratings.[20] The observation about vehicle weight differentials was echoed in a 2011 paper by Anderson and Aufhammer that effectively supports recent measures to expand CAFE standards to medium- and heavy-duty vehicles.[21] The CAFE standards are in place and operational. GHG reduction impacts on Washington will have clear results, and estimates in the literature of anticipated consumer costs are well bounded. However, a full assessment of all impacts including safety considerations would have considerable remaining uncertainty.

### EPA Mercury and Air Toxic Standards

***Program Summary:*** The U.S. EPA finalized the Mercury and Air Toxics Standards Rule (also known as the Utility MACT) in December 2011. The rule required existing electric generation units to reduce emissions of hazardous air pollutants to the level of the top 12 percent of existing units by 2015. For new power plants the rule called for a mercury emissions rate limit of 0.002 pounds per gigawatt-hour. Industry contested this level as unachievable and sought remedy prior to implementation of the new source performance standards (NSPS) for greenhouse gas emissions to allow them to begin construction prior to the implementation of the NSPS (see discussion on NSPS below). In July 2012 the agency agreed to reconsider the rule, and in March of 2013 issued a new "final" rule set mercury limits of 0.003 pounds per gigawatt-hour.

***Results of Preliminary Literature Review:*** The U.S. EPA estimates the rule will cost $9.6 billion in 2015, and a total of $89.9 billion between 2015 and 2034, with public health benefits ranging from $110 to $280 billion in the first year alone.[22] An independent analysis by NERA, conducted for the American Coalition of Clean Coal Electricity, found a similar cost beyond that of the Cross State Air Pollution Rule (see below) of $10.4 billion in 2015 and $94.8 billion between 2015 and 2034.[23] EPA estimates health benefits from the rule at between $33 billion and

[19] National Research Council, Transportation Research Board, *Effectiveness and Impact of Corporate Average Fuel Efficiency Standards*, 2002, P. 27 www.nhtsa.gov/cars/rules/cafe/docs/162944_web.pdf

[20] Oak Ridge National Laboratory, Effect of Fuel Economy on Automobile Safety: A Reexamination, Center for Transportation Analysis, S. Ahmad and D. Greene, November 2004, http://www-cta.ornl.gov/cta/Publications/Reports/TRB_05_1336_AhmadGreene.pdf

[21] Vehicle Weight, Highway Safety and Energy Policy, M. Anderson, M. Aufhammer, June 5, 2011, http://www.uni-heidelberg.de/md/awi/forschung/auffhammer_researchseminar.pdf

[22] U.S. EPA, *Regulatory Impact Analysis for the Final Mercury and Air Toxics Standard*, EPA-45 2/R-11-011, December 2011, http://www.epa.gov/ttn/ecas/regdata/RIAs/matsriafinal.pdf

[23] NERA Economic Consulting, *An Economic Impact Analysis of EPA's Mercury and Air Toxics Standards Rule*, ,P.Bernstein, S.Bllomberg, S. Mankowski,and S. Tuladhar, March 1, 2012, p. 2, http://www.nera.com/nera-files/PUB_MATS_Rule_0312.pdf

$90 billion annually, far greater than costs. However, NERA and others have criticized these estimated benefits because 90% of those benefits are associated with reduced premature death from particulates, which are a co-benefit, rather than the focus of the rule.[24]

## Clean Air Interstate Rule

***Program Summary:*** The EPA's Clean Air Interstate Rule (CAIR) was designed to address the problem of pollution from power plants in the eastern US that drifts from one state to another. CAIR covers all fossil-fueled power plants in 27 Eastern states and the District of Columbia with a nameplate capacity greater than 25 megawatts. Twenty-two states and the District of Columbia fall under the caps for both sulfur dioxide, oxides of nitrogen (NOx) and ozone season NOx. Three states are controlled for only ozone season NOx, and two states are controlled for only sulfur dioxide and NOx emissions. The cap went into effect for NOx in 2009 and will go into effect for sulfur dioxide in 2015. The program includes allowance trading to lower compliance costs. In December 2008, the U.S. Court of Appeals for the DC Circuit directed the EPA to revise CAIR in what would become the Cross-state Air Pollution Rule (CSAPR). Until CSAPR was implemented, CAIR was to remain the functioning regulation. On August 12, 2012, the U.S. Court of Appeals for the D.C. Circuit announced its intent to vacate the CSAPR. As a result of that decision sulfur dioxide and oxides of nitrogen from power plants in the Eastern U.S. continue to be regulated under CAIR. On June 24, 2013 the U.S. Supreme Court announced that it will review the decision of the appeals court.

***Result of Preliminary Literature Review:*** According to EPA, CAIR will impose annual costs of $3.7 billion beginning in 2015 but will generate some $82.4 billion in annual health benefits.[25] For additional benefit and cost information please see discussion of the Cross-state Air Pollution Rule below. The predominant impacts of both CAIR and CSAPR will be in the Eastern half of the United States. As the NEMS model that we will be using for this analysis provides results at the national and regional level, this study captures the geographic impacts. The regional results are then downscaled to Washington based on its historic share of fuel, energy, or emissions in the region as appropriate. So, if CAIR has little impact on the western region, it will have little impact on Washington.

## Cross-state Air Pollution Rule

***Program Summary:*** CSAPR was issued on July 6, 2011 under the "good neighbor" provisions of the Clean Air Act, intended to ensure that emissions from one state's power plants do not cause harmful pollution in other states. This rule was a response to the direction of the U.S. Court of Appeals for the D.C. Circuit, which in 2008 instructed EPA to revise the CAIR. The CSAPR is intended to replace and strengthen the CAIR (see above) by further reducing the

[24] U.S. EPA, *Regulatory Impact Analysis for the Final Mercury and Air Toxics Standard*, EPA-45 2/R-11-011, December 2011, http://www.epa.gov/ttn/ecas/regdata/RIAs/matsriafinal.pdf
[25] http://www.epa.gov/cair/impact.html

sulfur dioxide and oxides of nitrogen pollution from coal-fired power plants across 28 Eastern states. While similar to the CAIR in many ways, CSAPR contains tighter emissions caps, limits to interstate trading, and no carryover of banked allowances from the Acid Rain Budget programs. On August 12, 2012, the U.S. Court of Appeals for the D.C. Circuit announced its intent to vacate the CSAPR. As a result of that decision, sulfur dioxide and oxides of nitrogen form power plants in the Eastern U.S. continue to be regulated under CAIR. On June 24, 2013 the U.S. Supreme Court announced that it will review the decision of the appeals court.

***Results of Preliminary Literature Review:*** According to a study by the Brattle Group, the EPA has estimated costs of the CSAPR at approximately $1 billion annually between 2012 and 2020.[26] The Brattle Group goes on to summarize its own study, and additional studies by the Edison Electric Institute with support of the consultants ICF Incorporated, and the Bipartisan Policy Center. However, none of these studies addressed the costs of CSAPR independently, instead combining CSAPR costs with other EPA regulations, most notably the Mercury and Air Toxic Standards (MATS) discussed above. Estimated costs from the combined rules equaled between $70 billion and $130 billion over the 2008 to 2020 time frame, and each had a central value on the order of $10 billion per year. Most of these costs are attributable to MATS, suggesting independent estimates of the cost of CSAPR in line with EPA's estimates. (See discussion above). The U.S. EPA estimates the public health benefits of the CSAPR at between $110 and $280 billion and public welfare benefits of $4.1 billion in 2014.[27]

The CLEW has tasked SAIC with examining the impact of Clean Air Act requirements for emissions from stationary sources and fossil-fueled electric generating units on Washington State GHG emissions. While it remains uncertain whether the CAIR or CSAPR will be the mechanism EPA uses to regulate sulfur dioxide and oxides of nitrogen emissions from electric generating stations, one of the regulations will be in force. These regulations are likely to increase the cost of coal-fired electric generation, providing a competitive advantage to lower GHG emitting sources such as gas-fired and renewable generation. With the CAIR and CSAPR only applying to generation in the Eastern U.S., it is likely to have little impact on GHG emissions in Washington or its surrounding region. However, because it will affect the overall national generation mix, we examined it as part of this study to confirm these suppositions. As expected the CAIR and CSPR did not show a discernible material impact on Washington emission levels. (see discussion of results below).

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[26]The Brattle Group, *Potential Coal Plant Retirements and Retrofits Under Emerging Environmental Regulations*, Martin Celebi, Presented to Midwest renewable Energy Association, August 10, 2011, http://www.brattle.com/_documents/UploadLibrary/Upload981.pdf

[27]U.S. EPA, *Regulatory Impact Analysis for the Federal Implementation Plans to Reduce Interstate Transport of Fine Particulate Matter and Ozone in 27 states*; Correction of SIP Approvals for 22 States, Docket ID No. EPA-HQ-OAR-2009-0491, U.S. EPA Office of Air and Radiation, June 2011. http://www.epa.gov/airtransport/pdfs/FinalRIA.pdf

### Tax Incentives for Renewable Energy (PTC and ITC)

***Program Summary:*** The production tax credit for renewable electricity is equal to $0.023 per kWh of power for the first decade of production from qualifying renewable resources (generally wind, solar, and biomass). Alternatively, a tax credit equal to 30 percent of the investment in qualifying equipment may be taken. The PTC is slated to sunset on December 31, 2013, absent additional action by the U.S. Congress.

***Results of Preliminary Literature Review:*** A recent analysis by the National Research Council, using the NEMS version from the *Annual Energy Outlook 2011*, concluded that the PTC and ITC reduce U.S. national GHG emissions by 0.3 percent at the very high cost of $3.9 billion in foregone revenue to the U.S. Treasury. [28] The U.S. EIA's *Annual Energy Outlook 2013* examines a case where the PTC does not sunset at the end of 2013. The result is an increase in electrical generation from renewables, beyond the reference case, of approximately 5 percent in 2020, 18 percent in 2030, and 38 percent in 2040.[29]

### California Low Carbon Fuel Standard

***Program Summary:*** Issued on January 18, 2007, the Low Carbon Fuel Standard (LCFS) calls for a reduction of at least 10 percent in the carbon intensity of California's transportation fuels by 2020. The performance-based regulation was adopted in 2009, and the California Air Resources Board (CARB) began implementing the regulation in 2010. The regulated entities tend to be fuel producers and importers who sell motor gasoline and diesel fuel. The most common method for generating the credits required for compliance is the use of ethanol, followed by, to a lesser extent, natural gas and bio-based gases, biodiesel, and electricity.[30]

There has been a series of court challenges to the LCFS centered on the potential impact of the regulation on agricultural and ethanol production practices in other states. In December 2011, the U.S. District Court for the Eastern Division of California found that the regulation violated the Interstate Commerce Clause of the U.S. Constitution because it: 1) discriminates against the use of out-of-state corn-based ethanol; and 2) seeks to control farming and transportation practices outside of its own borders . In April 2012, the U.S. Ninth District Court of Appeals granted a stay of injunction while CARB appeals the injunction. The stay allowed the program to be enforced until the appeal is resolved. On September 18, 2013, the U.S. Ninth District Court of Appeals ruled two-to-one that the California LCFS did not violate the Interstate Commerce

[28] National Research Council, *Effects of U.S. Tax Policy on Greenhouse Gas Emissions*, Committee on the Effects of Provisions in the Internal Revenue Code on Greenhouse Gas Emissions, W. Nordhaus, S. Merrill, P. Beaton, Eds., June 20, 2013, p. 141

[29] U.S. Energy Information Administration, *Annual Energy Outlook 2013*, Figure 15, http://www.eia.gov/forecasts/aeo/source_renewable_all.cfm#updated_nosunset

[30] UC Davis Institute of Transportation Studies, *Status Review of California's Low Carbon Fuel Standard*, S.Yeh, J. Witcover, J. Kessler, Spring 2013, p. 1

Clause of the U.S. Constitution.[31] On June 6, 2013 California's Fifth Court of Appeals handed down a provisional ruling in a case that argued that the LCFS was implemented without adequate study of general environmental impacts as required by the California Environmental Quality Act (CEQA) and specifically improperly deferred development of mitigation measures for potential increases in NOx emissions that may occur due to the LCFS. The court has allowed CARB to proceed with the existing regulation but has provided formal direction for addressing the concerns raised by the lawsuit.

***Results of Preliminary Literature Review:*** Since the adoption of California's LCFS there has been consideration of similar regulations across multiple U.S. states including Oregon, Washington, and the eleven Northeastern states that comprise the Northeast States for Coordinated Air Use Management (NESCAUM). In August 2011, NESCAUM released an economic analysis of a potential LCFS for the Northeast region. Using the NEMS version that supported the *Annual Energy Outlook 2010*, NESCAUM found reduced transportation related GHG emissions of 5-9%, increased jobs, personal income and gross regional product that could be attributed to the Northeast LCFS. [32] In October 2011, IHS/CERA conducted an assessment of the NESCAUM report under contract to the Consumer Energy Alliance (CEA). The assessment suggested that many of the assumptions used for the NESCAUM report were too optimistic.[33] CEA then went on to perform its own analysis of an LCFS in the Northeast and Mid-Atlantic, using the NEMS version from *the Annual Energy Outlook 2011* and including its own assumptions.[34] The result showed decreases in jobs, and overall GDP, attributable to the Northeast LCFS, of a similar magnitude to the increase found earlier by NESCAUM. Although NESCAUM found gains and IHS/CERA found losses, the magnitude of the changes attributable to the LCFS in both the NESCAUM and CEA studies were quite similar, representing a fraction of one percent of the reference case, regardless of the sign of the impact.

Subsequent to the implementation of the California LCFS, there has been a series of dueling studies on the economic impacts of the regulation. The first, released in June 2012, was prepared by the Boston Consulting Group (BCG) on behalf of the Western States Petroleum Association (WSPA). Using proprietary models, the BCG forecast significant economic consequences from the California LCFS including a loss of 28,000 to 51,000 jobs, a loss of $4.4 billion in tax revenue and between $0.33 and $1.06 in costs per gallon.[35] A review of the BCG report by the

[31] Jacobs, J. Appeals court rejects industry challenge to Calif. low-carbon fuel standard. E&E News PM. September 18, 2013. Accessed September 2013 at: http://www.eenews.net/eenewspm/2013/09/18/stories/1059987472
[32] NESCAUM, *Economic Analysis of a Program to Promote Clean Transportation Fuels in the Northeast/Mid-atlantic Region,* Report Summary, August 18, 2011, http://www.nescaum.org/topics/clean-fuels-standard/
[33] *Assessment of the NESCAUM Economic Analysis of a Clean Transportation Fuels Program for the Northeast/Mid-atlantic Region*, prepared by IHS/CERA for the Consumes Energy Alliance, October 14, 2011,
[34] While the assumptions and findings of the study were the responsibility of CEA, the author of this study, SAIC, was retained to execute the NEMS model runs.
[35] Boston Consulting Group, *Understanding the Impacts of AB 32*, Prepared for the Western State Petroleum Association, June 19, 2012, pp.3-4. http://www.cafuelfacts.com/wp-content/uploads/2012/07/BCG_report.pdf

UC Davis Policy Institute for Energy, Environment and the Economy identified seven critical assumptions and five intermediate conclusions that made significant contributions to the negative outcomes in the BCG study. These include no response in fuels demand to increased price, a limited availability of "bankable" compliance credits and a small number of advanced technology vehicles in the fleet by 2020.[36] The reviewers state that "the report's full set of assumptions is unlikely and have concerns about certain aspects of the methodology." In June 2013, ICF International released the first phase of a two-phase study of the California LCFS to be completed for the California Electric Transportation Coalition. The results of macroeconomic modeling will be contained in the yet-to-be-released second phase of the study, but the first phase sought to develop plausible compliance scenarios. Key findings that differ from the BCG assumptions include that there will be significant over-compliance and banking in the early years of the regulation, the LCFS is driving investment in low-carbon fuels, and natural gas consumption in the transportation sector is poised to expand rapidly.[37]

Oregon authorized a LCFS in 2009 that would cut carbon intensity in cars and trucks by 10 percent per gallon by 2025. However, the authorization included a sunset provision allowing the LCFS to expire in 2015. As of a state Senate vote on July 8, 2013, the LCFS will be allowed to expire in 2015, but the topic may be heard for reconsideration at a short session of the Senate in February 2014.[38] The Oregon Department of Environmental Quality never moved to implement the standards because of the sunset date. A thorough examination of a Washington state LCFS was completed by the consulting firm TIAX in 2011 with follow-up work from Life Cycle associates in 2013. A detailed discussion of the methodology and results of those studies appear in the Task 2 Report of this study but the overall results generally supported LCFS as an economically positive policy option for the state. TIAX examined six scenarios. Under the worst scenario, employment decline by 200 while in all other scenarios it grew by anywhere from 3,600 to 12,000 people. Similarly in the worst scenario personal income declined by $13.8 million, but all other scenarios show personal income growing anywhere from $147 million to $526 million. Gross State Product decline by $36.5 million in the worst scenario but grew by between $164 million and $454 million in all other scenarios. [39]

[36] University of California, Davis, *Expert Evaluation of the Report: Understanding the Impacts of AB 32*, May 2013, pp. 9-10, http://policyinstitute.ucdavis.edu/files/general/pdf/2013-05-09_Expert-Evaluation-of-BCG-Report.pdf

[37] ICF International, *California's Low Carbon Fuel Standard: Compliance Outlook for 2020*, prepared for the California Electric Transportation Coalition, June 2013, pp.2-3., http://www.caletc.com/wp-content/downloads/LCFSReportJune.pdf

[38] Zheng, Y. The Oregonian. *Oregon Senate rejects 'clean fuels' bill, a top priority for environmental lobby*. (July 6, 2013). Accessed July 2013 at: http://www.oregonlive.com/politics/index.ssf/2013/07/oregon_senate_rejects_clean_fu.html#incart_river; and Greenwire. E&E Publishing. *State Senate rejects clean fuels bill*. (July 8, 2013). Accessed July 2013 at: http://www.eenews.net/greenwire/2013/07/08/stories/1059983987

[39] Pont, J. and J Rosenfeld. TIAX LLC for the State of Washington Department of Ecology. February 18, 2011. Table E-3. Page ix, Table E-3.

