CANDIDATE ACTIONS TO REDUCE TRANSPORTATION GREENHOUSE GAS EMISSIONS

Our region's role in defending the future

Evaluation Report

June 2018

Puget Sound Clean Air Agency

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Glossary:

BAU	Business-as-usual
BEV	Battery electric vehicle
CAFÉ	Corporate Average Fuel Economy
CI	Carbon intensity
CTR	Commute trip reduction
EPA	U.S. Environmental Protection Agency
EV	Electric vehicle
EVSE	Electric vehicle supply equipment
GHG(s)	Greenhouse gases
GHGe	Greenhouse gas emissions equivalency
ICE	Internal Combustion Engine
ISR	Indirect source rule
HDV	Heavy-duty vehicle
LCFS	Low-carbon fuel standard
LDV	Light-duty vehicle
LD-ZEV	Light-duty zero-emission vehicle
LTO	Landing and take-off emissions
$MMTCO_2e$	Million metric tons of carbon dioxide equivalency
MUD	Multiple unit development
MWh	Megawatt hour of energy
MY20XX	Model year (for vehicles)
OTAQ	U.S. EPA Office of Transportation & Air Quality
PHEV	Plug-in hybrid electric vehicle
PSRC	Puget Sound Regional Council
RD	Renewable diesel
RFP	Request for proposal
RNG	Renewable natural gas
RTP	PSRC's Regional Transportation Plan (2040 update)
SCC	Social cost of carbon
SOV	Single occupant vehicle
VMT	Vehicle miles traveled
ZEV	Zero-emission vehicle

Executive Summary:

In February 2017, the Puget Sound Clean Air Agency (Agency) Board adopted economy-wide greenhouse gas (GHG) emission targets of 50% below 1990 levels by 2030, and 80% below 1990 levels by 2050. These targets are based on the most recent scientific findings on the need to achieve significant emissions reductions to minimize the devastating impacts of climate change.

Since almost half of all GHG emissions in our region are from the transportation and mobile sector, the Agency's Board of Directors directed staff to identify and evaluate potential candidate actions that could achieve significant reductions in transportation-related GHG emissions. This report provides a summary of those candidate actions.

Agency staff evaluated eleven main candidate actions that fell into four main categories:

- Zero-emission vehicle (ZEV) adoption
- Alternative, lower GHG fuel use
- Mode-shift
- An Indirect Source Rule/Heavy-duty trucking requirements

Staff analyzed each of the candidate actions using 11 evaluation criteria to determine the action's emissions reductions including; practicality of implementation; economic costs/benefits; and community impacts. Later steps will include obtaining advice regarding legal or authority issues. We focused our evaluation on the 2030 time horizon and our 2030 GHG emissions target. The report and appendices provide detail on each candidate action and how each was evaluated.

The single most important criterion was the GHG emission reduction estimate for each of the candidate actions. The Agency's ambitious targets required us to look beyond smaller emissions-reduction strategies in order to identify robust actions the Agency could take to move us towards our targets. To this end, we developed "low" and "high" scenarios to examine how the estimated reductions helped us progress towards our GHG reduction targets. The following figures show the estimated scenarios for possible GHG emission reductions by 2030 using a number of the analyzed candidate actions. These highlight that some candidate actions are estimated to potentially achieve greater emission reductions in our region than others.

In Figures ES-1 and ES-2, the red line shows estimated historic regional transportation GHG emissions, while the solid black line shows a 2040 projection based on anticipated population increase alone. The dotted line shows a more likely 2040 projection based on population growth as well as "on-the-books" regulations and plans that will offset population growth – these include national vehicle emissions standards as well as the regional transportation plan. The green line shows the Agency's target, with the 2030 benchmark and out to 2040 (shown to coincide with the time horizon of PSRC's regional transportation plan).

The scenario shown in Figure ES-1, below, identifies candidate actions that could achieve a "strong" reduction in GHG emissions if implemented, in total about 3.6 $MMTCO_2e$, and is the "low" of our two estimated scenarios. The wedges in the chart identify candidate action 10, GHG requirements for on-road heavy-duty trucks; candidate action 9, an indirect source rule (using regional airports as an example); candidate action 8A, a methane regulation, using methane emissions for transportation fuels; candidate action 5, improved local government alternative fuel rule; candidate action 3 or 4, which would implement a low-carbon fuel standard or impose a tax or fee to achieve 10% carbon intensity on

fuels in the region; and candidate action 1, which would set a ZEV adoption timeline and end the sale of new Internal Combustion Engine(ICE) vehicles in our region by 2050. For the carbon intensity regulation and ZEV adoption, this scenario assumes a lower, more-modest rate of adoption when calculating GHG emission reductions.

Figure ES-1: Strong Scenario

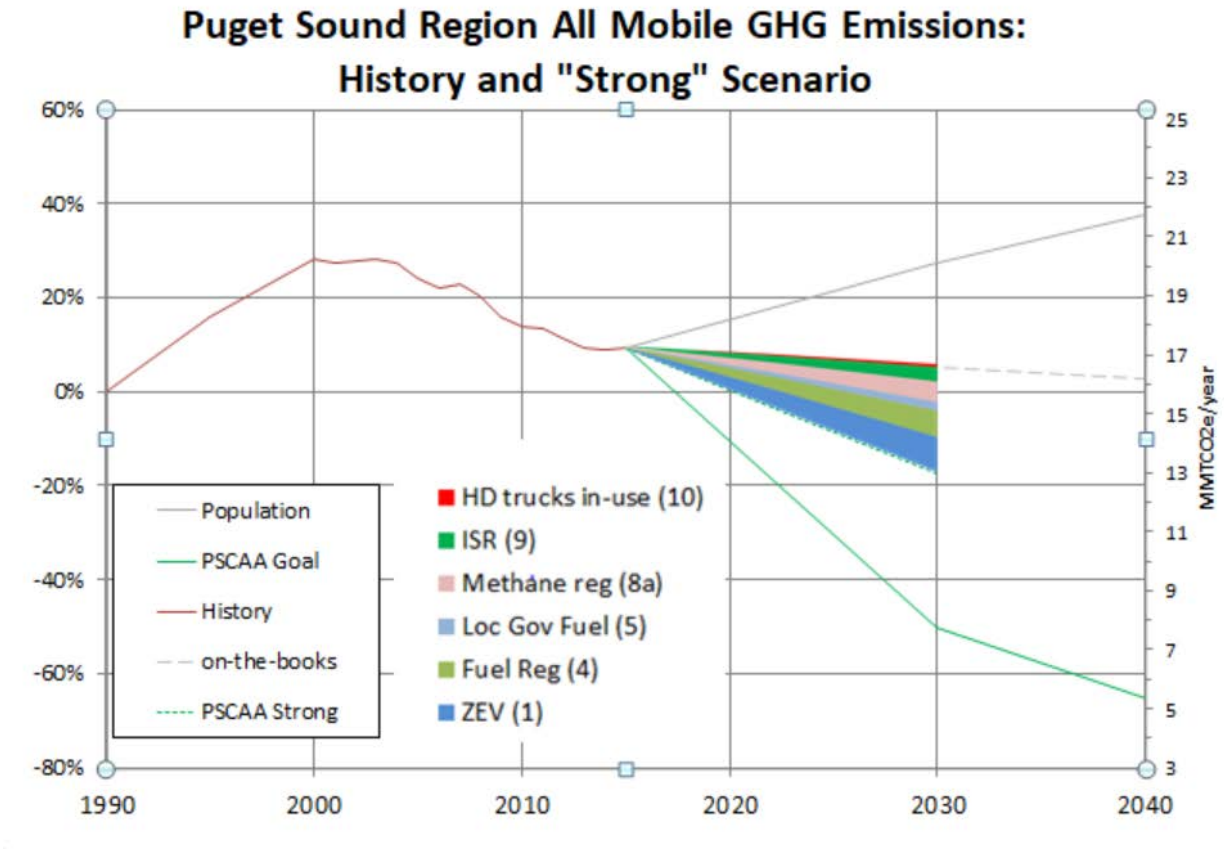


Figure ES-2: Ambitious Scenario

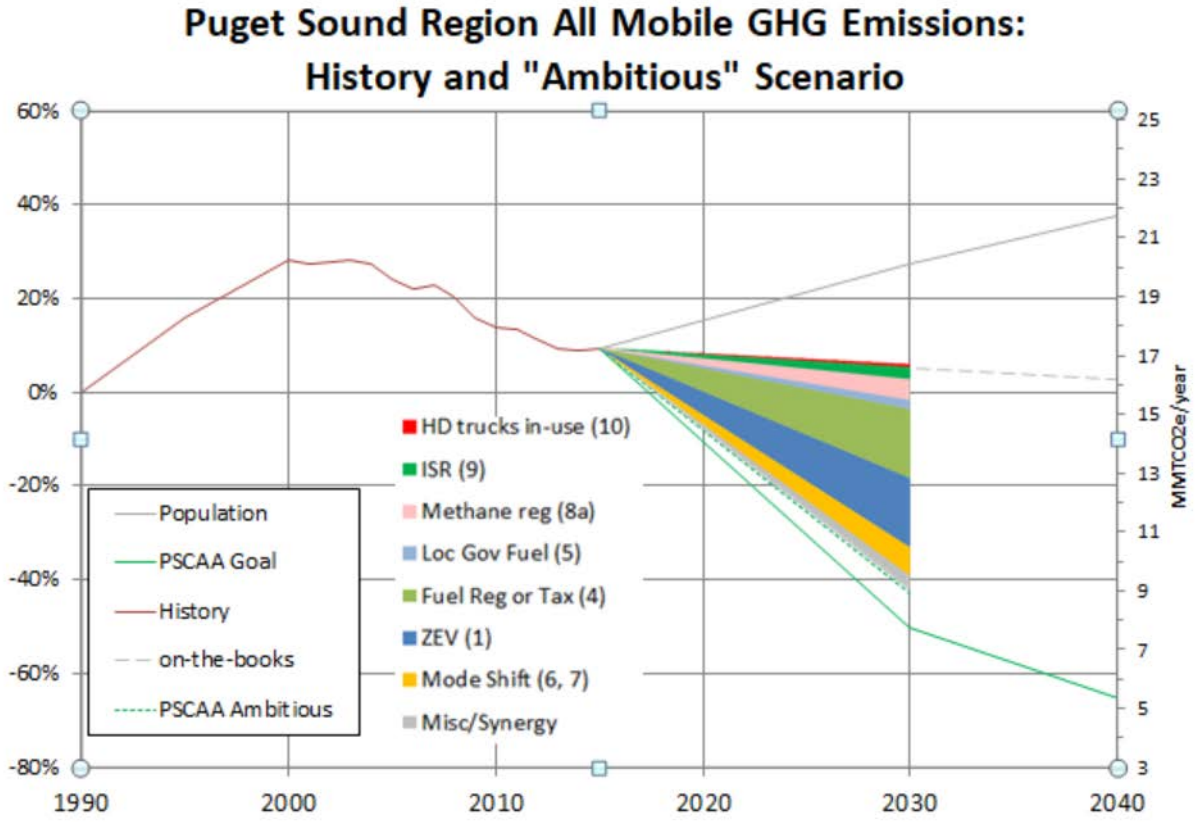


Figure ES-2, above, describes our "ambitious" scenario for estimated GHG reductions and is the "high" of our two estimated scenarios, likely achieving 7.0 $MMTCO_2e$ emission reductions. A number of the candidate actions stay the same, but there are three differences from the "strong" scenario. First, the carbon intensity regulation (Action 4) is increased to 25% for diesel fuels in the region by 2030 (gasoline stays at 10%). This is the most ambitious target of any program we are aware of.

Second, the ZEV requirement (Action 1) assumes an earlier date (2035) which results in greater, more ambitious emissions reductions by 2030. Last, we've included an additional wedge that accounts for mode shift items that would reduce trips "above and beyond" the measures included in Puget Sound Regional Council's (PSRC) regional transportation plan (2040 update) (Actions 6 and 7). These are driven by land use changes and greater transit, as well as user fees structured to reduce single occupancy vehicle (SOV) trips.

Several candidate actions and sub-actions do not appear in either scenario. This is because they overlap in their emissions reductions with other included actions, and to include them would in effect be double counting emissions reductions. The final wedge, "Misc/Synergy", is included to capture multiple smaller sub-actions or feedbacks that are too small to list individually and difficult to quantify individually. These include: ZEV infrastructure (Action 1D), ZEV sales incentives (Action 1D), a small cash-for-clunkers program (Action 1D), general consumer education (Action 1D), and other local/partner actions (Action 2C). The specific actions that can be estimated total 0.60 $MMTCO_2e$, and several additional actions couldn't be quantified. To be conservative, we round the category down to 0.5 $MMTCO_2e$.

Recommended Focus Areas:

To achieve the necessary emission reductions according to the Agency's targets, staff recommends implementing candidate actions in the following three focus areas.

Recommendation: Zero-emission vehicle adoption

The aim of this candidate action is to increase ZEV adoption in our region. This could be achieved through the use of fees or incentives, though dedicated funding needs to be secured to be successful. Additionally, the Agency could pursue an option that examines requirements for specific vehicle types or use cases. These could potentially include autonomous vehicles, Transportation Network Company vehicles (e.g., Uber; Lyft), or previously owned cars. Many of our staff recommendations to increase ZEV adoption could leverage current activities by the Western Washington Clean Cities Coalition that works with local fleets to reduce fuel consumption.

Recommendation: Alternative fuel use

The aim of this candidate action is to reduce the carbon-intensity of the fuels used in the transportation sector regionally. The Agency could pursue a low-carbon fuel standard (LCFS) for the region. The LCFS would cover the transportation & mobile sectors in the region, including on-road, non-road and mobile equipment, defined by the Agency's emission inventory. If pursued, the Agency would take on the technical role of identifying/cataloging the carbon intensity of fuels in our region and enforcing compliance of the standard with identified parties.

Recommendation: Continue/Strengthen work with partners to promote Mode Shift

This recommendation challenges us to pursue candidate actions that will further reduce car trips themselves and associated GHG emissions, beyond those laid out in Puget Sound Regional Council's Regional Transportation Plan (RTP). Mode shift is a large category defined by reducing Single Occupancy Vehicle (SOV) trips, and could be achieved through a variety of ways: more transit use; shifting to cycling or walking; eliminating the trip altogether (e.g., telecommuting); or structuring usage fees to minimize SOV trips. Of the potential actions listed, assessing road usage fees is the most promising potential candidate to achieve meaningful emissions reductions. The Agency could also continue to evaluate an Indirect Source Rule (ISR) as a mechanism to reduce GHG emissions in designated areas. This rule could potentially apply to specific activity centers, or downtown hubs that draw significant numbers of vehicles to these locations. An ISR could enhance mode shift by indirectly prompting businesses to expand programs like Commute Trip Reduction (CTR) to keep GHG emissions associated with their areas below designated limits.

Scale, Synergies, and Uncertainties:

To achieve a reduction of 50% in GHG emissions from transportation and mobile sources below 1990 levels by 2030, we need to reduce transportation and mobile sector GHG emissions by 8.7 $MMTCO_2e$. We estimate that the three focus areas above, using our "ambitious" scenario, may reduce emissions by 5.6 $MMTCO_2e$ in 2030. While these three don't achieve the entire transportation emissions reduction needed to meet the 2030 target, they are the most robust actions that set us on a path of GHG emissions reductions.

In review of the candidate actions and recommendations, the Agency identified a number of synergies among the top candidate actions. The candidate actions that achieve the greatest estimated GHG emission reductions – ZEV adoption and an LCFS – in some cases mutually enhance one another to

achieve the greatest potential GHG emission reductions. For example, electricity is a fuel that can be used for LCFS credits in California and Oregon systems, so higher ZEV use generates LCFS credits.

The LCFS candidate action also overlaps with other actions analyzed for promoting alternative fuel use, and could serve as a catalyst for expanding the alternative fuel industry in our region. Although the outcomes are the same – reduction of GHG emissions – how the actions are implemented differs. Similarly, the use of an Indirect Source Rule or a methane regulation could also contribute to other recommended candidate actions. For example, regulating methane emissions could stimulate the market to generate more renewable natural gas for transportation fuels, which would be a very low-carbon fuel and provide business development incentives under an LCFS.

The values provided are based on best available research and existing programs, and are intended to be aggressive – at the higher end of projections – to match the ambition in our GHG emissions reduction target. The emissions estimates and projections provided in this report have considerable uncertainty. Unfortunately, no information available in 2018 adequately captures the market uncertainty at play in both the ZEV and alternative fuels markets out to the 2030 horizon. In part due to this uncertainty, we suggest that the Agency regularly revisit these recommendations to update them with more current information. This process could also allow subsequent addition of candidate actions that were not initially pursued or considered. In addition, as specific candidate actions are pursued, a deeper staff analysis will be conducted in the design phase prior to implementation.

Many of the candidate actions we evaluated could also be pursued at a statewide level. Obvious examples include the LCFS and ZEV mandate, which were proposed but ultimately not adopted by the Washington State Legislature in the most recent session. While we pursue regional actions, we will continue to advocate with partners for many of the same actions at a statewide level. How these actions play out at different scales (regional vs. statewide) is another source of uncertainty and potentially synergy. To address this, we will continue to revise our focus areas if candidate actions are pursued at a state level.

Despite these uncertainties, we have a number of certainties that guide us in our recommendations. Science tells us that GHG emissions are directly related to a changing climate that impacts our region, our air quality, and our vulnerable populations. These negative impacts will grow and worsen without actions to reduce our GHG emissions and improve our environment. As our strategic plan guides us, we must help our region “do its part and more to protect our climate.” Success will be challenging, but failing to defend the future is not an option.

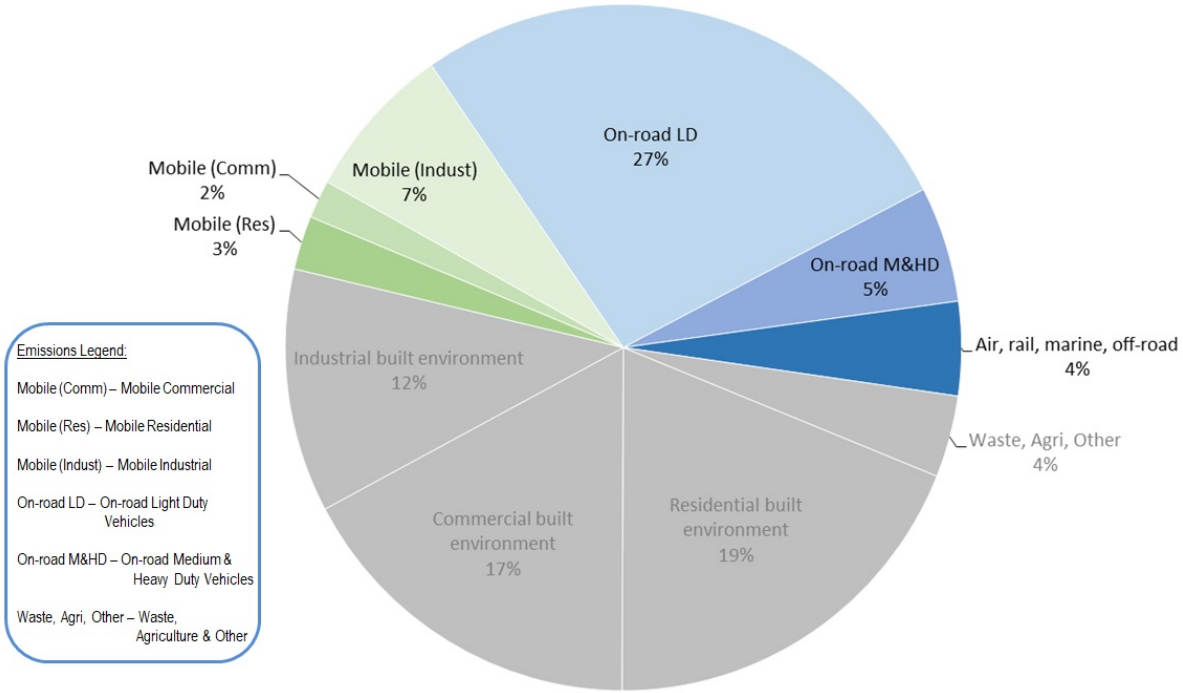
Chapter 1: Introduction

The Puget Sound Clean Air Agency (Agency) is a regional government agency whose mission is to protect public health, improve neighborhood air quality, and reduce our region's contribution to climate change. We achieve our mission through adopting and enforcing air quality regulations, monitoring air pollution, sponsoring voluntary and incentive programs, and educating people and businesses on and air and climate-friendly choices. The Agency was chartered by state law in 1967, and follows mandates set in the federal and Washington State Clean Air Acts.

The Agency developed their 2014 – 2020 Strategic Plan, and Goal Two of that plan includes an objective to "Become the most climate-friendly region in the United States."[1] In February 2017, the Agency Board of Directors adopted economy-wide greenhouse gas emission targets of 50% below 1990 levels by 2030, and 80% below 1990 levels by 2050. Because about half of our region's GHG emissions are within the transportation & mobile sector, the Agency focused its efforts to examine potential emission reduction actions in this sector. The candidate transportation-related actions examined by the Agency would work in conjunction with emission reduction efforts occurring in all sectors of the economy including energy, built-environment, and agriculture, among others.

According to recent data from the U.S. Energy Information Administration (Dec 2017), the transportation sector is now the leading source of greenhouse gas emissions in the United States.[2] The Agency's region has also seen the transportation sector's share of GHG emissions increase over the years, in large part due to emissions improvements in other sectors.[3] Figure 1 below shows the breakdown of the 2015 emissions inventory by sector, with transportation and mobile emissions accounting for almost 50% of GHG emissions in our region. Of these, on-road gasoline vehicles make up the largest portion, with 27% of total GHG emissions and more than half of the transportation and mobile emissions.

Figure 1: Emissions breakdown for Puget Sound region – highlighting transportation & mobile



This report provides background information on the candidate actions identified by Agency staff. At a high level, we assessed the candidate actions to determine if they could achieve a reduction in greenhouse gas emissions within the transportation & mobile sector. We focused our evaluation on the 2030 time horizon and our 2030 GHG emissions target. Additionally, we assessed how practical each would be to implement, the economic costs/benefits for the region of each, their community and social impacts, and an on-going consideration of legal implications and/or questions related to implementing the actions. These analyses are summarized in Chapter 3.

A central theme among all the candidate actions is equity, which is covered in greater detail in Chapter 4. Many of the candidate actions are designed to prompt behavior changes due to pricing, including taxes, fees, or incentives. Implementing taxes or fees on vehicles based on their fossil fuel use or GHG emissions could disproportionately impact communities already affected by socioeconomic, health, and air quality disparities. Eventual implementation of chosen candidate actions will need to be designed to mitigate these impacts, especially among vulnerable communities. These include low-income communities and people of color in urban areas, as well as rural and suburban populations that can have limited access to public transportation and potentially greater requirements for vehicle use commuting to work or for other daily activities. While no single policy or action may alleviate social and economic burdens for all individual needs, overall the benefits of GHG emission reductions extend to everyone in our four-county region.

In addition to vehicle fuels and technology, the Agency evaluated mode shift. Mode shift refers to an integrated transportation network that includes public transit, alternative transportation, and bicycle/pedestrian networks. Overlap and synergies between candidate actions within these three categories, and discussion of assumptions and uncertainties is described in more detail in Chapter 5.

Many economic and social benefits as well as costs are associated with the proposed candidate actions, which will require a substantive discussion on implementation. To achieve the Agency's goals of becoming the most climate-friendly region in the United States and to reach its stated GHG emission reductions, we will need to be leaders and innovators by adopting robust candidate actions to reduce the impacts of climate change.

Chapter 2: Candidate Action Process, List & Evaluation Criteria

Many actions have the potential to reduce greenhouse gas emissions in the transportation and mobile sector. Studies and reports by cities, states, federal government agencies, and non-government organizations have identified actions and described how local/state governments plan to implement them to reduce GHG emissions in this sector.[4-6] These plans also attempt to quantify the magnitude and effect such actions could have on GHG emission reductions. Actions that propose the greatest emission reductions may require a high level of political, social, and economic commitments to be successful.

Agency staff considered a number of actions and strategies, prioritizing robust actions that garnered the greatest emissions reductions. The Agency used information from scientific and technical reports (as described above) and in-house Agency knowledge, taking a step-wise approach to identify candidate actions to analyze.

The first step was collecting over 200 ideas from other reports, staff surveys, and brainstorming meetings. This collection was distilled to about 75 actions that were more distinct. This set was then analyzed and ranked based on qualitative estimates of the size of emissions reductions, technical feasibility, and ability for the Agency or our partners to implement, cost, and overall value. The actions with the largest potential emissions reductions, which also seemed technically feasible, were selected for more detailed analysis. These candidate actions and sub-actions are listed below in Table 1. The Agency also defined five evaluation criteria, which included emission reductions, practicality of implementation, economic costs/benefits, and community impacts (Table 2).

Table 1. Candidate Action Master List

Action	Description
1	Accelerate zero-emission vehicle (ZEV) adoption in the Puget Sound region
1a	Restrict sales of light-duty internal combustion engine (ICE) vehicles by a future date
1b	Adopt a ZEV mandate similar to California
1c	Differential sales tax based on vehicles GHG emissions
1d	ZEV infrastructure incentive programs; and smaller supporting initiatives
2	Increase the fuel economy for Light-Duty Vehicles (LDVs) in the Puget Sound region
2a	Regional fuel economy requirement with revised schedule
2b	Differential charges on vehicles based on fuel economy
2c	'Cash for Clunkers' program (targeting 5% to 10% of vehicles with the lowest fuel economy)
3	Differential charges on fuels based on life-cycle carbon-intensity
4	Life-cycle carbon-intensity requirements
5	Adopt improved local government alternative fuel rule
6	Further examination of PSRC's Regional Transportation Plan (RTP) for "Land Use" and "Choices"
7	Further examination of PSRC's RTP for "User Fees"
8	Incentivize production and use of renewable diesel (RD) and renewable natural gas (RNG)
8a	Regulate methane emissions or flaring to stimulate RNG production
8b	MTCA or similar toxics regulation that imposes a tax or fee on diesel to subsidize alternative fuels

8c	Local government fleets have RFP or bid for fuel purchase with required GHG reductions
Action	**Description**
8d	Assume funds available, back or secure loans for RD plants
8e	Assume funds available, back or secure loans for RNG digesters or capture and processing for municipal, agriculture, and smaller facilities
8f	Assume funds available; provide subsidy to vendors or fleets in our region for biofuels
8g	Biofuel mandate starting at B20 and ramping to X by 2030 of every gallon sold
9	Overall GHG limits on major activity centers through the adoption of an Indirect Source Rule (ISR)
10	GHG requirements on operation of heavy-duty on-road trucks
11	Incentivize the use of aviation biofuels

Table 2. Evaluation Criteria

Evaluation Criteria	**Description**
Emissions	Expected GHG equivalent emissions reductions in 2030 (based on four-county scenario forecasting)
	Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects
Practical	Expected technical, practical, market probability of achieving the emissions reductions
	Expected sustainable ability for the Agency or our jurisdictions to implement
	Ability to begin action soon
	Compatibility with other regional rules, policies, initiatives and community efforts
	Consistency with state or national transportation GHG reduction efforts
	Likelihood of providing a useful example for other regions
Legal	Initial review of extent of legal feasibility
Economic	Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness
Community	Expected community benefits / social effects, including geographic and demographic breadth and equity of those effects

Table 3 below is intended to provide a quick overview and high-level assessment on each of the candidate actions based on the evaluation criteria used for analysis. Table 4 provides a description of how each action was scored. Chapter 3 and Appendix A provide more detail as to how each candidate action was evaluated, and Appendix B provides technical detail and references on the assumptions and methodologies.

In our high level evaluation, we did not limit incentive-based candidate actions to known revenue sources and levels. In other words, we evaluated actions assuming that they had adequate resources (to be determined) to support them. Some candidate actions that score well for emissions reductions have significant upfront economic barriers. For example, the candidate action Cash-for-Clunkers would be well received, equitable, and reduce emissions in the region, but would require a significant monetary investment to implement and run successfully.