### Renewable Portfolio Standards

***Program Summary:*** While it has been considered, there is no federal renewable portfolio standard, nor can it be reasonably argued that we can expect one in the near future. However, 30 states and the District of Columbia currently have enforceable renewable portfolio standards including Washington, California, Oregon, Nevada and Montana. Each state determines its own renewable targets, eligible technologies and penalties for non-compliance. Washington State currently has an RPS of 15% by 2020, with solar, wind, biomass, geothermal, landfill gas, and marine sources, plus incremental electricity produced as a result of efficiency improvements made to hydroelectric facilities after March 31, 1999 qualifying under the standard.

***Results of Preliminary Literature Review:*** Washington's Renewable Portfolio Standards will be evaluated under Task 1 of this project. However, because the renewable targets of other states in close proximity to Washington may affect the mix of electricity imported and exported to and from Washington, we will examine the overall impacts of RPS requirements in the Western Electricity Coordinating Council / Northwest Power Pool (WECC/NWPP) area and Census Division 9 and their interaction with Washington's GHG reduction policies, including the State's Renewable Energy Standards. Because it is a regional model, NEMS does not capture fuel-specific provisions at the state level but rather subsumes these targets in an approximation of region-level compliance requirements (voluntary or discretionary targets are not modeled).

## 2.2 Pending Policies

### GHG Regulation for Coal-Fired Power Plants

***Program summary:*** Since January 2011, GHG emissions from large new and modified sources have been subject to regulation under the Prevention of Significant Deterioration (PSD) program, which requires all such sources to adopt the Best Available Control Technology (BACT) for reducing emissions. BACT standards are set by state permitting authorities on a case-by-case basis and often result in equipment and operational efficiency improvements. According to the Congressional Research Service (CRS), EPA and the states have issued fewer than 50 GHG permits to stationary sources in the year following the requirement's implementation[40] because the emission threshold for requiring permits was set at a high level[41] and few new facilities have been built in the aftermath of the recession.[42]

[40] According to then EPA Assistant Administrator Gina McCarthy's testimony to the House Energy and Commerce hearing on June 29, 2012, stating that EPA and the states had issued 44 permits for greenhouse gas emissions. This identical number appears in a September 14, 2012 report by the Clean Air Act Advisory Committee at http://www.epa.gov/nsr/ghgdocs/20120914CAAACPermitStreamlining.pdf

[41] New facilities need to add 100,000 tons per year of carbon dioxide equivalent and modifications must raise emissions by 75,000 tons per year to trigger the requirement.

[42] Congressional Research Service, *EPA Standards for Greenhouse Gas Emissions from Power Plants*, J. McCarthy, June 26, 2013, http://www.fas.org/sgp/crs/misc/R43127.pdf

On March 27, 2012 EPA proposed New Source Performance Standards (NSPS) to regulate GHG emissions from electric generation. The NSPS differs from the PSD in that the NSPS is a federally established performance standard enforced by the states rather than a state adjudicated requirement. This standard covers new fossil-fueled power plants larger than 25 megawatts of capacity, and is set at 1,000 pounds carbon dioxide per megawatt-hour, equivalent to the emissions level of a natural gas combined-cycle unit. Initially scheduled to go final on April 13, 2013, the EPA delayed the final rule after receiving some 2.7 million comments and extended the comment period to June 12, 2013. In contrast to many Clean Air Act standards, when the NSPS goes final, its performance standard is retroactive to the day it was proposed, potentially shutting down new coal plant construction as of March 27, 2012. However, the EPA proposal exempted plants constructed before April 13, 2013. There are some 15 "transitional" electric generating units that fall into this one-year window. Further, the NSPS requires that if EPA regulates new units for a pollutant then it must also regulate existing units for that pollutant. EPA may, however, set less stringent performance standards for the existing units.

President Obama, in his Climate Action Plan announced June 25, 2013, issued a Presidential Memorandum directing the U.S. EPA to work expeditiously to complete carbon pollution standards for both new and existing power plants.[43] The memorandum called for the reissuance of the proposed standards for the new units in September 2013 and for the issuance of final guidelines on existing units by June 1, 2015.

***Results of Preliminary Literature Review:*** Industry has resisted the NSPS for GHG from electric generating units by pointing out that the combination of a stringent performance threshold and the lack of economically competitive carbon capture and sequestration technology effectively ban the building of new coal-fired power plants. The EPA's Regulatory Impact Analysis for the proposal does not necessarily take issue with this conclusion but instead argues that this outcome is no different than that which will result from existing and anticipated economic conditions in the marketplace including the low projected cost of natural gas and the implementation of state renewable portfolio standards. Using the Integrated Planning Mode (IPM) developed by ICF International, the EPA conducted scenario analyses around higher natural gas prices and/or electric demand and found that in the absence of the rule, gas prices would need to reach $10.00 per million Btu to drive new coal-fired generation, an outcome viewed as very unlikely with current gas prices below $4.00 per million Btu. Given these market conditions, it is reasonable that some would question whether the rule is necessary. EPA responds that it is necessary as a "backstop" should market conditions change.[44]

[43] Executive Office of the President, *The President's Climate Action Plan*, June 2013, p.6

[44] U.S. EPA, *Regulatory Impact Analysis for the Proposed Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units*, EPA-452/R-12-001, March 2012, http://www.epa.gov/carbonpollutionstandard/actions.html

### Incentives for Renewable Energy on Federal Lands

***Program summary:*** As part of the President's Climate Action Plan, he directed the Department of Interior to permit an additional 10 gigawatts of renewable generation on public lands by 2020.[45] In April, 2013 the Bureau of Land Management issued a Final Rule to protect lands with pending right-of-way applications for wind or solar energy generation from appropriation by mining interests under existing public lands laws. Also, bills have recently been introduced into the U.S. House of Representative (H.R. 596) and U.S. Senate (S. 279) to establish wind and solar energy leasing programs on Federal lands in a similar fashion to oil and gas leasing programs.

***Results of Preliminary Literature Review:*** Since 2011, the Department of Interior has permitted 25 utility-scale solar facilities, nine wind farms, and 11 geothermal plants on federal lands. Many of these projects have been undertaken in 17 solar zones across six Western states – Arizona, California, Colorado, Nevada, New Mexico, and Utah. These projects are not without controversy however, as some residents and environmental groups complain about destroyed vistas and threats to migratory species.[46]

### Reduced Tax Expenditures for Fossil Energy (Oil and Gas Depletion Allowances)

***Program Summary:*** Using the depletion allowance, owners of oil and gas wells may deduct from their taxes an amount equal to the decline in the value of their reserves as oil or gas is extracted and sold. For small producers – those companies with less than 1,000 barrels per of oil production per day, or less than six million cubic feet of natural gas production per day – a percentage depletion equal to 15 percent of gross revenues associated with production may be deducted from taxes, even if, in the aggregate, this deduction exceeds the total cost of original investment in the property over the life of the property.

***Results of Preliminary Literature Review:*** A recent analysis by the National Research Council, using the NEMS version from the *Annual Energy Outlook 2011* concluded that the average effect of the depletion allowances on GHG emissions, over time, is too small to accurately estimate, or even determine if the sign of change is negative or positive.[47]

### REIT and MLP Parity

***Program Summary:*** While the production tax credit and investment tax credit for renewable technologies have played an important role in the growth of these energy sources, they have three primary shortcomings in addition to their potential costs to the U.S. Treasury. First, they

[45] Executive Office of the President, *The President's Climate Action Plan*, June 2013, p.7

[46] San Francisco Chronicle, *Anger Over Plans for Energy Plants on Public Lands*, Carolyn Lockhead, July 10, 2013. http://www.sfchronicle.com/science/article/Anger-over-plans-for-energy-plants-on-public-lands-4656189.php

[47] Effects of U.S. Tax Policy on Greenhouse Gas Emissions, Committee on the Effects of Provisions in the Internal Revenue Code on Greenhouse Gas Emissions, National Research Council, W. Nordhaus, S. Merrill, P. Beaton, Eds., June 20, 2013, p. 142

are subject to periodic renewal by Congress and the President and the uncertainty hampers potential investment, creating "lumps" in deal flows that do not necessarily reflect market fundamentals. Second, they only have value as tax equity and the number and diversity of investors with sufficient tax liability that is consistent enough over time to take advantage of this tax equity is very limited. According to the National Renewable Energy Laboratory (NREL), tax-equity based investment in renewables has been limited to some 20 investors and just $3-6 billion annually over the last several years.[48] Finally, these subsidies are cited by opponents of renewable energy investments as a demonstration that renewable energy cannot compete on a level economic playing field with fossil energy and thus should not be undertaken.

Because Real Estate Investment Trusts (REITs) and Master Limited Partnerships (MLPs) already benefit fossil energy, extending these benefits to renewable energy holds the attraction of not only substantially reducing the cost of financing for renewable energy investments but of putting renewable energy on a level playing field with many oil and gas investments that already benefit from this treatment. MLPs and REITs combine the tax benefits of a partnership with the liquidity of a publicly traded stock. Both MLPs and REITS are taxed based on returns to investors but are not taxed at that corporate level, eliminating the "double taxation" generally applied to corporations and their shareholders. REITs were initially authorized by Congress in 1960 to give retail investors a way to get into commercial real estate. They are required to pay at least 90 percent of their taxable income to shareholders. REITS are now used for funding timber, data centers, mobile phone towers, and natural gas pipelines. All that is required for renewable energy facilities to be included is a letter ruling by the Internal Revenue Service (IRS) that renewable facilities are "real property." To date, two firms (Hannon Armstrong Sustainable Infrastructure Capital Inc. and Power REIT) have been granted REIT status by the IRS through private letter rulings, however, neither firm has been forthcoming with the details of their respective rulings. Renewable Energy Trust Capital has asked for a ruling from the IRS on classifying solar farms as real property. This ruling is imminent. Ultimately, clean energy developers hope for a blanket IRS ruling that would expand these private letter rulings to other types of renewable facilities. Failing this result, Congress could take legislative action.

Because current law specifically prohibits MLP investment in "inexhaustible" (renewable) natural resources, extending MLPs to renewable energy requires Congressional action. S. 3275, the Master Limited Partnerships Parity Act (MLP Parity Act), is a bipartisan piece of legislation introduced in June 2012 that would open up MLPs to renewable energy. The MLP Parity Act would amend the Internal Revenue Code to expand the definition of "qualifying income" for MLP treatment to include income gains from renewable and alternative fuels. It was

[48] National Renewable Energy Laboratory, *Financing U.S. Renewable Energy Projects Through Public Capital Vehicles: Qualitative and Quantitative Benefits,* M.Mendelsohn and D. Feldman, April 2013, http://www.nrel.gov/docs/fy13osti/58315.pdf

reintroduced into both the Senate and House of Representatives on April 24, 2013. This legislation is reported to have significant bipartisan and bicameral support and could bring new financing not only to traditional renewable energy projects such as wind and solar, but also to nuclear power, energy storage, energy efficiency, carbon capture, and other less obvious clean energy initiatives.

***Results of Preliminary Literature Review:*** Studies of the additional capital flows for renewable energy projects from the extension of REITs have not been completed, and it may be useful to attempt some generic calculation of such an extension of REITs to renewable energy facilities as this study progresses. More work has been done on MLP parity. According to a 2012 study out of Southern Methodist University (SMU), Cox School of Business, providing MLP parity to renewables could yield an additional $3.2 billion to $5.6 billion of capital inflows to renewable projects between 2013 and 2021.[49] In 2012, installations of new photovoltaic (PV) capacity required financing of some $3.64 billion per gigawatt and installations of new wind capacity required financing of approximately $2.13 billion per gigawatt,[50] suggesting that MLP parity could drive between 1.5 and 2.6 gigawatts of additional capacity by 2021, even assuming no leverage in capital financing from these funds.

Because investors in MLPs and REITs pay taxes on dividends, the budget impact of MLP parity and extending eligibility for REITS is likely to be negligible. The total market capitalization of existing MLPs is approximately $300 billion, and, according to the Joint Committee on Taxation, these MLPs are expected to cost taxpayers about $1.2 billion between 2011 and 2015, or less than 0.1 percent of market capitalization annually. Assuming the high end of investment in renewables projected by SMU would generate an annual cost to taxpayers of under $5 million annually. Further, should we include gains in tax revenue that result from an increase in renewable power deployment and related economic activity in manufacturing, construction, and other areas, the budgetary impact may be net positive. A recent study by the U.S. Partnership for Renewable Energy Finance found that the budgetary burden from investment tax credits for solar energy was more than offset by the tax revenues generated from related leases and power purchase agreements, creating, in effect, a return of 10 percent for the federal government.[51]

[49] *Leveling the Playing Field: The Case for Master Limited Partnerships for* Renewables. Southern Methodist University, Cox School of Business, W.B. Bullock, B.L. Weinstein, and B. Johnson, May 2012. http://www.pressdocs.cox.smu.edu/maguire/AWEA%20final%20report%205-12.pdf

[50] National Renewable Energy Laboratory, *Financing U.S. Renewable Energy Projects Through Public Capital Vehicles: Qualitative and Quantitative Benef*its, M.Mendelsohn and D. Feldman, April 2013, http://www.nrel.gov/docs/fy13osti/58315.pdf

[51] *How to Attract Private Investment in Clean Energy*, Bloomberg, June 10, 2013, http://www.bloomberg.com/news/2013-06-10/how-to-attract-private-investment-in-clean-energy.html

### Expanded Natural Gas Exports

***Program Summary:*** Largely as a result of the revolution in extracting natural gas from shale formations using hydraulic fracturing, U.S. production of natural gas rose by more than a third, from 19.0 trillion cubic feet in 2005, to 25.3 trillion cubic feet in 2012. Over the same time frame, the price of natural gas at the wellhead dropped from $9.08 per thousand cubic feet to $3.35 per thousand cubic feet. [52] Concurrently, the share of electric generation generated by combusting coal declined from 49 percent to 37 percent and much of that generation shifted to gas, which grew from 20 percent of total generation to 31 percent of generation. Meanwhile, electric generation from renewable resources, including hydropower grew from 9 percent to 12 percent.[53] In April 2012, the share of electric generation from coal and natural gas were equal for the first time since at least the 1970s.[54] Shortly thereafter, the share of coal increased above 40% and the share of natural gas fired generation dropped to nearly 25%, remaining at those levels from November 2012 through March 2013 due to rising natural gas prices.[55] The share of coal-fired generation once again dropped below 40% between April 2013 and June 2013, as coal experienced incremental price increases. Together, these trends suggest an extreme sensitivity to fuel price within the electric generation sector.

Much of the shift from coal to natural gas is attributable to the large decline in gas prices. Further, the decline in relative prices of natural gas when compared to renewables may have hindered growth in electric generation from renewable sources.

According to the Reference Case forecast in EIA's Annual Energy Outlook 2013, natural gas production is expected to increase at an average rate of 1.3 percent per year, reaching 33.2 trillion cubic feet by 2040. Nearly all of this growth is attributable to increased production of shale gas.[56] Although the reduction in carbon dioxide emissions attributable to the combustion of natural gas when compared to the combustion of coal- or petroleum-based fuels is a simple matter of chemistry and is well known, the GHG impacts associated with fugitive emissions from natural gas production and hence life-cycle use of natural gas is far more uncertain, particularly for shale gas production, whose widespread expansion is a relatively recent phenomena. There is a large and growing literature on methane emissions from shale gas production but its findings are far from consensus, ranging from a slight improvement from

[52] U.S. Energy Information Administration, *Natural Gas: Gross Withdrawals and Production*, http://www.eia.gov/dnav/ng/ng_prod_sum_dcu_NUS_a.htm and U.S. Energy Information Administration, *U.S. Natural Gas Wellhead Prices*, http://www.eia.gov/dnav/ng/hist/n9190us3m.htm

[53] U.S. Energy Information Administration, Electric Power Monthly: Data for May 2013, Table 1.1, July 22, 2013, http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_1

[54] U.S. Energy Information Administration, *Monthly coal- and natural gas-fired generation equal for first time in April 2012, July 6, 2012*, http://www.eia.gov/todayinenergy/detail.cfm?id=6990#

[55] U.S. Energy Information Administration, *Coal regains some electric generation market share from natural gas*, May 23, 2013, http://www.eia.gov/todayinenergy/detail.cfm?id=11391

[56] U.S. Energy Information Administration, *Annual Energy Outlook 2013*, http://www.eia.gov/forecasts/aeo/source_natural_gas_all.cfm#natgascon

conventional gas production, to a slight increase in emissions, all the way to a substantial increase in emissions. For example in April 2011, the U.S. EPA included a separate emissions factor for methane from unconventional wells in their report, *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 – 2009*, for the first time. This methodological change greatly increased estimates of emissions from the natural gas system. By their April 2013 version of the report, EPA had lowered the emissions factor for wells with hydraulic fracturing substantially, lowering overall emissions from the natural gas system by some 20 percent. EPA also reports that as they collect more data from their Greenhouse Gas Reporting Program, these numbers may be adjusted again.[57] In an effort to address this uncertainty, the University of Texas, in conjunction with the Environmental Defense Fund and nine industry partners launched a comprehensive study of methane leakage rates from hydraulic fracturing wells.[58] They looked at 190 production sites and found that a majority had equipment in place that reduced methane missions by 99 percent suggesting that EPA's estimates of emissions from this source needed to be adjusted downwards.[59] The NEMS model only focuses on carbon dioxide emissions from fuel combustion and thus any consideration of life-cycle fugitive emissions must be conducted off-line.

At the projected rate of increase, production will exceed domestic consumption and the excess production is expected to be exported in the form of liquefied natural gas (LNG).[60] With current spot prices for LNG- at $15.40 per thousand cubic feet in northeast Asia and $11.60 per thousand cubic feet in Southern Europe, U.S. gas producers are anxious to begin exporting LNG. The chief obstacle to these exports is the availability of LNG export terminals.[61] The Federal Energy Regulatory Commission (FERC) maintains jurisdiction over the licensing of LNG export terminals, and FERC is currently considering applications for the siting and construction of 17 LNG export terminals, with an additional six in the proposal pipeline. DOE/FERC is under considerable pressure from some members of Congress to accelerate approvals. After approving its first export terminal in late 2011, the next approval did not come until May 2013. Approvals have since accelerated, with the third export terminal approved on August 7, 2013 and a fourth

[57] U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2013*, Chapter 10, Recalculations and Improvements, April 2013, http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Chapter-10-Recalcs.pdf

[58] Industry partners include, Anadarko Petroleum Corporation, BG Group plc, Chevron, Encana Oil & Gas (USA) Inc., Pioneer Natural Resources Company, Shell, Southwestern Energy, Talisman Energy, USA, and XTO Energy, http://www.engr.utexas.edu/news/7416-allenemissionsstudy

[59] http://www.utexas.edu/news/2013/09/16/understanding-methane-emissions/

[60] U.S. Energy Information Administration, *Annual Energy Outlook 2013*, http://www.eia.gov/forecasts/aeo/source_natural_gas_all.cfm#natgascon http://www.eia.gov/forecasts/aeo/source_natural_gas_all.cfm#prodiq.

[61] Bloomberg, *Northeast Asia LNG Rises on Lower Supplies in Pacific, WGI Says*, C.H. Hong, July 2, 2013, http://www.bloomberg.com/news/2013-07-03/northeast-asia-lng-rises-on-lower-supplies-in-pacific-wgi-says.html

approved on September 10' 2013.[62] While others have sought to slow the process because of the impact of higher natural gas prices on U.S. manufacturing, the DOE has pointed to a recent study by NERA Economic Consulting (see discussion below) that found a general increase in national wealth associated with increased natural gas exports.[63] Approval of a significant portion of these terminals will likely increase the export of natural gas with important implications for gas production and prices, which, in turn, are likely to have important impacts on the mix of electric generation in the future. While increased natural gas prices may make cleaner renewables more competitive, they may also moderate or even reverse the shift from coal-fired electric generation to natural gas-fired generation. The balance of these two effects will have important implications for GHG emissions. Further, that balance may interact with new regulations on GHG emissions from electric generation stations (see discussion above), in a manner that should be modeled using the overarching view of the NEMS system.

***Results of Preliminary Literature Review:*** The U.S. Department of Energy has commissioned two studies of the effects of increasing natural gas exports. The first, by the U.S. Energy Information Administration was completed in January 2012, and focused on impacts to domestic gas markets, and in particular on levels of production and domestic wellhead prices. Using the *Annual Energy Outlook 2011* version of NEMS, the EIA found that production would increase and that prices would rise by between $0.70 and $1.58 per thousand cubic feet on a baseline that was already anticipated to escalate over time.[64] The second study, completed by NERA Economic Consulting in December 2012, focused on the macroeconomic effects of the increase in natural gas exports. Not surprisingly, NERA found that overall GDP grew with increased exports. However, increases in national income were dominated by income to resource providers, while overall labor income experienced declines.[65] The NERA study went on to also suggest that the level of exports and price increases anticipated in the EIA study were somewhat overestimated given the likelihood of international competition among suppliers.[66]

[62] Claudia Assis, *And Cove Point Makes Three..LNG Export Terminal Approved, Energy Ticker*, September 11, 2013, http://blogs.marketwatch.com/energy-ticker/2013/09/11/and-cove-point-makes-three-lng-export-terminal-approved/
[63] Wall Street Journal, *Louisiana LNG Export Proposal Approved*, T.Tracy, August 7, 2013, http://online.wsj.com/article/SB10001424127887323477604578654070088855686.html
[64] U.S. Energy Information Administration Independent Statistics and Analysis, *Effect of Increased Natural Gas Exports on Domestic Energy Markets as requested by the Office of Fossil Energy*, January 2012. p. 8, http://energy.gov/fe/downloads/lng-export-study-related-documents
[65]NERA Economic Consulting *Macroeconomic Impacts of LNG Exports from the United States*, p. 8, http://energy.gov/fe/downloads/lng-export-study-related-documents
[66] NERA Economic Consulting, *Macroeconomic Impacts of LNG Exports from the United States*, p. 8, http://energy.gov/fe/downloads/lng-export-study-related-documents

# 3 Analytical Approach and Methodology

While the overall impact of federal statutes, regulations, and policies on national levels of greenhouse gas emissions is interesting, it is their specific direct impact on GHG levels in Washington, and their interaction with specific state policies and programs to reduce greenhouse gas emissions that is of particular relevance to this study. However, to determine those impacts and consider their interaction with state policies and programs we must first quantify the nationwide effects of the federal actions.

SAIC has selected the National Energy Modeling System (NEMS) as the principal tool for evaluating the effects of federal energy and environmental policies. NEMS was developed by the U.S. Energy Information Administration (EIA), the independent statistical agency within the U.S. Department of Energy, specifically to evaluate the implications of broad federal policies. It is the model that is used by the EIA to produce its Annual Energy Outlook, and to respond to specific requests by the U.S. Congress to evaluate contemplated new energy and environmental laws, such as the Waxman-Markey cap and trade legislation that had been earlier considered. The model is non-proprietary, publically available and scrupulously documented, allowing for a transparent discussion of methods and assumption used. The version supporting the *Annual Energy Outlook 2011* was recently used by Nordhaus et al. in their comprehensive study of the *Effects of U.S. Tax Policy on Greenhouse Gas Emissions*.[67] The model is deterministic, providing single point estimates of carbon emissions and other outputs for any given set of input assumptions. Uncertainty in the model's projections of policy impacts can, to a limited extent, be investigated by varying the model's assumptions on certain macroeconomic variables (e.g., GDP and world crude oil prices), but the required scenario analyses are beyond the scope of this project.

NEMS includes all prominent existing federal energy and environmental laws including *inter alia*, the Mercury and Air Toxic Standards, the Clean Air Interstate Regulations, the Cross State Air Pollution Rule, Clean Air Act restrictions on sulfur dioxide emissions and oxides of nitrogen, the oil and gas depletion allowance, and the production tax credit and investment tax credit for renewable energy. While not federal programs, the model also discretely represents California's Low-Carbon Fuel Standard and the Renewable Portfolio Standards implemented at the state-level. Although they are embedded in NEMS, there are no discrete levers for separating tailpipe emission standards in NEMS. However, the tailpipe emission standards are fully integrated into the new CAFE standards and thus it is appropriate to treat them jointly. Additionally, proposed policies such as REIT and MLP parity and expanded export licenses for liquefied natural gas are not captured within the existing model. However, after an initial literature review to assess the anticipated results of these policies, we may wish to integrate those effects into future model

[67] National Research Council, *Effects of U.S. Tax Policy on Greenhouse Gas Emissions*, Committee on the Effects of Provisions in the Internal Revenue Code on Greenhouse Gas Emissions, W. Nordhaus, S. Merrill, P. Beaton, Eds., June 20, 2013.

runs. Finally, although the exact nature of proposed future restrictions on GHG emissions from electric generating stations is not known, SAIC can represent differing levels of potential restrictions by increasing the risk cost premium for building new coal-fired generation within NEMS. For this analysis, SAIC will be using the NEMS version developed to support the *Annual Energy Outlook 2012.*

The NEMS version used in this analysis is temporally limited to projections out to 2035. This is primarily because uncertainty increases when projections reach the point where model results are no longer useful — in other words, the 2050 estimates are much less certain than the 2035 estimates. This increasing uncertainty over time is largely the result of progressively more unpredictable developments and advances (e.g., technological, social, economic, legislative) that will dramatically impact energy and emissions in the future. One recent example is the developments of hydraulic fracturing technology and its application to shale gas which is changing the energy supply landscape. As a result of model limitations, and the very limited value of extending projections out to 2050 through post-processing and extrapolation of model results, the timeframe for this analysis has been constrained to 2035.

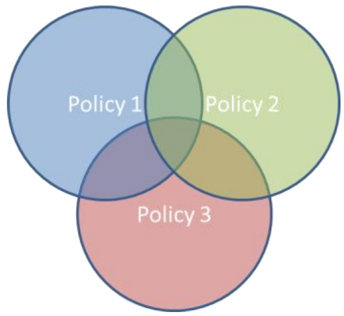
The complex nature and robust characterization of federal policies that makes NEMS the preferred tool of many analysts when conducting this sort of study also creates challenges in representing and interpreting model results, and all conclusions should recognize uncertainty and potentially confounding factors. In some cases, apparently counterintuitive results may be ultimately explained by understanding multiple levels of causation represented in NEMS. For example, while a regulation on coal-fired electric generation such as the Mercury and Air Toxic Standards would be expected to increase the cost of coal-fired generation and favor future natural gas and renewable builds, thus lowering GHG emissions, the parasitic load of emissions control equipment used to meet regulations at existing and new coal-fired power plants will likely increase GHG emissions. The weighted impacts of these countervailing effects may vary over time, altering the emissions profile associated with this regulation. More broadly, because the policies examined in this study have various periods of applicability and differing sunset dates, their interactions will vary over time and alter the trend line for the impacts of any one policy. Thus, a careful, systematic approach to completing this analysis must be undertaken.

Our first step will be an isolated policy analysis—the effect of each federal policy on GHG and emissions will be evaluated exclusive of all interactions with other policies. Our general approach will be to estimate emission reductions as the difference between emissions with and without the policy, as calculated through NEMS modeling. Thus, expected "business-as-usual" (BAU) developments, such as the general trend towards cleaner sources of electricity generation (e.g., natural gas), are captured in all model scenarios. SAIC's general approach to evaluating the individual and composite contribution of current federal policies is as follows with graphical representations included for clarity (for all model runs, the impacts on Washington will be disaggregated from the rest of the country):

1. The reference case version of the model will be considered the baseline scenario.

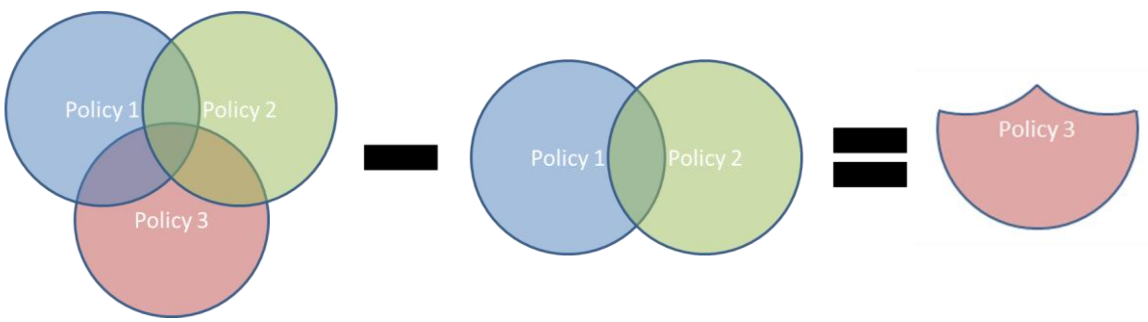
2. Remove all federal policies from the baseline scenario. The difference between this model run and the baseline scenario in step 1 represents the reduction due to all of the federal policies, including interactions.

**Figure 1. Graphical representation of the reduction due to all of the federal policies, including interactions**




3. Remove each policy separately, and make a run, comparing emissions to the baseline scenario. The difference in emissions represents the reduction due to the policy exclusive of all interactions with other policies.

**Figure 2. Graphical representation of the process used to calculate the reduction due to a single federal policy, exclusive of all interactions**




4. Any difference between the reduction due to all of the federal policies as calculated in step 2 and the sum of the individual policy emission reductions as calculated in step 3 equals the overlap between the federal policies (i.e., the portion of emissions that cannot be credited to a single policy).

**Figure 3. Graphical representation of the sum of reductions due to individual federal policies, exclusive of all interactions**

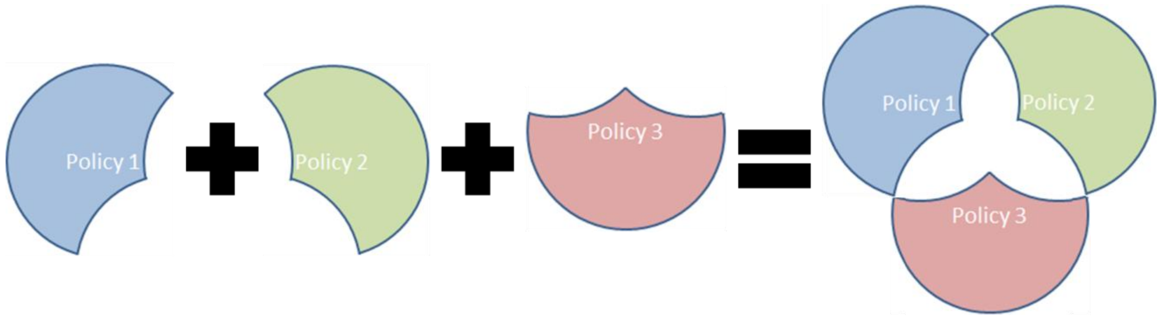
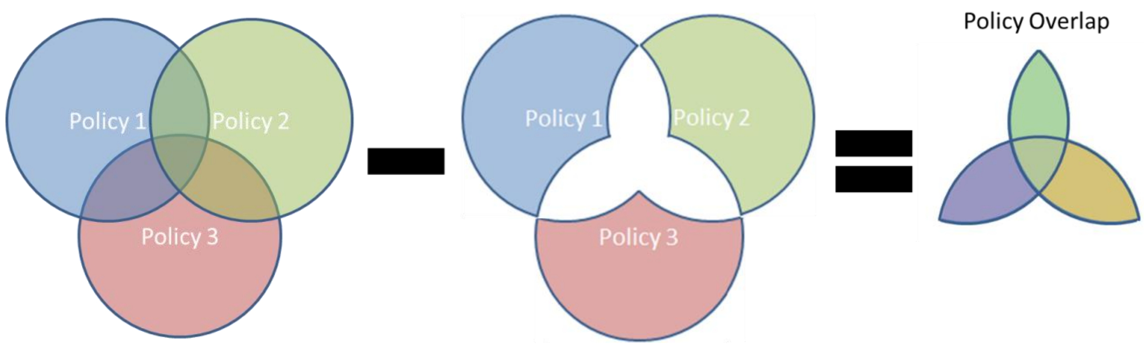



**Figure 4. Graphical representation of the difference between the reduction due to all of the federal policies (calculated in step 2) and the sum of the individual emission reductions (calculated in step 3) which equals the overlap between the federal policies**




Note that this approach is opposite, in a sense, to the approach used to estimate energy and emissions impacts of existing State policy under Task 1. As mentioned previously, this was done to capture expected BAU developments in all model scenarios. Such precision is only possible with modeling tools such as NEMS, thus, an alternative approach was required for Task 1.