Table 3. High-Level Evaluation of Candidate Actions (Matrix Table)

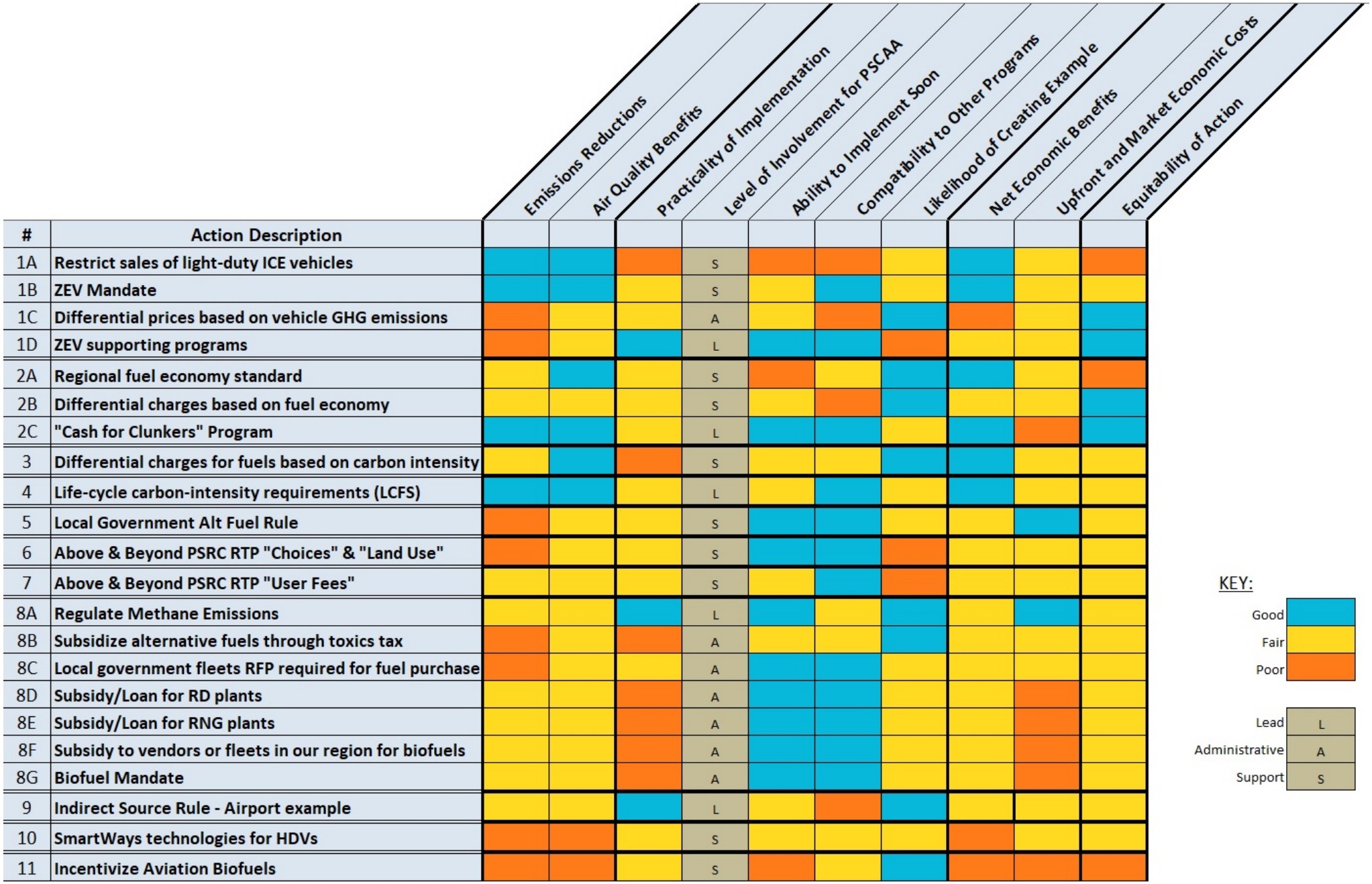


Table 4. Description of High-Level Evaluation of Candidate Actions (Matrix Table)

Evaluation Criteria	**Description**	**Score**		
Emissions reductions	Maximum emissions reductions (by 2030)	Above 1.0 MMT CO2e	Between 0.5 and 1.0 MMT CO2e	Below 0.5 MMT CO2e (or not quantified at this time)
Air Quality Benefits	Likelihood of reducing criteria air pollutants	Good	Fair	Poor
Practicality of Implementation	Ability of PSCAA and/or partners implement action	Good	Fair	Poor
Level of Involvement for PSCAA	Designated role for PSCAA	Lead	Administrative	Supporting
Ability to Implement Soon	Timeframe for implementing action	by 2019 or 2020	Between 2021 and 2025	After 2025
Compatibility to Other Programs	Action likely compatible with other regional programs	More than three examples	One to three examples	No other examples
Likelihood of Creating Useful Example	Existing repeatable examples	New policy - has not been implemented elsewhere at this level	Policy has been implemented before, but at a different level	Policy has been implemented before at this level
Net Economic Benefits	Overall economic benefits	Health savings cost and economic benefits are high (good)	Health savings cost and economic benefits are moderate (fair)	Health cost and economic savings/benefits are low (poor)
Upfront and Market Economic Costs	Overall economic costs	Upfront and market economic costs are low (good)	Upfront and market economic costs are moderate (fair)	Upfront and market economic costs are expensive (poor)
Action Equitability	Action has known ways in which it can be implemented equitably	Good	Fair	Poor

Chapter 3: Quantitative and Qualitative Evaluation of Actions

Agency staff conducted a quantitative and qualitative evaluation of the candidate actions that could potentially reduce greenhouse gas emissions within the transportation & mobile sector for the Puget Sound region; results are summarized in this section. Each summary includes a candidate action description, the expected emissions reductions and air quality impacts, an approach to implementation, and the potential economic and community costs/benefits, as described below. A more in-depth review of the evaluation analysis for the candidate actions can be found in Appendix A.

Candidate action synopsis: A brief description of the candidate action, which may include one or more associated sub-actions.

Emissions reductions and air quality impacts: This section evaluates the expected greenhouse gas emission reductions that could potentially be achieved by implementing the candidate action. Additionally assesses the expected air pollution impacts (co-benefits).

Approach to implementation: For each candidate action, or set of sub-actions, this section describes the steps the Agency can take to develop and implement the candidate action, or sub-actions. This criterion also assesses the ability for our agency or our jurisdictions to successfully implement and identifies potential barriers. This section may include background on the design of a program and/or policy from examples of similar strategies implemented in other US States or localities.

Potential community & economic costs/benefits: The section provides the estimated level of costs/benefits from GHG emission reductions based on the Social Cost of Carbon (SCC). That is, if financial investments are used today to reduce GHG emissions, there will be future monetary benefits. On the other hand, if there is no action taken to reduce GHG emissions, there will be future monetary costs. The SCC can be used to weigh the benefits of reduced warming against the costs of cutting emissions. We also include economic co-benefits of reducing health impacts from air pollution. For more information on the development and use of the SCC and background on the screening model to estimate economic health co-benefits, please see Appendix C. In some cases this section will provide an estimate on the cost-savings from reduced use of petroleum by candidate actions. Additionally, we attempted to qualitatively capture the largest expected impacts on the local economy and important costs to consumers, businesses, and the government. This section also evaluates the expected community and social impacts on equity of each of the candidate actions, and the extent to which each candidate action should address these concerns.

We evaluated all candidate actions in isolation compared to the baseline. By taking this approach, we were able to evaluate each candidate action equally, although there are potential interactions that could influence the costs/benefits if candidate actions are implemented at the same time. Identified synergies are discussed in Chapter 5.

3.1. Candidate Action 1: Accelerate zero-emission vehicle (ZEV) adoption in the Puget Sound region

Candidate action synopsis: Action 1 aims to accelerate zero-emission vehicle (ZEV) adoption in the Puget Sound region, and ultimately end the sale of internal combustion engine (ICE) vehicles by some point in the future. This action could be accomplished through a number of different strategies. We analyzed the following four sub-actions:

- **1A.** Counties or cities could pass regulations that restrict light-duty ICE vehicles (could only be ZEV) by some future date
- **1B.** Counties, cities, or the Agency could adopt a ZEV mandate in some form similar to California, but at a regional level
- **1C.** Counties or cities may be able to impose a differential sales tax or incentives (could be revenue neutral) based on vehicles GHG emissions
- **1D.** Counties, cities, the Agency, and/or others could implement ZEV infrastructure incentive programs and smaller supporting initiatives that educate consumers about ZEVs and reduce barriers to adoption

Emissions reductions and air quality impacts: Through these candidate sub-actions, GHG emission reduction that could be achieved is approximately 1.2 to 2.3 $MMTCO_2e$ per year in 2030. The higher-end of these reductions comes from assuming increased adoption at ZEV and restricting sales of ICE vehicles sooner rather than later. Air quality benefits are strongly correlated with ZEV adoption, with greater benefits in areas with larger ZEV adoption. The Northwest region is well-positioned to benefit from improved air quality with its reliance on hydropower - a relatively clean source of electricity - for a large portion of its power needs. Air quality benefits in the region will improve with this candidate action, with the distribution of benefits potentially greater where there is initially increased ZEV adoption. As ZEVs become a large fraction of the fleet, the benefit will be greater across the region.

Approach to implementation:

- **1A.** The reduction of ICE vehicles could be implemented in a number of ways – e.g. geographic restrictions, ban of new sales, or prohibiting registrations of newly transferred ICE vehicles in our jurisdiction after a certain date.
- **1B.** Counties, cities, or the Agency could adopt a ZEV mandate similar to California, but at a regional level. This would require extensive discussion and coordination with other jurisdictions/agencies to ensure the action meets our targets for efficacy and equity.
- **1C.** Sales tax or vehicle registration fees could be implemented on vehicles based on GHG emissions, with proceeds funding ZEV rebate and incentive programs. Agency staff has had experience with designing and implementing rebate programs; such an approach expanded to vehicles could be implemented with sufficient funding. Agency partners (counties, cities, and towns) may be better equipped to set differential charges for ZEV and ICE vehicles.
- **1D.** Infrastructure, incentive, education, and supporting initiatives could be carried out by the Agency (and/or others) as an extension or expansion of our current work in grants, outreach, and Clean Cities.

Recently, many cities and countries around the world have made declarations to ban the sale of ICE vehicles at a future date. The Agency will track how other cities and counties approach this to identify tactics that could be replicated in our region. Additionally, other potential strategies may allow us to implement some of these sub-actions on a partial basis. For example, our Agency and/or partners may

have the ability to enforce a ZEV mandate on specific vehicles or use cases such as autonomous vehicles, Transportation Network Companies (e.g. Uber; Lyft), or possibly used vehicles.

Potential community & economic costs/benefits: The potential economic benefits of increasing ZEV adoption in our region for the maximum scenario would be approximately $70 million to $325 million annually in 2030. This is calculated from the Social Cost of Carbon, with the range showing different discount rates. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $16 million to $80 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. Reduced gasoline consumption from ZEV adoption is also anticipated to keep approximately $370 million to $700 million dollars in the local economy annually, by 2030. Greater benefits are gained in the long term (beyond 2030) for both the economy and human health. The major obstacles could be political will and initial costs. Costs mainly include the upfront costs to purchase ZEV, which are currently more expensive to purchase than vehicles with internal combustion engines (ICE), as well as the costs of infrastructure development.

An important aspect of ZEV adoption is the expectation that zero-emission vehicle technology will improve in the near future and cost-savings will be greater than fossil-fuel vehicles, in terms of both the up-front cost and upkeep for ZEVs. A recent report estimates that ZEV vehicles will reach cost parity with ICE light-duty vehicles in the 2025 timeframe.[7] ZEV adoption requirements and ICE vehicle reduction policies that focus on taxes, fees, and acquiring new vehicles have the potential to negatively impact low-income and other vulnerable communities. It is important that any action taken be fully vetted to include equitable options that are inclusive to all communities and any costs (e.g. taxes/fees) are progressive in nature or support equitable changes throughout the region.

3.2. Candidate Action 2: Increase the fuel economy for Light-Duty Vehicles (LDVs) in the Puget Sound region

Candidate action synopsis: The aim of Action 2 is to increase the overall fuel economy for Light-Duty Vehicles (LDVs) in the Puget Sound region. This could be achieved by attaining greater than federal fleet-average GHG emissions and above national Corporate Average Fuel Economy (CAFÉ) standards, as per a revised schedule, for example reaching "73 miles per gallon (mpg)" for MY2030 (as opposed to "54.5 mpg" for that MY). The following sub-actions were considered separately:

- **2A.** Regional fuel-economy requirement with revised schedule, as stated
- **2B.** Differential charges on vehicles based on fuel economy
- **2C.** 'Cash for Clunkers' program to remove the worst 5% to 10% of vehicles (those with the lowest fuel economy rating)

Emissions reductions and air quality impacts: The emission reductions achievable from these candidate actions could range from approximately 0.9 to 1.3 $MMTCO_2e$ in 2030. The higher end of this estimate could be realized if the 'Cash for Clunkers' program replaced the worst 10% of vehicles (lowest fuel economy rating) with ZEVs. Similar to Action 1, a qualitative estimate is that criteria air pollutants would be moderately reduced, with greatest reductions occurring where the distribution of vehicles with improved fuel economy will be located in the region. Benefits could be greater if economic costs and health impacts reduced are distributed equally among all communities in the region. Overall, harmful air pollutants will decrease as the regional fleet changes over to ZEVs and vehicles with greater fuel economy.

Approach to implementation: The Agency could have different roles depending on each of the candidate sub-actions. Many identifiable agency partners (smaller than the State) could have challenges implementing fuel-economy requirements for vehicles in their jurisdictions. The Agency and local partners may be better equipped to also explore implementing fuel-economy requirements among specific technologies and uses (e.g. autonomous vehicles; transportation network companies).

Similar to Action 1, partners such as cities and counties may be better suited to identify ways to implement a tax or fee based on vehicle fuel economy, which in turn could fund programs like 'Cash for Clunkers.' These types of programs that promote purchases of vehicles with high fuel-economy ratings would work best if there is dedicated funding for the Agency/cities/counties to administer or they are funded by reciprocal taxes or fees on vehicles with low fuel-economy ratings.

Potential community & economic costs/benefits: The potential economic cost-benefits are based on the Social Costs of Carbon, could approximately be between $75 million to $150 million annually in 2030 for the most ambitious candidate 2 action. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $11 million to $46 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. These do not include the significant at-the-pump savings from reduced gasoline consumption that would occur as average fuel economy increased. Initial costs will vary depending on the sub-action, for example a 'Cash for Clunkers' program that replaces low mpg vehicles with a ZEV would potentially cost $300 million per year over a 10-year period (assumption of $10,000 per car). Any changes to the fuel-economy requirements of vehicle fleets would likely incur major push-back from manufacturers and industry. Sub-actions with associated taxes and fees could face challenges with political and general consumer acceptance. Depending on new vehicle requirements, the cost of vehicles may increase which could disproportionately impact car-dependent low-income households. Candidate actions that include taxes or fees would need to be designed and implemented in a progressive manner, so that costs and benefits are more equitable.

3.3. Candidate Action 3: Differential charges on fuels based on life-cycle carbon-intensity

Candidate action synopsis: This candidate action applies differential charges on transportation fuels sold in the Puget Sound region, based on the lifecycle carbon-intensity (CI) of the fuel. Differential charges would be larger for high carbon-intensity fuels and smaller for low carbon-intensity fuels. This is intended to develop the market for, and promote the transition to low carbon-intensity fuels like biodiesel, renewable diesel, renewable natural gas, and ethanol, or towards the use of zero-emission vehicles (ZEVs). For this action, one potential implementation route is that counties impose a sales tax based on fuels' carbon intensities (vendors remit to state): scaled roughly at 20% for petroleum gasoline and diesel (~$0.50 per gallon) and 0% for the lowest CI alternative fuels, which could potentially start as early as 2019. The charge or fee could be operated anywhere in the range from revenue neutral (credit to low-CI fuels) to full collection which could be used for equity measures.

Emissions reductions and air quality impacts: A differential charge on fuels, based on their carbon intensity, could reduce emissions by approximately 0.9 $MMTCO_2e$ in the transportation and mobile sector by 2030. Additionally, the reduced use of gasoline and diesel would improve air quality throughout the region. A thorough analysis of life-cycle emissions of alternative fuels would be required to determine specifically which pollutants are reduced and by what amount. A previous study shows that under foreseeable scenarios we will see reductions in key pollutants–including harmful fine particle and diesel pollution–in our region with greater alternative fuel use in our fleet.[8]

Approach to implementation: Similar to Action 2 above, Agency partners such as counties and cities may be better equipped to implement a fuel charge or tax in their jurisdictions. The Agency could assist our partners in some of the technical challenges by identifying and categorizing fuels based on carbon intensity. The Agency could additionally support our partners with keeping track of the carbon intensity of fuels used in the region and potentially running the program to certify the fuel distribution and use. The approach of a fuel tax, in addition to a State fuel tax, has been successful at a regional level in other parts of the United States. The funds collected from the fuel tax could be used to fund programs to support the transition away from the use of fossil fuels, reduce vehicle miles traveled (VMT) an enhance other transportation options. Funds could also support regional alternative fuel production or subsidize lower carbon-intense fuels: giving partial credit to lower carbon intense fuel allows them to come to cost parity (and beyond) with fossil fuels. The funding could also be used to mitigate equity concerns by providing assistance to lower-income individuals and communities.

Potential community & economic costs/benefits: The benefits from the Social Costs of Carbon, if the candidate action is taken, would range from $17 to $75 million per year in 2030. The range represents different discount rates. We were unable to quantify the anticipated economic health co-benefits at this time. The reductions in gasoline and diesel consumption could also keep approximately $277 million per year in the local economy in 2030, assuming a switch to ZEV and biodiesel.

The costs of this candidate action are mainly a $0.50/gallon tax which would reduce fuel purchases. The current Washington State fuel tax is $0.494/gallon with the Federal fuel tax of $0.184/gallon. The addition of a $0.50/gallon tax would put a fuel tax in the region over $1.00/gallon. Overall public acceptance of a tax of this scale is likely a substantial barrier, even if funds collected are used to offset other costs borne by consumers. If this candidate action is combined with a low-carbon fuel standard (Candidate Action 4) it could potentially stimulate an alternative-fuel industry in the region, which could alleviate the possible economic impacts from any increased fossil fuel prices to some degree. As with any tax or fee, the Agency and partners would need to consider how to implement this action equitably so there is no undue burden on low-income populations or others who could be disproportionately impacted (e.g. rural communities).

3.4. Candidate Action 4: Life-cycle carbon-intensity requirements

Candidate action synopsis: This candidate action would require all transportation fuel sold in the Puget Sound region (King, Kitsap, Pierce, and Snohomish counties) by fuel distributors/importers each year to meet or exceed California type carbon-intensity fuel standards. The state, counties, or the Agency could implement a Low-Carbon Fuel Standard (LCFS) modelled after the California standard, with a target of -16% (-10% from substitution of gasoline and -25% from substitution of diesel) in GHG carbon intensity (compared to baseline) by 2030.

Emissions reductions and air quality impacts: A regional LCFS could achieve maximum emission reductions in the transportation & mobile sector of approximately 1.3 to 2.3 $MMTCO_2e$ per year by 2030. These reductions would come from light-duty and heavy-duty vehicles as well as non-road vehicles. Similar to Action 3, a thorough analysis of life-cycle emissions of alternative fuels would be required to determine specifically which criteria pollutants are reduced and by what amount. A previous study shows that under foreseeable scenarios, we will see reductions in key criteria pollutants – including harmful fine particle and diesel pollution - in our region with greater alternative fuel use in our fleet.[7]

Approach to implementation: The Agency would take the lead role in the administration of an LCFS program, and while no regional examples of low-carbon fuel standards exist, there are nearby examples of programs in California, Oregon, and British Columbia. Having a consistent market along the West Coast will likely increase the market probability of success. We may be able leverage IT tools and technical support from California, as other jurisdictions have. Similarly, if we adopt similar carbon intensities from current programs, this could considerably reduce complexity.

Potential community & economic costs/benefits: The potential economic benefits from the Social Costs of Carbon at the maximum emissions reduction level would be approximately $108 million to $192 million per year in 2030. The range represents different discount rates. We were unable to quantify the anticipated economic health co-benefits at this time. A LCFS could likely incentivize a local biofuel industry, in which case approximately $67 million per year could stay in the local economy. This conservatively assumes that no ZEVs are used to meet the LCFS and assumes all ethanol is produced out-of-state. This candidate action could see greater potential if combined with Action 3, and which could potentially create local jobs. Similar to Action 3, higher costs for fuels may have a greater impact on low-income and rural communities that need to drive more and thus spend a greater portion of their income on fuels and needs to be considered in implementation.

3.5. Candidate Action 5: Adopt improved local government alternative-fuel rule

Candidate action synopsis: This candidate action could strengthen the state's alternative fuel use requirement for publicly owned vehicles and fleets in the Agency's four-county region. Currently the law states that, "All state agencies (and local government agencies by 2018) must, to the extent practicable, use 100% biofuels or electricity to operate all publicly owned vehicles (including marine vessels and construction equipment)." Redefining "practicable" to more-enforceable language and lowering the reporting thresholds has the potential to strengthen this law. Washington State Department of Transportation (WSDOT) Ferries and transit buses use about 90% of the fuels used by public and government fleets.

Emissions reductions and air quality impacts: If the state's alternative fuel use requirement is bolstered and enforced, the region could see maximum GHG emission reductions of approximately 0.3 $MMTCO_2e$ per year by 2030. Similar to candidate actions that introduce a fuel tax or low-carbon fuel standard, the exact co-benefits of reduced criteria air pollutants would depend specifically on which fuels are substituted. A thorough analysis of life-cycle emissions of alternative fuels would be required to determine specifically which criteria pollutants will be reduced and by what amount. Overall, we would expect to see a modest reduction in criteria air pollutants, with greater air quality benefits in communities that have heavy transit and or/ferry use.

Approach to implementation: This candidate action is based on the state's alternative fuel use rule and Agency partners, such as counties, cities, and towns may be better equipped to implement. Using the state's framework, the Agency may be able to administer the reporting requirements for government fleets in our four-county jurisdiction, and pair this with a consulting program to help fleets determine their best vehicle and fuel choices and identify potential funding. Some of this work is already occurring for members of the Western Washington Clean Cities Coalition. Additionally, some major bus and ferry fleets have expressed interest and commitment in moving towards all-electric. If this shift takes place without application of the state rule, it would minimize the benefits of pursuing this candidate action.

Potential community & economic costs/benefits: The Social Costs of Carbon benefit would amount to approximately $7 million to $33 million per year by 2030, if this candidate action is taken to reduce emissions. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $21 million to $54 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. Currently, biodiesel is close to parity with petroleum diesel whereas renewable diesel is somewhat more expensive. This equates to an estimated cost of $20 million annually for the current price difference and fuel volume, although if petroleum-based fuels are replaced with local biofuel, we could potentially keep about $92 million per year in the local economy in 2030. The Agency may also have to consider that if fuel prices increase for transit, it could result in unintended consequences that negatively impact vulnerable populations, although electrification with its lower fuel costs could reduce or negate those effects.

3.6. Candidate Action 6: Mode Shift - Actively engage in PSRC Regional Transportation Plan (RTP) for "Land Use " and "Choices"

Candidate action synopsis: This candidate action evaluates the RTP (2040 update) and proposes additional measures that could be implemented regarding transportation "Choices" and "Land Use." The Agency could work closely with the Puget Sound Regional Council (PSRC) to identify measures with the most potential to reduce emissions and the best method for implementation. Included within the RTP (2040 update):

A. Land Use: adopted regional growth strategy and targets to focus growth in compact urban areas (e.g. 30% of growth targeted near transit stations)
B. Choices: regional integrated transit network and multimodal investments (e.g. 80% of population with access to transit; 37% with access to frequent transit)
C. Technology: adopted CAFÉ and GHG vehicles standards and inspection & maintenance programs (further addressed in Action 1)
D. User Fees: proposed financial strategy, including express toll lanes, road usage charge, parking fees, facility tools, etc. (further addressed in Action 7)

Because candidate sub-actions C and D are addressed elsewhere (candidate Actions 1 and 7), the content of this evaluation will focus on A and B, which encompasses land use changes and "choices," which includes transit and other mode-shift options.

Emissions reductions and air quality impacts: The Puget Sound Regional Council used 2006 as a base year to assess GHG emission reductions. The Agency used 1990 as a base year to set our GHG emission reduction goals. Additionally, PSRC defines transportation as on-road vehicles whereas the Agency has identified the transportation and mobile sector as including on-road and non-road vehicles, as well as mobile equipment in construction and agriculture. For the RTP (2040 update), PSRC estimates a 24% reduction from 2006 baseline emissions by 2040 for the on-road transportation sector, which equates to a GHG emission reduction of 3.1 $MMTCO_2e$ by 2040. If additional actions under scenarios A and B were pursued (changes to land use and greater access to an integrated transit network), scaled estimates for additional annual reduction could be approximately 0.2 to 0.4 $MMTCO_2e$ per year in 2030. These additional actions translate to 50-70% of growth targeted near transit stations (up from 30% included in RTP), and expansion of pedestrian network to transit as well additional commute trip reduction via alternative work schedules. Driven by a reduction in VMT, a qualitative estimate is that air pollutants would be moderately reduced with the overall reduction of GHG emissions.

Approach to implementation: The Puget Sound Regional Council has proposed additional actions in each of the four sub-actions described above to further increase and accelerate GHG emissions reductions. The "Choices" strategy within the RTP (2040 update) includes the regional integrated transit network that includes a variety of multimodal investments such as Sound Transit 3 expansion, Metro Connects, and the bicycle/pedestrian network. A key question under this action is whether or not the Agency's Board of Directors recommends that we pursue additional actions beyond the scope of the RTP. An appropriate role for the Agency could be to participate in VISION2050 process to help ensure both land use actions as well as other actions (e.g. infrastructure for EVs; public transit use and access) are addressed and supported.

In a separate exercise with EPA's Office of Transportation and Air Quality (OTAQ), the Agency explored specific leveraging actions that include: expanding the commute trip reduction (CTR) program in our four-county region with more aggressive targets, expanding employer eligibility, and lowering the employer-size threshold; increasing ORCA LIFT card eligibility from 200% to 300% above the poverty line as well as eliminating the current modest fare; and advocating for Smart Growth land use to increase population density around public transit centers. While we evaluated these actions, we use only PSRC's local emissions estimates for this specific candidate action.

Potential community & economic costs/benefits: The Social Costs of Carbon applied to the GHG emission reductions gained from the maximum level of 'above and beyond' additional actions under "choices" and "land use" (those considered here for potential Agency action in candidate action 6) yield benefits that range from $7 million to $33 million per year in 2030. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $8 million to $40 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. PSRC's general assumption is that through the implementation of the RTP, wide-ranging benefits include monetary savings from reduced congestion and fuel consumption. Promotion and investment in mode shift should center on reducing reliance on SOVs for transportation and increasing the viability of alternative modes of transportation. Under land-use scenarios, there is potential displacement of low-income residents in communities where density is prioritized around transit hubs (the potential for residents to be "priced-out"). Our focus groups expressed an interest in requirements for developers to build affordable housing near urban centers or transit hubs. This could allow lower-income workers to use transit to commute to work. Additionally, focus groups noted that improvements in "last mile" transportation access for outlying communities or for workers who have long-distance commutes with limited transit options would be helpful. These could include increased van pools, electric vehicle shuttles (specific to communities/neighborhoods), and expanded bike-share programs.

3.7. Candidate Action 7: Evaluate PSRC Regional Transportation Plan (RTP) for "User Fees"

Candidate action synopsis: Candidate action 7 evaluates and assesses the "User Fees" portion of PSRC's updated RTP, in parallel to Action 6. Implementing fees such as road usage fees currently identified as 5 cents/mile off-peak and 10 cents/mile on-peak could be examined to determine if the Agency will advocate for more stringent fees to gain additional GHG emissions reductions.

Emissions reductions and air quality impacts: Similar to candidate Action 6, the Puget Sound Regional Council used 2006 as a base year to assess GHG emission reductions, unlike PSCAA, which uses 1990. For the RTP, PSRC estimates a 24% reduction from 2006 baseline for the on-road transportation sector which equates to GHG emission reductions of 3.1 $MMTCO_2e$ by 2040. If additional actions under "User Fees" were pursued, PSRC estimates additional annual reductions are possible in 2040. Scaled linearly

to 2030, the result is an estimated annual reduction of 0.3 to 0.6 $MMTCO_2e$ per year in 2030. Driven by a reduction in vehicle miles traveled (VMT) from the introduction of a road-usage charge, a qualitative estimate is that criteria air pollutants could be moderately reduced with the overall reduction of GHG emissions.

Approach to implementation: Puget Sound Regional Council has proposed additional action in each of these four sub-actions to further increase and accelerate GHG emissions reductions. In their "User Fees" category, PSRC modified a possible road-usage charge scenario to potentially increase during on-peak hours (to 15 cents/mile) and decrease during off-peak hours (2.5 cents/mile). The objective of the financial strategies of the RTP is to maintain adequate funding for the region's transportation infrastructure. They have not fully explored additional financial revenues to support projects to reduce GHG emissions. The "User Fees" strategy within the RTP also includes express toll lanes, license and registration fees, transit fares increases; vehicle fuel and excise taxes; and other pricing strategies.

A key question under this action is whether or not the Agency should consider pursuing additional actions beyond the scope of the RTP, including those which could support or fund projects to reduce GHG emissions. An appropriate role for the Agency could be to participate in venues like the State Transportation Commission to encourage user fees that seek to minimize VMT and congestion beyond the financial objective to address the projected gasoline tax funding gap. In addition, the Agency explored increasing road usage fees to 15 cents/mile for all trips in a separate analysis with EPA OTAQ, though we include only PSRC local emission estimates for this candidate action.

Potential community & economic costs/benefits: Applying the Social Costs of Carbon to the GHG emission reductions gained from the maximum level of 'above and beyond' user fees actions, the benefits range from $11 million to $50 million per year in 2030. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $16 million to $79 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. The Puget Sound Regional Council's general assumption is that through the implementation of the RTP, the wide-ranging benefits include monetary savings from reduced congestion and fuel consumption.[9] Some considerations should be taken into account when identifying 'user fees'. Low-income and rural communities that are being pushed from the urban core may need to drive further distances; without mitigation strategies, a road-usage tax could be regressive for these individuals. People might also identify ways to get around tolls (through local roads) and cause traffic and air pollution levels to increase in other areas. A combination of incentives, outreach, and education (potentially funded by usage fees) could help to reduce barriers, increase public support, and ultimately support behavior change and reduce SOV use.