The modeling approach for evaluating the contribution of federal policies towards meeting Washington's GHG emission reduction targets includes an analysis of the interactions between federal policies. However, there will also be interactions between federal policies and the state policies implemented by Washington. Because the federal policies are outside of Washington's control, SAIC will consider these interactions during the analysis of existing and proposed state policies.

To supplement the NEMS modeling exercise outlined above, for each federal policy where the model output raises additional questions, SAIC will review existing policy documentation, data, and implementation history in conjunction with Washington's existing GHG emissions inventory and forecast to develop an understanding of each policy's evolution, requirements, and available data sets.

## 4 Preliminary Results

We began our analysis by conducting model runs for 10 potential policy cases. The first two cases represented the NEMS baseline condition used for the *Annual Energy Outlook 2012*, with the minor modification of incorporating the California Low Carbon Fuel Standard (LCFS). This case will be referred to as the WA baseline case to differentiate it from the standard EIA reference case for *Annual Energy Outlook 2012*. This does not imply that this case only refers to Washington State. We will derive national level impacts and regional assessment from the WA Baseline case. The name serves to delineate the reference case used for this study from the EIA reference case that may be used for other studies.

The second case differed from the first in that in addition to including the LCFS, the model was adjusted to extend the Production Tax Credit (PTC) out through 2040, unchanged, rather than the current baseline which has the PTC sunset at the end of 2013.[68] Cases three through nine represent the sequential shut down of the policies currently in the baseline, one by one, to isolate their individual impacts on energy production and consumption and GHG emissions. The final case shuts down all policies simultaneously to understand the interactions among them and their overall contribution to altering energy markets and GHG emissions. See Table 1 for a summary description of the policy cases examined. Once cases one through nine were run, results at the national level and for Census Division 9, consisting of California, Oregon, Washington, Hawaii and Alaska or the Western Electricity Coordinating Council, Northwest Power Pool[69] as appropriate, were each examined. As described above at the end of the Overview section above, and detailed in Appendix C, regional results in Census Division 9 (or the Western Electricity Coordinating Council/Northwest Power Pool as applicable) are downscaled to Washington based on its historic share of fuel, energy, or emissions in the region as appropriate.

Recall the general analytical approach described above when examining the results reflected in the figures below. When comparing Case 2, the extension of the Production Tax Credit to Case 1, the reference case, we are quantifying the impact on GHG emissions from adding an extension of the tax credit to all other existing Federal policies captured in NEMS. As a result, the figures show increased renewable generation and decreased carbon dioxide emissions over time associated with this case. The analysis of Case 3 through Case 9 requires some additional processing to develop an intuitive illustration of the results. In each of these cases, we are turning off an existing policy captured in the NEMS reference case. When we turn off policies that generally reduce energy consumption or carbon dioxide emissions, the output from the case will show an increase in energy consumption or carbon dioxide emissions. In order to produce the figures shown below, SAIC multiplies the resulting NEMS output by negative one to capture the impact of the individual policy examined. For example, in Case 9, NEMS forecasts that

[68] The value for the Production Tax Credit is held constant, in 2004 dollars, within NEMS through 2040.
[69] NEMS evaluates electricity impacts at the power pool level but reports out GHG emission levels at the census division level.

shutting off CAFE standards will increase total U.S. energy consumption by nearly 0.9 quadrillion Btu in 2035. Thus, we can deduce (and display in Figure 5) that the existence of CAFE standards decreases U.S. total energy consumption by 0.9 quadrillion Btu in 2035).

In the Case 10, the combined case, all federal policies examined under Case 3 through Case 9 are turned off and the Production Tax Credit is allowed to sunset after 2013. The effect of the combined case is far greater than any individual case that includes shutting off only one policy, and is also greater than the simple sum of the policies evaluated individually. This is because some of the policies have overlapping impacts that generate reductions and the model only reports the effect of each policy exclusive of all interactions when evaluated individually.

**Table 1. Case Definitions for Preliminary Analysis of Federal Policies**

| Case ID | Case Name | Case Description |
|---|---|---|
| **Case1** | WA Baseline | AEO 2012 Reference Case with CA LCFS Incorporated |
| **Case2** | WN Credit 2040 | AEO 2012 Reference Case with CA LCFS and PTC Extended to 2040 |
| **Case3** | MATS Off | WA Baseline with Mercury and Air Toxics Standard Turned Off |
| **Case4** | CAIR/CSAPR Off | WA Baseline with Clean Air Interstate Rule and Cross-state Air Pollution Rule Turned Off |
| **Case5** | CAA Off | WA Baseline with Clean Air Act Turned Off |
| **Case6** | RPS Off | WA Baseline with Renewable Portfolio Standards Turned Off |
| **Case7** | RFS Off | WA Baseline with Renewable Fuels Standards Turned Off |
| **Case8** | CA LCFS Off | WA Baseline with California Low Carbon Fuel Standard Turned Off |
| **Case9** | CAFE Off | WA Baseline with CAFE Turned Off |
| **Case10** | Combined | WA Baseline with all Policies Turned Off |

As shown in Figure 5 below, the federal policy that has the largest impact on total energy consumption is the CAFE standards [70] which reduce total national energy consumption by as much as 0.8% by 2035 or 0.9 quadrillion Btu. By 2035, the new CAFE standards will lower U.S. carbon dioxide emissions by more than one percent or 63 million metric tons (Figure 6).

[70] This adjustment to the model left the passenger vehicle standard at the pre-EISA 2007 level of 27.5 mpg and the light-duty truck standard at the 2011 level of 24.0 mpg.

While the impact of the Production Tax Credit on total energy consumption is less marked, it appears that extending it to 2040 reduces national carbon dioxide emissions by nearly 1.3% in 2035, or an estimated 78 million metric tons. This is likely attributable to the role of the tax credit in making renewable electricity, particularly from wind, more economical than fossil-based alternatives. Once fully implemented, the Renewable Fuel Standards have a smaller, but still important role in reducing national carbon dioxide emissions.

The Renewable Portfolio Standards have an impact similar to the Renewable Fuel Standards through 2025, however, beyond 2025 that impact rapidly dissipates, perhaps because many of the target dates in the standards do not go beyond that year. Although the Clean Air Interstate Rule (CAIR) or Cross-state Air Pollutant Rule (CSAPR) are aimed at criteria pollutants, because they make coal-fired generation more expensive, they are likely to drive a shift toward lower-emitting generation sources, as shown in Figure 6, and will likely also contribute to an overall reduction in US carbon dioxide emissions despite the parasitic load of pollution control equipment at coal-fired power plants. For more detail on the impacts of individual policies, particularly at the regional and state level, please see discussion below. The sequence in which the policies are presented differs slightly from that in Section 2 above so that we can group the analysis of transport-based policies and electric-generation based policies.

**Figure 5. Change in Total U.S. Energy Consumption from Federal Policies Modeled**

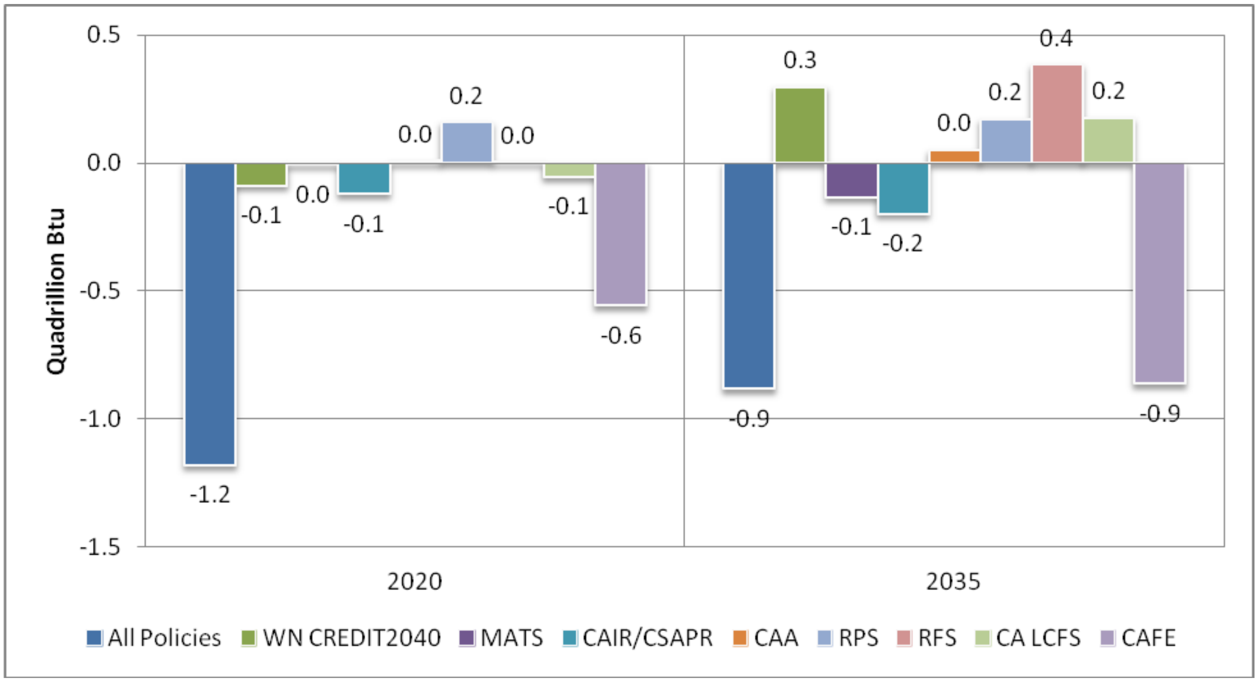
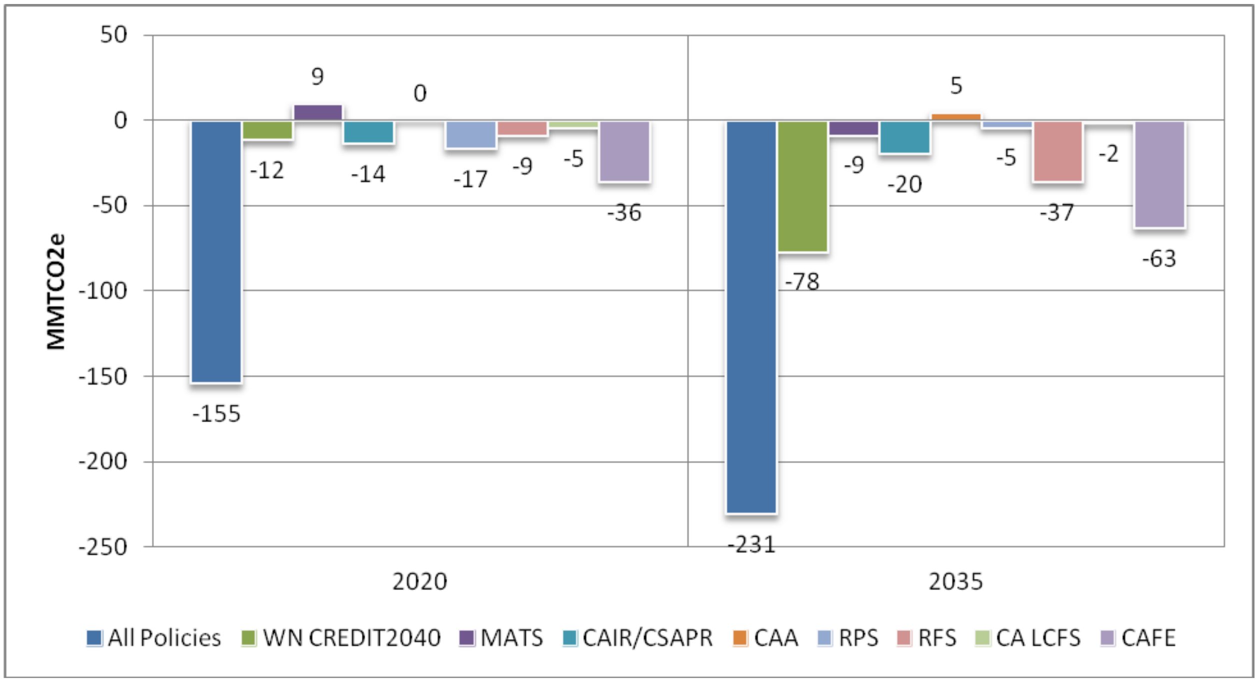



**Figure 6. Change in Total U.S. Energy-related Carbon Dioxide Emissions from Federal Policies Modeled**



## 4.1 Transportation-related Policies

In contrast to the distribution of greenhouse gas emissions found in most states, transportation, rather than electric power generation is the largest single source of GHG emissions in Washington. Transportation represented 44.3 percent of Washington's overall greenhouse gas emissions in 2010, and on-road motor fuels represented 31.4 percent of overall greenhouse gas emissions. While these emissions declined between 2007 and 2010, they were still above their 1990 levels.[71] Further, the recent decline is largely attributable to higher gasoline prices and a flattening in vehicle miles travelled due to the recent economic crisis. It is likely that as the U.S. economy returns to more typical growth patterns, transport emissions will resume their escalation absent policy intervention. As shown in Figure 7 and Figure 8 below, CAFE standards have the largest impact on gasoline consumption and GHG emissions at the national level of any transportation-related federal policy. At the national level the Renewable Fuel Standards provide a reduction in carbon dioxide emissions about one-third that of CAFE standards in 2020 and one-half that of the CAFE standards in 2035. In Census Division 9 the LCFS and RFS play a larger role than CAFE in reducing carbon dioxide emissions in 2020. By 2035, reductions from CAFE exceed those from LCFS and the RFS reductions appear to reverse. (Figure 9 and Figure 10). The regional impact of the LCFS is not surprising as the California transportation sector is by far the largest component of transport related emissions in Census Division 9. The reversal in the RFS is more difficult to explain but is likely related to the interactive effects of the RFS with the LCFS and CAFE standards.