3.8. Candidate Action 8: Incentivize production and use of renewable diesel and renewable natural gas

Candidate action synopsis: Candidate action 8 aims to incentivize the production and use of renewable diesel and renewable natural gas in the Agency's four-county jurisdiction. Conceptually, this could be achieved by providing funding assistance (tax breaks, loan guarantees, contracts, or other) for the construction of renewable diesel and renewable natural gas facilitates. A per-gallon or per-BTU subsidy that stimulates a set volume per year of renewable diesel or renewable natural gas can also incentivize production and use of these fuels. Potential sub-actions include:

8A. Regulate methane emissions or flaring to stimulate RNG production in the region

8B. MTCA or similar toxics regulation that imposes a tax or fee on diesel to subsidize alternates.
8C. Local government fleets have RFP or bid for fuel purchase with required GHG reductions by 2030
8D. Assuming funds available, back or secure loans for RD plants
8E. Assuming funds available, back or secure loans for RNG digesters or capture and processing for municipal, agriculture, and smaller facilities
8F. Assuming funds available, provide subsidy to vendors or fleets in our region for biofuel
8G. Biofuel mandate for every gallon sold, starting at B20 and ramping up with renewable diesel (local production and feedstocks, considering carbon intensity)

Emissions reductions and air quality impacts: Incentivizing the production and use of renewable natural gas and renewable diesel could achieve a maximum of approximately 1.6 $MMTCO_2e$ GHG emissions reductions within the transportation and mobile sector in 2030, depending on the sub-action taken. Similar to candidate Actions 3 & 4, a thorough analysis of life-cycle emissions of renewable diesel and renewable natural gas would be required to determine specifically which pollutants would be reduced and by what amount. Further analysis of the introduction of new industrial facilities will also have to be monitored, as these could potentially introduce new (likely modest) emissions in areas where facilities are operating. Overall, we would expect to see a reduction in air pollutants and improvement in air quality across the region.

Approach to implementation: All of the sub-actions identified are designed to work towards promoting RNG/RD production and use in our region. Each strategy is technically feasible with nascent markets already in our region; the mandates and additional incentives could help to grow the industry. The Agency could potentially examine whether a methane regulation may be feasible and worthwhile within our jurisdiction. Our partners, such as counties and cities, may be better equipped to implement a toxics tax similar to that of the MTCA for fossil fuels at the regional level. Although substantial dedicated funding may be needed, the strategies incentivizing and subsidizing RD/RNG production could be administrative programs run by the Agency. These programs could be financed through taxes or regulatory fees from other strategies in this candidate action (e.g. 8B) or other potential sources.

Potential community & economic costs/benefits: The Social Costs of Carbon (cost-benefits) range from $30 million to $134 million per year in 2030 (depending on discount rate) if maximum emissions reductions are realized. The range represents different discount rates. We were unable to quantify the anticipated economic health co-benefits at this time. Upfront investment capital for renewable diesel and renewable natural gas facilities are substantial. A renewable diesel plant's capital costs could be approximately $300 million. For modifications to an existing natural gas plant to enable it to manufacture RNG, upfront capital costs depend on the type of feed stock and could be as high as $0.5 million. Based on current pricing, subsidies of around $1.00 - $2.00/gallon of RD/RNG could be needed to incentivize the purchase of these low-carbon fuels. Combining this candidate action with candidate action 4 (LCFS) could stabilize the market in our region. The Agency will need to consider where facilities would be built and build in strategies to mitigate/offset potential new emissions in areas that may already have existing air quality issues. The development of new industry in the area may have some economic benefits to our region/state as well, with new jobs for alternative fuel production.

3.9. Candidate Action 9: Overall GHG limits on major activity centers

Candidate action synopsis: Candidate action 9 seeks to reduce GHG, criteria, and toxics pollution from mobile sources that are A) drawn to large activity centers such as SeaTac airport, a stadium, or major goods distribution centers; or B) drawn to specific routes or sections of I-5 and 405 during commute hours which have caused the flow to exceed road capacity and thus generated excessive emissions primarily due to congestion. Also known as an "indirect source rule" (ISR), the Agency could set a GHG emission limit and require facilities to report and reduce emissions by a set amount/percentage by a target date. For example, A) a large activity center, like SeaTac airport, may be required to largely eliminate GHGs from ground operations, a 50% reduction in landing and take-off (LTO) emissions (similar to their biofuel target), and a 50% reduction in non-preferred (higher GHG, low vehicle occupancy, etc.) trips by 2030. or B) all employers and businesses with more than 40 employees, or businesses/events/locations that draw more than 500 cars/day or more than 100 cars during peak commute hours must develop CTR/transit plans to reduce SOV trips/visit.

Emissions reductions and air quality impacts: If implemented, an Indirect Source Rule at either a regional airport or among specific activity centers that draw mobile sources to a centralized location, the GHG emissions reductions would be approximately 0.4 $MMTCO_2e$ per year in 2030. These reductions could also depend on the targets set for each area in which an Indirect Source Rule is applied. There would be a decrease in air pollutants from the reduction of vehicular traffic to and from these activity centers, with greater improvements in air quality in locations near identified activity centers (in this example, near major roadways and regional airports).

Approach to implementation: An ISR likely would require a substantial stakeholder and public input process to inform rule development. An ISR has been successfully implemented in other regions, specifically for land development and construction activities, although the Agency would be exploring developing an ISR outside of new land-development projects.

Potential community & economic costs/benefits: The Social Costs of Carbon could amount to cost-benefits of approximately $7 million to $33 million per year in 2030 if emissions reductions from an airport ISR were achieved. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $16 million to $40 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. If an ISR significantly reduced road congestion, the annual benefit could exceed $1 billion per year, just for wasted fuel and time.[10] Alternatively, reduction of vehicle trips to major activity centers (e.g. SeaTac), the gas savings could be approximately $10 million per year in 2030, depending on location. To estimate the economic costs of a potential ISR for regional airports or major activity centers, the Agency could consider what costs are associated with reducing GHG emissions in these areas. For example, current bio-jet fuel is about $0.40 - $2.70 more per gallon more than petroleum-based jet fuel. This could cost $10-70 million for the aviation fuel if a requirement were set for regional airports to reduce emissions through the introduction of aviation biofuels, although new developments could reduce those costs over time. Additionally, there could be other associated costs to businesses or consumers within a designated emission reduction zone identified by an ISR.

In developing the ISR, the Agency would identify the areas where emissions need to be reduced; the regulated entity would define how those reductions occur in the designated area. The Agency would also need to consider how potentially reducing congestion or traffic to major activity centers could impact low-income communities and others who rely on SOV transportation to either jobs or other

necessary businesses that fall within these emissions reduction zones. And although air pollution would decrease in designated locations, areas just outside the inclusion zone of an ISR could be impacted by congestion, parking issues and increased air pollution. The Agency should also consider the different equity implications while exploring how an ISR could be implemented in the region. For example, to reduce the negative impact to small businesses, those businesses that fall within an ISR area could have scaled requirements according to size, with the larger businesses bearing a greater burden since they draw more mobile sources than smaller businesses.

3.10. Candidate Action 10: GHG requirements on operation of heavy-duty on-road trucks

Candidate action synopsis: This candidate action attempts to reduce emissions from heavy-duty on-road trucks within the four-county region (King, Kitsap, Pierce, and Snohomish). The Agency could either work with partners or directly incentivize tractors (trucks) and trailers operating in the region to use U.S. EPA-certified SmartWay technology, or retrofit vehicles with SmartWay-verified technologies, phased in by a set date.

Emissions reductions and air quality impacts: The maximum GHG emissions reductions from the use of SmartWay technologies on heavy duty vehicles (tractors (trucks) and trailers) in the region could equal approximately 0.1 $MMTCO_2e$ per year in 2030. SmartWay technology is identified as fuel savings improvement so there should be a proportional reduction in air pollutants with decreased fuel use. The impacts could be varied because they would only occur while the vehicles were moving at highway speeds and so areas with congestion and lower speeds may see little change. A complete picture requires further analysis.

Approach to implementation: SmartWay technologies are technically feasible and widely available for use across the United States. The Agency could potentially benefit by working with partners, such as the Ports of Tacoma & Seattle and private industry, who are better equipped to require or incentivize the use of SmartWay technology. The Agency could also take a supporting role by administering a voluntary program with partners to have tractors and trailers retrofit with SmartWay technologies without the need for enforced regulations.

Potential community & economic costs/benefits: The Social Costs of Carbon cost-benefits could amount to approximately $2 million to $8 million per year in 2030. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $4. million to $10.3 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. This candidate action could potentially reduce diesel fuel consumption and save vehicle owners about $30 million per year in 2030 through direct fuel savings. Payback for the purchase of the SmartWays technology could occur in about 5 years, depending on individual mileage and routes. The Agency should consider that, depending on cost of technologies, there are likely barriers for individual owner-operators to adopt the SmartWay technologies. Education and outreach may need to be a part of this strategy to inform how SmartWay technologies have long-term cost benefits despite higher upfront costs. Additionally, depending on the routes used for trucks that adopt the SmartWay technology, areas that are frequented by heavy-duty vehicles should experience air pollution reductions. Reduced diesel emissions that result from fuel efficiency would have a positive air quality benefit.

3.11. Candidate Action 11: Incentivize the use of aviation biofuels

Candidate action synopsis: Candidate action 11 aims to reduce GHG emissions within the aviation industry by incentivizing the use of biofuels at regional airports. The Agency, with partners, could administer a per-tonne subsidy/tax/charge that stimulates a set volume per year of aviation biofuel production to achieve a 20% blend of biofuels by 2030. The Agency could also provide funding assistance for installation of aviation biofuel production facilities for fueling in the region, although the scale of that could be a challenge.

Emissions reductions and air quality impacts: Incentivizing the use of aviation biofuels and achieving a 20% blend into current stock could amount to GHG emission reductions of approximately 0.1 $MMTCO_2e$ per year in 2030. Reduction of petroleum-based jet fuel would lead to some reductions in air pollutants, with further analysis needed to estimate the air quality improvements from this action. Overall, the reduction in air pollutants would be minimal, compared to other sources of criteria air pollutants in the region.

Approach to implementation: Agency partners such as the Port of Seattle and other regional airport administrators could be better equipped to implement aviation biofuel requirements. The Agency could potentially provide financial resources to the regional airports to subsidize biofuels, though dedicated funding would be required to support this strategy. The Agency could also partner with the Port and other regional airports to work on advocacy and outreach to help the aviation biofuels industry develop within the region. These approaches could allow the Agency to take on a supporting or administrative role.

Potential community & economic costs/benefits: The Social Costs of Carbon benefits could be approximately $2 million to $8 million per year in 2030, if a 20% blend of aviation biofuels is achieved and could grow as additional petroleum-based jet fuel is replaced. The range represents different discount rates. We were unable to quantify the anticipated economic health co-benefits at this time. The most significant barrier to implementation could be the cost associated with developing, producing, and distributing aviation biofuels. Currently, these fuels are largely unavailable, with only one refinery existing in southern California. Upwards of $1 billion is likely necessary to initiate production and distribution of aviation biofuels in the region. The technological methods available today require imported oils from out-of-state and other co-products which may cost as much as three times the amount of petrol jet fuel. Significant investment today is needed to secure feedstock locations, industrial facilities, and distribution networks, which may not realize cost parity for almost 10 years. The economy within this sector could improve by incentivizing both the production of fuel and production of local feedstock in our region.

Chapter 4: Equity Considerations

Maintaining the status quo around transportation and climate policy will be detrimental to everyone in our region and beyond. However, there are positive gains for us all if we can continue to change the way we utilize transportation, adjust how we hold ourselves accountable for travel-related emissions, and prioritize approaches that equitably support individuals to do what's right for the climate.

To better understand the impacts our draft greenhouse gas emission reduction actions and strategies might pose for communities, we conducted four high-level focus groups with representation from low-income constituents, communities of color, and rural stakeholders. In particular, these conversations were intended to help us learn about any implications on regional equity. For the purposes of this evaluation, we are applying the definition of equity that is included in our 2014-2020 Strategic Plan:

> Equity means "the quality, state, or idea of being just, fair, and impartial." When it comes to air pollution, some populations in our region are more impacted than others, often due to geography and socio-economic circumstances. Our goal is to rebalance the burden of pollution to be more fair and impartial, so that no community faces greater risk than others. When we refer to "equity," we describe our approach toward ensuring everyone, everywhere, benefits from clean, healthy air to breathe.

Understanding this is merely the first round of stakeholder involvement needed for this process, we consistently heard that community groups are eager to see how our Agency can incorporate the concerns they shared. Since we are taking time to ask and learn, there is an expectation that we will be true to our intent of minimizing negative impacts on those who are already disproportionately impacted.

The focus groups discussed the potential for a number of positive impacts from candidate actions, benefitting both urban and rural/suburban communities. Some of these include:

1. Reduced exposure to air pollutants due to cleaner vehicles
2. Increased access to transit and infrastructure in more communities (e.g. bike lanes, zero-emission vehicle parking, broader transit access)
3. Reduced fuel costs for those who live in areas with limited public transportation
4. Potential for new industries and employment through zero-emission vehicle technology and maintenance or alternative fuel markets

The focus groups also shared concerns and general themes on the candidate actions. These included:

1. Taxes and fees could potentially be regressive and negatively impact limited-income earners and smaller businesses
2. The region needs infrastructure investments to help shift from being an SOV -reliant culture, to that of providing a range of available and affordable transportation options–such as public transit, walking, biking
3. The Indirect Source Rule (ISR) is promising since it holds larger sources and/or employers accountable

Focus groups shared that equity concerns need to be considered at the point of program design as well as when implementing any market-based actions.

All focus groups shared a concern that any kind of tax or fee runs the risk of being regressive: negatively impacting those who are low-income, and not helping those who need the incentives most. Low-income individuals may not be able to afford to adopt newer technologies due to cost constraints as well as a lack of infrastructure to support electric vehicle technology, for instance. Additional costs for fuel and/or road-usage fees could comprise a disproportionately larger portion of expenses for low-income households than those in upper income brackets. Depending on how rebate or incentive programs are designed, outcomes may vary in terms of how beneficial they are as an incentive for lower-income communities.

Regarding zero-emission vehicle mandates and road usage fees, focus groups expressed concern for independent transportation industry drivers who may bear a disproportionate burden of the costs. Independent contractors such as delivery service and taxicab drivers, and other low-income commuters would see a greater proportion of their income go towards operation and overhead costs. As a result, focus group participants wanted to be sure that larger corporate entities that rely on independent owner/operators/drivers are also held accountable for their collective emissions.

Regarding taxes and fees on internal combustion engines, focus groups raised concerns for small businesses and owner/operators. However, a shift from internal combustion engines to cleaner technology or fuels could provide opportunity for technical training and workforce development in the electric vehicle and zero-emission vehicle sectors. We heard similar comments related to development of alternative fuels industries - which the Agency and partners should consider ways to stimulate pathways for communities of color to participate in the development of this industry. Job placement or job training with “green” industries could help to establish relationships with previously underserved communities by including them in the transition from fossil fuels. The question remains how we could implement strategies that ensure those who have the least resources to invest in workforce training and development would be able to take advantage of these types of advancement opportunities.

Focus groups viewed mode shift more favorably than market-based emissions-reduction strategies, since the responsibility and accountability for implementing such strategies as commute-trip reduction programs would be borne by employers. This, in turn, could help shift individual behaviors and emissions more effectively by institutionalizing shared mobility. However, in more rural parts of the region, it was noted that the options need to be accessible and convenient, and there needs to be a greater investment in infrastructure in order for these types of alternative transportation options to be viable.

The focus groups expressed interest in the ISR, largely because it would put the onus on large, revenue-generating hubs to take responsibility for mitigating or minimizing their GHG impact. Depending on how a source might design a program to meet the requirements of an Indirect Source Rule, however, there was concern that a rule could relocate the emissions and related impacts to neighboring areas, thereby just shifting the equity impacts.

The focus groups raised additional concerns about potential disproportionate impacts for employees of the focus of an ISR. Ultimately, the question was: will the enforcement of an ISR be applied to the company or pushed on to contractors and employees? In addition, groups talked about scaling any kind of enforcement actions/penalties to be commensurate with the size/profit/population of the

organization, in order for the rule to be more effective. Overall, the focus groups suggested that any rules or policies we pursue needed to have appropriate consequences associated with them to ensure both compliance and effectiveness.

In terms of recommended next steps, the focus groups suggested that the Agency invest in educating residents about any potential options in order for them to be knowledgeable enough to weigh in on potential implications, final decisions, and design of any programs. They also offered that since the community is often their own best advocate, if we provide the information and initial training, there would likely be groups willing to help with the organizing and advocacy work necessary to help push some of these policy shifts with their elected officials.

The Agency will need to ensure that those who will be impacted are able to participate in next-step design processes. Our goal is to move forward on our candidate actions in an equitable and responsible manner, knowing that our constituents are relying on us to also minimize any unintended consequences that might add further disproportionate burdens.

Chapter 5: Scenarios, Recommendations, and Synergies

5.1 'High' and 'Low' Scenarios

As part of our analysis, staff developed "low" and "high" scenarios to examine how the estimated reductions helped achieve progress towards our GHG reduction targets. The following figures show the estimated scenarios for possible GHG emission reductions by 2030 using a number of the analyzed candidate actions.

In Figures 2 and 3, the red line shows estimated historic regional transportation GHG emissions, while the solid black line shows a 2040 projection based on anticipated population increases alone. The dotted line shows a more likely 2040 projection based on population growth as well as "on-the-books" regulations and plans that will offset GHG emissions associated with population growth – these include national vehicle emissions standards as well as the regional transportation plan. The green line shows the Agency's target, with the 2030 benchmark and out to 2040 (shown to coincide with the time horizon of PSRC's regional transportation plan).

The scenario shown in Figure 2 identifies candidate actions that could achieve a "strong" reduction in GHG emissions if implemented, in total about 3.6 $MMTCO_2e$, and is the "low" of our two estimated scenarios. The wedges in the chart identify candidate action 10, GHG requirements for on-road heavy-duty trucks; candidate action 9, an indirect source rule (using regional airports as an example); candidate action 8A, a methane regulation, using methane emissions for transportation fuels; candidate action 5, improved local government alternative fuel rule; candidate action 3 or 4, which would implement a low-carbon fuel standard or impose a tax or fee to achieve 10% carbon intensity on fuels in the region; and candidate action 1, which would set a ZEV adoption timeline and end the sale of ICE vehicles in our region by 2050. For the carbon intensity regulation and ZEV adoption, this scenario assumes a lower, more-modest rate of adoption when calculating GHG emission reductions.

Figure 2: Strong Scenario

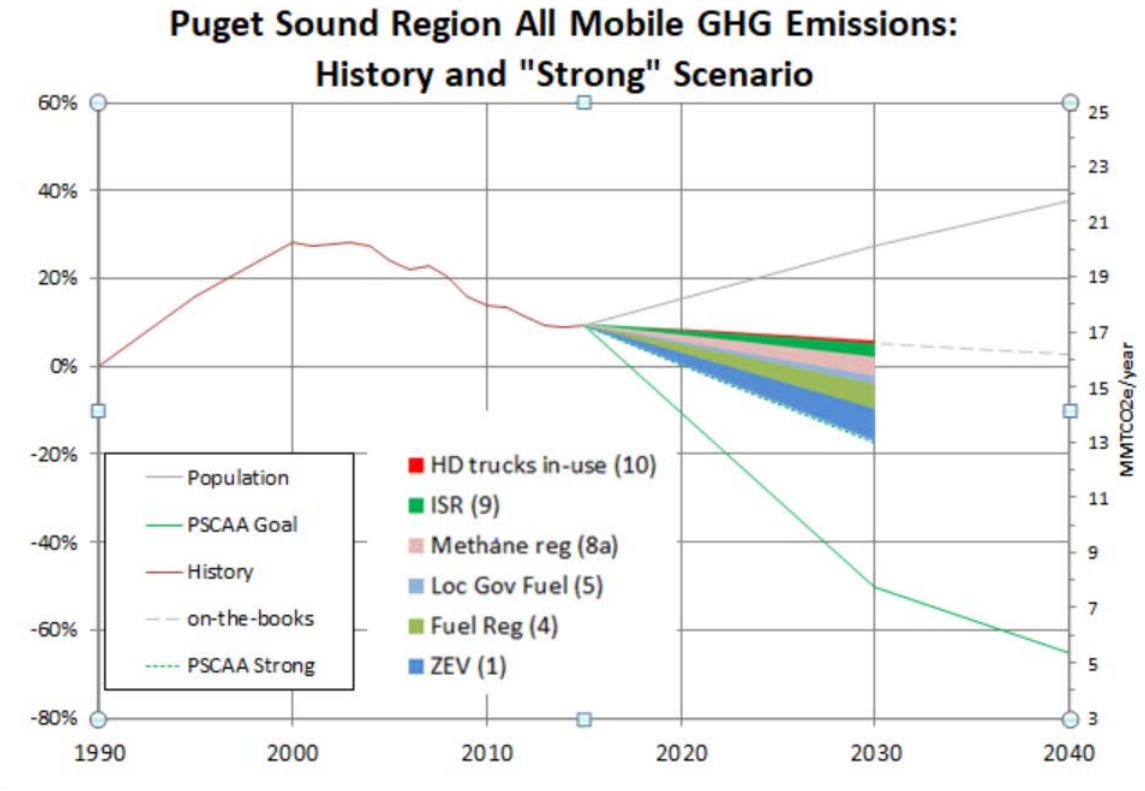


Figure 3: Ambitious Scenario

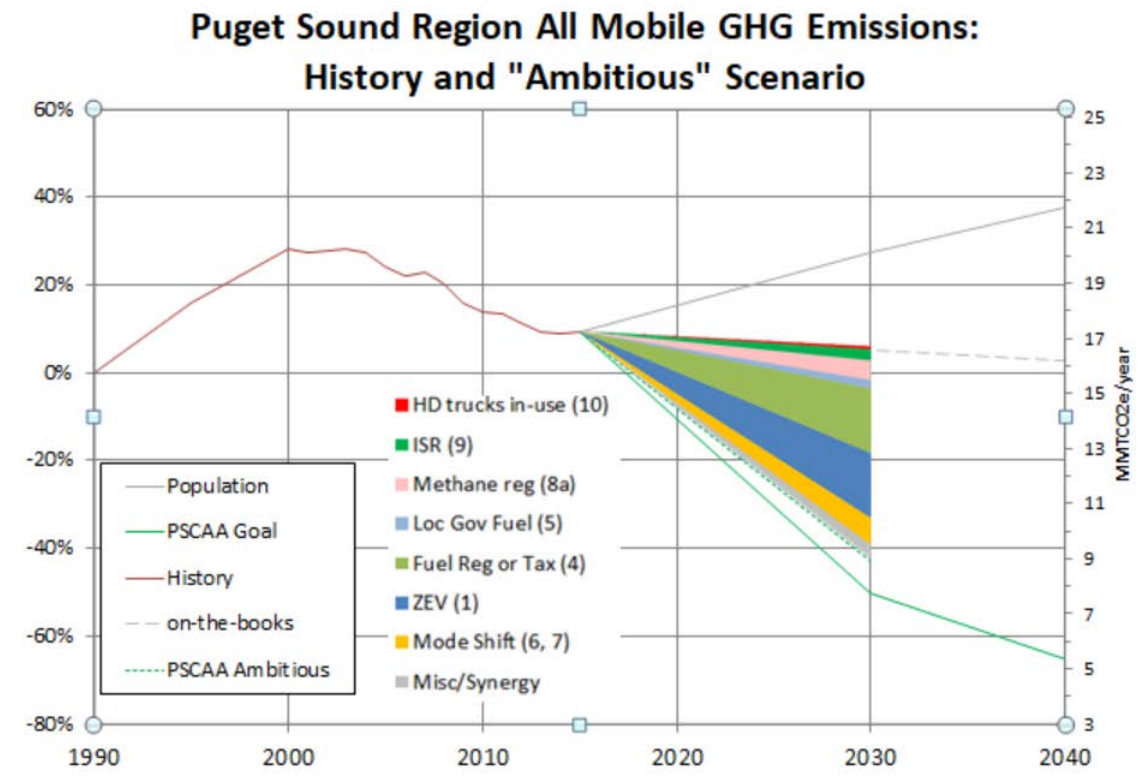


Figure 3, above, above, describes our "ambitious" scenario for estimated GHG reductions and is the "high" of our two estimated scenarios, likely achieving 7.0 $MMTCO_2e$ emission reductions. A number of the candidate actions stay the same, but there are three differences from the "strong" scenario. First, the carbon intensity regulation (Action 4) is increased to 25% for diesel fuels in the region by 2030 (gasoline stays at 10%). This is the most ambitious target of any program we are aware of. Second, the ZEV requirement (Action 1) assumes an earlier date (2035) which results in greater, more ambitious emissions reductions by 2030. Last, we've included an additional wedge that accounts for mode shift items that would reduce trips "above and beyond" the measures included in Puget Sound Regional Council's (PSRC) regional transportation plan (2040 update) (Actions 6 and 7) These are driven by land use changes and greater transit, as well as user fees structured to reduce single occupancy vehicle (SOV) trips.

The "ambitious" scenario includes candidate actions that potentially achieve large GHG emission reductions or that may be more practical in application and cost. Several candidate actions and sub-actions do not appear in either scenario. This is because they overlap in their emissions reductions with other included actions, and to include them would in effect be double counting emissions reductions. The final wedge, "Misc/Synergy", is included to capture multiple smaller sub-actions or feedbacks that are too small to list individually and difficult to quantify individually. These include: ZEV infrastructure (Action 1D), ZEV sales incentives (Action 1D), a small cash-for-clunkers program (Action 1D), general consumer education (Action 1D), and other local/partner actions (Action 2C). The specific actions that can be estimated total 0.6 $MMTCO_2e$, and several additional actions couldn't be quantified. To be conservative, we round the category down to 0.5 $MMTCO_2e$.

Our high level analysis of the candidate actions and projected estimates from the scenarios of GHG emission reductions lend themselves to the three general recommendations below:

5.2 Recommended Focus Areas

To achieve the necessary emission reductions according to the Agency's targets, staff recommends implementing candidate actions in the following three focus areas.

<u>Recommendation: Zero-emission vehicle adoption</u>
The aim of this candidate action is to increase ZEV adoption in our region. This could be achieved through the use of fees or incentives, though dedicated funding needs to be secured to be successful. Additionally, the Agency could pursue an option that examines requirements for specific vehicle types or use cases. These could potentially include autonomous vehicles, Transportation Network Company vehicles (e.g., Uber; Lyft), or used cars. Many of our staff recommendations to increase ZEV adoption could leverage current activities by the Western Washington Clean Cities Coalition that works with local fleets to reduce fuel consumption.

<u>Recommendation: Alternative fuel use</u>
The aim of this candidate action is to reduce the carbon-intensity of the fuels used in the transportation sector regionally. The Agency could pursue a low-carbon fuel standard (LCFS) for the region. The LCFS would cover the transportation & mobile sectors in the region, including on-road, non-road and mobile equipment, defined by the Agency's emission inventory If pursued, the Agency would take on the technical role of identifying/cataloging the carbon intensity of fuels in our region and enforcing compliance of the standard with identified parties.

Recommendation: Continue/Strengthen work with partners to promote Mode Shift

This recommendation challenges us to pursue candidate actions that will further reduce trips themselves and associated GHG emissions, beyond those laid out in Puget Sound Regional Council's Regional Transportation Plan (RTP). Mode shift is a large category defined by reducing Single Occupancy Vehicle (SOV) trips, and could be achieved through a variety of ways: more transit use; shifting to cycling or walking; eliminating the trip altogether (e.g., telecommuting); or structuring usage fees to minimize SOV trips. Of the potential actions listed, assessing road usage fees is the most promising potential candidate to achieve meaningful emissions reductions. The Agency could also continue to evaluate an Indirect Source Rule (ISR) as a mechanism to reduce GHG emissions in designated areas. This rule could potentially apply to specific activity centers, or downtown hubs that draw significant numbers of vehicles to these locations. An ISR could enhance mode shift by indirectly prompting businesses to expand programs like Commute Trip Reduction (CTR) to keep GHG emissions associated with their areas below designated limits.

5.3 Scale, Synergies, and Uncertainties

To achieve a reduction of 50% in GHG emissions from transportation and mobile sources below 1990 levels by 2030, we would need to reduce transportation and mobile sector GHG emissions by 8.7 $MMTCO_2e$. We estimate that the three focus areas above, using our "ambitious" scenario, may reduce emissions by 5.6 $MMTCO_2e$ in 2030. This amount is based on adding candidate action "ambitious" estimates for candidate actions 1 (ZEV), 4 (LCFS) and 6 and 7 (mode shift). While these three don't achieve the entire transportation emissions reduction needed to meet the 2030 target, they are the most robust actions that set us on a path of GHG emissions reductions.