[71] State of Washington, Department of Ecology, *Washington State Greenhouse Gas Emissions Inventory, 1990 - 2010*, December 2012, Publication no. 12-02-034

**Figure 7. Change in U.S. Motor Gasoline Consumption from Federal Policies Modeled**

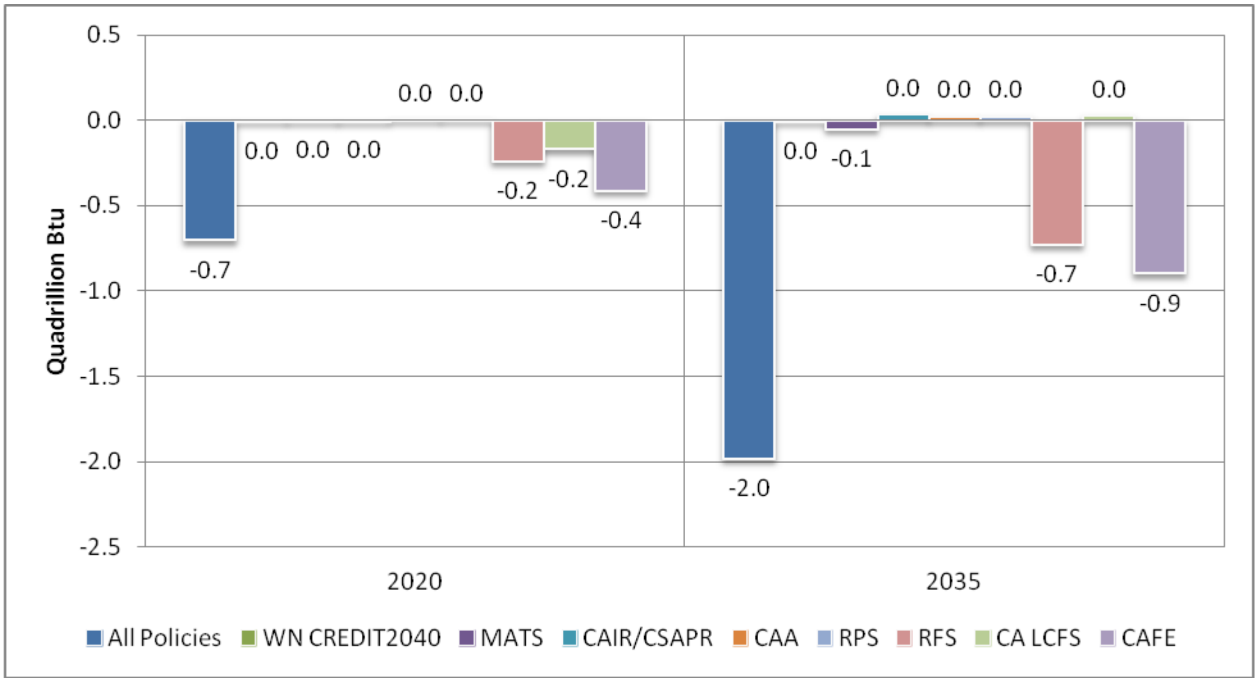



**Figure 8. Change in U.S. Carbon Dioxide Emissions from Transportation from Federal Policies Modeled**

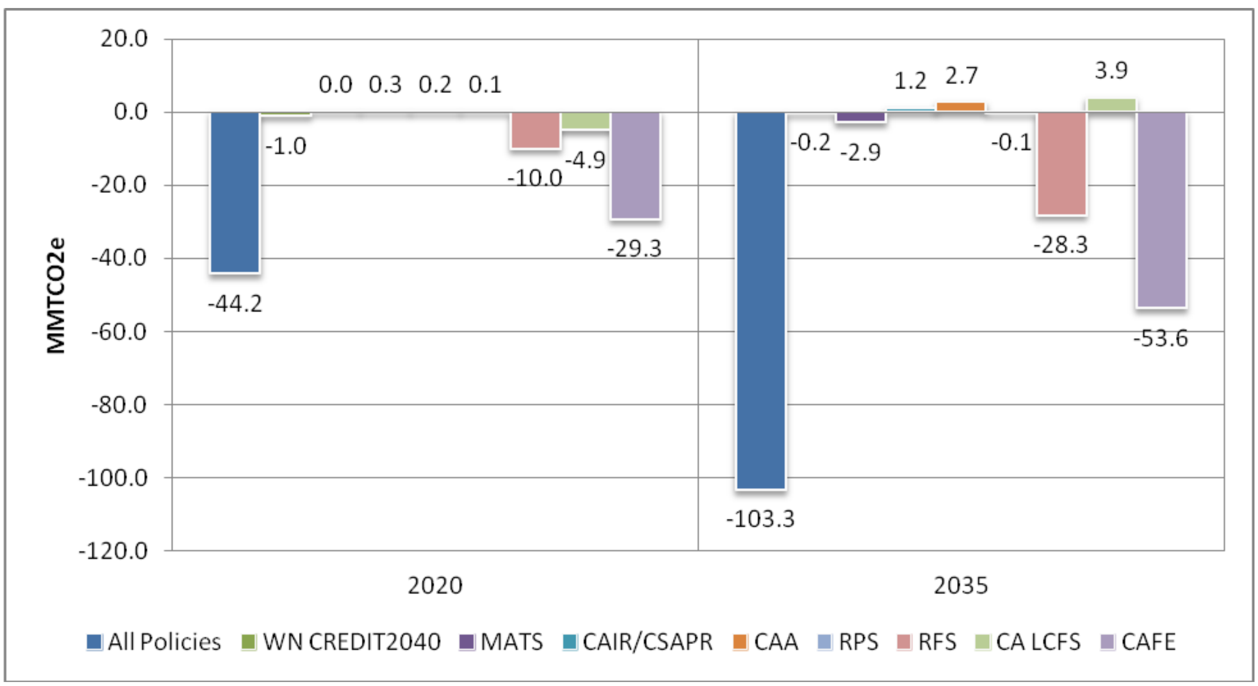


**Figure 9. Change in Motor Gasoline Consumption in Census Division 9 from Federal Policies Modeled**

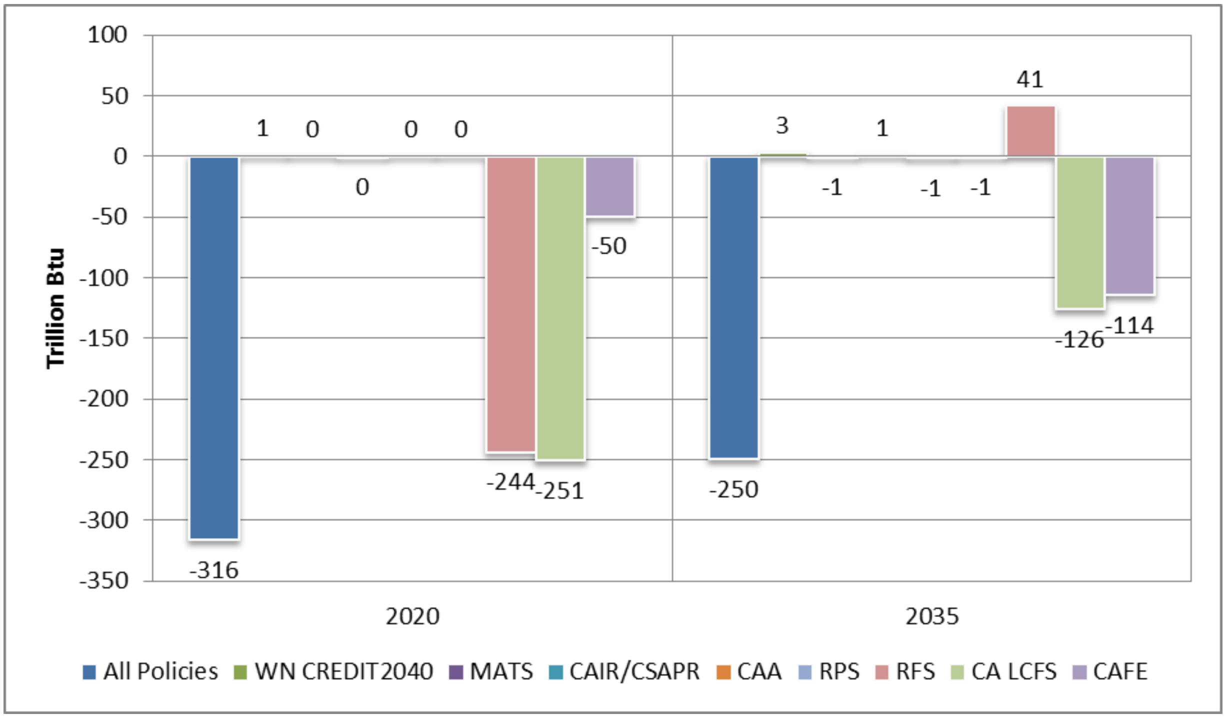



**Figure 10. Change in Carbon Dioxide Emissions from Transportation in Census Division 9 from Federal Policies Modeled**

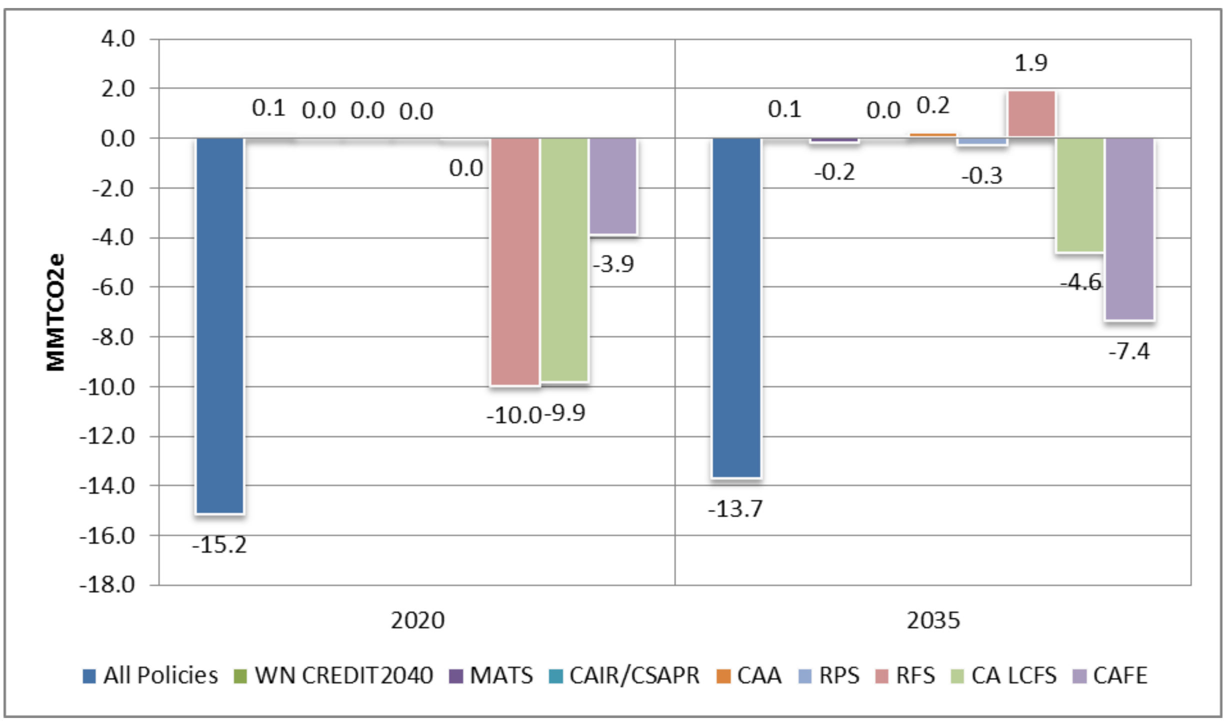


**Figure 11. Change in Motor Gasoline Consumption in Washington State from Federal Policies Modeled**

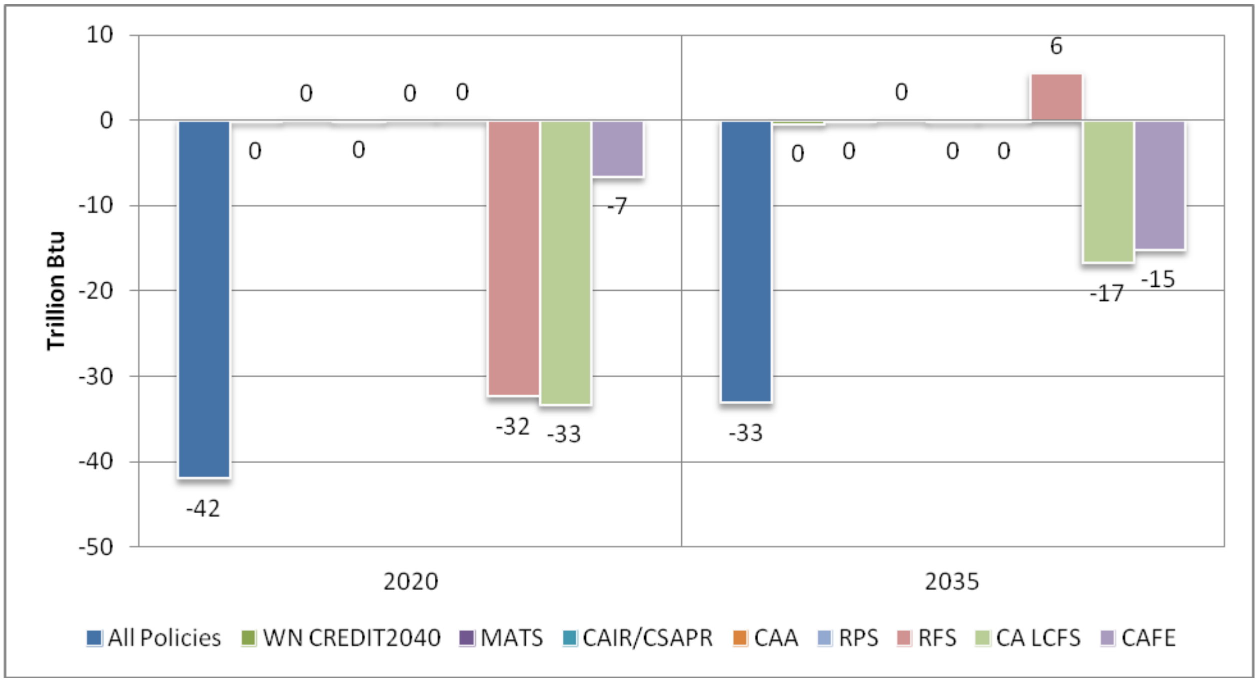
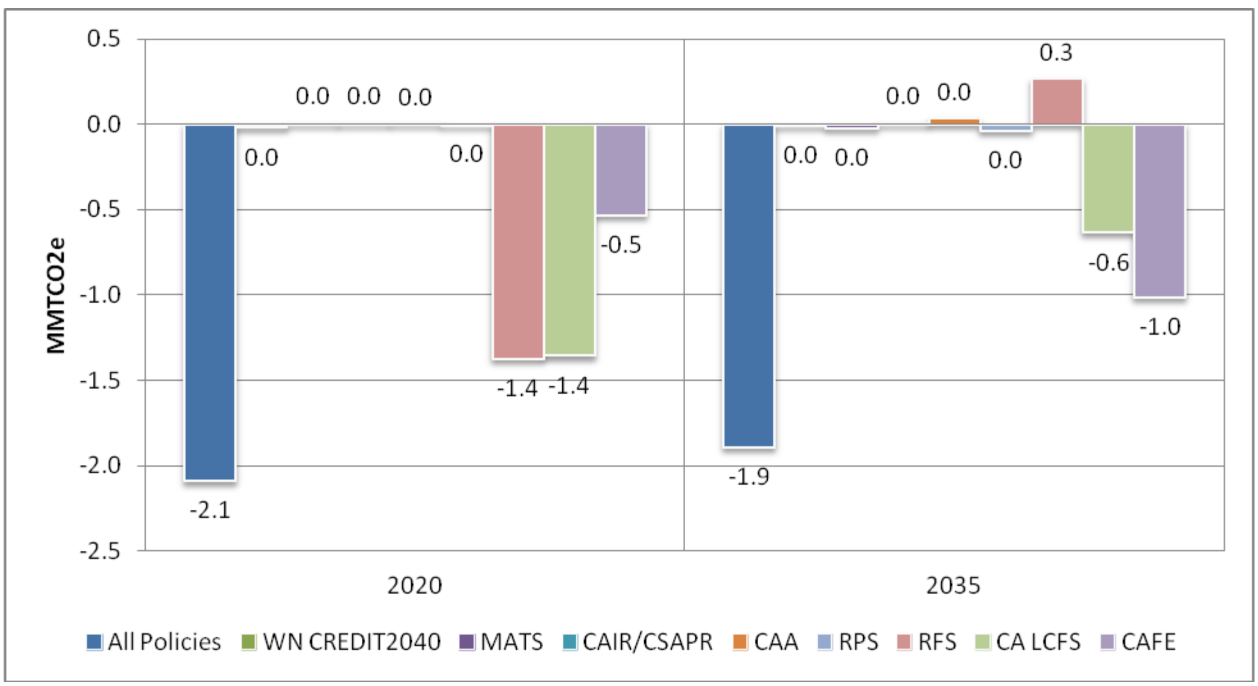



**Figure 12. Change in Carbon Dioxide Emissions from Transportation in Washington State from Federal Policies Modeled**



### Renewable Fuels Standards (RFS-1 and RFS-2)

At the national level, The Renewable Fuels Standards (RFS) is second only to CAFE in reducing carbon dioxide emissions from the transportation sector. As shown in Figure 8 the RFS is projected to reduce carbon dioxide emissions by 28.3 million metric tons across the U.S. in 2035. This differs from the 37 million metric tons of carbon dioxide reductions associated with RFS shown in Figure 6. Because Figure 6 captures total U.S. energy-related carbon dioxide emissions it will capture reductions associated with this policy outside the transportation sector as there are, to some degree, spillover effects in the residential, commercial and industrial sectors. At the census division level, reductions in carbon dioxide emissions exceed those from CAFE standards in 2020 but diminish rapidly by 2035 until it no longer provides additional emissions reduction benefits. For Washington alone, the impacts of the national RFS are nearly three times as large as CAFE in 2020 but similarly dissipate by 2035 (Figure 11 and Figure 12). This is expected as our methodology scales Washington impacts to the broader Census Division results.

***Recommendations for Further Analysis:*** The preliminary results of this analysis point directly at a strong interactive effect between the California LCFS and the RFS. In addition, the RFS and the CAFE standards are likely to also have some interactions. Once all of these interactions are accounted for, it would be worthwhile to investigate potential methods for isolating the impacts of the RFS and LCFS on Washington. NEMS and current post-processing methods do not allow for this level of granularity. Further, a more complete understanding of the reversal in the impacts of the RFS between 2020 and 2035 should be developed.