Top candidate actions share many synergies and overlap. The candidate actions that achieve the greatest estimated GHG emission reductions – ZEV adoption and a LCFS – in some cases depend on each other to achieve the greatest potential GHG emission reductions. For example, electricity is a fuel that can be used for LCFS credits in California and Oregon systems. The LCFS candidate action also overlaps with other actions analyzed for promoting alternative fuel use, and could serve as a catalyst for development of an alternative fuel industry to start in our region. While the outcomes are the same – reduction of GHG emissions – the mechanisms in how the actions are implemented are different. Similarly, the use of an ISR or methane rule could also contribute to the recommended candidate actions, particularly those that encourage mode shift or even ZEV adoption (presuming an ISR applied to a designated area could potentially exempt ZEV from the provision).

In our estimated scenarios, alternative fuels, at the "high" end, achieve the greatest GHG emission reductions in our region. Our estimate is very ambitious, with a target greater than any existing program. Additionally, the Agency should consider the short-term and long-term implications of alternative fuel use. Alternative fuel use and production may be seen as "bridging-the-gap" between the use of fossil fuels and electrification. Some government agencies and non-profit organizations have chosen to pursue full electrification and skip over alternative fuels – limiting their promotion and use. There is some evidence that electrification technology is improving exponentially and pursuing full adoption of electric transportation now is preferable, though there is still significant uncertainty in both the technology and market adoption.

Comparable policies that may be implemented, in parallel, by the Agency or at the state or federal level, could have indirect impacts that could increase the GHG emission reductions estimated from a single action, though it may be unlikely that we could determine the extent of how policies influence one

another. That is, there could be indirect benefits of adopting a candidate action that are known but their effect may not be measureable.

While we developed the proposed candidate action and GHG emission reduction estimates with the best available information, there are still factors we cannot identify with certainty. There may be factors such as community adoption and impacts, economic costs and benefits, or technological advances that will not be realized until a future date. In part due to this uncertainty, we suggest that the Agency revisit recommendations on a regular basis to update with more current information. This process could also allow subsequent addition of candidate actions that were not initially pursued or considered. In addition, as specific candidate actions are pursued, a deeper staff analysis will be conducted in the design phase prior to implementation.

The proposed recommendations could also have synergistic effects on candidate actions that we choose not to pursue fully. The Agency will continue to work with partners and monitor what additional policies in our region develop to reduce GHG emissions in the transportation and mobile sector. These may include aviation biofuels or renewable natural gas /renewable diesel production, among others. We will also continue to work with partners to enact change at a broader state level. For example, several of the candidate actions proposed here (low carbon fuel standards, ZEV mandate) were active though ultimately did not pass recent Legislative sessions. We anticipate many of the items will return in future sessions, and we will continue to advocate for GHG emission reductions in the transportation sector at a statewide level.

In some cases, the Agency is already pursuing some parts of these candidate actions. Since 2007, the Agency has hosted the Western Washington Clean Cities (WWCC) coalition, which advances the use and availability of alternative fuel and electric vehicles, and supporting infrastructure. WWCC educates stakeholders on technology options, seeks funding opportunities for vehicle and station deployments, and advocates for sustainable transportation policies. In 2016, WWCC stakeholders collectively displaced 20 million gallons of petroleum – preventing nearly 116 tons of greenhouse gas emissions.

While there many uncertainties in our analysis, we do have some certainty that guides us in our recommendations. We are certain that GHG emissions are directly related to a changing climate that impacts our region, our air quality, and our vulnerable populations. These negative impacts will grow and worsen without actions to reduce our GHG emissions and improve our environment. As our strategic plan guides us, we must help our region “do its part and more to protect our climate.” Success will be challenging, but failing to defend the future is not an option.

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Appendix

Appendix A: List of Evaluation Criteria and Candidate Action Sheets

Emissions-Reducing

1. Expected GHG equivalent emissions reductions in 2030 (based on four-county scenario forecasting)
2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects

Practical

3. Expected technical/practical/market probability of achieving the emissions reductions
4. Expected sustainable ability for our agency or our jurisdictions to implement (perhaps with partners)
5. Ability to begin action soon
6. Compatibility with other regional rules, policies, initiatives and community efforts
7. Consistency with state or national transportation GHG reduction efforts
8. Likelihood of providing a useful example for other regions ("could leverage change")

Legal

9. Initial review of extent of legal authority or feasibility for our agency or our jurisdictions to adopt

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness

Community

11. Expected community benefits / social effects, including geographic and demographic breadth and equity of those effects

Evaluation of Candidate Action I

(Overall program to keep Zero-Emission Vehicle (ZEV) sales ahead of California mandate)

Synopsis of Action

Action 1 aims to accelerate zero-emission vehicle (ZEV) adoption in the Puget Sound region, and ultimately end the sale of internal combustion engine (ICE) vehicles by some point in the future. This action could be accomplished through a number of different strategies. We analyzed the following four sub-actions:

- **1A.** Counties or cities could pass regulations that restrict light-duty ICE vehicles (could only be ZEV) by some future date
- **1B.** Counties, cities, or the Agency could adopt a ZEV mandate in some form similar to California, but at a regional level
- **1C.** Counties or cities may be able to impose a differential sales tax or incentives (could be revenue neutral) based on vehicles GHG emissions
- **1D.** Counties, cities, the Agency, and/or others could implement ZEV infrastructure incentive programs and smaller supporting initiatives that educate consumers about ZEVs and reduce barriers to adoption

Summary

Emissions reductions and air quality impacts: Through these candidate sub-actions, GHG emission reduction that could be achieved is approximately 1.2 to 2.3 $MMTCO_2e$ per year in 2030. The higher-end of these reductions comes from assuming increased adoption at ZEV and restricting sales of ICE vehicles sooner rather than later. Air quality benefits are strongly correlated with ZEV adoption, with greater benefits in areas with larger ZEV adoption. The Northwest region is well-positioned to benefit from improved air quality with its reliance on hydropower, a relatively clean source of electricity, for a large portion of its power needs. Air quality benefits in the region will improve with this candidate action, with the distribution of benefits potentially greater where there is initially increased ZEV adoption. As ZEVs become a large fraction of the fleet, the benefit will be greater across the region.

Approach to implementation:

- **1A.** The reduction of ICE vehicles could be implemented in a number of ways – e.g. geographic restrictions, ban of new sales, or prohibiting registrations of newly transferred ICE vehicles in our jurisdiction after a certain date.
- **1B.** Counties, cities, or the Agency could adopt a ZEV mandate similar to California, but at a regional level. This would require extensive discussion and coordination with other jurisdictions/agencies to ensure the action meets our targets for efficacy and equity.
- **1C.** Sales tax or vehicle registration fees could be implemented on vehicles based on GHG emissions, with proceeds funding ZEV rebate and incentive programs. Agency staff has had experience with designing and implementing rebate programs; such an approach expanded to vehicles could be implemented with sufficient funding. Agency partners (counties, cities, and towns) may be better equipped to set differential charges for ZEV and ICE vehicles.
- **1D.** Infrastructure, incentive, education, and supporting initiatives could be carried out by the Agency (and/or others) as an extension or expansion of our current work in grants, outreach, and Clean Cities.

Recently, many cities and countries around the world have made declarations to ban the sale of ICE vehicles at a future date. The Agency will track how other cities and counties approach this to identify tactics that could be replicated in our region. Additionally, other potential strategies may allow us to implement some of these sub-actions on a partial basis. For example, our Agency and/or partners may have the ability to enforce a ZEV mandate on specific vehicles or use cases such as autonomous vehicles, Transportation Network Companies (e.g. Uber; Lyft), or possibly used vehicles.

Potential community & economic costs/benefits: The potential economic benefits of increasing ZEV adoption in our region for the maximum scenario would be approximately $70 million to $325 million annually in 2030. This is calculated from the Social Cost of Carbon, with the range showing different discount rates. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $15.8 million to $80 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. Reduced gasoline consumption from ZEV adoption is also anticipated to keep approximately $370 million to $700 million dollars in the local economy annually, by 2030. Greater benefits are gained in the long term (beyond 2030) for both the economy and human health. The major obstacles could be political will and initial costs. Costs mainly include the upfront costs to purchase ZEV, which are currently more expensive to purchase than vehicles with internal combustion engines (ICE), as well as the costs of infrastructure development.

An important aspect of ZEV adoption is the expectation that zero-emission vehicle technology will improve in the near future and cost-savings will be greater than fossil-fuel vehicles, in terms of both the up-front cost and upkeep for ZEVs. A recent report estimates that ZEV vehicles will reach cost parity with ICE light-duty vehicles in the 2025 timeframe.[1] ZEV adoption requirements and ICE vehicle reduction policies that focus on taxes, fees, and acquiring new vehicles have the potential to negatively impact low-income and other vulnerable communities. It is important that any action taken be fully vetted to include equitable options that are inclusive to all communities and any costs (e.g. taxes/fees) are progressive in nature or support equitable changes throughout the region.

Analysis and Results

Emissions-Reducing

1. Expected GHGe emissions reductions in 2030:
   A. For the 100% Light Duty-ZEV by date certain action: For scenarios that would require 100% LD-ZEV sales by 2050, 40, 35 requires annual increases of 3%, 4.5%, and 6%; and changes (reduces) net GHGs (total transportation) in 2030 by 1.2, 1.5, and 2.3 MMTCO2e respectively, which translates to -9%, -13%, -16% per year in 2030.
   B. For an action where we adopt California ZEV mandate or similar rate: The net GHGe reduction would be about -6.5% in 2030. At a ZEV rate of 1.5 times greater than the California mandate, would result in a reduction of -10% GHGe in 2030.
   C. For sales tax/incentives based on GHG emissions, a differential tax/incentive of $2,500 for PHEV and $5,000 for ZEV would create a 29% increase in PHEV/ZEV sales which would reduce GHGs by about 0.2 MMTCO2e/year, about 1.2% of total transportation GHGs.
   D. Voluntary and supporting measures
      i. For ZEV infrastructure incentives and supporting initiatives, an assumed $3M per year investment program would increase adoption of ZEVs and reduce GHGs by 0.1-0.3 MMTCO2e/year, or about 0.5% to 1.8% per year (of total transportation).

ii. For dealer or sales people incentives was insufficient information to make estimate.
iii. For bulk purchases, with $0.5-$1M in staff support, could in theory result in additional 70,000-140,000 vehicles cumulative, by 2030 with 0.2-0.4 MMTCO2e/year, about 1.2-2.4% per year.

E. Smaller supporting initiatives such as building codes, education, and barrier reduction: supporting information was not readily found although there was insufficient time to allow for a thorough search.

- Assumptions and uncertainties. Applies to all: The GHGe reduction estimate accounts for the difference between tailpipe emissions of a typical fossil gasoline vehicle and the electric utility grid emissions from charging a typical battery electric vehicle (BEV) on a Puget Sound average grid (all GHG produced per all MWh delivered). The marginal GHGe emissions of producing the BEV (with an internal combustion engine vehicle) is currently small and is offset in about 6 months of use for a typical vehicle in the Puget Sound. This offset is expected to decrease further as battery production efficiency improves, and the electricity grid improves for both the battery production facility and the Puget Sound grid. E.g., the existing battery production facility used by Tesla is powered almost entirely from wind and solar, and, the Puget Sound grid is expected to lower its carbon intensity as PSE significantly reduces its coal generation and adds more renewables. Alternatively, the battery production GHGe average over the battery's life is estimated to currently be about 10% of the in-use GHGe emissions, so reduces the net GHG savings by about 10%.

2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects.
   A. ZEV adoption is correlated fairly strongly with income and this relationship is expected to continue until the price difference between ZEVs and conventional gasoline vehicles is minimal (e.g. less than a few hundred dollars). Consequently, the benefits of lower emissions would be greater in a) neighborhoods and cities with a higher rate of ZEV adoption (meaning higher income neighborhoods) and b) neighborhoods in close proximity to major highways. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $15.8 million to $80 million in 2030.

Practical

<u>Strategy A: Prohibit Sale of Light-Duty Vehicles/ ICE Vehicles at Some Future Date</u>

Options for this strategy include:
- A proposed ban on the *sales* of new/used ICEs within the Agency's jurisdiction at some future date.
- Proposed ban on additional *registrations* of new/used ICEs owned by residents within Agency's jurisdiction at some future date.
- Potentially creating ICE-free zones within the Agency's jurisdiction.

3. Expected technical, practical, market probability of achieving the emissions reductions:
   A. Probability of achieving emissions reductions: HIGH, on per vehicle/per capita basis. This would require turnover of gasoline/diesel cars to be truly effective.
   B. Practicality of implementation:
      i. As a regional air quality agency the implementation of this action would require more information though could be better suited to our partners (cities & counties).

ii. Potentially banning *sales* of ICE's within our jurisdiction could prompt residents to simply travel to a city outside our jurisdiction to purchase a gasoline car. Potentially banning vehicle *registrations* could better protect against that, but would be logistically more complicated, requiring coordination with state vehicle licensing office and involve added equity issues..

iii. If implemented by the Agency, this would likely require a compliance and enforcement component.

iv. Cities and countries around the world are making commitments to ban internal combustion engines or sell only zero emission vehicles, including the City of Seattle. Plans to achieve these goals remain to be determined. Global and local initiatives, however, would reinforce and lend support to a regional plan.

4. Expected sustainable ability for our agency or our jurisdictions to implement.

A. Will PSCAA implement or a partner?
   i. It is unknown whether the Agency could restrict the sales of gasoline cars, or establish ICE-Free Zones. It is likely a more feasible for these strategies to be implemented at the county or city level.

B. If PSCAA is implementing, or implementing partially (e.g., outreach/ communication/ administration only) what resources will be required (FTE's/Financial responsibility/IT/etc.) and can we provide them?
   i. If the Agency is to implement; we would likely have to support our county partners. Some of the major implementation steps that would require staff time and money include:
      a. Determining legal pathways for banning sales/registrations of ICEs or establishing ICE-Free Zones
      b. Determining a potential compliance strategy: consequences of noncompliance, enforcement program
      c. Establish the proposed ban(s)/zones
      d. Conduct outreach to all affected stakeholders:
         - City/county governments
         - Automakers
         - Auto dealers / Dealer associations
         - Fleets
         - Specialty users
         - Consumers
         - Local businesses
         - Communities
      e. Monitor for compliance/enforce

C. What are likely obstacles/barriers to implementation (e.g. cost; equity)
   i. There could be potential for resistance/opposition from automakers and auto dealers
   ii. There could also be potential for resistance/opposition from counties/state agencies to undertake this work
   iii. This would likely require more ZEV infrastructure buildouts
   iv. There could be resistance from consumers and businesses (e.g.oil companies)
   v. Equity issues – addressed below.

5. Ability to begin action soon.

A. Assess the probability of emissions reductions and ability of our Agency to implement and give narrative on earliest possible date.
   i. This could hinges on the legal mechanism by which this is implemented and the willingness of our partners to undertake this. How would our partners go about implementing this action? How long would it take to research and develop any potential rule/regulation and then get it passed/adopted?
   ii. Dependent on buildout of charging infrastructure
   iii. Timeline – have everything in place by 2030.

6. Compatibility with other regional rules, policies, initiatives and community efforts.

A. For each action, identify at least 1-2 other regional rules, policies, etc. to determine how it will impact/support these additional policies.
   i. Cities/countries around the globe are making declarations to ban ICEs in the future. How exactly they will accomplish it remains to be determined. City of Seattle is among those discussing them, which signals an opportunity to partner with them and explore replicating their approach throughout the region.
      - Seattle, other major world cities pledge to ban gas, diesel vehicles
      - France Plans to End Sales of Gas and Diesel Cars by 2040
      - Britain bans gasoline and diesel cars starting in 2040
      - Scotland set 2032 ban on diesel/gasoline cars
      - Politicians are racing to show the world how quickly their countries can go green
   ii. Cities are establishing pollution pricing and congestion zones to discourage vehicle pollution in their centers. Examples:
      - Madrid chargers higher polluting cars *more* to park.
      - Oslo plans to ban all cars from its city center.
      - London charges drivers a fee to enter congestion zones.

7. Consistency with state or national transportation GHG reduction efforts.

A. For each action, identify at least 1-2 state or national transportation policies regarding GHG reduction and determine how it may support or compare to a larger GHG reduction effort.
   i. This action is synergistic with California's ZEV mandate.

8. Likelihood of providing a useful example for other regions.

A. Briefly summarize whether there are prior examples, and what they are (based on criteria 6 + 7).
   i. As noted above, strategies like this are being announced by political leaders across the globe, thus providing a useful example for other regions, as well as opportunities for cooperation.

B. Determine if action/strategy we develop can be used as a local/regional example for implementation.
   i. Yes. If cities/counties in our jurisdiction were to implement a proposed ban on the sales/registrations of ICEs at a regional level, that could create a replicable model for others to follow.

Strategy B: Regional Adoption of CA ZEV Mandate

3. Expected technical, practical, market probability of achieving the emissions reductions

A. Probability of achieving emissions reductions: HIGH, on per vehicle/per capita basis. This would require turnover of gasoline/diesel cars to be truly effective.
B. Practicality of implementation:
    i. Implementing a regional ZEV program would be similar to a state-level program, but at a regional level. Our research has not found any precedent and would require more extensive analysis on adoption and impacts.
    ii. Process would potentially be time-consuming. A ZEV program would require that automakers have a minimum of two model years to comply once the ZEV program is adopted.
    iii. The Agency would potentially need to develop in-house ability for the design and the implementation of the program.
    iv. On the plus side, CA and OR programs are well-established and offer a model that could be replicated.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
    A. Will PSCAA implement or a partner?
        i. The Agency could implement or partners in our jurisdiction may be better equipped to implement, depending on how the program is designed.
    B. If PSCAA is implementing, or implementing partially (e.g., outreach/ communication/ administration only) what resources will be required (FTEs/Financial responsibility/IT/etc.) and can we provide them?
        i. We have staff capable of standing up a regional ZEV program, but given the potential time-consuming nature of the endeavor, we might need to either scale back on other work, or add additional resources. Some of the tasks involved include:
            a. Review of similar ZEV programs to verify/establish structure.
            b. Draft and adopt regional ZEV rule/regulation
            c. Set up the ZEV credits "bank" (can use CA & OR models as example)
            d. Outreach to automakers/auto dealers, consumers and fleets
            e. Develop compliance framework
    C. What are likely obstacles/barriers to implementation (e.g. cost; equity)
        i. Automakers and dealers strongly opposed inclusion of the ZEV mandate in the CA Clean Cars legislation adopted in 2005 ~and were successful in defeating it. They likely would oppose a regional mandate.
        ii. Administration of the program could be time-consuming and require permanent additional dedicated staff.
        iii. The region would need to build out additional charging infrastructure.

5. Ability to begin action soon.
    A. Assess the probability of emissions reductions and ability of our Agency to implement and give narrative on earliest possible date.
        i. This tactic would bring a greater quantity and wider variety of electric vehicles to our region – offering more consumer choice. It also sends a market signal to automakers. Given that the greater Puget Sound region has one of the highest per capita sales rates in the nation for electric vehicles, it is likely the trend would continue and even increase, with more stock available.
        ii. Internal work to develop a regional ZEV program similar to that of CA could commence fairly quickly. What is unknown is the extent to which a legal review/analysis would be needed.

iii. Development of any potential ZEV legislation could require roughly 2 model year "notice" for automakers.
iv. Consider CA timeline on their ZEV mandate.

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. For each action, identify at least 1-2 other regional rules, policies, etc. to determine how it will impact/support these additional policies.
      i. There are no known examples of a regional ZEV mandate.
      ii. There are, however, ten states that have adopted a state ZEV mandate:
         a. https://www.c2es.org/document/zev-program/
      iii. Creating a WA ZEV is listed as a strategy in the state's EV Action Plan
         a. http://www.wsdot.wa.gov/NR/rdonlyres/28559EF4-CD9D-4CFA-9886-105A30FD58C4/0/WAEVActionPlan2014.pdf
      iv. It's also aligned with goals set forth by the Pacific Coast Collaborative:
         a. http://pacificcoastcollaborative.org/

7. Consistency with state or national transportation GHG reduction efforts.
   A. For each action, identify at least 1-2 state or national transportation policies regarding GHG reduction and determine how it may support or compare to a larger GHG reduction effort.
      i. See #6 under Strategy A. This action supports broader state and regional policies.

8. Likelihood of providing a useful example for other regions.
   A. Successfully demonstrating a regional application of the ZEV mandate would indeed provide a useful example for other areas across the nation to replicate.

Strategy C: Impose Regional Sales Tax/Incentive Based on a Vehicle's GHG Emissions

3. Expected technical, practical, market probability of achieving the emissions reductions
   A. Probability of achieving emissions reductions: HIGH, on per vehicle/per capita basis. With the right funding structure, this strategy would ostensibly motivate consumers to purchase vehicles with lower emissions.
   B. Practicality of implementation: Time of sales rebates for purchases of electric/plug-in hybrids are a proven method of incentivizing sales. The Agency has experience with rebate/coupon programs, so implementing one for electric vehicles would not be impractical. The more challenging aspect would be pairing the rebate with a tax on higher GHG-emitting vehicles. We do not have practical experience collecting or distributing tax revenue.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
   A. Will PSCAA implement or a partner?
      i. Implementing a point-of-sale rebate program would be something the Agency could undertake.
   B. If PSCAA is implementing, or implementing partially (e.g., outreach/ communication/ administration only) what resources will be required (FTE's/Financial responsibility/IT/etc.) and can we provide them?
      i. We currently have staff experienced with designing and implementing rebate programs. Using our Wood Stove Program as an example, it required two FTEs to keep this program running in one county, in addition to overhead. We'd likely need, at a minimum, to double

the existing staff working in this field to administer a vehicle rebate program in all four counties.
   ii. Communications staff would be needed to design and create informational materials about the program, and to get the word out to our constituents.
   iii. We would need to secure funding for this – both for administration, and for actual rebates issued.
   iv. In the scenario where we impose a tax/fee on higher GHG-emitting vehicles, which in turn funds the rebates for lower GHG-emitting vehicles, we would need to develop the administrative infrastructure for managing the funds.
C. What are likely obstacles/barriers to implementation (e.g., cost, equity)
   i. Funding.
   ii. Taxes/fees on gasoline cars would be unpopular.
   iii. Could drive sales of gasoline vehicle out of our region.
   iv. Need IT infrastructure to run/implement program

5. Ability to begin action soon.
   A. Assess the probability of emissions reductions and ability of our Agency to implement and give narrative on earliest possible date.
      i. Designing a rebate program could begin immediately.
      ii. Securing the revenue to fund it, however, could take several years.
      iii. Legislative earliest action – 2019-2020

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. For each action, identify at least 1-2 other regional rules, policies, etc. to determine how it will impact/support these additional policies.
      i. Many EV rebate programs exist.
         a. Oregon recently passed a law establishing a rebate of up to $2,500 for electric vehicle purchases. http://blog.ucsusa.org/josh-goldman/how-the-oregon-rebate-for-electric-cars-works
         b. California offers up to $2,500 for the purchase or lease of BEVs, $1,500 for PHEVs, and $900 for electric motorcycles.
   B. If no current policies exist, identify plans or promoted legislation (enacted or not) that fit this criteria (e.g., analysis plans).

7. Consistency with state or national transportation GHG reduction efforts.
   A. For each action, identify at least 1-2 state or national transportation policies regarding GHG reduction and determine how it may support or compare to a larger GHG reduction effort.
   B. See #6 above. Many states have effectively offered rebates for EV purchases.

8. Likelihood of providing a useful example for other regions.
   A. Briefly summarize whether there are prior examples, and what they are (based on criteria 6 + 7).
      i. See #6 above for examples.
   B. Determine if action/strategy we develop can be used as a local/regional example for implementation.
      i. Yes.

Strategy D: Implement ZEV Infrastructure Programs and Smaller Supporting Initiatives.

3. Expected technical, practical, market probability of achieving the emissions reductions: This strategy includes ZEV infrastructure incentive programs; and smaller supporting initiatives through advocacy and education surrounding ZEV adoption. Strategies we explored include:
   A. Electric vehicle infrastructure incentive programs
      i. Electric vehicle infrastructure programs do not directly achieve emissions reductions. To be effective, infrastructure buildout would need to be paired with efforts to stimulate ZEV purchases.
   B. Auto dealer or auto salesperson incentive, based on volume of ZEVs sold
   C. Community purchase or sales blitz programs.
      i. Community purchase/sales blitz programs can reduce emissions, if participants are switching from a gas/diesel car to a ZEV.
   D. Smaller supporting initiatives, such as amending building codes, conducting more outreach.
      - *Sub-strategy B was determined to be ineffective if individually implemented.*
      - *Sub-strategy D was too vague to analyze.*
      - *Thus, we focused on A and C.*

4. Expected sustainable ability for our agency or our jurisdictions to implement.
   A. Will PSCAA implement or a partner?
      i. The Agency could effectively administer either of these sub-strategies.
   B. If PSCAA is implementing, or implementing partially (e.g., outreach/ communication /administration only) what resources will be required (FTE's/Financial responsibility/IT/etc.) and can we provide them?
      i. The Agency currently has staff with required skillset to administer either sub-strategy A or C.
      ii. Either sub-strategy will require staff to design, implement, promote and administer the program. Depending on scale and scope of the programs, approximately 2-3 FTEs could be needed.
   C. What are likely obstacles/barriers to implementation (e.g. cost, equity)
      i. EVSE projects are costly and can take a long time from start to finish.

5. Ability to begin action soon.
   A. Assess the probability of emissions reductions and ability of our Agency to implement and give narrative on earliest possible date.
      i. We could begin design and implementation of either of these sub-strategies this year, if we so choose. The Community Purchase/Sales Blitz option is *more* practical, as it doesn't require much additional funding, only staff time.

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. For each action, identify at least 1-2 other regional rules, policies, etc. to determine how it will impact/support these additional policies.
      i. The infrastructure incentive program aligns with other state infrastructure initiatives, such as:
         a. The Electric Vehicle Infrastructure Pilot Project, in which the state is investing $1 million to expand fast-charging infrastructure along key travel corridors.
         b. Electrify America will be investing $11 million in Washington for EV infrastructure, as required by the VW settlement decree.
   B. If no current policies exist, identify plans or promoted legislation (enacted or not) that fit this criteria (e.g. analysis plans).

7. Consistency with state or national transportation GHG reduction efforts.
   A. For each action, identify at least 1-2 state or national transportation policies regarding GHG reduction and determine how it may support or compare to a larger GHG reduction effort.
      i. See #6 above for examples.

8. Likelihood of providing a useful example for other regions.
   A. Briefly summarize whether there are prior examples, and what they are (based on criteria 6 + 7).
      i. Drive Electric Northern Colorado has had great success organizing community purchase programs. http://driveelectricnoco.org/group-buy/
      ii. The Energy Challenge in Bend also organized a community purchase program. http://cascadebusnews.com/electrifying-central-oregon-one-car-time-2/
   B. Determine if action/strategy we develop can be used as a local/regional example for implementation.
      i. Yes.

Legal

9. The Agency will continue to evaluate pertinent legal questions throughout the process.

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness.
   A. For light-duty vehicle (LDV) ZEVs by a certain date, the Social Cost of Carbon (SCC) benefits from reduction of GHG emissions: 100% LD-ZEV by 2050 - $21.9m to $100m; 100% LD-ZEV by 2040 - $31.1m to $141.5m; 100% LD-ZEV by 2030 - $71.3m to $325.5m (discount rates of 5% and 2.5%, respectively). This reduction in gasoline consumption would keep $400M - $1.2B in the local economy, per year, in 2030.
   B. For the adoption of a ZEV mandate, either similar to California or more stringent, the SCC benefits from reduction of GHG emissions: With a -6.5% GHG reduction in 2030 - $20.1m to $98.1m (discount rates of 5% and 2.5%, respectively). This reduction in gasoline consumption would keep $370M in the local economy, per year, in 2030.
   C. For differential charges on new or existing vehicles to promote ZEV sales:
      i. With an elasticity of 1.3 (5.8% per $1000) $2,500 and $5,000 incentives on PHEV/ZEV purchase would increase sales by 29%. This reduction in gasoline consumption would keep $65M in the local economy, per year, in 2030. The SCC benefits from reduction of GHG emissions with a 0.2 MMTCO2e/year reduction in 2030 would be between $3.7m/year to $16.7m/year (discount rates of 5% and 2.5%, respectively).
      ii. Differential charge strategies that include fees on automakers/automaker incentives remain unclear considering the limited information we have on how manufacturers would respond to a fee, some may pass on to vehicle prices and it is not apparent how much to charge and how to distribute.
      iii. Fees on consumers that may include an annual registration/licensing fee would potentially be difficult to administer and after reviewing the literature, multiple sources recommend incentives are most effective if offered at the point-of-sale.
      iv. Incentives/tax at time of sale based on GHG emissions follows the same pricing structure as C(i) above.

D. For actions regarding infrastructure incentives, dealers or salesperson incentives, community purchases, and smaller supporting initiatives, there is limited research and elasticity information to calculate estimates; however, we did review some programs and research to determine crude estimates.
    i. By incentivizing ZEV infrastructure we determined that with an existing network of about 600 public chargers, increasing that by ~40% (adding 200-250 chargers) would cost about $3M. This would save approximately $30M-$90M in the local economy.
    ii. Dealer or salesperson incentives to reward the sale of a ZEV have been used Vermont and Connecticut. Oregon is also considering legislation to support this incentive as well. These examples use $250 per ZEV sold as an incentive, but no evaluations have been completed on the effectiveness or cost-benefit of such programs.
    iii. Group buys are programs, typically partnerships between governments or NGOs and dealers, which leverage collective buying power to lower vehicle prices for individual consumers. Guaranteeing a given sales volume can make dealers willing to cut prices on a group of cars. For example, some counties in Colorado and the city of Denver partnered to offer their residents a discount on and electric vehicles. The 2015 EV group purchase program was the first of its kind in the country and resulted in Boulder Nissan selling over four times more LEAFs per month than normal (62 versus 13).

- Actions identified as small supporting initiatives including building codes, barrier reduction, outreach & education could not identify specific cost or elasticity information that was not anecdotal. We may be able to reference some of these existing plans or proposals, but we are unable to calculate change in purchase or use based on these actions. Most of the time the smaller actions listed here have been incorporated into larger strategies. For example, rebates for purchasing ZEVs coincide with outreach and education initiatives to "drum up" interest for electric vehicles. Parsing out the impact of these smaller initiatives is difficult and individual impacts will be small fraction of the larger actions.

Community

11. Expected community benefits and social effects, including geographic and demographic breadth and equity of those effects.
    A. Low-income individuals and some businesses may need an affordable alternative to ICE's. Banning the sale of new ICE vehicles only would be preferable to allow for a transition and potentially a used-car market for ZEVs to develop. Some low wage jobs (auto-mechanics, gas-station workers) will be lost over time – other opportunities can be explored in shifting to an economy without ICE vehicles. Industry transition away from ICE vehicles will require workforce development to newer vehicle technologies – these opportunities should be prioritized to those who were impacted by an ICE vehicle ban.
    B. Adoption rates of ZEVs will be different based on income, potentially continuing poor air quality in less affluent neighborhoods; individuals who depend on using LDVs for their livelihood may be impacted. Unfamiliarity of new vehicle technologies may limit the adoption of ZEVs in certain areas/communities. Low income and rural communities have longer commutes – action assumes EV range will accommodate.
    C. Fees/tax on ICE engines could be regressive. Incentives favor high income earners who can afford to purchase ZEVs or new automobiles – progressive rebate program that have larger incentives for low-income earners should be implemented if this action is pursued. Fees/taxes should go to new vehicle purchases instead of all vehicle purchases since low-income

communities may participate more in used vehicle sales. Purchase of vehicles with low/bad credit history can be a barrier, incentivizing ZEV vehicles could address this issue. If low-income communities/communities of color are unable to participate in ZEV adoption programs due to unfamiliarity and price barriers, air quality impacts from vehicle pollution will persist in these neighborhoods.

D. Infrastructure may not be in place among most communities. Low-income individuals may not own a home or live in MUDs which may not have access to charging infrastructure. Rebates for charging infrastructure would benefit home owners, which favors higher-income households. Investing in low-income communities ZEV infrastructure will be an important piece of ZEV adoption and may require additional resources in addition to rebate programs. Education and outreach to communities to inform how new vehicle technologies work and how any rebates/incentives benefit individuals and community members will be necessary. To promote greater adoption of ZEVs, work with communities to place infrastructure where it is most needed. To assist in ZEV adoption, familiarize community members with ZEVs by prioritizing electrification of community hubs and associated fleets like churches, community/senior centers, libraries and schools.

Evaluation of Candidate Action II

(Sales fleet-average GHG emission requirements)

Synopsis of Action

The aim of Action 2 is to increase the overall fuel economy for Light-Duty Vehicles (LDVs) in the Puget Sound region. This could be achieved by attaining greater than federal fleet-average GHG emissions and above national Corporate Average Fuel Economy (CAFÉ) standards, as per a revised schedule, for example reaching "73 miles per gallon (mpg)" for MY2030 (as opposed to "54.5 mpg" for that MY). The following sub-actions were considered separately:

- **2A.** Regional fuel-economy requirement with revised schedule, as stated
- **2B.** Differential charges on vehicles based on fuel economy
- **2C.** 'Cash for Clunkers' program to remove the worst 5% to 10% of vehicles (those with the lowest fuel economy rating)

Summary

Emissions reductions and air quality impacts: The emission reductions achievable from these candidate actions could range from approximately 0.9 to 1.3 $MMTCO_2e$ in 2030. The higher end of this estimate could be realized if the 'Cash for Clunkers' program replaced the worst 10% of vehicles (lowest fuel economy rating) with ZEVs. Similar to Action 1, a qualitative estimate is that criteria air pollutants would be moderately reduced, with greatest reductions occurring where the distribution of vehicles with improved fuel economy will be located in the region. Benefits could be greater if economic costs and health impacts reduced are distributed equally among all communities in the region. Overall, harmful air pollutants will decrease as the regional fleet changes over to ZEVs and vehicles with greater fuel economy.

Approach to implementation: The Agency could have different roles depending on each of the candidate sub-actions. Many identifiable agency partners (smaller than the State) could have challenges implementing fuel-economy requirements for vehicles in their jurisdictions. The Agency and local partners may be better equipped to also explore implementing fuel-economy requirements among specific technologies and uses (e.g. autonomous vehicles; transportation network companies).

Similar to Action 1, partners such as cities and counties may be better suited to identify ways to implement a tax or fee based on vehicle fuel economy, which in turn could fund programs like 'Cash for Clunkers.' These types of programs that promote purchases of vehicles with high fuel-economy ratings would work best if there is dedicated funding for the Agency/cities/counties to administer or they are funded by reciprocal taxes or fees on vehicles with low fuel-economy ratings.

Potential community & economic costs/benefits: The potential economic cost-benefits are based on the Social Costs of Carbon, could approximately be between $75 million to $150 million annually in 2030 for the most ambitious candidate 2 action. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $11.3 million to $45.7 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. These do not include the significant at-the-pump savings from reduced gasoline consumption that would occur as average fuel economy increased. Initial costs will vary depending on the sub-action, for example a 'Cash

for Clunkers' program that replaces low mpg vehicles with a ZEV would potentially cost $300 million per year over a 10-year period (assumption of $10,000 per car). Any changes to the fuel-economy requirements of vehicle fleets would likely incur major push-back from manufacturers and industry. Sub-actions with associated taxes and fees could face challenges with political and general consumer acceptance. Depending on new vehicle requirements, the cost of vehicles may increase which could disproportionately impact car-dependent low-income households. Candidate actions that include taxes or fees would need to be designed and implemented in a progressive manner, so that costs and benefits are more equitable.

Analysis and Results

Emissions-Reducing

1. Expected GHGe emissions reductions in 2030.
   A. Overall actions to achieve an average "73 mpg" fuel economy for the region would reduce GHGs by about 0.9 MMTCO2e/year.
   B. If differential charges were able to achieve an average "73 mpg" fuel economy for the region, there would be similar GHG reductions as above.
   C. A program that replaced the worst 5% and 10% of light-duty vehicles (including light-duty trucks) with a vehicle typical of the remainder of the fleet could reduce GHGs by at most 2.9% and 5.9%, respectively, of total transportation. For replacing the worst 5% and 10% to with only ZEVs, the program would reduce GHGs by 9.8% and 17.9%, respectively.

2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects.
   A. The action would have health co-benefits by reducing criteria pollutants and toxics. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $11.3 million to $45.7 million in 2030.

Practical

3. Expected technical, practical, market probability of achieving the emissions reductions
   A. A review of vehicle technology suggests that the average fuel economy of internal combustion engines (ICEs) could be doubled by 2050, though currently the most fuel efficient ICEs are around "35 mpg". Reaching an average "73 mpg" for MY2030 may be technically unachievable for internal combustion engines alone, but could potentially be achieved by hybrid vehicles (gas + electric). Another way to achieve this target is to rely on zero-emission vehicles which have an associated "mpg" above 100 (most EVs). If there is a fleet change-over to a majority hybrid and ZEV fleet by 2030, there is high likelihood that emission reductions could be achieved, but a lower likelihood in the practicality or market probability of this action.
   B. Similar to Action #1(C), which supports differential charges on zero-emission vehicles based on GHG emission – this action applies differential charges on vehicles based on fuel economy. This has a high likelihood of reducing emissions, though the practical and market probabilities are much less certain given the difficulty and potential barriers applying a fee/tax on vehicles sold in our region based on fuel economy. An additional way to implement would be to base the differential charges for fuel economy but implement via a 'congestion pricing' program (for example, differential usage fees based on fuel economy).
   C. A program to replace the worst 5% and 10% of light-duty vehicles (by fuel economy) would be technically feasible and is highly likely to reduce emissions. While the Agency does have

experience implementing rebate/coupon programs, a significant funding source would be needed. Unless secured, the practical application of this action would be low. Additionally these programs can help support not just a change to better fuel economy vehicles, but vehicles could be traded in for other resources such as transit passes or electric bicycles to encourage mode shift.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
   A. To assess the agency's or our partner's ability to implement consider these questions:
      i. Depending on how the actions get implemented the Agency will have different roles. It would be unlikely that the Agency would take the lead role in implementing a regional fuel economy standard. The Agency would benefit with working on city & county partners or in supporting a state adoption of California fuel economy standards. Another way the Agency could take a more active role would be to potentially regulate Autonomous vehicles (self-driving cars) or Transportation Network Companies (e.g. Uber, Lyft). For sub-actions (A) and (B) the Agency could enforce an average fuel economy to be more stringent on these types of vehicle fleets. Sub-action (C), the Agency would perform the role of program administration.
      ii. In advocating for sub-action (A) the Agency would only require resources for outreach and advocacy. If the Agency takes a regulatory approach (sub-actions (A) and (B)) more resources would be required to administer and enforce the regulation. This may require additional administrative staff and inspectors. Additional legal resources may be initially required for research and analysis. The Agency would also have to take an active role in obtaining support for regulations from members of our jurisdiction. For sub-action (C) the Agency would run the rebate/coupon program. This may require additional staff resources or IT resources, depending on how program would function.
      iii. If the Agency acts to develop regulations on self-driving vehicles or Transportation Network Companies on sub-action (A) and (B) there may be time constraints and legal requirements towards adoption. Barriers to adoption also include opposition that would require certain industries or manufacturers to comply with regional standards. As with other actions where differential charges/fees are assessed on vehicle owners, applying these costs equitably is needed to prevent undue burden on low income individuals. Sub-action (C) would require substantial financial investments to pay for the program itself.

5. Ability to begin action soon.
   A. Sub-actions (A) and (B) would require letters to manufacturers to inform them of the Agency's intent to have cars produced to meet set fuel economy standards. This could possibly be implemented at the earliest for MY2025. For implementation of sub-actions (A) and (B) through regulation of specific industries, advance noticed would need to be given and technologies available (autonomous vehicle level 4+). Earliest potential dates would be between 2022 and 2030. For sub-action (C) the "cash-for-clunkers" program could start as early as 2019 with only limitations being funding sources.

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. Currently the Port of Seattle, specifically at SeaTac airport only allows Transportation Network Company drivers whose vehicles have a blended MPG rating of 45 or higher to pick up passengers. This is an example of how sub-actions (A) and (B) can be implemented. Though, while the Port of Seattle has the authority to contract out to ride-share companies and set terms, the Agency will have to examine how to expand this. 'Cash for Clunkers' programs have

been implemented locally in the San Joaquin Valley, California which supports giving rebates to low-income families to purchase cleaner vehicles. This particular program is supported by the state, though there are various privately run programs that give cash for old vehicles as well.

7. Consistency with state or national transportation GHG reduction efforts.
   A. The Corporate Average Fuel Economy (CAFÉ) standards are set nationally, and only California has the legal right to set more stringent standards. Other states are allowed to choose whether they follow California standards. A regional fuel economy requirement would be similar in nature to these standards.
      B. Some newer mobile technologies and businesses are not fully covered by federal or state regulations. These include self-driving cars and the Transportation Network Companies. Some states have already taken the initiative, in Massachusetts legislative bills H.1829, S.1945 were introduced to the state on how to regulate autonomous vehicles and stated that any autonomous vehicle level 3 or above must be a "zero-emissions vehicle". Recently, the City of Seattle has included electrification of ride share and taxi fleets in its latest list of climate priorities.[2]
   C. The 'Cash for Clunkers' was previously a national program, though would be able to be implemented at any level since it is a voluntary program and is only limited by the amount of funding received to administer the program.

8. Likelihood of providing a useful example for other regions.
   A. While the CAFÉ standards are not new and moving LDVs to a better fuel economy will reduce harmful air pollution and reduce GHG emissions, regulating these standards are within the federal domain (or specifically for California). To apply greater fuel economy standards to vehicles, the Agency could regulate autonomous vehicles and vehicles that are within a Transportation Network Company.
   B. While the sub-actions have been implemented in some form outside of our region, they have done so at different levels (e.g. Federal; SeaTac; State). By implementing these actions they can be used as a local/regional example for other municipalities or regions.

Legal

9. The Agency will continue to evaluate pertinent legal questions throughout the process.

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness.
    A. The SCC benefits from reduction of GHG emissions: With a 0.9 $MMTCO_2e$/year reduction would amount to $16.5m to $75.1m per year (discount rates of 5% and 2.5%, respectively). With a 1.8 $MMTCO_2e$/year reduction would amount to $32.9m to $150.2m per year (discount rates of 5% and 2.5%, respectively). The reduction in gasoline purchases would keep approximately $100-$200M in the state/local economy per year, in 2030.

Community

11. Expected community benefits and social effects, including geographic and demographic breadth and equity of those effects.

    A & B. Cost of vehicles could increase which could negatively impact low-income individuals. Depending on structure, car dealerships and employees may be impacted by pushing some sales out of region. Level-of-knowledge to maintain vehicles may impact low-wage earners by eliminating lower-skilled jobs in the long-term. Adoption rates of more efficient vehicles will likely be slower based on income and accessibility, improving air quality more slowly in less affluent neighborhoods; individuals who depend on using LDVs for their livelihood may be impacted.

    C. Cash for Clunkers: Proportion of rebate for low-income individuals may need to be higher (progressive rebate system based on income) to encourage participation and adoption of higher fuel efficient vehicles. Education and outreach programs regarding participation in these types of programs.

Evaluation of Candidate Action III

(Differential charges on fuels based on life-cycle carbon-intensity)

Synopsis of Action

This candidate action applies differential charges on transportation fuels sold in the Puget Sound region, based on the lifecycle carbon-intensity (CI) of the fuel. Differential charges would be larger for high carbon-intensity fuels and smaller for low carbon-intensity fuels. This is intended to develop the market for, and promote the transition to low carbon-intensity fuels like biodiesel, renewable diesel, renewable natural gas, and ethanol, or towards the use of zero-emission vehicles (ZEVs). For this action, one potential implementation route is that counties impose a sales tax based on fuels' carbon intensities (vendors remit to state): scaled roughly at 20% for petroleum gasoline and diesel (~$0.50 per gallon) and 0% for the lowest CI alternative fuels, which could potentially start as early as 2019. The charge or fee could be operated anywhere in the range from revenue neutral (credit to low-CI fuels) to full collection which could be used for equity measures.

Summary

Emissions reductions and air quality impacts: A differential charge on fuels, based on their carbon intensity, could reduce emissions by approximately 0.9 $MMTCO_2e$ in the transportation and mobile sector by 2030. Additionally, the reduced use of gasoline and diesel would improve air quality throughout the region. A thorough analysis of life-cycle emissions of alternative fuels would be required to determine specifically which pollutants are reduced and by what amount. A previous study shows that under foreseeable scenarios we will see reductions in key pollutants–including harmful fine particle and diesel pollution–in our region with greater alternative fuel use in our fleet.[3]

Approach to implementation: Similar to Action 2 above, Agency partners such as counties and cities may be better equipped to implement a fuel charge or tax in their jurisdictions. The Agency could assist our partners in some of the technical challenges by identifying and categorizing fuels based on carbon intensity. The Agency could additionally support our partners with keeping track of the carbon intensity of fuels used in the region and potentially running the program to certify the fuel distribution and use. The approach of a fuel tax, in addition to a State fuel tax, has been successful at a regional level in other parts of the United States. The funds collected from the fuel tax could be used to fund programs to support the transition away from the use of fossil fuels, reduce vehicle miles traveled (VMT) an enhance other transportation options. Funds could also support regional alternative fuel production or subsidize lower carbon-intense fuels: giving partial credit to lower carbon intense fuel allows them to come to cost parity (and beyond) with fossil fuels. The funding could also be used to mitigate equity concerns by providing assistance to lower-income individuals and communities.

Potential community & economic costs/benefits: The benefits from the Social Costs of Carbon, if the candidate action is taken, would range from $17 to $75 million per year in 2030. The range represents both different discount rates, as well as a range of underlying health studies. We were unable to quantify the anticipated economic health co-benefits at this time. The reductions in gasoline and diesel consumption could also keep approximately $277 million per year in the local economy in 2030, assuming a switch to ZEV and biodiesel.

The costs of this candidate action are mainly a $0.50/gallon tax which would reduce fuel purchases. The current Washington State fuel tax is $0.494/gallon with the Federal fuel tax of $0.184/gallon. The addition of a $0.50/gallon tax would put a fuel tax in the region over $1.00/gallon. Overall public acceptance of a tax of this scale is likely a substantial barrier, even if funds collected are used to offset other costs borne by consumers. If this candidate action is combined with a low-carbon fuel standard (Candidate Action 4) it could potentially stimulate an alternative-fuel industry in the region, which could alleviate the possible economic impacts from any increased fossil fuel prices to some degree. As with any tax or fee, the Agency and partners would need to consider how to implement this action equitably so there is no undue burden on low-income populations or others who could be disproportionately impacted (e.g. rural communities).

Analysis and Results

Emissions-Reducing

1. Expected GHGe emissions reductions in 2030.
    a. For the gasoline sector, this could reduce GHGs by about 0.9MMTCO2e/year in 2030, about 5% of total transportation GHGs.

2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects.
    a. The action would have health co-benefits by reducing criteria pollutants and air toxics. For the criteria pollutant reductions, the health value is ~ $7-14M per year.

Practical

3. Expected technical, practical, market probability of achieving the emissions reductions
    A. This strategy, if implemented, is technically practical and achieves emissions reductions through the reduction on CI fossil fuel use. The practical and market probability are much less certain given that an increase in a gasoline tax may be met with political barriers.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
    A. With support from the Agency, we could advocate for our city and county partners to take legislative action on passing an excise/sale tax on carbon intensity of fuels. Gasoline and diesel fuel would potentially be taxed 100% while renewable diesel or other biofuels would be taxed based on their carbon intensity. The Agency could also assist with technical aspects.
    B. The Agency could provide resources in the form of technical expertise in identifying and evaluating the carbon intensity of fuels. This may include spot inspection of facilities to determine if distributors are in compliance. This could require additional staff resources or could be incorporated into regular inspection/permitting schedules. Consideration will also need to be given on how to implement a tax structure in which revenue from the tax would be used to promote alternative fuels, zero-electric vehicles, or subsidize low-income families.
    C. The main barriers would likely be political; if a fuel tax was not palatable to legislators, elected officials, and general public this could not be implemented. Additionally, a fuel tax just within the Puget Sound region may drive fuels sales just outside our jurisdiction which could impact local businesses and subsequent economies (e.g., employment). Also, if the Agency could take on a greater role by providing expertise and inspection time, more staff may be required.

5. Ability to begin action soon.

A. This action could potentially be enacted and take effect by 2019, depending on legislative support at the city and county level.

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. Currently the Washington State tax on gasoline and diesel is $0.494. With the Federal gasoline and diesel tax ($0.184 and $0.244, respectively) a $0.50 additional tax on fossil fuels would increase fossil fuels taxes to over $1.00 per gallon. This tax could be lower based on the carbon intensity of fuels. No other regional, state, or local government entity has proposed such a large increase in a fuel tax, and it's unlikely it would be palatable. Pennsylvania currently has the highest gasoline tax at $0.58 per gallon. California recently (Nov 1, 2017) raised its tax on gasoline $0.12 and diesel $0.20, though both still remain under the amount illustrated as an example in this candidate action.

      Currently, some city and regional governments enact local area fuel taxes. For example, the Northern Virginia Regional Gas Tax applies to suburbs of Washington DC. . The tax of 2.1% is collected by the Commonwealth and remitted to Northern Virginia Transportation Commission (NVTC). NVTC holds the funds in trust for member jurisdictions to use – with part of the funds used to public transit subsidies.

      California's county Boards of Supervisors are authorized to place a countywide gas tax on the ballot for voter approval, as per Sections 9501-9507 of the California Revenue and Taxation Code. Although this section of the California Revenue Code was in place for many years, no county in California has ever attempted to place a local countywide gas tax on the ballot, reflecting the public opposition to fuel tax increases. Following a 2/3 majority approval by the Board of Supervisors to place a measure on the ballot, the countywide gas tax would need to be approved by a 2/3 majority of San Francisco voters. The tax would be collected by the California Department of Taxes and Fees Administration and distributed back to San Francisco net of a state administration fee on a regular basis.

   B. How would this action work in conjunction with other policies?
      I. A gasoline tax could work in conjunction with an LCSF which would make lower carbon intense fuels less expensive or come into cost parity with gasoline
      II. Other programs that incentivize zero-emissions vehicles could work well with a fossil fuel tax to move consumers to alternative fuel vehicles.
      III. A policy that ties the money collected from taxes could potentially go to a carbon reduction program (e.g. transit passes).

7. Consistency with state or national transportation GHG reduction efforts.
   A. Outside of the recent tax increases from California, which are intended to repair roads and bridges across the state, while strengthening mass transit and creating employment opportunities, there are few specific state or national transportation GHG policies that include a fuel tax to reduce GHG emissions or fund GHG reducing activities.

8. Likelihood of providing a useful example for other regions.
   A. Considering there are previous examples of fossil fuel taxes, the Agency would have access to some practical and legislative models to refer to for development and implementation of this action.

B. Although there are previous regional fuel tax regulations, the action is based on the carbon intensity of the fossil fuels. If this action is fully implemented it could be used an example of how to develop a fuel tax based on the carbon intensity of the fuels used and identify differential pricing to support lower carbon intensive fuels, like renewable diesel, and promote the adoption of zero-electric vehicles.

Legal

9. The Agency will continue to evaluate pertinent legal questions throughout the process.

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness.
    A. Given a long-run elasticity of -0.7 (~-0.4 through vehicles MPG and -0.3 for VMT), a tax of $0.50/gallon could reduce gasoline purchase by approximately 12%. This reduction in gasoline consumption could keep about $100-200M in the state/local economy, per year, in 2030. The SCC benefits from reduction of GHG emissions: With a 0.9 MMTCO2e/year reduction could amount to $16.5m to $75.1m per year (discount rates of 5% and 2.5%, respectively).
    B. A flat tax could be regressive. To be more equitable applying taxes/fees, a rebate or similar mechanism to help low-income individuals/families would likely be needed.

Community

11. Expected community benefits and social effects, including geographic and demographic breadth and equity of those effects.
    A. A flat tax could be regressive. To be more equitable applying taxes/fees, a rebate or similar mechanism to help low-income individuals/families would be needed; individuals who depend on using LDVs for their livelihood may be impacted. Individuals in the service/freight sectors who rely on M/HDVs for their livelihood may be negatively impacted due to using a greater proportion of their income on fuels. Low income and rural communities have longer commutes and fuel taxes may impact them more.

Evaluation of Candidate Action IV

(Life-cycle carbon-intensity requirements)

Synopsis of Action

This candidate action would require all transportation fuel sold in the Puget Sound region (King, Kitsap, Pierce, and Snohomish counties) by fuel distributors/importers each year to meet or exceed California type carbon-intensity fuel standards. The state, counties, or the Agency could implement a Low-Carbon Fuel Standard (LCFS) modelled after the California standard, with a target of -16% (-10% from substitution of gasoline and -25% from substitution of diesel) in GHG carbon intensity (compared to baseline) by 2030.

Summary

Emissions reductions and air quality impacts: A regional LCFS could achieve maximum emission reductions in the transportation & mobile sector of approximately 1.3 to 2.3 $MMTCO_2e$ per year by 2030. These reductions would come from light-duty and heavy-duty vehicles as well as non-road vehicles. Similar to Action 3, a thorough analysis of life-cycle emissions of alternative fuels would be required to determine specifically which criteria pollutants are reduced and by what amount. A previous study shows that under foreseeable scenarios, we will see reductions in key criteria pollutants – including harmful fine particle and diesel pollution - in our region with greater alternative fuel use in our fleet.[7]

Approach to implementation: The Agency would take the lead role in the administration of an LCFS program, and while no regional examples of low-carbon fuel standards exist, there are nearby examples of programs in California, Oregon, and British Columbia. Having a consistent market along the West Coast will likely increase the market probability of success. We may be able leverage IT tools and technical support from California, as other jurisdictions have. Similarly, if we adopt similar carbon intensities from current programs, this could considerably reduce complexity.

Potential community & economic costs/benefits: The potential economic benefits from the Social Costs of Carbon at the maximum emissions reduction level would be approximately $108 million to $192 million per year in 2030. The range represents different discount rates. We were unable to quantify the anticipated economic health co-benefits at this time. A LCFS could likely incentivize a local biofuel industry, in which case approximately $67 million per year could stay in the local economy. This conservatively assumes that no ZEVs are used to meet the LCFS and assumes all ethanol is produced out-of-state. This candidate action could see greater potential if combined with Action 3, and which could potentially create local jobs. Similar to Action 3, higher costs for fuels may have a greater impact on low-income and rural communities that need to drive more and thus spend a greater portion of their income on fuels and needs to be considered in implementation.

Analysis and Results

Emissions-Reducing

1. Expected GHGe emissions reductions in 2030.

A. For on-road LD: at -10% to -25% CI by 2030, this could reduce emissions by about 0.76 to 1.9 MMTCO2e per year. For on-road HD, -10% to -25% could be 0.18-0.45 MMTCO2e/year. For Nonroad: 0.4 to 1.0 MMTCO2e per year. The combined total could be 1.3 to 3.3 MMTCO2e per year. The 'strong' scenario uses 10% for both on-road LD and nonroad. The 'ambitious' scenario uses 10% for gasoline and 25% for diesel (total 2.3 $MMTCO_2e$).

2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects.
   A. We anticipate a LCFS in our region would reduce criteria and toxic pollutants and provide air quality co-benefits, as described in a previous report.

Practical

3. Expected technical, practical, market probability of achieving the emissions reductions
   A. GHG emissions reductions are viable from a low carbon fuel standard – we have nearby examples of programs currently being successfully implemented: notably California, Oregon, and British Columbia. A consistent market across the West Coast likely increases the market probability of success – it shows a clear market signal, greater confidence for investors of low carbon fuels, and leveraging resources across programs. The known programs have targets of overall carbon intensity reduction of 10% reduction over 10 years. As we move beyond this, the probability of achieving the emissions reductions could potentially become more challenging. One report notes that 25% emission reduction by 2030 is on the ambitious/aggressive upper end of the range by 2030 for potential reductions in carbon intensity.[4] Also, as we move away from guidelines we could adopt from California's program, the complexity and ability to implement increase and decrease, respectively.
   B. The Agency could get more detailed about how the carbon intensities of the fuels compare to the carbon intensity of a ZEV. This gets to the question of whether an LCFS is worth the investment in our timeframe. It could be possible that we would want to pursue a program that focuses specifically on diesel.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
   A. To assess the Agency's or our partner's ability to implement, consider these points:
      i. The clearest partner to implement this program would be Washington State, given that these fuel programs are typically implemented at the state level. The State has not yet been able to implement this program. Beyond Washington State, there's no other apparent partner to implement the program.
      ii. If the Agency could implement this program, then it's appropriate to assume a similar implementation scale and scope as that of Oregon, with a roughly similar population as our jurisdiction. With help from California, who makes its IT tools for reporting and technical support readily available, Oregon is able to support its program with a small staff. The Agency would need to consider what staff capacity would be required to implement a comparable program in our region. We would need to address appropriate skill sets as well. While it's unusual for a fuel carbon intensity requirement to be required at a scale less than statewide, we do have some past experience with different fuels being made available/sold within our counties (as opposed to the rest of the state). Examples include the voluntary low Reid vapor pressure (low RVP) that refineries took on and supplied within our jurisdiction to address potential ozone issues.
      iii. What are likely obstacles/barriers to implementation (e.g. cost; equity): Barriers include market complexity – currently about 150 entities reporting to Oregon under their program

– again, if we assume similar carbon intensities to California then we can likely better manage this complexity. Additional barriers, as discussed above, could be cost and staff capacity.

5. Ability to begin action soon.
   A. The earliest possible date would be subject to our ability to successfully draft and implement the rule that governs a carbon intensity requirement in our region. Such a process would likely be involved, spanning at least 24 months. Even if identified as a recommendation to pursue in early 2018, earliest implementation of a rule would likely be early 2021. Lead times for actual implementation after rule passage have typically been several years (e.g. California, Oregon).

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. We haven't found examples of a carbon intensity requirement enforced at a regional government level.
   B. If no current policies exist, the Agency could identify plans or promoted legislation (enacted or not) that fit this criteria (e.g. analysis plans).

7. Consistency with state or national transportation GHG reduction efforts.
   A. As noted above, our region (or even Washington State) requiring a carbon intensity standard for fuels could serve to strengthen efforts across the West Coast. The Pacific Coast Collaborative, comprised of California, Oregon, Washington and British Columbia, is committed to expanding the scope of existing programs for greater market commitment of low intensity fuels (note: Washington is the one member without an active LCFS program).