### CAFE Standards and Tailpipe Emission Standards for Carbon Dioxide

As shown in Figure 7 through Figure 10 above, the upward revision in CAFE standards will have important impacts on motor gasoline consumption and greenhouse gas emissions at both the national and census division levels. The revision to CAFE standards is forecast to reduce U.S. motor gasoline consumption six percent in 2035, or 0.9 quadrillion Btu, equivalent to 63 million metric tons of carbon dioxide (53.6 million metric tons in the transportation sector as shown in Figure 8).[72] At the census division level, the increased CAFE standards lower motor gasoline consumption by as much as eight percent in 2027 and by 2035, lower GHG emissions by 7.4 million metric tons of carbon dioxide equivalent. At the state-level, CAFE standards are expected to reduce emissions by a little more than one percent or 1.0 million metric tons of carbon dioxide in 2035, exclusive of all interactions (Figure 12). This reduction coincides with a decrease in motor gasoline consumption within the state of about 15 trillion Btu in 2035 (Figure 11).

[72] As discussed above under the Renewable Fuels Standards, the overall reduction in total U.S. energy related emissions will exceed those in the transportation sector due to relatively small spillover effects in the residential, commercial and industrial sectors.

***Recommendations for Further Analysis:*** Over time**,** CAFE standards grow to the most important non-state-level policy mechanism for reducing consumption and GHG emissions in the transportation sector as the RFS and California LCFS sunset and diminish in impact. This importance justifies considerable further analysis. CAFE standards are likely to have interactions with the Renewable Fuels Standards and California LCFS, which should be disentangled. Once that is completed, the results should be incorporated into our assessment of state-level policies and WA specific impacts.

### California Low Carbon Fuel Standards (LCFS)

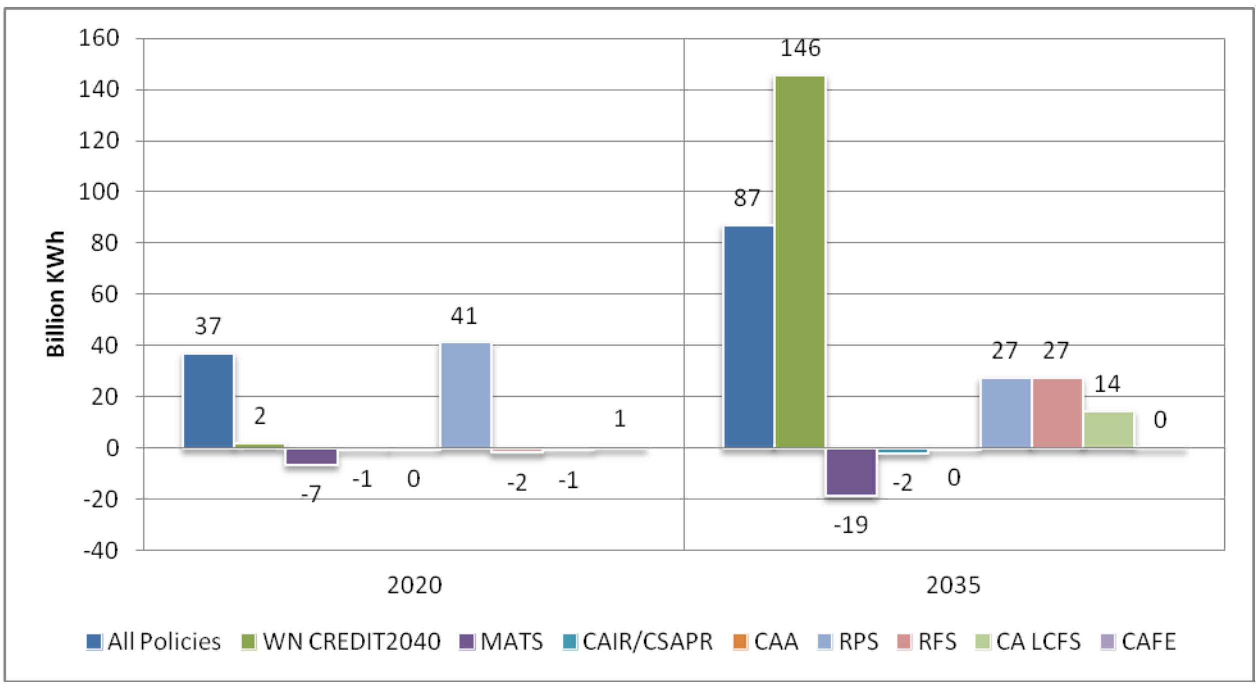
Although the LCFS is not a federal policy, the prominent role it plays in California's efforts to reduce greenhouse gas emissions, and the proximity and influence of California's fuel markets on Washington persuaded SAIC to model the impacts of this policy. SAIC added the California LCFS to the NEMS version used for the *Annual Energy Outlook 2012*, to establish the WA Baseline case, and then turned the LCFS off to gauge its impact on carbon dioxide emissions. As one might expect, and reflected in Figure 9 and Figure 10 above, because of California's prominent role in the Census Division 9 transportation economy, the LCFS shows important impacts on GHG emissions in Census Division 9. The LCFS reduces carbon dioxide emissions in Census Division 9 by 9.9 million metric tons in 2020 and 4.6 million metric tons in 2035. The state-level results reflect similar magnitude and trends of results as Census Division 9 due to the apportioning methodology used and may not be an appropriate measure of California LCFS impacts in Washington. The state-level results are likely overestimated since California is most impacted by the LCFS in Census Division 9 and Washington is only impacted by spillover effects.

***Recommendation for Further Analysis:*** The impact of the California LCFS on GHG emissions in Census Division 9 should be explored further. As a start, it is not clear what the LCFS will provide in GHG reductions that are not provided by the Federal RFS. The interactions of the LCFS with CAFE standards and the Renewable Fuel Standards should be examined in detail. In addition, while the preliminary literature showed considerable uncertainty regarding the economic impacts of the LCFS in the northeast and California, there is sufficient evidence that the LCFS in these locations would reduce GHG emissions within their geographic boundaries. Accordingly, the analysis of a state-level LCFS within Washington is justified. SAIC is examining the previous literature on the potential of a Washington LCFS to reduce emissions at reasonable cost within the Task 2 Report part of the broader study under this project.

## 4.2 Electric-generation Related Policies

In 2010, almost two-thirds (66 percent) of Washington's in-state electricity generation was hydroelectric. This yielded some of the nation's lowest electricity rates and total emissions from net consumption of electricity of just 20.7 million metric tons of carbon dioxide equivalent. This was equal to about 21.8 percent of total state emissions. Low electricity rates and low aggregate emissions creates challenges in achieving GHG reductions through typical electricity supply and demand mechanisms, with the possible exception of an electricity GHG performance standard to mitigate the higher carbon content of imported electricity. As revealed in Figure 13 through Figure 16 below, the aggregate impact of the 30-state Renewable Portfolio Standards (RPS) seems to have its greatest effect prior to 2025 on the portion of electric generation attributable to renewables and the reduction of GHG emissions at both the federal and census division or Western Electricity Coordinating Council, Northwest Power Pool[73] (WECC/NWPP) levels. The diminished impacts of the RPS after 2025 are likely the result of the target dates for most RPS being set at 2025 or earlier, with only Hawaii (2030), Delaware and Illinois (2026) having later dates. Of course, it is unlikely at that point that existing generation capacity will be removed or that states will dramatically scale back their expectations of the portion of generation they expect from renewable resources. From the model's perspective though, this generation capacity is now part of the reference case and the policy will not drive further variance from that reference case. By 2035, in the absence of the RPS, increases in renewable generation are driven by the extension of the Production Tax Credit.

**Figure 13. Change in U.S. Renewable Source Generation from Federal Policies Modeled**




[73] The WECC/NWPP is characterized as Electricity Market Module 21 in NEMS.

**Figure 14. Change in U.S. Carbon Dioxide Emissions from Electric Power from Federal Policies Modeled**

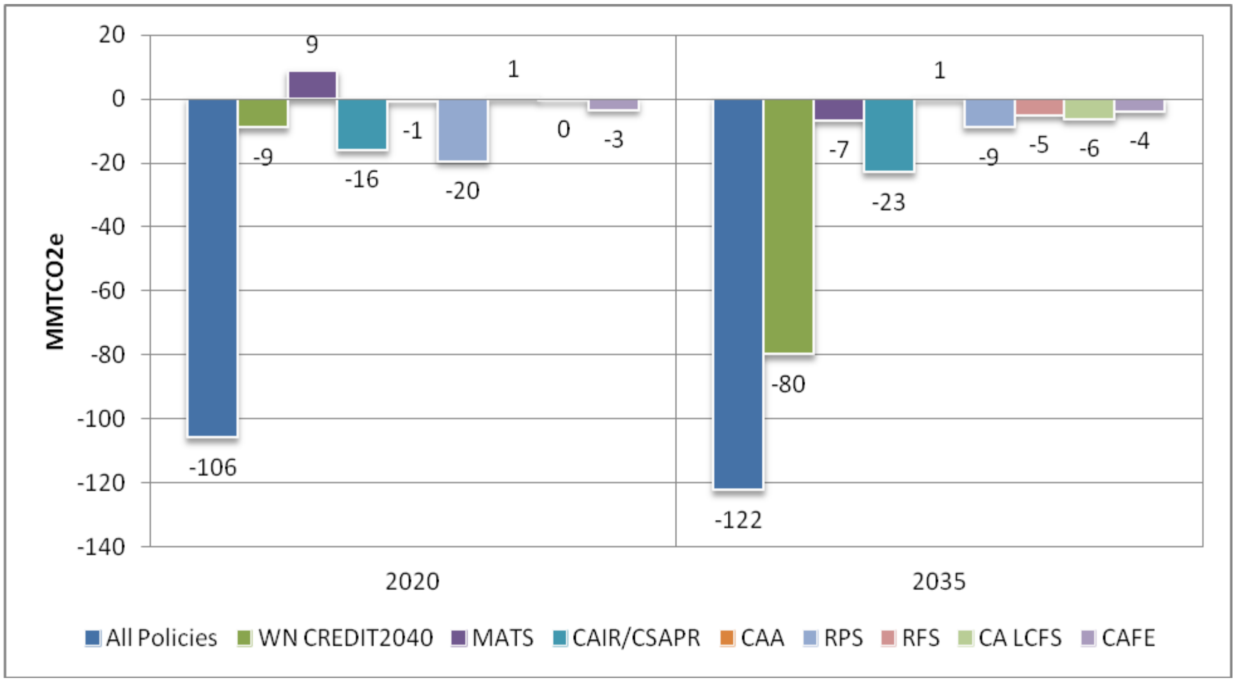


**Figure 15. Change in WECC/NWPP Renewable Source Generation in WECC/NWPP from Federal Policies Modeled**

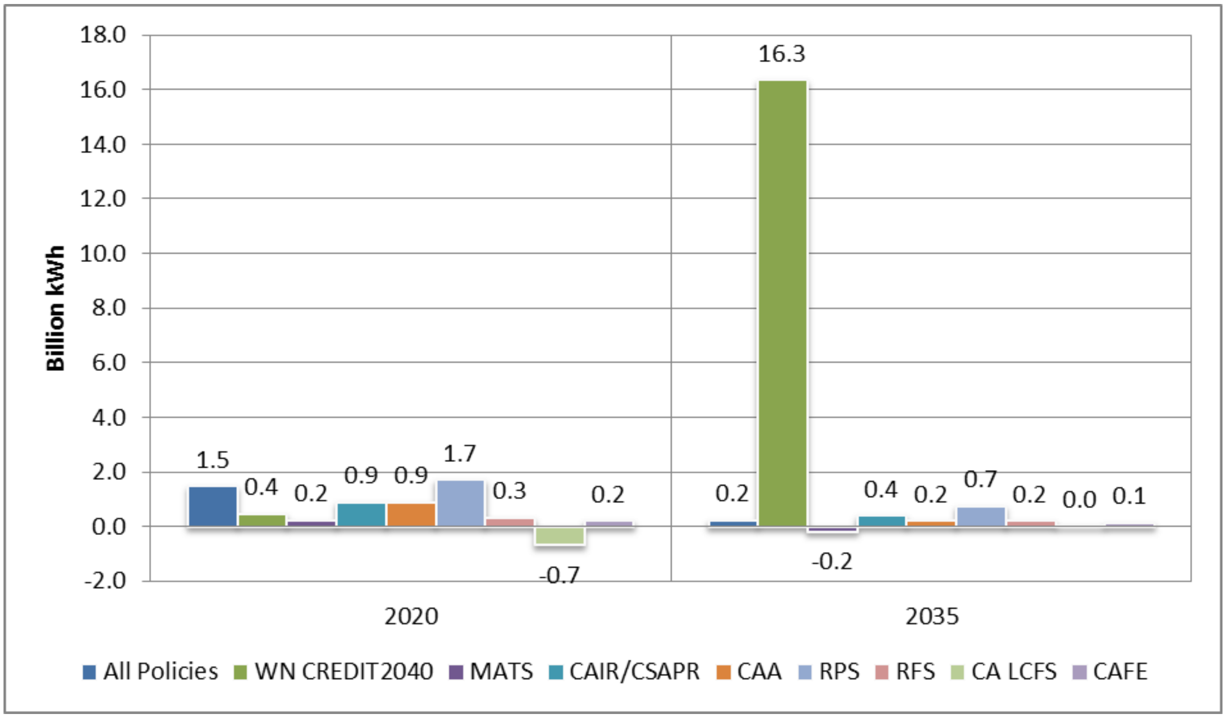



**Figure 16. Change in Carbon Dioxide Emissions from Electric Power Generation in Census Division 9 from Federal Policies Modeled**

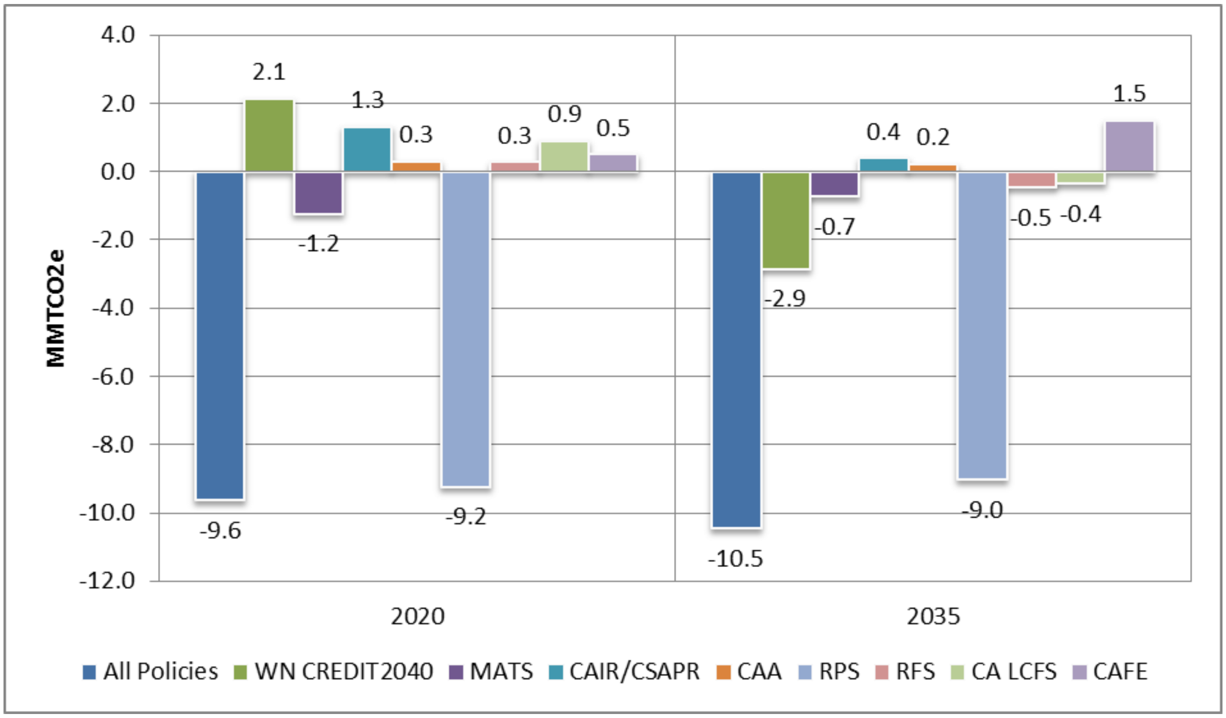


**Figure 17. Change in Washington State Renewable Source Generation from Federal Policies**

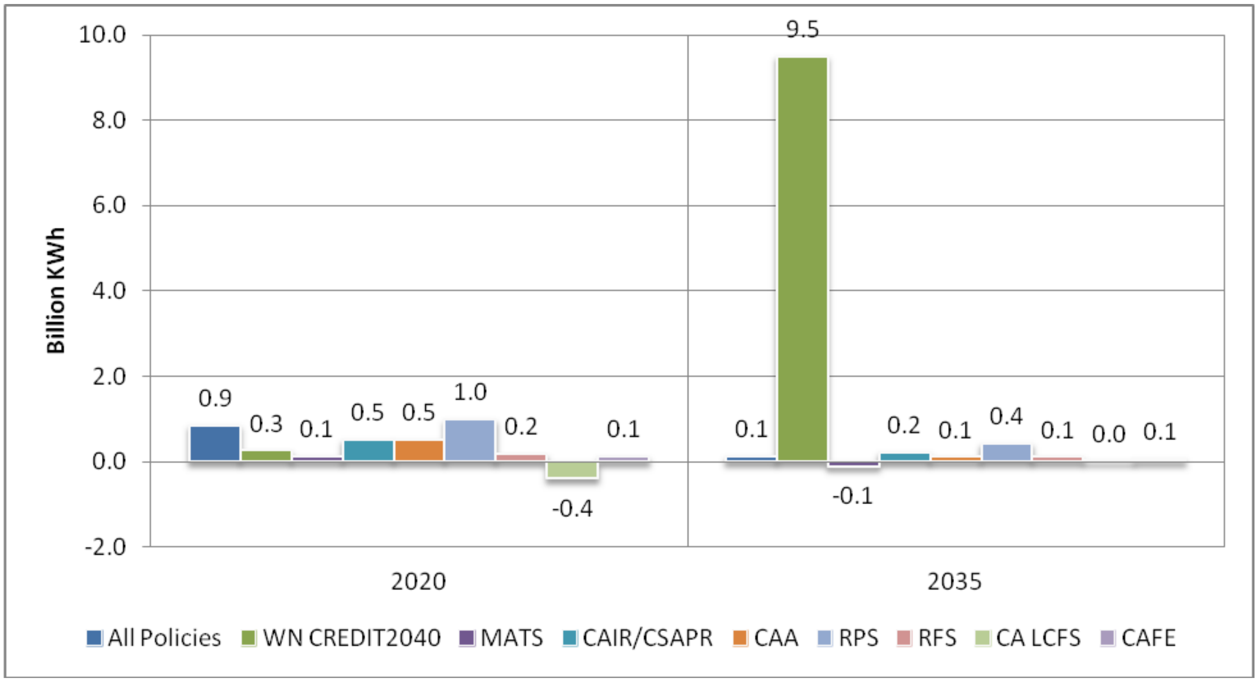
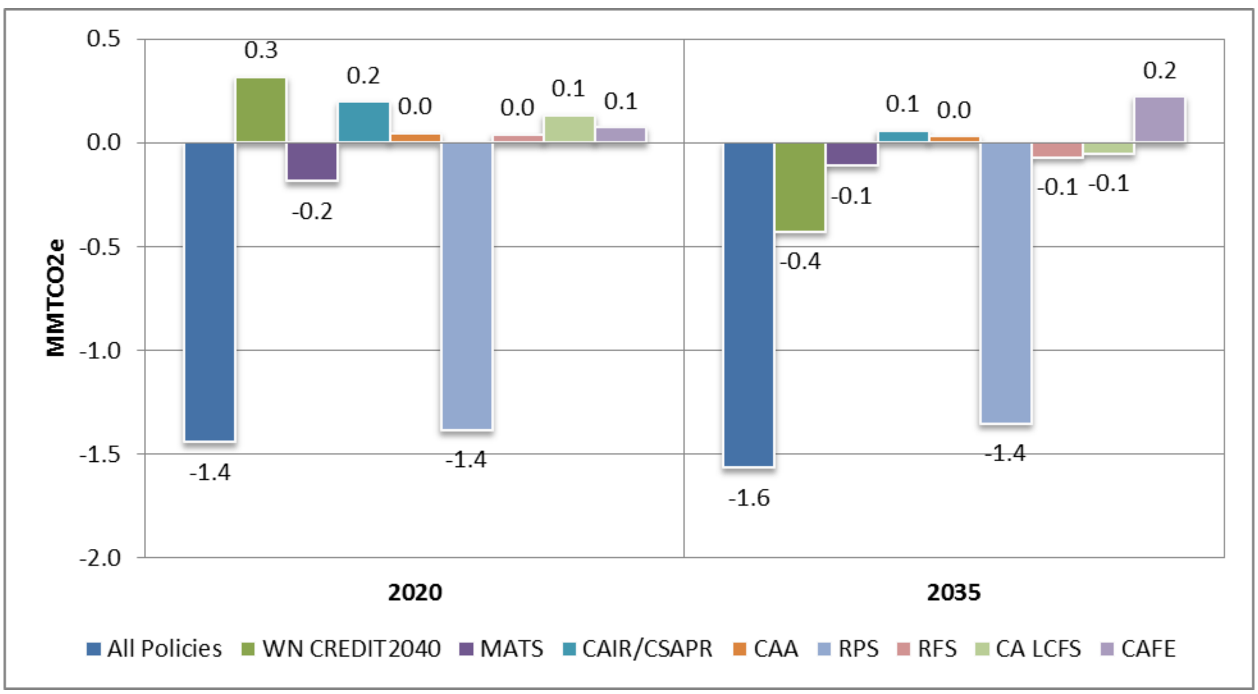



**Figure 18. Change in Washington State Carbon Dioxide Emissions from Electric Power from Federal Policies Modeled**



### EPA Mercury and Air Toxic Standards

Initial modeling of the Mercury and Air Toxics Standards (MATS) shows that these standards will yield less renewable generation and higher emission levels at the national level in 2020 (Figure 13 and Figure 14). While the decrease in renewable generation persists to 2035, the effect on emission levels reverses, likely due to the displacement of coal-fired electric generation capacity with natural gas-fired generation. The near term increase in carbon dioxide emissions is not particularly surprising as pollution control technology for mercury and air toxics removal increase ancillary power requirements increasing the amount of coal that needs to be consumed to satisfy electricity demand and effectively increasing carbon dioxide emissions per kilowatt-hour generated. Over time, this impact is overcome as the fleet shifts away from coal-fired generation.

***Recommendations for Further Analysis:*** The renewable electric generation results for this policy are somewhat counterintuitive as MATS should increase the costs of new coal-fired generation, favoring increased renewable builds. Further investigation to understand this outcome at the national and regional level is underway. That said, the overall impact of MATS is relatively small and is likely to be muted to a large degree in Washington State given the absence of significant coal-fired generation. Further inquiry into the apparently counter-intuitive result is may yield some insights but it remains likely that MATS will not have sufficient impact on Washington to justify further state-level analysis.

### Clean Air Interstate Rule and Cross-State Air Pollution Rule

Figure 14 shows that in 2020, the Clean Air Interstate Rule (CAIR) or the Cross-state Air Pollution Rule (CSAPR) would reduce national carbon dioxide emissions from electricity generation by 16 million metric tons carbon dioxide equivalent, with reductions growing to 23 million metric tons carbon dioxide equivalent in 2035. Figure 13 does not show a concurrent increase in national level renewable generation from CAIR/CSAPR suggesting that the rules are forecast to cause a shift from coal-fired generation to natural gas-fired generation. There are no similar reductions in emissions in Census Division 9, again likely attributable to the reduced level of existing coal-fired generation there. Similarly, at the state-level, the impacts of CAIR/CSAPR on energy consumption, renewable generation, and carbon dioxide emissions are estimated to be marginal across the study time horizon.

***Recommendations for Further Analysis:*** Like MATS, the CAIR/CSAPR is likely to have a non-material impact on Washington given the relatively limited role of coal-fired electricity in Washington's energy mix and the regulation's focus on units in the Eastern half of the U.S. Thus it is difficult to argue for the allocation of additional study resources for further analysis of this policy. At the national level, there are several interesting questions that may warrant investigation within a different forum, such as does the change in GHG emissions results from a shift from coal-fired generation to gas-fired generation. Additionally, as many previous studies have conflated the costs of MATS and CAIR/CSAPR, an effort to disaggregate those costs may be worthwhile, particularly given the apparently highly diverse effects on GHG emission levels of the two policies.

### Renewable Portfolio Standards (RPS)

We have examined the impacts of the 30 state (plus District of Columbia) RPS to understand their national impact and potential spillover effects in Washington. NEMS subsumes individual state targets in an approximation of region-level compliance requirements (voluntary or discretionary targets are not modeled). While it does not have the granularity to examine the direct impacts of Washington's own RPS, it does provide useful insight into the impact of the region's aggregate RPS requirements on electric generation and carbon dioxide emissions across the region and within Washington. Figure 13 and Figure 14 demonstrate that, in the aggregate, these RPS will increase total U.S. renewable electric generation and reduce carbon dioxide emissions by 20 million metric tons carbon dioxide in 2020. The national impact of the RPS diminishes subsequently over time as many of the State RPS have target dates set for 2025 or earlier, dropping the reduction in carbon dioxide to nine million metric tons by 2035. These impacts are similar in WECC/NWPP and Census Division 9 (Figure 15 and Figure 16), though the percentage change in renewable power generation in WECC/NWPP is lower – likely due to a relatively much larger installed base of renewable generation – and the RPS plays a larger role in the reduction of carbon dioxide emissions in Census Division 9, on the order of nine million metric tons in 2020 and 2035.. In the Washington State electric power sector, carbon dioxide emissions reductions attributable to the RPS in states across the surrounding region are expected to be approximately 1.4 million metric tons in both 2020 and 2035. Overall, these reductions represent an improvement of about 1.5 percent.

***Recommendations for Further Analysis:*** Although NEMS is not the right tool to examine the specific impacts of Washington's own RPS on the state's energy economy, that analysis will be conducted with off-line tools as a part of other tasks under this study. The substantial impacts of the RPS at the national and Census Division levels justifies further investment to determine the impact of the RPS in surrounding states, most notably California's very aggressive target of 33% by 2020, on Washington. SAIC will seek additional granularity on the impact of multiple state RPS, to determine to what extent such policies need to be added to an interactions analysis with other state policies.

### Tax Incentives for Renewable Energy (PTC and ITC)

After showing almost no impact on the amount of electric generation from renewable energy in 2020 (Figure 13), the effect of the PTC on renewable electric generation grows substantially through 2035, when total U.S. renewable electric generation is 20% higher than it otherwise would be in the absence of the PTC. Figure 14 shows a similar effect on total U.S. carbon dioxide emissions from electricity generation in 2035, with emissions some 80 million metric tons carbon dioxide lower than in the absence of the PTC. Figure 15 represents a similar trend in the PTCs impact on renewable generation in WECC/NWPP, but the absence of an accompanying reduction in carbon dioxide emissions from electric generation in Census Division 9, as captured in Figure 16 is somewhat confounding, though likely the result of comparing the WECC/NWPP region to Census Division 9 which is not an apples-to-apples comparison. To understand the geographical differences between these regions, maps are provided in Appendix A and B. In Washington, the PTC has a marginal impact on renewable generation while RPS targets are still active (through 2025), then increases renewable generation dramatically out to 2035. The PTC is projected to increase renewable generation in Washington by about nine percent, or 9.5 billion kilowatt-hours (Figure 17).

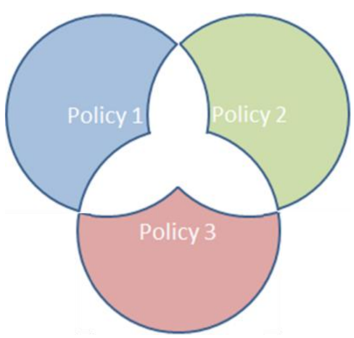
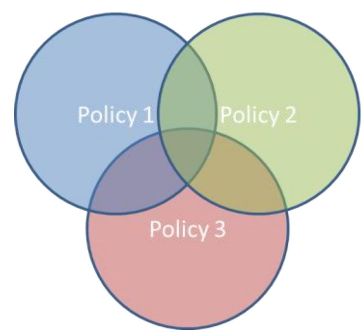
***Recommendations for Further Analysis:*** The rapid escalation in the impacts of the PTC after 2025 is concurrent with the rapid decrease in effects of the RPS after 2025. This suggests potential interactions between these two policies that need to be resolved. Each has robust influence on renewable generation and carbon dioxide emissions across the country, somewhat less so in WECC/NWPP and Census Division 9. Our first step will be to resolve the apparent conflict between levels of renewable generation in WECC/NWPP and carbon dioxide emission levels in Census Division 9. At this juncture, resolution of the potential interactions, followed by a review of potential methods to resolve comparison issues between the WECC/NWPP and Census Division 9 regions is warranted.

## 4.3 Combined Case

The final case examined combines all of the adjustments to the WA baseline reference case previously analyzed individually in Case 3 through Case 9. In the combined case, all federal policies described above are turned off and the Production Tax Credit is allowed to sunset after 2013. This combined case shows that together, the federal policies modeled decrease total U.S carbon dioxide emission by 155 million metric tons in 2020 and 231 million metric tons in 2035. **(**Figure 6**)**. About half of that decrease is attributable to declines in motor gasoline consumption driven by CAFE, Renewable Fuel Standards and Low Carbon Fuel Standards. The bulk of the remaining decreases are attributable to increased generation of electricity from renewable resources associated with extending the Production Tax Credit to 2040 and, in the years prior to 2025, the Renewable Portfolio Standards **(**Figure 13**).** These trends were consistent with the Washington state-level results. Holding all else equal if all of the federal policies evaluated were to be eliminated, carbon dioxide emissions in Washington would be projected to be approximately 3.7 million metric tons (4.5%) higher in 2035 than current emissions levels (Figure 20).

When the individual impacts of each of Case 3 through Case 9 are summed they equal far less than the overall impact of the combined case. There are interactions between multiple policies such as CAFE standards, Renewable Fuel Standards, and the Low Carbon Fuel Standard or the Renewable Portfolio Standards and the Production tax Credit and the individual results of each policy represent only the portion of reductions that are exclusive of interactions with other policies. Some of these interactions will completely negate the impact of one or more of the identified policies in certain years, some may merely diminish the impact of one or more of the identified policies and some may even have synergistic effects, which, when combined, result in a greater impact than when assessed independently. The sum of the individual impacts on carbon dioxide emissions of the policies studied, exclusive of all policy interactions, is some 10 percent less than the impact of the combined case at the national level and 50 percent less at the Census Division and Washington State levels in 2035. This means that without additional analysis, approximately 50 percent of anticipated carbon dioxide reductions in Washington during 2035 can be credited to a specific federal policy and 50 percent cannot. These carbon dioxide emissions reductions in 2035 are illustrated graphically below at the state level.

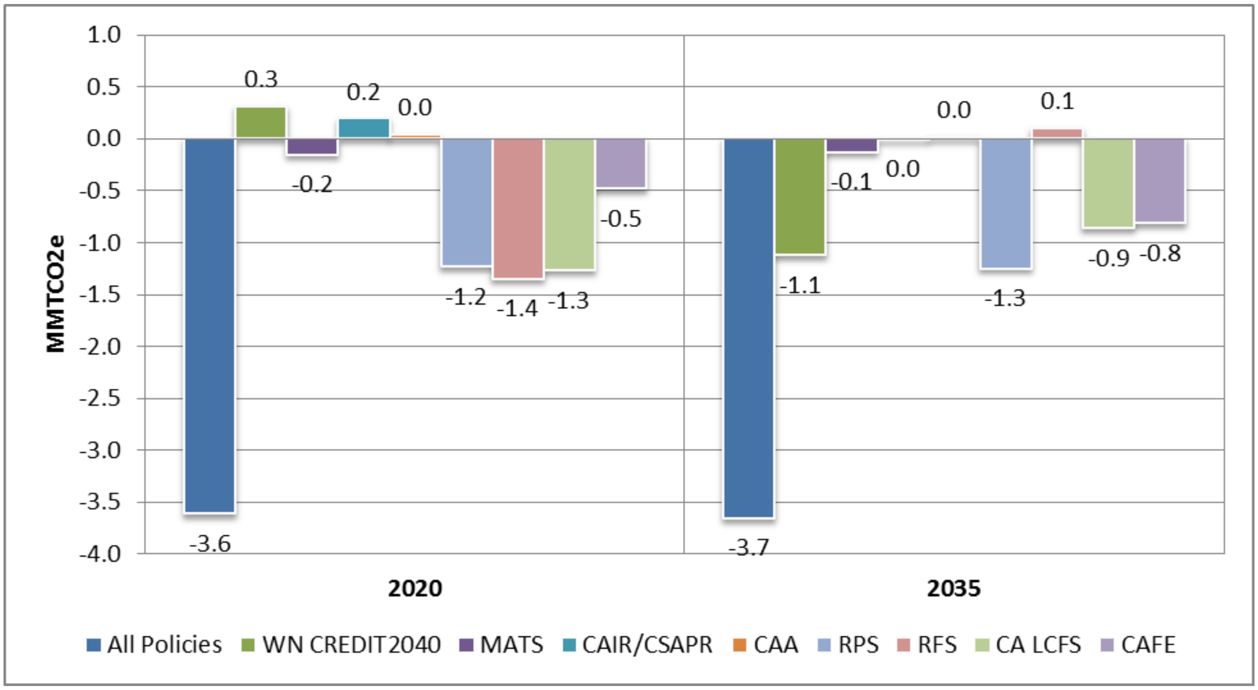
**Figure 19. Projected Washington State Carbon Dioxide Emissions Reductions in 2035; (1) Exclusive of Policy Interactions, (2) Isolated for Policy Overlap, and (3) Overall Reductions.**

| **$CO_2$ Reductions Exclusive of Policy Interactions** | **Policy Overlap $CO_2$ Reductions** | **Total $CO_2$ Reductions** |
|---|---|---|
| ***1.8M $mtCO_2$*** | ***1.8M $mtCO_2$*** | ***3.7M $mtCO_2$*** |
|  |  |  |



***Recommendations for Further Analysis:*** The effect of the combined case is far greater than any individual case that includes shutting off only one policy, and is also larger than the sum of the individual policies since some of those policies will completely negate or diminish the impacts of one another. Our intuition suggests there are two groupings with large interactive effects. For transportation related consumption and emissions, the CAFE standards, Renewable Fuels Standard, and the California Low Carbon Fuel Standard are likely to have strong interactions. For the electricity sector, Renewable Portfolio Standards and the Production Tax Credit are likely to have interactive effects. Further modeling to disaggregate the share of the combined case attributable to each of these policies is likely to yield interesting and valuable results if authorized by the CLEW.