8. Likelihood of providing a useful example for other regions.
   A. The three known low carbon fuel standard programs – California[5], Oregon[6], and British Columbia[7] – work under the California program. All three employ market flexibility and reporting of "cradle to grave" carbon intensities to create credits and deficits in the system. Overall, the carbon intensity for the entire fleet overall is reduced in all three of these examples by 10% from a 10 year baseline.
   B. Determine if action/strategy we develop can be used as a local/regional example for implementation.

Legal

9. The Agency will continue to evaluate pertinent legal questions throughout the evaluation process.

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness.
    A. Following CA LCFS, but delayed, -10% to - 16% by 2030 could conservatively cost about $0.36/gallon to $0.44/gallon.[8] The SCC benefits from reduction of GHG emissions: For on-road LD, 0.76 MMTCO2e per year reductions in 2030 - $13.9m to $34.8m/year (discount rates of 5% and 2.5%, respectively). For on-road HD, 0.18-0.45 MMTCO2e per year reductions in 2030 - $3.3m to $8.2m/year and $15.0m to $37.6m/year (discount rates of 5% and 2.5%, respectively). For Nonroad, 0.4 to 1.0 MMTCO2e per year reductions in 2030 - $7.3m to $33.4m/year and $18.3m to $83.4m/year (discount rates of 5% and 2.5%, respectively). The combined total could

be 1.3 to 2.3 MMTCO2e per year in 2030 which would account for $23.8m to $108.5m/year and $42.1m to $192 m/year (discount rates of 5% and 2.5%, respectively).

Community

11. Expected community benefits and social effects, including geographic and demographic breadth and equity of those effects.
    A. Similar to Action III, higher costs may have a greater impact on low-income and rural communities that need to drive more and thus spend more on fuels. An LCFS could potentially have a greater impact on improving air quality since it would be adopted equally across the region instead of based on price structure for purchasing low carbon intense fuels. A potential increase in the production of low-carbon intense fuels could be beneficial for the development of an industry in the region.

Evaluation of Candidate Action V

(Adopt improved local government alternative fuel rule)

Synopsis of Action

This candidate action could strengthen the state's alternative fuel use requirement for publicly owned vehicles and fleets in the Agency's four-county region. Currently the law states that, "All state agencies (and local government agencies by 2018) must, to the extent practicable, use 100% biofuels or electricity to operate all publicly owned vehicles (including marine vessels and construction equipment)." Redefining "practicable" to more-enforceable language and lowering the reporting thresholds has the potential to strengthen this law. Washington State Department of Transportation (WSDOT) Ferries and transit buses use about 90% of the fuels used by public and government fleets.

Summary

Emissions reductions and air quality impacts: If the state's alternative fuel use requirement is bolstered and enforced, the region could see maximum GHG emission reductions of approximately 0.3 $MMTCO_2e$ per year by 2030. Similar to candidate actions that introduce a fuel tax or low-carbon fuel standard, the exact co-benefits of reduced criteria air pollutants would depend specifically on which fuels are substituted. A thorough analysis of life-cycle emissions of alternative fuels would be required to determine specifically which criteria pollutants will be reduced and by what amount. Overall, we would expect to see a modest reduction in criteria air pollutants, with greater air quality benefits in communities that have heavy transit and or/ferry use.

Approach to implementation: This candidate action is based on the state's alternative fuel use rule and Agency partners, such as counties, cities, and towns may be better equipped to implement. Using the state's framework, the Agency may be able to administer the reporting requirements for government fleets in our four-county jurisdiction, and pair this with a consulting program to help fleets determine their best vehicle and fuel choices and identify potential funding. Some of this work is already occurring for members of our Clean Cities Coalition. Additionally, some major bus and ferry fleets have expressed interest and commitment in moving towards all-electric. If this shift takes place without application of the state rule, it would minimize the benefits of pursuing this candidate action.

Potential community & economic costs/benefits: The Social Costs of Carbon benefit would amount to approximately $7 million to $33 million per year by 2030, if this candidate action is taken to reduce emissions. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $21.2 million to $53.8 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. Currently, biodiesel is close to parity with petroleum diesel whereas renewable diesel is somewhat more expensive. This equates to an estimated cost of $20 million annually for the current price difference and fuel volume, although if petroleum-based fuels are replaced with local biofuel, we could potentially keep about $120 million per year in the local economy in 2030. The Agency may also have to consider that if fuel prices increase for transit, it could result in unintended consequences that negatively impact vulnerable populations, although electrification with its lower fuel costs could reduce or negate those effects.

Analysis and Results

Emissions-Reducing

1. Expected GHGe emissions reductions in 2030.
   A. Total local government use is about 0.39 MMTCO2e/year, with ferries and transit buses comprising about 90% of the total. A 100% alternative fuel requirement (no fossil fuels) would reduce GHG emissions by ~80% across all local government sectors, assuming the biofuels were produced locally (biodiesel and renewable diesel), and gasoline light duty vehicles became electric. This would result in a reduction of about 0.3 MMTCO2e, approximately 1.8% of total GHGs. Depending on feedstock and production location, could have wide range of impacts on criteria and toxics emissions.

2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects
   A. A thorough analysis of life-cycle emissions of alternative fuels could be required to determine specifically which criteria pollutants will be reduced and by what amount. Overall, we would expect to see a modest reduction in criteria and toxic air pollutants. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $21.2 million to $53.8 million in 2030.

Practical

3. Expected technical, practical, market probability of achieving the emissions reductions
   A. Moving all government fleets toward alt fuels could reduce emissions; although most fleets are collectively a very small proportion of overall traffic, so the size of the emissions reductions for these could potentially be small. Targeting only the largest diesel users (WSF and large transit agencies) could provide the greatest benefits.
   B. Feasibility studies have been completed showing that 2 Jumbo Mark-II ferries could be converted to all-electric operation with a very favorable return on investment time of 4 years, after which there would be millions of dollars in fuel savings each year. These are the two largest of 23 total ferries in the system. We have less information about the potentially ability to convert any of the other 21 ferries.

      In transit systems, King County Metro has already dedicated itself to going all-electric with its buses by 2030. Some other transit agencies such as Pierce Transit, Kitsap, and Everett are exploring this option as well. Electric buses have a greater capital cost than conventionally-fueled buses and require heavy-duty charging infrastructure. The capital costs of all-electric buses are going down due to lower battery costs ($700,000 vs. $1,200,000 previously), and the fuel cost savings will also help to make all-electric bus fleets more economically viable.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
   A. The Agency could potentially take over the reporting requirement for gov't fleets in our 4 counties, and pair this with a consulting program to help fleets determine their best vehicle choices and identify funding.
   B. This would require some staff to collect data or provide consulting services and administer the program and current staff capacity would need to be considered. If there is a financial penalty involved in non-compliance, or if we offer some financial assistance to fleets to cover incremental costs of cleaner vehicles or other type of incentive, then this could require additional resources and work.

C. The main difficulty is that there are a large number of public fleets in our 4 counties, many of which only have a relatively small number of vehicles.

5. Ability to begin action soon.
   A. This would affect fleets' new vehicle purchases only, so the timeline could be fast (less than a year).

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. This could strengthen and enforce the state's existing local government alternative fuel rule within our 4-county region.

7. Consistency with state or national transportation GHG reduction efforts.
   A. Government fleets have traditionally been leaders in adoption of cleaner transportation technologies, and Clean Cities already works with these fleets as much as possible. By being early adopters, government fleets could help develop a market for clean technologies and set an example for the general public.

8. Likelihood of providing a useful example for other regions.
   A. There are various types of clean fleet rules or regulations out there. For example in California, the SQAMD has several and CARB also has rules/programs.
   B. This could be a good example for other regions to follow in its particular form, although we would be far from the first to have rules or programs to clean up public fleets.

Legal

9. The Agency will continue to evaluate pertinent legal questions throughout the process.

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness.
    A. Currently, biodiesel is close to equal the price of petrol diesel while renewable diesel is $0.25-0.55/per gallon more expensive than petrol diesel. If replacement were local biofuel, we could keep about $120M per year in the local economy. The SCC benefits from reduction of GHG emissions: With a 0.4 MMTCO2e reduction could amount to $7.3m to $33.4m per year (discount rates of 5% and 2.5%, respectively).

Community

11. Expected community benefits and social effects, including geographic and demographic breadth and equity of those effects.
    A. If fuel prices go up for transit vehicles, fare prices could increase. Additionally, to save on operational costs, transit agencies may cut routes and frequency of service in certain areas. Would benefit overall air quality in communities that have heavy transit use. Potential impact to low-wage workers if numbers of transit vehicles or routes are reduced. Reductions in fuel costs through widespread electrification (which is already a goal for most fleets) may avoid any such outcomes.

Evaluation of Candidate Action VI

(Mode Shift - Actively engage in PSRC/transit/county/city Regional Transportation Plan (RTP) update for "Choices" and "Land use")

Synopsis of Action

This candidate action evaluates the RTP (2040 update) and proposes additional measures that could be implemented regarding transportation "Choices" and "Land Use." The Agency could work closely with the Puget Sound Regional Council (PSRC) to identify measures with the most potential to reduce emissions and the best method for implementation. Included within the RTP (2040 update):

A. Land Use: adopted regional growth strategy and targets to focus growth in compact urban areas (e.g. 30% of growth targeted near transit stations)
B. Choices: regional integrated transit network and multimodal investments (e.g. 80% of population with access to transit; 37% with access to frequent transit)
C. Technology: adopted CAFÉ and GHG vehicles standards and inspection & maintenance programs (further addressed in Action 1)
D. User Fees: proposed financial strategy, including express toll lanes, road usage charge, parking fees, facility tools, etc. (further addressed in Action 7)

Because candidate sub-actions C and D are addressed elsewhere (candidate Actions 1 and 7), the content of this evaluation will focus on A and B, which encompasses land use changes and "choices", which includes transit and other mode-shift options.

Summary

Emissions reductions and air quality impacts: The Puget Sound Regional Council used 2006 as a base year to assess GHG emission reductions. The Agency used 1990 as a base year to set our GHG emission reduction goals. Additionally, PSRC defines transportation as on-road vehicles whereas the Agency has identified the transportation and mobile sector as including on-road and non-road vehicles, as well as mobile equipment in construction and agriculture. For the RTP (2040 update), PSRC estimates a 24% reduction from 2006 baseline emissions by 2040 for the on-road transportation sector, which equates to a GHG emission reduction of 3.1 $MMTCO_2e$ by 2040. If additional actions under scenarios A and B were pursued (changes to land use and greater access to an integrated transit network), scaled estimates for additional annual reduction could be approximately 0.2 to 0.4 $MMTCO_2e$ per year in 2030. These additional actions translate to 50-70% of growth targeted near transit stations (up from 30% included in RTP), and expansion of pedestrian network to transit as well additional commute trip reduction via alternative work schedules. Driven by a reduction in VMT, a qualitative estimate is that air pollutants would be moderately reduced with the overall reduction of GHG emissions.

Approach to implementation: The Puget Sound Regional Council has proposed additional actions in each of the four sub-actions described above to further increase and accelerate GHG emissions reductions. The "Choices" strategy within the RTP (2040 update) includes the regional integrated transit network that includes a variety of multimodal investments such as Sound Transit 3 expansion, Metro Connects, and the bicycle/pedestrian network. A key question under this action is whether or not the Agency's Board of Directors recommends that we pursue additional actions beyond the scope of the RTP. An appropriate role for the Agency could be to participate in VISION2050 process to help ensure

both land use actions as well as other actions (e.g. infrastructure for EVs; public transit use and access) are addressed and supported.

In a separate exercise with EPA's Office of Transportation and Air Quality (OTAQ), the Agency explored specific leveraging actions that include: expanding the commute trip reduction (CTR) program in our four-county region with more aggressive targets, expanding employer eligibility, and lowering the employer-size threshold; increasing ORCA LIFT card eligibility from 200% to 300% above the poverty line as well as eliminating the current modest fare; and advocating for Smart Growth land use to increase population density around public transit centers. While we evaluated these actions, we use only PSRC's local emissions estimates for this specific candidate action.

Potential community & economic costs/benefits: The Social Costs of Carbon applied to the GHG emission reductions gained from the maximum level of 'above and beyond' additional actions under "choices" and "land use" (those considered here for potential Agency action in candidate action 6) yield benefits that range from $7 million to $33 million per year in 2030. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $7.9 million to $39.7 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. PSRC's general assumption is that through the implementation of the RTP, wide-ranging benefits include monetary savings from reduced congestion and fuel consumption. Promotion and investment in mode shift should center on reducing reliance on SOVs for transportation and increasing the viability of alternative modes of transportation. Under land-use scenarios, there is potential displacement of low-income residents in communities where density is prioritized around transit hubs (the potential for residents to be "priced-out"). Our focus groups expressed an interest in requirements for developers to build affordable housing near urban centers or transit hubs. This could allow lower-income workers to use transit to commute to work. Additionally, focus groups noted that improvements in "last mile" transportation access for outlying communities or for workers who have long-distance commutes with limited transit options would be helpful. These could include increased van pools, electric vehicle shuttles (specific to communities/neighborhoods), and expanded bike-share programs.

Analysis and Results

Emissions-Reducing

1. Expected GHGe emissions reductions in 2030.
   PSRC does not have a 1990 base year within the current modeling framework, which is the year on which Puget Sound Clean Air Agency's GHG goals are based. 2006 is the earliest year to which plan results can be compared. PSRC estimates 2006 baseline emissions for the on-road sector at approximately 13.0 $MMTCO_2e$ with a 24% reduction equivalent to a 3.1 $MMTCO_2e$ reduction by 2040.

   A. Land use: The RTP land use plan (part of the 24% overall reduction) has a target of 30% of growth near transit. In excess of the RTP, increasing the growth target to 50% to70% around transit stations would result in an additional estimated 2% -4% (by 2040 from 2006 levels) - or an annual reduction of 0.4 to 0.8 $MMTCO_2e$ by 2040. Scaled linearly to 2030, the result is an estimated annual reduction of 1% to 2% MMTCO2e by 2030.

      Using broad metrics and sketch models, the Agency worked with EPA Office of Transportation of Air Quality (OTAQ) to estimate how broad shifts in density, land use, and increased access to

jobs and transit could impact emissions reductions (*All estimates for VMT and CO2e reductions from EPA OTAQ are in draft form and subject to change, January 2018*). The following demographics were modeled for their emissions reductions:

- An increase in population density by 50% (2040 compared to 2040 Baseline-as-usual (BAU))
- an increased accessibility to jobs (by vehicle and transit by 3% and 60%, respectively, 2040 compared to 2040 BAU)
- improved access to transit as measured by a 15% reduction in overall distance to transit stop (2040 compared to 2040 BAU)
- increase in diversity of land use types by 5%

This scenario resulted in an estimated 3.6% in VMT and correlated GHG emissions reductions of 0.62 $MMTCO_2e$ in 2040, compared to 2040 BAU. While we provide EPA's estimate here, we don't include this in our "strong" or "ambitious" scenarios – rather, we use PRSC's estimates for land use.

B. Choices: Implementation of the long-range transit plan and other multimodal components of the integrated transportation plan, with about 80% of population with access to transit service, and 37% with access to frequent transit service is estimated to be part of the overall 24% reduction by 2040 (from 2006 levels). For example, the Sound Transit3 expansion alone includes: An additional 62 miles of light rail (116 miles total, projected to serve 600,000 riders every day); bus rapid transit (BRT) that connects buses into light rail; expanding south line capacity for Sounder Train (up to 40% more passengers); improved walking and cycling routes to stations. ST3 alone is estimated to reduce annual VMT by 314-411 million miles. PSRC estimated an additional 1-2% of emissions reductions could be achieved in 'choices' through a combination of expansion of pedestrian and transit networks, as well as expansion of commute trip options through additional alternative work schedules.

Implementation of the regional bicycle network is also included in the overall 24% reduction, and is estimated to be a small portion beyond the RTP, an increase in commute trip reduction options and an increase in pedestrian access to transit would result in an additional estimated 1-2% in greenhouse gas emissions (by 2040 from 2006 levels) - or an annual reduction of 0.1 to 0.2 $MMTCO_2e$ by 2040. Scaled linearly to 2030, the result is an estimated annual reduction of 0.05 to 0.1 $MMTCO_2e$ by 2030.

Using broad metrics, the Agency worked with EPA OTAQ to estimate how an expansion of the CTR program (from employers >100 to employers>50) could impact emissions. This expanded the program from 727,000 employees covered in 2040, to 884,000 covered, and resulted in a 0.09% annual reduction in VMT (2040 compared to 2040 BAU). This correlated to an annual reduction of 0.01 MMTCO2e in 2040 (compared to 2040 BAU).

OTAQ also estimated how a higher income threshold for the ORCALift program could impact emissions. This expanded the ORCALift program to 390,000 eligible in 2040 (compared to BAU estimate of 220,000 eligible) and resulted in a reduction in VMT of 1.8%, and a resulting annual reduction of 0.13 MMTCO2e in 2040 (compared to 2040 BAU). This reduction is likely a high end estimate, with a gross assumption that all who are eligible would participate. While we provide the EPA estimates, these were not included in either the "strong" or "ambitious" scenarios – instead, we use values provided by PSRC.

C. Technology: implementation of current CAFÉ standards and projected turnover of fleet is estimated by PSRC to be part of the overall 24% reduction by 2040 (from 2006 levels). Beyond the RTP, an increase in the rate of EV use (25% - 50% of total fleet by 2040) as well as fuel and heavy duty improvements yields additional 20-40% additional emissions reductions (by 2040 from 2006 levels). Mechanisms to increase EVs, as well their evaluation, are included under Action I.

D. User fees: a combination of express toll lanes, road usage charges ($0.05/mile and $0.10/mile peak), parking fees, and certain facility tolls are estimated by PSRC to be part of the overall 24% reduction by 2040 (from 2006 levels). Beyond the RTP, greater road usage charges ($0.15/mile during on peak) could yield an additional 5% GHG emissions reduction (by 2040 from 2006 levels). Evaluation of user fees is evaluated under Action VII.

2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects
Mode shift and land use that minimize SOV trips ultimately reduce vehicle miles traveled. This VMT reduction would result in fewer criteria and toxic emissions associated with light duty vehicles, and improved air quality and public health. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $7.9 million to $39.7 million in 2030.

Practical

3. Expected technical, practical, market probability of achieving the emissions reductions
   A. Land use - Our jurisdictions regularly incorporate land use planning requirements into their comprehensive plans, in coordination with PSRC. Current land use assumptions, and the drive for targeted growth, seem achievable. It's less clear how much more challenging the 'above and beyond' growth (50-70% vs. 30% near transit) will be to achieve, and what additional land use changes will be identified as part of VISION2050.
   B. Choices - Similarly, transit agencies and ST3 specifically had broad public support, given congestion in the rapidly-growing Puget Sound area. Emissions reductions tied to increased transit access seem achievable.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
   A. Land use –
      i. PSCAA would not likely directly implement – rather, it would be PSRC as well as our local jurisdictions that create their own growth plans in accordance with VISION2050.
      ii. An appropriate role for the Agency could be to participate in VISION2050 to help ensure both land uses as well as other actions (e.g. infrastructure for EVs) are addressed and supported.
      iii. Barriers could include reluctance from jurisdictions to implement dense growth; also pushback from residents experiencing growth negatively (e.g. growth without the proportionate transit support).
   B. Choices –
      i. PSCAA would not implement (largely) – rather, it would be partners at transit agencies as well as cities and counties engaged in the integrated transit network. Other potential partners include Commute Trip Reduction and advocacy organizations like Transportation Choices, Cascade Bicycle, Feet First, etc.
      ii. A potential role for the Agency could be to try to influence the commute trip reduction (CTR) program – and to explore innovative ways to divert SOV commute trips (telework,

greater rideshare, etc.). This could include potentially working directly with large employers for pilot studies. If desired, we could explore ability to implement a regulatory CTR if voluntary pilots/measures not effective and/or inability to affect statewide CTR. There could be potential to tie in commuting with an indirect source rule – e.g. either for large employers or congested roadways (Action IX). Similarly, there could be synergy with user fees – many of these could be structured to reduce single occupancy vehicles (Action VII).

5. Ability to begin action soon.
   A. Land Use - By definition, changing land use patterns and increasing density is slow to achieve. Achieving potential land use changes beyond the current RTP (e.g. those included in VISION2050) could take even longer to achieve.
   B. Choices - Building the infrastructure for the integrated transit network will take time. For example, estimates for ST3 – one component of an integrated transit network - place additional stations in the 2023 through 2041 timeline, given requirements for public engagement and EIS process, final design, construction, and safety certification and testing for each station and line. Work on the CTR, expanding income access to transit could potentially take place more quickly because they don't have the constraints of a physical building timeline.

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. Land Use - By definition, this action is highly compatible and leverages and builds with and upon the transportation planning processes at PSRC.
   B. There are several community groups/efforts (e.g. transportation choices) involved in expanding transit access.

7. Consistency with state or national transportation GHG reduction efforts.
   A. Several metropolitan areas have identified changing land use patterns and increasing density and access to transit as a way to reduce GHGs. An example includes the Bay Area Air Quality Management District (BAAQMD). Their GHG plan estimates a reduction of 22,275 $MTCO_2e$ annually by 2030 due to changes in land use.[9]
   B. The BAAQMD also includes provisions to expand transit and regional rail service – combined, they estimate approximately 70,000 $MTCO_2e$ reduced annually. They also include pedestrian and bicycle measures such as safe routes to school and bicycle and pedestrian facilities – together they estimate just below 10,000 $MTCO_2e$ reduced annually from these measures.

8. Likelihood of providing a useful example for other regions.
   A. Our experience could be added to other areas to provide examples for other regions looking to reduce their GHG emissions.

Legal

9. The Agency will continue to evaluate pertinent legal questions throughout the process.

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness.

Applying the SCC to the actions above and beyond the RTP for just 'choices' and land use, e.g. those considered here for potential Agency action in Action VI, the benefits could range from $25m to $33m per year in 2030. Reduction of GHG emissions: 0.2 to 0.4 $MMTCO_2e$ per year reductions in 2030 - $3.7m to $16.6m/year and $7.3m to $33.4/year (discount rates of 5% and 2.5%, respectively).

A. Historically, Puget Sound residents have used approximately 2% of their personal income on public sector transportation. The PSRC RTP expects to keep just below this 2% expenditure in the future continuing to support the regional transportation networks. The plan states that:

> "The financial element of the plan provides a comprehensive picture of the financial requirements to maintain and improve the region's transportation system. The transportation improvements identified in the plan are estimated to cost approximately $197 billion (year 2018 constant dollars) between 2018 and 2040, including over $105 billion to operate, maintain, and preserve the existing system."[10]

Additionally:

> "Most new sources would involve some type of new legislative authority or approval. And as such the new revenue expectations should be taken as a blueprint for action and not a prescription of exact details relating to granting and implementation of revenue authority."

PSRC's general assumption is that through the implementation of the RTP the wide-ranging benefits include monetary savings from reduced congestion and fuel consumption. Through the use of transportation demand management systems, they will help improve transit infrastructure and services by making "lower-cost high-efficiency operations easier to use and more readily available".

Community

11. Expected community benefits and social effects, including geographic and demographic breadth and equity of those effects.
    A. Land-Use: Under land-use scenarios, there is potential displacement of low-income residents in communities where density is prioritized around transit hubs (pricing-out). This could potentially force low-income individuals further out of city-center driving up transportation costs for those displaced individuals. If there is limited transit access where individuals are pushed out to then there could be compounding issues regarding congestion. A potential way to mitigate 'pricing out' could be to set requirements for developers to build affordable housing near urban centers or transit hubs so workers can easily use transit or alternative transit options to commute to work. Additionally, incentives from employers (e.g. health premium reductions, free transit passes) to get workers to live closer to work.

> Transit hubs may draw sources of pollution with ICE use (e.g. Park and Rides). The Agency, PSRC, and partners will need to determine what reductions in emissions or transportation management systems could help mitigate transit sources of pollution around hubs.

Our discussions with focus groups highlighted that these groups, often representing low-income communities, value investment in infrastructure for alternative transportation, such as the increasing sidewalks and bicycle lanes. Suggestions have gone as far as having a moratorium on vehicle use in some locations.

B. Choices (mode shift): Promotion and investment in mode shift could center on reducing reliance on SOVs for transportation and increasing the viable of alternative modes of transportation (e.g. bike/ped). Overall increase in transit access, especially among low-income communities and rural populations.

Employers could be required, along with other CTR programs, to allow for these programs to benefit workers who have non-peak commute schedules (e.g. overnight shift). Employer participation in CTR programs could include more stringent enforcement measures (record keeping and reporting requirements).

Improvements in “last mile” transportation access for outlying communities or for workers who have long distance commutes with limited transit options would be helpful. These could include increased van pools, electric vehicle shuttles (specific to communities/neighborhoods), and expanded bike share programs.

Evaluation of Candidate Action VII

(Evaluate PSRC Regional Transportation Plan (RTP) 2040 update "User Fees" outcomes)

Synopsis of Action

Candidate action 7 evaluates and assesses the "User Fees" portion of PSRC's updated RTP, in parallel to Action 6. Implementing fees such as road usage fees currently identified as 5 cents/mile off-peak and 10 cents/mile on-peak could be examined to determine if the Agency will advocate for more stringent fees to gain additional GHG emissions reductions.

Summary

Emissions reductions and air quality impacts: Similar to candidate Action 6, the Puget Sound Regional Council used 2006 as a base year to assess GHG emission reductions, unlike PSCAA, which uses 1990. For the RTP, PSRC estimates a 24% reduction from 2006 baseline for the on-road transportation sector which equates to GHG emission reductions of 3.1 $MMTCO_2e$ by 2040. If additional actions under "User Fees" were pursued, PSRC estimates additional annual reductions are possible in 2040. Scaled linearly to 2030, the result is an estimated annual reduction of 0.3 to 0.6 $MMTCO_2e$ per year in 2030. Driven by a reduction in vehicle miles traveled (VMT) from the introduction of a road-usage charge, a qualitative estimate is that criteria air pollutants could be moderately reduced with the overall reduction of GHG emissions.

Approach to implementation: Puget Sound Regional Council has proposed additional action in each of these four sub-actions to further increase and accelerate GHG emissions reductions. In their "User Fees" category, PSRC modified a possible road-usage charge scenario to potentially increase during on-peak hours (to 15 cents/mile) and decrease during off-peak hours (2.5 cents/mile). The objective of the financial strategies of the RTP is to maintain adequate funding for the region's transportation infrastructure. They have not fully explored additional financial revenues to support projects to reduce GHG emissions. The "User Fees" strategy within the RTP also includes express toll lanes, license and registration fees, transit fares increases; vehicle fuel and excise taxes; and other pricing strategies.

A key question under this action is whether or not the Agency should consider pursuing additional actions beyond the scope of the RTP, including those which could support or fund projects to reduce GHG emissions. An appropriate role for the Agency could be to participate in venues like the State Transportation Commission to encourage user fees that seek to minimize VMT and congestion beyond the financial objective to address the projected gasoline tax funding gap. In addition, the Agency explored increasing road usage fees to 15 cents/mile for all trips in a separate analysis with EPA OTAQ, though we include only PSRC local emission estimates for this candidate action.

Potential community & economic costs/benefits: Applying the Social Costs of Carbon to the GHG emission reductions gained from the maximum level of 'above and beyond' user fees actions, the benefits range from $11 million to $50 million per year in 2030. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $15.7 million to $79.3 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. The Puget Sound Regional Council's general assumption is that through the implementation of the RTP, the wide-ranging benefits include monetary savings from reduced congestion and fuel consumption.[11] Some considerations should be taken into account when identifying 'user fees'. Low-

income and rural communities that are being pushed from the urban core may need to drive further distances; without mitigation strategies, a road-usage tax could be regressive for these individuals. People might also identify ways to get around tolls (through local roads) and cause traffic and air pollution levels to increase in other areas. A combination of incentives, outreach, and education (potentially funded by usage fees) could help to reduce barriers, increase public support, and ultimately support behavior change and reduce SOV use.

Analysis and Results

Emissions-Reducing

1. Expected GHGe emissions reductions in 2030.
   A. As part of their RTP, PSRC included implementation of user fees and more specifically road usage charges in its total estimate of 24% reduction of GHG emissions (2040 from 2006). The total estimate includes other actions like fleet turnover, transit, and land use changes. The underlying assumption for the road usage charge is $.05/mile off-peak and $.10/mile peak. PSRC also modeled a scenario with up to $.15/mile assessed for peak travel and estimated an additional 5% of GHG emissions possible.

   In addition, using broad metrics and sketch models, EPA OTAQ modeled VMT pricing of $0.15 per mile (overall, not just peak hours). Compared to a 2040 'BAU' rate of $0.10 per mile, the additional charge resulted in possible annual VMT reductions of 3.2% and GHG emissions reductions of 0.24 $MMTCO_2e$ in 2040. While we include EPA's estimate here, PSRC's value is included in the "ambitious" scenario.

2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects
   A. Driven by a reduction in vehicle miles traveled (VMT) from the introduction of a road-usage charge, we anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $15.7 million to $79.3 million in 2030.

Practical

3. Expected technical, practical, market probability of achieving the emissions reductions
   A. In theory, charging differential road usage fees will affect VMT by increasing drivers' awareness of the 'hidden costs' of driving, thus influencing behavior to minimize cost/VMT. Charging higher fees at peak times in theory could reduce congestion as well. Most of the road usage charge studies to date have been limited pilots – there are no large scale programs to point to definitive results.[12] Pilot studies do indicate that drivers who participated did make changes to their driving behavior, with a modest decrease in VMT.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
   A. This would likely not be implemented by the Agency, but rather by state partners. More information is needed to understand how such a system could work, or who would deliver it, on a regional scale.