**Figure 20. Change in Total Energy Related Carbon Dioxide Emissions in Washington State from Federal Policies**




## 4.4 Pending Policies

The policies that follow have been proposed but do not exist in current law or regulation. However, it is plausible that they will be implemented by statute, regulation or executive order in the next several years. They have been selected for their likely relevance to Washington's efforts to reduce GHG emissions. The determination of whether we should conduct further quantitative analysis was made based on their applicability to the Washington energy economy and the results of the preliminary literature review described above.

### GHG Regulation for New and Existing Coal-Fired Power Plants

While a re-issued NSPS for electric generating units is likely to be subjected to multiple lawsuits and other potential delays, the recent urgency expressed by the President suggests that this rule will likely go final in the next several years. Similarly, it is likely that the EPA will subsequently move forward with performance standards for existing generating units, though the design and level of those thresholds is impossible to predict.

***Recommendations for Further Analysis:*** It is a relatively manageable task to model the impact of the NSPS on new generating units by placing a technology constraint on a case. However, it is likely that a NEMS modeling case using the *Annual Energy Outlook 2012* version will show very similar results to the EPA's analysis of no additional coal-fired units with or without the regulation. Yet, it may be informative to test the proposition by running a case with increased natural gas exports and hence prices, as this is also a plausible scenario (see discussion of natural gas exports below). Similarly, it may be interesting to test the impact of the NSPS on new units when the RPS is shut off since the EPA has cited interactions with those state policies.

While it is impossible to predict the exact nature of the NSPS for existing electric generation units post-2015, we can model a proxy effect by increasing the regulatory cost risk in the model incrementally for two or three possible cases.

### Incentives for Renewable Energy on Federal Lands

Although more than one-quarter of all land in Washington is owned by the Federal Government, little of it is owned by the Bureau of Land Management (BLM). Rather, most of it is owned by the U.S. Forest Service or is part of the National Park System. Further, according to NREL, those BLM lands contain no viable concentrated Solar, PV, or wind resources. The BLM has identified some viable biomass and geothermal resources on their lands in the state.[74]

***Recommendations for Further Analysis:*** Given the relatively limited availability of viable renewable resources on public lands in Washington it is unlikely to be a critical portion of our analysis of potential state GHG reduction policies. Additional renewable builds on public lands in WECC/NWPP will be captured elsewhere in the existing NEMS case runs we have, or will complete. Off-line discussions with a representative of the Governor's Office of Regulatory Assistance to determine opportunities for permitting renewable projects on public lands in the states will be pursued.

### Reduced Tax Expenditures for Fossil Energy (Oil and Gas Depletion Allowances)

In his Climate Action Plan, President Obama called for the elimination of all U.S. fossil fuel tax subsidies in his Fiscal Year 2014 budget. While there are other policies that arguably subsidize fossil fuel consumption, the largest tax subsidy is the oil and gas depletion allowance, estimated to equal about $1 billion annually. A recent National Research Council study, performed using NEMS found that the average effect on GHG emissions over the time horizon of the model is too small to accurately estimate, or even determine if the sign of the change is positive or negative. [75]

***Recommendation for Further Analysis:*** Since Washington does not have any oil and gas production of consequence it is unlikely that the removal of this tax expenditure would have any effect on the state. Combined with the inability of previous researchers to detect any material

[74]U.S. Department of Interior, U.S. Department of Energy, *Assessing the Potential for Renewable Energy on Public Lands*, February 2003, http://www.nrel.gov/docs/fy03osti/33530.pdf
[75]National Research Council, Effects of U.S. Tax Policy on Greenhouse Gas Emissions, Committee on the Effects of *Provisions in the Internal Revenue Code on Greenhouse Gas Emissions*, W. Nordhaus, S. Merrill, P. Beaton, Eds., June 20, 2013, p. 142

change in GHG emissions at the national level attributable to this tax expenditure makes it clear that no further analysis of this policy is needed.

### REIT and MLP Parity

REIT and MLP parity are policies that are gaining momentum, with two renewable energy firms having been granted REIT status through private IRS rulings and the reintroduction of the MLP Parity Act in both the U.S. House of Representatives and U.S. Senate. It is likely that REIT and MLP parity would have interactions with both the Production Tax Credit (PTC) and Renewable Portfolio Standards. REIT and MLP parity are often championed as a method for achieving the same objectives as the PTC at lower cost to the U.S. Treasury.

***Recommendation for Further Analysis:*** REIT and MLP Parity may play an important role in further greening the electric sector in Washington (and throughout the U.S.) but it is unlikely during the duration of this project that it can be accurately represented in NEMS. Instead, we will undertake a qualitative analysis in an attempt to assess the opportunity to take advantage of these policies within Washington.

### Expanded Natural Gas Exports

Although Washington produces almost no natural gas, it is a significant consumer of natural gas and has a well-developed infrastructure to take advantage of low-cost natural gas supply.[76] There is some uncertainty over the impact of low-cost natural gas on greenhouse gas emissions with some parties fearful that low-cost natural gas is crowding out new investment in renewable energy. Others have argued that natural gas and renewables are complementary energy sources, with renewables offering a price hedge against potential volatility in natural gas prices and natural gas providing capacity to firm up otherwise intermittent renewable generation.[77]

A considerable amount of modeling has been conducted on potential increased natural gas exports that one might expect should FERC license a majority of the 17 liquefied natural gas expert terminals currently proposed. While the authors of these studies differ on the magnitude of exports, the ultimate price and the allocation of costs and benefits, they all foresee a change in price significant enough that it may alter the relationship between, coal, natural gas, and renewable fuels in the marketplace.

***Recommendation for Further Analysis Program:*** Additional cases of NEMS should be run that reflect a low and a high range of natural gas prices assumed to increase under an increased export scenario. Impacts of the initial cases should be evaluated to determine if further adjustment to additional cases is necessary. In particular, the effect of variation in the natural gas

[76] Washington Department of Commerce, *2013 Biennial Energy Report: Issues, Analysis and Updates*, R. Weed, Report to Legislature, Dec 2012, p.36

[77] Washington Department of Commerce, 2013 *Biennial Energy Report: Issues, Analysis and Updates*, R. Weed, Report to Legislature, Dec 2012, p.52

price on RPS and PTC should be examined in cases where the GHG NSPS are in place and where the GHG NSPS is turned off.

The NEMS model only focuses on carbon dioxide emissions from fuel combustion. It does not consider the contribution of fugitive emissions to life-cycle GHG emissions. Although the reduction in carbon dioxide attributable to the combustion of natural gas when compared to the combustion of coal or petroleum-based fuels is a simple matter of chemistry and is well known, the GHG impacts associated with fugitive emissions from natural gas production and hence life-cycle use of natural gas is far more uncertain, particularly for shale gas production, whose widespread expansion is a relatively recent phenomena. There is a large and growing literature on methane emissions from shale gas production but its findings are far from consensus, ranging from a slight improvement from conventional gas production, to a slight increase in emissions, all the way to a substantial increase in emissions. Since most of the recent growth in U.S. gas supply and nearly all of the future growth is attributed to the exploitation of shale gas, if this study determines that a large portion of emission reductions will be achieved by switching from coal to natural gas fired generation or by shifting a large portion of the transportation sector to natural gas fuel in the future, additional consideration of life-cycle fugitive emissions should be conducted using off-line analysis and tools.

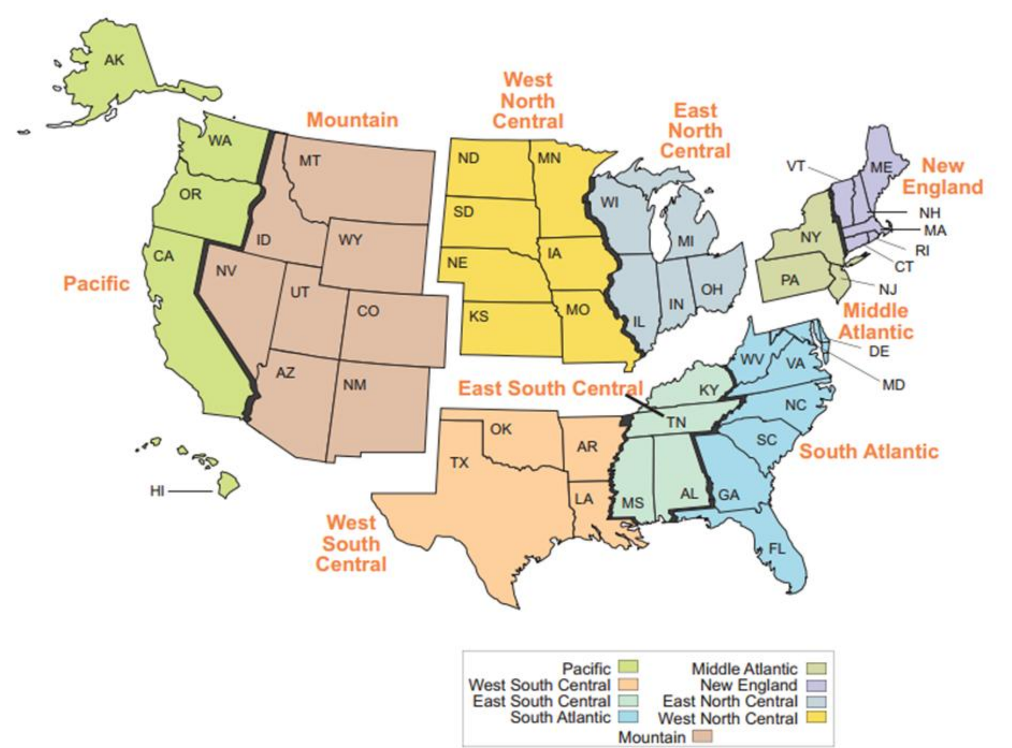
# 5 Appendices

These appendices include a U.S. Census Division Map, a NEMS Electricity Market Module Regional Map, and details on the methodology used to estimate state-level impacts from regional NEMS results.

## 5.1 Appendix A – U.S. Census Division Map

Washington is one of five states included in Census Division 9 (CD9), otherwise known as the Pacific division.

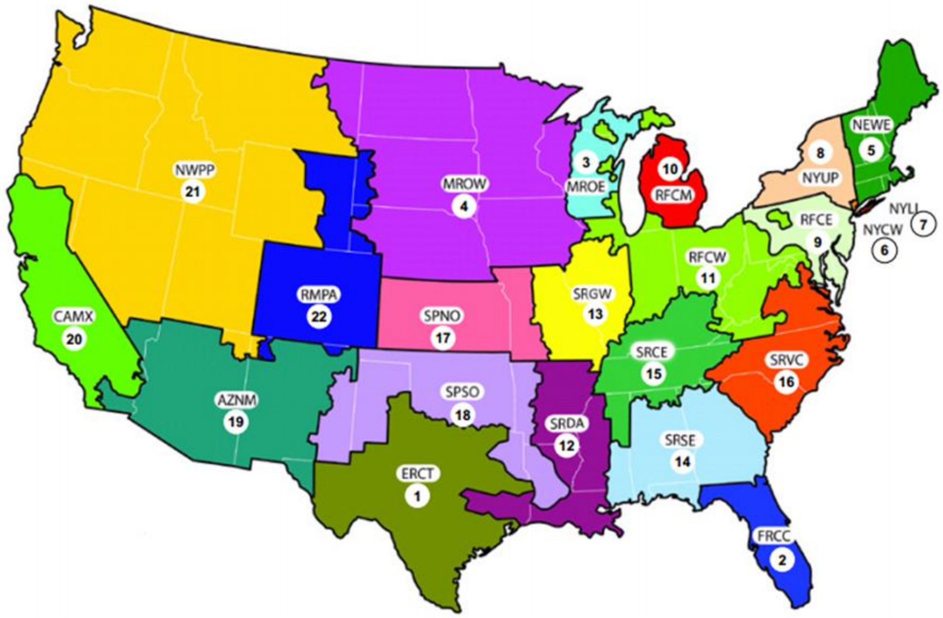
Figure F1. United States Census Divisions



## 5.2 Appendix B – NEMS Electricity Market Module Regional Map

Washington is located entirely within the Western Electricity Coordinating Council / Northwest Power Pool region.

Figure F2. Electricity market module regions




| | | | | | |
|---|---|---|---|---|---|
| 1. | ERCT | TRE All | 12. | SRDA | SERC Delta |
| 2. | FRCC | FRCC All | 13. | SRGW | SERC Gateway |
| 3. | MROE | MRO East | 14. | SRSE | SERC Southeastern |
| 4. | MROW | MRO West | 15. | SRCE | SERC Central |
| 5. | NEWE | NPCC New England | 16. | SRVC | SERC VACAR |
| 6. | NYCW | NPCC NYC/Westchester | 17. | SPNO | SPP North |
| 7. | NYLI | NPCC Long Island | 18. | SPSO | SPP South |
| 8. | NYUP | NPCC Upstate NY | 19. | AZNM | WECC Southwest |
| 9. | RFCE | RFC East | 20. | CAMX | WECC California |
| 10. | RFCM | RFC Michigan | 21. | NWPP | WECC Northwest |
| 11. | RFCW | RFC West | 22. | RMPA | WECC Rockies |

## 5.3 Appendix C - Methodology for Washington State Projection

SAIC applied the historic share of energy and fuel consumption and $CO_2$ emissions, as appropriate, to regional NEMS projection to arrive at state-level results. SAIC first used averaged historic data from 2006 through 2010 obtained from State Energy Data System (SEDS)[78] and State $CO_2$ Emissions database[79] (both sources are maintained by the Energy Information Administration) to estimate Washington State's share or weight in the region where it is located, then multiplied this share or weight to the region's projection produced by NEMS. Specific equations used to calculation state-level results for each metric are provided below:

*State Total Energy Consumption = WA Total Energy Consumption Share in CD9 (calculated using SEDS historic data) x CD9 Total Energy Consumption*

*State Total Energy $CO_2$ Emissions = WA Total Energy $CO_2$ Emissions Share/weight in CD9 Total Energy $CO_2$ Emissions (calculated using EIA state $CO_2$ emissions historic data) x CD9 Total Energy $CO_2$ Emissions*

*State Motor Gasoline = WA Gasoline Consumption Share/weight in CD9 (calculated using SEDS historic data) x CD9 Gasoline Consumption*

*State $CO_2$ Emissions by Transportation = WA Transportation $CO_2$ Share/weight in CD9 Transportation $CO_2$ emissions (calculated using EIA state $CO_2$ emissions historic data) x CD9 Transportation $CO_2$ Emissions*

*State Renewable Source Electricity Generation = WA Renewable Generation Share/weight in EMM21 (calculated using SEDS historic data and NEMS EMM21 calibration data) x EMM21 Renewable Generation*

State $CO_2$ Emissions by Electric Power = WA Electricity Generation $CO_2$ Share/weight in CD9 Electricity Generation $CO_2$ Emissions (calculated using EIA state Electricity generation $CO_2$ emissions historic data) x CD9 Electricity Generation $CO_2$ Emissions

[78] EIA. 2013. State Energy Data System. Accessed August 2013 at: http://www.eia.gov/state/seds/
[79] EIA. 2013. State $CO_2$ Emissions. Accessed August 2013 at: http://www.eia.gov/environment/emissions/state/state_emissions.cfm