5. Ability to begin action soon.
   A. Compared to projects that require building of robust infrastructure, road usage charges could begin relatively soon. The Regional Transportation Plan has road usage charges taking place past

2026. It seems unrealistic to move this date any sooner, in particular unrealistic to get ahead of the current pilot study in Washington State – would want to utilize findings of the just-starting pilot project to inform design. [Currently, the Washington State Transportation Commission is recruiting 2,000 volunteers to participate in a statewide pilot to track their mileage. Volunteers will have the ability to record miles using an odometer (low tech), or use a GPS unit, or at the most high tech end utilize an app to seamlessly record miles driven. The year-long pilot is designed to address the feasibility of road usage charges: how people would record their miles, how participation would impact miles driven, etc.].

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. This is clearly compatible with PSRC's RTP, as it's included within their plan. Going "above and beyond" the proposed fees could fundamentally shift the conversation around road usage fees. Currently they're proposed primarily as a way to address a funding gap, with other potential co-benefits.

7. Consistency with state or national transportation GHG reduction efforts.
   A. Road usage charges are being explore all along the west coast:
      I. Oregon has a road usage charge pilot "OreGo" in place since July 2015, with a mileage fee of 1.25 cents/mile.
      II. British Columbia, and specifically the city of Surrey, is exploring road usage charges in upcoming pilots as well.
      III. BAAQMD includes "value pricing" in its transportation measures, and estimates that doing so will reduce ~275,000 MT CO2e annually by 2030).
      IV. California DOT completed a 9-month pilot in March 2017 with 5,000 drivers and a range of options for reporting VMT – low to high tech. Low tech options are more resource-intensive to administer, while offering the tradeoff of more privacy for participants. Lots of examples here – fill out later: http://www.dot.ca.gov/road_charge/news/.
   B. There are also examples across other states: for example, Minnesota completed a pilot study with 500 drivers to test the ability to implement a more broad-scale program.

8. Likelihood of providing a useful example for other regions.
   A. Road usage charge pilots are being implemented across the states, including a few internationally. Findings here at a local level could add to that body of research.

Legal

9. The Agency will continue to evaluate pertinent legal questions throughout the evaluation process.

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness.

    Applying the SCC to the actions above and beyond the RTP for just 'user fees' for potential Agency action in Action VII, the benefits could range from $5.5m to $50.1m per year in 2030. Reduction of GHG emissions: 0.3 to 0.6 MMTCO2e per year reductions in 2030 - $5.5m to $25m/year and $10.9m to $50.1/year (discount rates of 5% and 2.5%, respectively).

i. Historically, Puget Sound residents have used approximately 2% of their personal income on public sector transportation. The PSRC RTP expects to keep just below this 2% expenditure in the future continuing to support the regional transportation networks. The plan states that:

> "The financial element of the plan provides a comprehensive picture of the financial requirements to maintain and improve the region's transportation system. The transportation improvements identified in the plan are estimated to cost approximately $197 billion (year 2018 constant dollars) between 2018 and 2040, including over $105 billion to operate, maintain, and preserve the existing system."

Additionally:

> "Most new sources would involve some type of new legislative authority or approval. And as such the new revenue expectations should be taken as a blueprint for action and not a prescription of exact details relating to granting and implementation of revenue authority."

With the phasing in of newer technologies and the increase in fuel efficiency of new vehicles, the long-run viability of a fuel tax comes into question. The implementation of a road-usage fee will supplement the lost revenue from those lost to fuel taxes in the future. It is uncertain whether the fuel tax will be removed or phased out incrementally.

Community

11. Expected community benefits and social effects, including geographic and demographic breadth and equity of those effects.
    A. Low-income communities are being pushed from the urban core and would need to drive further distances, same with rural communities; a road-usage tax could be regressive for these individuals. However, road usage charges are potentially less regressive than simply continuing the gasoline tax, which penalizes older vehicles with lower MPG. Other user fees such as congestion pricing and tolls could also be regressive – may benefit non-traditional workers (outside of 9am-5pm work schedules). There are already costs from congestion for our region's residents including lost time and stress. People may identify ways to get around tolls (local roads) and cause air pollution levels to increase in other areas. Increased parking fees could be used to deter SOV travel, but may negatively impact those who need to use vehicles due to limited transit options. Fees and taxes are more apt to successfully change behavior and reduce SOV use when combined with incentives, outreach, and education.

Evaluation of Candidate Action VIII

(Incentivize production and use of renewable diesel or renewable natural gas)

Synopsis of Action

Candidate action 8 aims to incentivize the production and use of renewable diesel and renewable natural gas in the Agency's four-county jurisdiction. Conceptually, this could be achieved by providing funding assistance (tax breaks, loan guarantees, contracts, or other) for the construction of renewable diesel and renewable natural gas facilitates. A per-gallon or per-BTU subsidy that stimulates a set volume per year of renewable diesel or renewable natural gas can also incentivize production and use of these fuels. Potential sub-actions include:

- **8A.** Regulate methane emissions or flaring to stimulate RNG production in the region
- **8B.** MTCA or similar toxics regulation that imposes a tax or fee on diesel to subsidize alternates.
- **8C.** Local government fleets have RFP or bid for fuel purchase with required GHG reductions by 2030
- **8D.** Assuming funds available, back or secure loans for RD plants
- **8E.** Assuming funds available, back or secure loans for RNG digesters or capture and processing for municipal, agriculture, and smaller facilities
- **8F.** Assuming funds available, provide subsidy to vendors or fleets in our region for biofuel
- **8G.** Biofuel mandate for every gallon sold, starting at B20 and ramping up with renewable diesel (local production and feedstocks, considering carbon intensity)

Summary

Emissions reductions and air quality impacts: Incentivizing the production and use of renewable natural gas and renewable diesel could achieve a maximum of approximately 1.6 $MMTCO_2e$ GHG emissions reductions within the transportation and mobile sector in 2030, depending on the sub-action taken. Similar to candidate Actions 3 & 4, a thorough analysis of life-cycle emissions of renewable diesel and renewable natural gas would be required to determine specifically which pollutants would be reduced and by what amount. Further analysis of the introduction of new industrial facilities will also have to be monitored, as these could potentially introduce new (likely modest) emissions in areas where facilities are operating. Overall, we would expect to see a reduction in air pollutants and improvement in air quality across the region.

Approach to implementation: All of the sub-actions identified are designed to work towards promoting RNG/RD production and use in our region. Each strategy is technically feasible with nascent markets already in our region; the mandates and additional incentives could help to grow the industry. The Agency could potentially examine whether a methane regulation may be feasible and worthwhile within our jurisdiction. Our partners, such as counties and cities, may be better equipped to implement a toxics tax similar to that of the MTCA for fossil fuels at the regional level. Although substantial dedicated funding may be needed, the strategies incentivizing and subsidizing RD/RNG production could be administrative programs run by the Agency. These programs could be financed through taxes or regulatory fees from other strategies in this candidate action (e.g. 8B) or other potential sources.

Potential community & economic costs/benefits: The Social Costs of Carbon (cost-benefits) range from $30 million to $134 million per year in 2030 (depending on discount rate) if maximum emissions

reductions are realized. The range represents both different discount rates, as well as a range of underlying health studies. We were unable to quantify the anticipated economic health co-benefits at this time. Upfront investment capital for renewable diesel and renewable natural gas facilities are substantial. A renewable diesel plant's capital costs could be approximately $300 million. For modifications to an existing natural gas plant to enable it to manufacture RNG, upfront capital costs depend on the type of feed stock and could be as high as $0.5 million. Based on current pricing, subsidies of around $1.00 - $2.00/gallon of RD/RNG could be needed to incentivize the purchase of these low-carbon fuels. Combining this candidate action with candidate action 4 (LCFS) could stabilize the market in our region. The Agency will need to consider where facilities would be built and build in strategies to mitigate/offset potential new emissions in areas that may already have existing air quality issues. The development of new industry in the area may have some economic benefits to our region/state as well, with new jobs for alternative fuel production.

Analysis and Results

Emissions-Reducing

1. Expected GHGe emissions reductions in 2030.
   A. A methane regulatory approach that reduced fugitive, flared, or wasted methane by capturing and converting to RNG (and displaced diesel) would reduce transportation GHGs by at least 0.7 MMTCO2e/year, about 5% of total transportation.
   B. A $0.50/ gallon tax on diesel fuel would bring biodiesel to parity and could reduce diesel GHGs by approximately 20% (B20 everywhere). This would be similar to Action 3, but would apply only to diesel fuel (instead of diesel and gasoline). Excluding on-road gas from the 2015 inventory, the ratio of diesel is roughly 0.3. Applying this to Action 3 (0.9 MMTCO2e), the result is 0.3 MMTCO2e.
   C. A 100% reduction in government fleets (no petro fuel, RD with local feedstock) in 2030 would reduce GHG emissions by about 0.3 MMTCO2e, ~ 1.8% of total GHGs.
   D. No method to constrain actual reductions from just an investment approach, but reasonable volume is about 100 Mgal/year of RD - ~ 0.8 MMTCO2e or ~ 5% of total transportation.
   E. Similarly, a no way to constrain actual reductions from just an investment approach, but a RNG upper limit (50% of methane to RNG) is about 0.7 MMTCO2e or 5% of total transportation.
   F. Subsidy for biofuels – Similar to action 8B (0.3 MMTCO2e)
   G. Biofuel mandate – See action 8B (0.3 MMTCO2e)

2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects
   a. A thorough analysis of life-cycle emissions of alternative fuels could be required to determine specifically which criteria pollutants will be reduced and by what amount. Overall, we expect to see a reduction in criteria and toxic air pollutants, with potentially greater air quality co-benefits in communities that have heavy transit and diesel use.

Practical

3. Expected technical, practical, market probability of achieving the emissions reductions
   A. Methane capture and processing has demonstrated to be cost effective in many cases. With a modest emissions fee or production subsidy this could have a moderate likelihood of success with proven emissions reductions.

B. Multiple biofuels and options are available and technically feasible. A modest subsidy to aid biodiesel at the pump, RNG production/conversions, or bulk buys, could result in price parity or a gain for alternative fuels in the region. Moderate likelihood of success with known emissions reductions.
C. Biodiesel production has been demonstrated in the region and could be expanded for the local government need by 2030. This matches current state efforts. Could easily be pursued if state effort fails. High likelihood of success.
D. Facilitate a loan/bid for facilities to produce large volume of biofuel by 2030 with carbon intensity (CI) stipulations and additional requirements for local sales volume. Low likelihood of success. Would require a significant sum of money as well as substantial administrative/auditing requirements.
E. Assuming funding available, action is technically sound and generally economically viable and even profitable. If multiple smaller projects are assumed this would indicate a potential low-moderate likelihood of success. Similar to above strategy though, this would require a significant sum of money to implement.
F. Assuming funding is available, this strategy could provide subsidy at point of sale or directly to vendor. It is unclear if a large scale shift in production or consumption would occur and benefit would be directly tied to size of subsidy. This potentially has a low likelihood for long-term shift, high likelihood for direct per-dollar benefit.
G. If a range of biofuels are able to meet mandate requirements, and if most are close to cost parity (Assuming is legally and politically feasible). Moderate likelihood of success.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
   A. Regulate methane emissions or flaring to stimulate RNG production.
      i. The Agency could examine how it would regulate.
      ii. Determine what monitoring requirements are needed in addition to inspectors/engineers for compliance. Program administration may be needed which would potentially require additional staff resources.
   B. MTCA or similar toxics regulation that imposes a tax or fee on diesel to subsidize alternates.
      i. Partners, such as cities or counties, may be better equipped to impose an excise tax on fossil fuels (e.g. ~2 cents).
      ii. The Agency could take an advocacy approach to work with partners to adopt tax. If Agency will administer program, increases in staff capacity to run program could be required.
      iii. Partners, such as cities and counties, may be resistant to implementing any sort of tax (political barriers). A small tax may not have any significant equity issues, but would need to consider impacts. Additional Agency resources will be needed to run any program.
   C. Local Gov't fleets have RFP or bid for fuel purchase with required GHG reductions by 2030
      i. This candidate action could be administered by city/county fleet managers.
      ii. The Agency could help to administer through identifying fuel sources and determine compliance with CI fuels. This may require additional staff capacity.
      iii. The burden of costs would be on the public sector. It's unclear at this time how these costs will be distributed. Larger fleet budgets, workforce reductions to recoup costs, and potential fare increases are possible scenarios (among others). The Agency may need additional capacity to help administer program, including IT resources.
   D. Assume funds available, back or secure loans for RD plants.
      i. If funding is available the Agency could administer program.

ii. It would need to be determined where funds are coming from, grants, capital funds, or state monies - administer program to distribute loans. Would require potential work with financial institutions to secure loans and agreements.
iii. Costs, in terms of financial risks, would potentially be high with unknown funding sources. High risk to give out loans that are tied to Agency or other financial partners. Additional resources needed for agency to administer program.

E. Assume funds available, back or secure loans for RNG digesters or capture and processing for municipal, agriculture, and smaller facilities.
   i. The Agency could administer program (e.g. revolving loan program).
   ii. Determine where funds are coming from, grants, capital funds, or state monies - administer program to distribute loans. Would require additional staff and potential work with financial institutions to secure loans and agreements.
   iii. Cost would potentially be high with an unknown funding source. Revolving loans reducing financial commitment though would still need to consider complexity and number of projects. May need backing from financial institution or government agency (e.g. State Treasury/Department of Commerce).

F. Assume funds available, provide subsidy to vendors or fleets in our region for biofuel
   i. The Agency could administer program.
   ii. Determine where funds are coming from, grants, capital funds, or state monies and administer program to distribute subsidy. May require additional Agency staff to administer program. Subsidy may be funded by other GHG reduction actions that implement taxes or fees.
   iii. Costs could be significantly high – would need to determine funding sources. Additional agency resources would be needed to implement.

G. Biofuel mandate starting at B20 and ramping to X by 2030 of every gallon sold (local production and feedstocks, considering carbon intensity, and conscious of source [e.g., no palm oil]).
   i. Partners, such as counties could be better equipped to implement through regulation/law.
   ii. The Agency could take an advocacy approach to work with partners to help adopt regulation. Agency may be required to administer program by determining carbon intensity of fuels.
   iii. Counties may be resistant to implementing any sort of regulation (political barriers). Fuel could potentially be more expensive which may impact low-income individuals. Would need expanded local production and feedstocks to meet demand to keep costs low.

5. Ability to begin action soon.
   A. Each of the strategies listed for this action would potentially be implemented as soon as feasible. In most cases, when regulatory authority has been established and taxes/fees established actions could be implemented as soon as possible, likely 2019-2020.
   B. Strategies that require funding sources for loans or subsidies would be implemented as soon as program structure is in place. These strategies would be likely in the 2019-2020 timeframe as well.
   C. Developing a RNG or RD facility, either from scratch or by retrofitting older plants, could still take up 3-5 years before the production of fuel would be considered a consistent source.

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. There are currently facilities in Washington State that produce renewable natural gas (e.g. Cedar Hills) which gives precedent for expanding the industry in this area. There are no renewable diesel plants in the region, though companies like US Oil have expressed interest in retro-fitting

some of their petroleum refineries to produce renewable diesel. Additionally, REG has expressed interest in expanding their operations into renewable diesel (Grays Harbor, WA).

7. Consistency with state or national transportation GHG reduction efforts.
   A. Currently there are federal rules for methane releases at landfills which require at a minimum, flaring. EPA has a methane-outreach program (LMOP) which is a voluntary program to reduce methane emissions. California Air Resource Board also has methane reduction programs. These rules/regulations could be modified to increase regulatory authority over methane releases.
   B. Oregon and California have fully fledged businesses in renewable natural gas and renewable diesel buoyed by the States LCFS which can be implemented in any jurisdiction that can sustain and promote these types of businesses.
   C. Many states have biofuel mandates. For example, Oregon has a B5 mandate and Minnesota has a seasonal biofuel mandates, B20/B5.
8. Likelihood of providing a useful example for other regions.
   A. Most of these technologies and businesses are already established so our region would not be a useful example, but would use other areas as examples to initiate a biofuel mandate, or establish RNG and RD facilities here.
   B. In the case of methane emission regulation, we could provide an example of a program that identifies, measures, and monitors then regulates methane emissions from a variety of sources.

Legal

9. The Agency will continue to evaluate pertinent legal questions throughout the process.

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness.
    A. By regulating methane emissions from flaring and incentivizing RNG production (8A) the SCC benefits from this reduction in GHG emissions could amount to a 0.7 $MMTCO_2e$ reduction would amount to $12.8 to $58.4m per year (discount rates of 5% and 2.5%, respectively)
    B. SCC benefits from reduction of GHG emissions: (8C) By reducing 0.3 $MMTCO_2e$ by 2030 could amount to $5.5 to $25m (discount rates of 5% and 2.5%, respectively); (8D) a reduction of ~1.6 MMTCO2e/year would amount to $29.2 to $133.5m per year (discount rates of 5% and 2.5%, respectively); (8E) an upper limit for 0.7 $MMTCO_2e$ by 2030 could amount to $12.8 to 58.4m (discount rates of 5% and 2.5%, respectively).
    C. Additionally, we need to consider that a renewable diesel plant capital costs are approximately $300M. Renewable natural gas upfront capital costs depend on type of feed stock; for example upfront costs for a dairy farm RNG could be approximately $300K with $50K annual benefits.
    D. Current subsidies of around $1.00 - $1.50/gallon would be needed to incentivize the purchase of low-carbon fuels. In the near future, 2019-2020, subsidies of around $1.50 - $2.00/gallon could be needed as low carbon fuel standards in surrounding regions (California, Oregon, and Canada) increase and it becomes more profitable for local producers to sell fuel to these areas instead of keeping it in Washington (without a LCFS).

Community

11. Expected community benefits and social effects, including geographic and demographic breadth and equity of those effects.
    A. Regulations for methane emissions would have positive air quality benefits for surrounding areas.
    B. A regulation to implement a toxics tax could be regressive for low-income diesel truck drivers who own their own vehicles (independent contractors). This may apply to the operators on other M/HDVs who depend on these types of vehicles for their livelihood.
    C. If fuel prices go up for transit vehicles, fare prices could potentially increase. Additionally, to save on operational costs, transit agencies may cut routes and frequency of service in certain areas. This would benefit overall air quality in communities that have heavy transit use. There could be potential impacts to low-wage workers if numbers of transit vehicles or routes are reduced Reductions in fuel costs through widespread electrification (which is already a goal for most fleets) may avoid any such outcomes. (D – F) Depending on where facilities are built, there could be minimal local impacts on air quality due to industrial processes. We heard from focus groups that there may need to be pathways specifically to include communities of color so that they can participate in and benefit from economic shifts in the industry (e.g. biofuel production).
    G. Fuel costs could increase, which would have a greater impact on low-income and rural communities that need to drive more and thus spend more on fuels. Potentially have a greater impact on improving air quality since it will be adopted equally across the region instead of based on price structure for purchasing low carbon intense fuels – less regressive than a fuel tax system. A potential increase in the production of low-carbon intense fuels could be beneficial for the development of an industry in the region or state. This could create more jobs depending on the location of these industries. Our focus groups expressed an interest in workforce development and training opportunities for low-income individuals and persons-of-color.

Evaluation of Candidate Action IX

(Overall GHG limits on major activity centers)

Synopsis of Action

Candidate action 9 seeks to reduce GHG, criteria, and toxics pollution from mobile sources that are A) drawn to large activity centers such as SeaTac airport, a stadium, or major goods distribution centers; or B) drawn to specific routes or sections of I-5 and 405 during commute hours which have caused the flow to exceed road capacity and thus generated excessive emissions primarily due to congestion. Also known as an "indirect source rule" (ISR), the Agency could set a GHG emission limit and require facilities to report and reduce emissions by a set amount/percentage by a target date. For example, A) a large activity center, like SeaTac airport, may be required to largely eliminate GHGs from ground operations, a 50% reduction in landing and take-off (LTO) emissions (similar to their biofuel target), and a 50% reduction in non-preferred (higher GHG, low vehicle occupancy, etc.) trips by 2030. or B) all employers and businesses with more than 40 employees, or businesses/events/locations that draw more than 500 cars/day or more than 100 cars during peak commute hours must develop CTR/transit plans to reduce SOV trips/visit.

Summary

Emissions reductions and air quality impacts: If implemented, an Indirect Source Rule at either a regional airport or among specific activity centers that draw mobile sources to a centralized location, the GHG emissions reductions would be approximately 0.4 $MMTCO_2e$ per year in 2030. These reductions could also depend on the targets set for each area in which an Indirect Source Rule is applied. There would be a decrease in air pollutants from the reduction of vehicular traffic to and from these activity centers, with greater improvements in air quality in locations near identified activity centers (in this example, near major roadways and regional airports).

Approach to implementation: An ISR likely would require a substantial stakeholder and public input process to inform rule development. An ISR has been successfully implemented in other regions, specifically for land development and construction activities, although the Agency would be exploring developing an ISR outside of new land-development projects.

Potential community & economic costs/benefits: The Social Costs of Carbon could amount to cost-benefits of approximately $7 million to $33 million per year in 2030 if emissions reductions from an airport ISR were achieved. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $15.7 million to $39.7 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. If an ISR significantly reduced road congestion, the annual benefit could exceed $1 billion per year, just for wasted fuel and time.[13] Alternatively, reduction of vehicle trips to major activity centers (e.g. SeaTac), the gas savings could be approximately $10 million per year in 2030, depending on location. To estimate the economic costs of a potential ISR for regional airports or major activity centers, the Agency could consider what costs are associated with reducing GHG emissions in these areas. For example, current bio-jet fuel is about $0.40 - $2.70 more per gallon more than petroleum-based jet fuel. This could cost $10-70 million for the aviation fuel if a requirement were set for regional airports to reduce emissions through the introduction of aviation biofuels, although new developments could reduce those costs over time.

Additionally, there could be other associated costs to businesses or consumers within a designated emission reduction zone identified by an ISR.

In developing the ISR, the Agency would identify the areas where emissions need to be reduced; the regulated entity would define how those reductions occur in the designated area. The Agency would also need to consider how potentially reducing congestion or traffic to major activity centers could impact low-income communities and others who rely on SOV transportation to either jobs or other necessary businesses that fall within these emissions reduction zones. And although air pollution would decrease in designated locations, areas just outside the inclusion zone of an ISR could be impacted by congestion, parking issues and increased air pollution. The Agency should also consider the different equity implications while exploring how an ISR could be implemented in the region. For example, to reduce the negative impact to small businesses, those businesses that fall within an ISR area could have scaled requirements according to size, with the larger businesses bearing a greater burden since they draw more mobile sources than smaller businesses.

Analysis and Results

Emissions-Reducing

1. Expected GHGe emissions reductions in 2030.
    a. As a percentage of total transportation, ground operations 0.5%, "Non-preferred" trips to SeaTac 1%, LTO 4.8%. Assuming 50% reduction in LTO per biofuel target, 50% reduction in "non-preferred" trips, and 100% reduction in ground operations, this would yield a reduction of 3.5% of total transportation, about 0.5 $MMTCO_2e$/year.
    b. The upper limit for the direct traffic reduced would be about 2% of total transportation. The upper limit for the indirect effect of eliminating traffic delays would be about 5%. Combined, a conservative projection for efficacy would be about 4%, or about 0.5 $MMTCO_2e$ per year.

2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects.
    a. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $15.7 million to $39.7 million in 2030.

Practical

Strategy A: SeaTac ISR example

3. Expected technical, practical, market probability of achieving the emissions reductions
    A. Eliminate GHGs from ground operations: electrification has already occurred for Alaska ground operations, very likely could be done by all remaining carriers. There are no technical barriers and it is economically viable (capital investment returned through lower fuel costs). High likelihood of success.
    B. 50% reduction in LTO emissions: Aviation biofuels have already been demonstrated and approved for general use. Two barriers are cost and availability. Cost would be expected to drop as production volumes increase and the northwest does have capability to produce substantial fraction of biomass as feedstock for local production. Moderate likelihood of success.
    C. Reduce “non-preferred” trips to SeaTac by 50%: SeaTac could promote a range of options to reduce low-occupancy vehicles trips and high GHG trips: SOV parking surcharge or ban onsite SOV parking, more EV charging and DC fast charging, longer-distance satellite park and rides

with low GHG shuttles; vouchers/discounts for shuttles/transit/HOVs, etc. Moderate likelihood of success.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
   A. The direct sub-actions could all be facilitated by the Port (SeaTac airport), so the Agency's only ongoing work would be to review progress reports. The main task for the Agency would be to draft and promulgate the Indirect Source Rule. This could require a substantial stakeholder input process, rule writing, and public input.

5. Ability to begin action soon.
   A. The stakeholder input process could begin within a few months, but the completion of the rule and promulgation would likely take 1.5- 2 years. The work by the Port would begin after that point and so initial effects likely wouldn't occur until 2-3 years. This would place us in an early 2020's timeframe for implementation.

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. The goal aligns with the initiatives of the Port, the county, and Puget Sound Regional Council. But, the specific targets are more aggressive.

7. Consistency with state or national transportation GHG reduction efforts.
   A. Indirect Source Rules were originally proposed in the 1970s, when the U.S. EPA was criticized for making state air quality plans but failing to maintain air quality. The courts proposed ISRs to allow for air quality maintenance and to incorporate air quality into planning, but resistance from the building and development industries succeeded in limiting the U.S. EPA's authority to implement ISRs. In the Clean Air Act Amendments of 1977, states were allowed to implement ISRs, but they were optional.
   B. In 2005, the San Joaquin Valley wide Air Pollution Control District (SJV APCD) and the Imperial County Air Pollution Control District in California adopted ISRs, which require that developers decrease or mitigate pollution due to future developments, traffic impacts, and overall land use patterns.

8. Likelihood of providing a useful example for other regions.
   A. This action has the potential of providing an example for other regulators, but doesn't provide much for specific solutions to the transit GHG problems. While we can leverage the work that has been done previously in California, we will "break new ground" in applying an ISR to already developed structures or large activity centers like SeaTac.

Strategy B: Road-segment congestion ISR

3. Expected technical, practical, market probability of achieving the emissions reductions
   a. For some employers and locations, it may be difficult to impossible to significantly reduce peak-time vehicle traffic. For a broad scope this action has low likelihood for success. For a narrower subsector of employers, events, or businesses, success could be reasonably easy through transit incentives, teleworking, carpooling incentives, and SOV parking disincentives. For a narrow scope, this action has high likelihood of success.

4. Expected sustainable ability for our agency or our jurisdictions to implement.

a. The direct actions for reducing GHGs would be enacted by the various employers, events, and activity centers. The main task for the Agency would be to draft and promulgate the Indirect Source Rule. This would require a substantial stakeholder input process, rule writing, and public input. The secondary task for the Agency would be to monitor progress reports from all affected parties. These barriers may make the ISR difficult to implement and maintain.

5. Ability to begin action soon.
   a. The stakeholder input process could begin within a few months, but the completion of the rule and promulgation would likely take 1.5- 2 years. The work by the Port could begin after that point and so initial effects likely wouldn't occur until 2-3 years. This would likely place us in an early 2020's timeframe for implementation.

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   a. The goal aligns with the initiatives of Seattle, King County, and Puget Sound Regional Council, and the State Commute Trip Reduction Program. But, the specific targets are more aggressive.

7. Consistency with state or national transportation GHG reduction efforts.
   a. Indirect Source Rules were originally proposed in the 1970s, when the U.S. EPA was criticized for making state air quality plans but failing to maintain air quality. The courts proposed ISRs to allow for air quality maintenance and to incorporate air quality into planning, but resistance from the building and development industries succeeded in limiting the U.S. EPA's authority to implement ISRs. In the Clean Air Act Amendments of 1977, states were allowed to implement ISRs, but they were optional.
   b. In 2005, the San Joaquin Valley wide Air Pollution Control District (SJV APCD) and the Imperial County Air Pollution Control District in California adopted ISRs, which require that developers decrease or mitigate pollution due to future developments, traffic impacts, and overall land use patterns.

8. Likelihood of providing a useful example for other regions.
   a. This action has the potential of providing an example for other regulators, but doesn't provide much for specific solutions to the transit GHG problems. While we can leverage the work that has been done previously in California, we will "break new ground" in applying an ISR to already developed structures or large activity centers.

Legal

9. The Agency will continue to evaluate pertinent legal questions throughout the process.

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness.
    a. Currently bio-jet fuel is about $0.4-2.7/gallon more than petro based, depending on feedstock. This would cost $10-70M for the aviation fuel, ground ops cost unknown, and non-preferred trip reduction is unknown. SCC benefits from reduction of GHG emissions: A 0.5 $MMTCO_2e$ per year could amount to $9.1 to $41.7m per year (discount rates of 5% and 2.5%, respectively).

b. The gas savings would be about $85M/year. INRIX estimates delay value as lost time of $2B for Seattle area. SCC benefits from reduction of GHG emissions: A 0.5 $MMTCO_2e$ per year could amount to $9.1 to $41.7m per year by 2030 (discount rates of 5% and 2.5%, respectively).

Community

11. Expected community benefits and social effects, including geographic and demographic breadth and equity of those effects.
    A. Potential to impact airport workers who commute by personal vehicles, by restricting vehicle types that can access 'activity centers' (e.g. SeaTac). There is potential for a sizable pushback from industry and businesses that would be impacted by an Indirect Source Rule. Areas just outside the inclusion zone for an ISR may be impacted by congestion, parking issues and increased air pollution. Businesses impacted by the ISR may need to be scaled in how they respond; large businesses would bear a greater burden since they draw more mobile sources as opposed to small independently owned businesses. Enforcement of the ISR would need to be carefully considered as independent contractors for large businesses like Amazon, Uber, Lyft, etc., may bear an undue burden if they are specifically targeted. Additionally, adequate enforcement and penalties may be needed to ensure the effectiveness of this rule as a strategy for reducing GHG emissions in the transportation sector.
    B. Improved air quality for people who work inside an ISR inclusion zone. Policy puts onus on source as opposed to individuals. Because of this, ISR may gain more support among environmental and community groups.

Evaluation of Candidate Action X

(GHG requirements on operation of heavy-duty on-road trucks)

Synopsis of Action

This candidate action attempts to reduce emissions from heavy-duty on-road trucks within the four-county region (King, Kitsap, Pierce, and Snohomish). The Agency could either work with partners or directly incentivize tractors (trucks) and trailers operating in the region to use U.S. EPA-certified SmartWay technology, or retrofit vehicles with SmartWay-verified technologies, phased in by a set date.

Summary

Emissions reductions and air quality impacts: The maximum GHG emissions reductions from the use of SmartWay technologies on heavy duty vehicles (tractors (trucks) and trailers) in the region could equal approximately 0.1 $MMTCO_2e$ per year in 2030. SmartWay technology is identified as fuel savings improvement so there should be a proportional reduction in air pollutants with decreased fuel use. The impacts could be varied because they would only occur while the vehicles were moving at highway speeds and so areas with congestion and lower speeds may see little change. A complete picture requires further analysis.

Approach to implementation: SmartWay technologies are technically feasible and widely available for use across the United States. The Agency could potentially benefit by working with partners, such as the Ports of Tacoma & Seattle and private industry, who are better equipped to require or incentivize the use of SmartWay technology. The Agency could also take a supporting role by administering a voluntary program with partners to have tractors and trailers retrofit with SmartWay technologies without the need for enforced regulations.

Potential community & economic costs/benefits: The Social Costs of Carbon cost-benefits could amount to approximately $2 million to $8 million per year in 2030. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $4.1 million to $10.3 million in 2030. The range represents both different discount rates, as well as a range of underlying health studies. This candidate action could potentially reduce diesel fuel consumption and save vehicle owners about $30 million per year in 2030 through direct fuel savings. Payback for the purchase of the SmartWays technology could occur in about 5 years, depending on individual mileage and routes. The Agency should consider that, depending on cost of technologies, there are likely barriers for individual owner-operators to adopt the SmartWay technologies. Education and outreach may need to be a part of this strategy to inform how SmartWay technologies have long-term cost benefits despite higher upfront costs. Additionally, depending on the routes used for trucks that adopt the SmartWay technology, areas that are frequented by heavy-duty vehicles should experience air pollution reductions. Reduced diesel emissions that result from fuel efficiency would have a positive air quality benefit.

Analysis and Results

Emissions-Reducing

1. Expected GHGe emissions reductions in 2030.

A. Assuming there is minimal penetration of CA trucks into WA without this action, the upper limit would be a reduction of about 0.1 $MMTCO_2e$ per year, about 0.8% of total transportation.

2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects
   Air quality benefits in communities in close proximity to major highways with HDV traffic would be likely increase. We anticipate the economic health co-benefit from reduced exposure to air pollutants to be an additional $4.1 million to $10.3 million in 2030.

Practical

3. Expected technical, practical, market probability of achieving the emissions reductions
   A. The Agency could start a voluntary program or incentivize their use. The use of SmartWay technologies is technically and practically feasible: these technologies have been in use since 2004 and are a proven method for reducing GHG emissions from heavy duty tractors and trailers.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
   A. To assess the agency's or our partner's ability to implement consider these questions:
      i. The Agency would run a voluntary program with partners to have tractors and trailers change to SmartWay technologies without enforced regulations.
      ii. The Agency would also need to perform outreach and education around the implementation and to advocate for the voluntary program and acquire partners.
      iii. The economic benefits of fuel savings from using SmartWay technologies would need to be highlighted in all communications regarding either a regulatory or voluntary approach.

5. Ability to begin action soon.
   A. SmartWay technologies are currently available. The only delay would to implement and to identify any partners/sources of funds for a voluntary program. 2019 may be the earliest the Agency can implement.

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. There are no regional rules or policies related to HD vehicles. California implemented a HDV GHG rule requiring SmartWay technologies on new and existing tractors (trucks) and trailers. CA's rule requires all trucks that travel on CA highways to have SmartWay technologies, even if trucks are not registered in CA, so some portion of WA trucks already are required to have these technologies installed.
   B. For port-related heavy-duty trucks, we may be able to obtain commitments related to the use of SmartWay technologies on trucks during the next update to the Northwest Ports Clean Air Strategy (to occur in 2018). However, prior experience with port commitments to meeting goals under the NWPCAS would imply we shouldn't rely on substantial voluntary compliance or on significant reductions if SmartWay goals are added to the Strategy update. Further requirements on truck owners are likely to be very unpopular with them. .

7. Consistency with state or national transportation GHG reduction efforts.
   A. Currently EPA SmartWay certified technologies are available. California is the only state that requires the use of SmartWay technologies on tractors and trailers. Application of these requirements to the Puget Sound region would be similar with these efforts.

8. Likelihood of providing a useful example for other regions.
   A. Briefly summarize whether there are prior examples, and what they are (based on criteria 6 + 7).
      i. California implemented a HDV GHG rule requiring SmartWay technologies on new and existing tractors (trucks) and trailers that use CA highways. SmartWay-equipped trucks and trailers already travel on WA highways to an unknown extent, either as a result of traveling to CA and thus being required to have SmartWay installed or due to truck owners choosing to purchase SmartWay-equipped trucks or install retrofits. CA's rule exempts short-haul trucks, such as port drayage trucks.

   B. Determine if action/strategy we develop can be used as a local/regional example for implementation.
      i. Washington could examine the adoption CA's HD truck/trailer GHG requirements, along the lines of adopting CA car rules. It's unknown whether the Agency could adopt those rules locally or implement our own.

Legal

9. The Agency will continue to evaluate pertinent legal questions throughout the process.

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness.
    A. This would reduce diesel fuel consumption and save about $30M/year. Payback would occur in about 5 years, depending on individual mileage and routes. SCC benefits from reduction of GHG emissions: A 0.1 MMTCO2e per year would amount to $1.8 to $8.3m per year (discount rates of 5% and 2.5%, respectively).

Community

11. Expected community benefits and social effects, including geographic and demographic breadth and equity of those effects.
    A. Depending on cost of technologies, may be a barrier to independent contractors (individual drivers who own their own rigs). Education and outreach will need to be a part of this strategy to inform how SmartWays technologies have long-term cost benefits despite higher upfront costs. Potential to improve air quality through reduction of diesel fumes/fuel efficiency.

Evaluation of Candidate Action XI

(Incentivize the use of aviation biofuels)

Synopsis of Action

Candidate action 11 aims to reduce GHG emissions within the aviation industry by incentivizing the use of biofuels at regional airports. The Agency, with partners, could administer a per-tonne subsidy/tax/charge that stimulates a set volume per year of aviation biofuel production to achieve a 20% blend of biofuels by 2030. The Agency could also provide funding assistance for installation of aviation biofuel production facilities for fueling in the region, although the scale of that could be a challenge.

Summary

Emissions reductions and air quality impacts: Incentivizing the use of aviation biofuels and achieving a 20% blend into current stock could amount to GHG emission reductions of approximately 0.1 $MMTCO_2e$ per year in 2030. Reduction of petroleum-based jet fuel would lead to some reductions in air pollutants, with further analysis needed to estimate the air quality improvements from this action. Overall, the reduction in air pollutants would be minimal, compared to other sources of criteria air pollutants in the region.

Approach to implementation: Agency partners such as the Port of Seattle and other regional airport administrators could be better equipped to implement aviation biofuel requirements. The Agency could potentially provide financial resources to the regional airports to subsidize biofuels, though dedicated funding would be required to support this strategy. The Agency could also partner with the Port and other regional airports to work on advocacy and outreach to help the aviation biofuels industry develop within the region. These approaches could allow the Agency to take on a supporting or administrative role.

Potential community & economic costs/benefits: The Social Costs of Carbon benefits could be approximately $2 million to $8 million per year in 2030, if a 20% blend of aviation biofuels is achieved and could grow as additional petroleum-based jet fuel is replaced. The range represents both different discount rates, as well as a range of underlying health studies. We were unable to quantify the anticipated economic health co-benefits at this time. The most significant barrier to implementation could be the cost associated with developing, producing, and distributing aviation biofuels. Currently, these fuels are largely unavailable, with only one refinery existing in southern California. Upwards of $1 billion is likely necessary to initiate production and distribution of aviation biofuels in the region. The technological methods available today require imported oils from out-of-state and other co-products which may cost as much as three times the amount of petrol jet fuel. Significant investment today is needed to secure feedstock locations, industrial facilities, and distribution networks, which may not realize cost parity for almost 10 years. The economy within this sector could improve by incentivizing both the production of fuel and production of local feedstock in our region.

Analysis and Results

Emissions-Reducing

1. Expected GHGe emissions reductions in 2030.
   A. Assuming a 20% blend of biofuels into current stock with a 100% decrease in GHGe would equate to a 0.1 $MMTCO_2e$ reduction by 2030.

      (If we assume a 20% fuel blend into current Jet Fuel by 2030 with 100% CI reduction

      654,600 MT CO2e (Cascadia report on airport emissions without fuels)

      20% of 654,600 = 130,920 (0.1 $MMTCO_2e$ (rounded)) which would be the $MMTCO_2e$ reduced.

      Current trends in aviation biofuel and the technological limitations on short-term gains - a 20% reduction in carbon intensity (through intro of aviation biofuels) is a strong goal, but still within reason.)

2. Expected air pollution effects (co- or dis-benefits), including distributional equity of those effects
   A. We anticipate a modest reduction in criteria and toxic air pollutants with the reduction of petrol based jet fuel. Further analysis may be needed to be able to make a full determination of air quality improvements from this candidate action.

Practical

3. Expected technical, practical, market probability of achieving the emissions reductions
   A. There is currently only one facility and one methodology (for making aviation biofuel) used in commercial production, location in California. The success of this facility is due to a number of factors, a low carbon fuel standard, federal and state grants, off-take agreements with airlines, refurbished facility, availability of feedstock, and sales of high value co-products. Current technology allows for making biofuels, but significant time and financial resources are required to commercialize these methods. Financial investments and subsidies for both facility development and aviation biofuels would be needed for the next 10+ years to incentivize their use. Given the long-term rate of return, this action has a low-to-medium likelihood of success.

4. Expected sustainable ability for our agency or our jurisdictions to implement.
   A. There are two potential options for the Agency's role in incentivizing the use of aviation biofuels. First would be to provide financial resources to regional airports in subsidizing the purchase of aviation biofuels. The second would be to partner with the Port of Seattle (SeaTac Airport) to work on advocacy, outreach and partnership approach in laying foundation for development of aviation biofuels production in the region. This would require partnerships with state and local officials, businesses, and agricultural community to improve public perception of aviation biofuels.
   B. The Agency has the ability to run a program to dispense financial resources to incentivize the purchase of aviation biofuel and could administratively run the program. This may require 1-2 addition FTEs. If the Agency partner's with the Port of Seattle we may co-facilitate advocacy and outreach programs without a significant drain on Agency resources.
   C. The most significant barrier to implementation would be the costs to implement a subsidiary program without dedicated funding. There are political barriers that require extensive outreach and education regarding technology and time frames that are outside of the election cycles. Incentivizing production in state would also require agriculture to support feedstock which is currently unavailable.

5. Ability to begin action soon.
   A. The goal of this action is to achieve a 20% blend of aviation biofuels by 2030, either through a gradual increase or through a set deadline by 2030.

6. Compatibility with other regional rules, policies, initiatives and community efforts.
   A. Currently there are no regional rules, policies or initiatives that support the incentivizing of aviation biofuels. U.S. Oil in Tacoma has made statements that they may retrofit one of their old refineries to produce aviation biofuels, but no plans or commitments have been established. Additionally, a LCFS in California will divert most alternative fuels produced in our region if there is no price parity with other state/regional policies.

7. Consistency with state or national transportation GHG reduction efforts.
   A. As stated above, only one company commercially produces aviation biofuel, AltAir Fuels. There are no other specific federal or state policies to incentivize the production of aviation biofuels. A number of different companies have established partnerships and off-set agreements, but are not fully operational. Fulcrum Bioenergy (CA), Red Rock Biofuels (OR), and SG Preston (PA) among others are upcoming companies hoping to become established in the aviation biofuel industry.

8. Likelihood of providing a useful example for other regions.
   A. If the Agency incentivizes and achieves the goal of producing aviation biofuels in the region to get a 20% blend by 2030, the region would be among the first in the world to establish a production pathway for aviation biofuels and be an example to many other regions.

Legal

9. The Agency will continue to evaluate pertinent legal questions throughout the process.

Economic

10. Expected regional economic benefits and costs, broadly scoped, including distributional equity of those effects, and cost-effectiveness.
    A. SCC benefits from reduction of GHG emissions: A 0.1 $MMTCO_2e$ per year would amount to $1.8 to $8.3m by 2030 (discount rates of 5% and 2.5%, respectively).
    B. Recent studies have suggested that incentivizing the production of aviation biofuels in the region could cost upwards of $1 billion USD. This includes the facilities for refining, amble supply of feedstock, and connections to fueling pipelines for SeaTac. Investments in these areas would be costly, but may generate new jobs and industry for the area.

Community

11. Expected community benefits and social effects, including geographic and demographic breadth and equity of those effects.
    A. Ground transportation in our area is a much more visible and relevant source of air pollution to communities. Also, since the use and production of aviation biofuels is a nascent industry, costs for producing the fuels may drive up costs for flights, which could impact consumers.

Appendix A References:

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Appendix B: Technical Guide for Candidate Actions and Scenario Projections: Methodology and References

This appendix summarizes the technical details of the evaluation of the potential candidate actions, historical emissions, and future emissions for our 2018 Transportation Candidate Actions for Greenhouse Gas Emission Reduction – Draft Evaluation Report. Part 1 covers the calculations, assumptions, and sources for the individual candidate actions. Part 2 describes the historical emissions and the Part 3 addresses how the emissions were projected into the future.

1) Evaluation of candidate actions
   a) General description and common references and calculations

All reductions are reported for the year 2030.

For this document the term *conservative* is used to describe assumptions or simplifications made, and means a bias toward producing a smaller reduction, or lower efficacy, than without that assumption. Thus, the net result is to reduce the potential for overestimating efficacy.

Several actions required projecting a reference case (or no action) called "On the Books" (OtB) into the future and then either A) calculating a change to the 2030 OtB (*perturbed baseline*), or B) projecting an action case into the future and then calculating the difference between the 2030 OtB and the 2030 action case (*differing projections*).

The base year for all projections and references is 2015 because that is the most recent emission inventory for the Puget Sound Region. For this analysis, "current emissions" means emissions in the calendar year 2015 as described in the 2015 Puget Sound Clean Air Agency, Greenhouse Gas Emission Inventory (2015 EI).[1]

For many actions, the OtB scenario is calculated by scaling current emissions projected into the future using a population growth rate from the Washington State Office of Financial Management.[2]

For many actions, an "elasticity" was used to calculate the effectiveness or impact. "Elasticity" is the ratio of percent change in purchase or use of a product or service to the percent change in cost of the product or service. Elasticity = % Δquantity/% Δprice. E.g. for this analysis, an elasticity of 1.0 means that for a 1% decrease in cost, the sales would increase by 1%.

   b) Action 1, Increase the number of ZEVs
      i) For Action 1, which proposes a ZEV requirement: The emissions reduced were calculated using a perturbed emissions baseline in 2030, and a projected ZEV vehicle fraction.

For the OtB emissions scenario, the emissions in 2016 were set as a reference value of 1.0. Future emissions were projected from 2016 using population growth and a scaled light duty CAFE standard.

For ZEV vehicle fraction, the annual ZEV sales were calculated from the assumed annual sales rate of equivalent ZEV credits (where hybrids and PHEVs received partial credits). For calculating the fraction in 2030, the annual ZEV (equivalent) sales were summed over 2018 through 2030.

The MMT CO_2 reduced in 2030 is then calculated by multiplying the average emissions per vehicle in 2016 by the number of ZEV equivalents on the road in 2030, multiplied by a factor that represents the lower (OtB) average vehicle emissions in the future due to the CAFE standard. This GHG reduction is then reduced (i.e. yielding a smaller reduction) to account for the marginal emissions that would be produced by the electrical grid to charge the extra EVs. For the average across all of Puget Sound, this is about a 22% reduction (compared to the tailpipe GHGs reduced). The 22% value was calculated by dividing the regional average GHG emissions of the electrical grid by the GHG emissions of an energy equivalent amount of gasoline displaced, to obtain a percent. The regional average GHG emissions of the electrical grid were calculated by weighting each utilities' (Seattle City Light, PSE, Snohomish Public Utilities, Tacoma Power, etc.) carbon intensity by their population served.

The range of scenarios was produced by picking a 100% (or near) ZEV sales year and assuming that annual sales increase linearly until the 100% ZEV sales year. For 100% ZEV sales by year 2050, 2040, and 2035, this would require annual (year-to-year additive) increases in ZEV sales by 3%, 4.5% and 6% respectively beginning in 2018.

The key assumptions or simplifications include:

- Annual vehicle sales rates, fleet turnover, and VMT are similar through 2030
- The CAFE standard for vehicles sold in 2030 represents the entire in-use fleet in 2030. This is likely a conservative estimate because the entire in-use fleet will have not yet reached the sales CAFE in 2030, and so would use more gas than a new vehicle sold in 2030.
- ZEV battery marginal emissions represent < 6 months of emissions savings when used in our regional grid (under current carbon intensity) and so could be considered a 6 month delay in achieved benefit, which is not significant for rough planning purposes.
- The regional electrical grid and marginal ZEV production emissions remain constant (This is conservative as most long-range plans and projections include reduction in carbon intensity of the grid and battery production.)
- ZEV sales will increase linearly year-by-year

ii) For Action 1, this follows a schedule similar to the California ZEV mandate: The California ZEV mandate extends to only 2025 so does not directly apply to 2030. For our 2030 estimate, the 2025 ZEV credit sales rate of 22% was assumed to remain constant from 2025 through 2030.

The same calculations were done as for Action 1i, but the annual ZEV sales rates were set to match the California ZEV mandate credits through 2025, and then the 2025 rate through 2030. The same assumptions and simplifications apply as Action 1i.

iii) For Action 1 with differential charges on new or existing vehicles based on GHG emissions: For this sub-Action, it was assumed that the cost of a new ZEV or non-ZEV would be the limiting cost for adoption, not differential charges on existing vehicles. The emissions reduction was calculated with a differing projections approach.

The OtB emissions were calculated from a projection of fleet fuel economy through 2030. The fleet was modeled as a sequence of fuel economy bins from 5 to 125 mpg, for each year. The fraction of the actual production fleet, in each MPG bin, for past years was obtained from an EPA report (EPA-420-R-16-010, Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2016, Appendix C). The future fleet was simulated by shifting the main population of internal combustion engines (ICE) to higher MPG, increasing the fraction in the strong hybrid regime (~ 50 mpg), and increasing the fraction in the ZEV regime (~100 mpg). For all years the sum of the bins was normalized (corrected to sum to 1). The shifting in the fleet MPG composition was done so that the weighted MPG for the entire fleet matched the CAFE projections. The specific adjustments were as balanced and conservative as plausible: ZEVs increasing minimally (reaching 15% of sales by 2030), hybrids have stronger growth and reach ~ 20% of annual sales, and the peak (mode) of ICE vehicles shifts higher with the lowest MPG portion dropping significantly. Since the CAFE standard does not specify the specific distribution of MPG, there is a range of distributions that could meet it. So, there is no good forecast for precisely what a reference (OtB) 2030 MPG population will look like, although a conservative (safe) estimate is one in which the distribution changes the least.

The Action projection was calculated by adding an increase in annual ZEV sales in addition to the OtB scenario and then calculating a new fleet averaged MPG (weighted by MPG bin fraction). The incentive sizes follow those used in California, other jurisdictions, and the federal tax credit. The elasticities for ZEV purchase were obtained from a published study.[3] We used the value of 5.8% per $1000 obtained for individuals who had been prompted about the lifetime value of electric vs gasoline as we assume that our climate actions would include a significant amount of public outreach and education.

iv) For Action 1, fees on automakers based on GHG emissions of cars sold. Multiple sources reported that financial incentives are more effective the more obvious they are to the buyer

at the time of sale. The effect is reported to be strong enough that programs seeking to increase ZEV purchase should not implement per purchase incentives at any place other than at the time of sale. Additionally, we do not have any reliable information as to how manufacturers would respond to a fee or penalty based on GHG emissions.

v) For Action 1, Fee on consumer annual registration or licensing: See Action 1, iv). Based on the literature surveyed[4], it can be expected that the apparent value to a customer of an incentive that is not at the time of sale (delayed rebate, tax credit, annual registration credit/fee) would be significantly less than that obtained at the time-of-sale (aka on-the-hood incentives, discounts, or instant rebates).

vi) For Action 1, taxes at time of sale based on GHG emissions: This Action operates similarly to Action 1, iii) where the elasticity of the purchase would produce the same result whether incentives for ZEVs or taxes for ICE vehicles. So, the results from Action 1, iii) can be interpreted as a being applicable to marginal cost changes (taxes, incentives, or a mix).

vii) For Action 1, of the remaining sub-actions, only ZEV infrastructure and bulk/community buys could be quantified, but were still considered too small to be considered as separate Actions. These will be bundled in Action Miscellaneous/Synergies as the final Action. The other named actions under ZEVs, dealer or sales-staff incentives and sales/promotion blitz, lacked the information to allow for a reasonable scenario to be constructed and quantified.

(1) ZEV infrastructure (chargers) impacts on ZEV sales were modeled based on an infrastructure: sales elasticity of 0.8 due to a virtuous network effect.[5] $2.5M/year in infrastructure spending was assumed at current costs for adding a mix of Level 2 and Level 3 chargers (consistent with current split, roughly 6x more Level 2 then Level 3). This was translated in a % increase in the number of chargers, which was then multiplied by the elasticity to obtain a % increase in ZEV sales. The ZEV sales were summed through 2030. The total emissions reduced were then calculated from the product of the number of additional ZEVs and the average emissions reduction per vehicle (from the Action 1 ZEV mandate modeling) (0.1 MMTCO2).

(2) ZEV miscellaneous actions including: bulk buys, dealer/sales incentives, promotional blitzes, additional ZEV benefits such as parking or lane use. Based on reports of bulk buys from Boulder, CO, significant numbers of additional sales were prompted because of the reduced price. Assuming these purchases have some combination of A) wouldn't have happened otherwise, or B) have virtuous network effects early on and accelerate overall adoption sufficient bring a similar number of additional ZEVs by 2030, we assume a target of 35,000 additional vehicles through bulk buys over the next 7 years. Based on Boulder's reports, the labor cost would be about $500,000/year. The emissions reductions are calculated based on the reduction per vehicle from Action 1. For the dealer incentives, promotional blitzes, and extra ZEV benefits, little elasticity

information was found. So, we use the reduction from an aggressive bulk buy program as the bundled value and consider the reductions from the remaining items (not quantified separately) to be a buffer that is not added. Thus, the value for the bundled Action is conservative (0.1 $MMTCO_2e$).

c) For Action 2, reduce the fleet average GHG emissions to below that of the national CAFE standard, with two potential methods.

i) The first method would be raising the fleet fuel economy above the existing fuel economy requirements. The effect for this Action was calculated with a perturbed baseline technique.

The OtB projection was generated as described in Action 1, i) with the fleet average emissions set to 1 in 2016 and decreasing proportionally to the national CAFE standard and population growth.

The action scenario was generated by simulating an MPG standard above the OtB CAFE standard. In this scenario, the MPG rises faster than in the OtB CAFE, and continues to rise after 2025; the MPG rises faster than the existing CAFE standard and continues up, reaching 73 MPG in 2030. The target was selected because numerous current plug-in hybrids (PHEVs) already have effective MPGs of 70-110. This is in contrast to the existing CAFE standard which reaches 54.5 mpg in 2025 and is presumed to remain constant thereafter. The increased standard was converted to a relative emission factor, which was then applied to the 2016 reference emissions, and then subtracted from the OtB 2030 emissions.

ii) The second method would be a cash-for-clunkers program or an MPG floor, with the emissions reductions being modeled identically. The same OtB projection was used as for Action 2 c) i), above.

The Cash-for-clunkers action scenario was estimated using the spreadsheet model described in Action 1, iii). The spreadsheet has mpg distribution divided into 5 mpg bins for each year. The historical data are the fraction of actual annual production, and the future years contain projections. The 2030 OtB scenario was tuned to match the CAFE sales requirement. Three scenarios were simulated, the worst 1% and 2% (based on MPG bins) to the distribution of the rest of the fleet, and the worst 1% to only ZEVs. The scenarios were modeled by reducing the bottom end of the distribution starting with the lowest bin and working up until 1% or 2% were reached. For each instance, the total distribution was normalized to 1 to retain the full vehicle count. For the 1% to ZEV scenario, 1% was taken off the bottom of the distribution as described above, and 1% was added to the ZEV bin (effectively 125 mpg). And, the full distribution was normalized to retain the full vehicle count. (0.1-0.3 MMT CO_2)

This analysis makes at least two major assumptions: A) that the lowest MPG bin vehicles are driven, on average, similar mileage as the rest of the vehicles in the distribution. While there is evidence that the older and lower MPG vehicles tend to be driven less, two factors

suggest this may not be a major issue: 1) the pool of vehicles in the 15-20 MPG bin in 2030 will be almost 10%, meaning that an incentive program could focus on only vehicles/users with high annual mileage and 2) vehicles in this category will be mostly 12-20 year old cars (model year 2010-2018), which should have potential for many more thousands of miles especially considering the trend in for longer life span with the current WA state average at 13.4 years. The second major assumption is that vehicle purchase/ownership rate per capita remains constant. This may not be a safe assumption as trends to transportation-as-service, ride hailing, and ride sharing (Uber, Lyft, etc.) are increasing rapidly in urban corridors, and, autonomous vehicles may create another significant paradigm shift with consequences that are significantly different than business as usual.

d) For Action 3: differential charges on fuels based on life-cycle carbon intensity.

This emissions reduction for this Action was calculated with a perturbed baseline approach.

The OtB baseline emissions were calculated by projecting current fuels consumption to 2030 assuming population growth and reductions due to improved fleet MPG of CAFE. This is described in Action 1, i).

For the Action scenario, a change in consumption was calculated based on an elasticity for fuel tax of -0.7. While this elasticity refers to a decrease in gasoline consumption, there are actually two different impacts: a reduction in VMT, and (purchasing) more fuel-efficient vehicles. For this Action, the charge was chosen to be a $0.50 tax per gallon of 100% fossil fuel. There is no special justification for this rate other than it seemed to be a moderately large, yet reasonable value. For reference, the current Washington State tax on fuel is $0.494/gallon.

For calculating the impact, the elasticity was applied to an assumed current gas price of $3/gallon. For applying this to 2030, it was assumed that either gas prices would remain roughly constant, or that the tax would scale with inflation or gas prices, in order to maintain a similar percentage.

It should also be noted that nothing in the calculation requires that the differential cost be a tax. A tax on fossil fuels or a credit to low-carbon fuels, or some combination thereof, should respond similarly. So, this Action could be structured of as tax, a credit, or a fully or partially revenue neutral action. Also, some of the response to this Action could be a reduction in the carbon intensity of the fuel blend or fuels sold at the pump or in fleets. For the point of calculating efficacy, we assume this fraction will be small, or it will be behave with similar elasticity as the differential charge, or some combination of both.

e) For Action 4: life cycle carbon intensity requirements.

The emissions reductions for this Action were calculated with a perturbed baseline approach similar to Action 3, ix).

The OtB emissions baseline was calculated as in Action 1 for light duty vehicles. For heavy duty on-road and non-road fuel consumption, values from current emissions inventories were assumed to be constant because 1) the turn-over for these categories tends to be much slower than for light duty, 2) reductions in emissions due to improved standards are expected to be mostly offset by increases in population and heavy duty VMT.

For the Action scenario, the reduction in carbon intensity was modeled as a net of -10% overall and – 10% on-road (gasoline) and -25% nonroad (diesel) These values were selected because -10% is roughly in line with conservative estimates of existing plans (CA LCFS has -10% in 2020) and previous LCFS proposals and goals. The upper end reduction was selected because it is the largest value that seems practical based on existing aggressive projections from reports[6] and professional judgement. This value is also in line, and slightly more ambitious, than LCFS programs likely targets for 2030: 18% overall in California, and 10-15% in British Columbia. For context, the upper end of in-state cellulosic capacity (from in-state feedstock) is about 260 MGY (million gallons/year). This volume could achieve -25% by itself, in 2030. Additionally, there is a vastly greater potential pool of imported, moderate carbon intensity (CI) fuels (including 50-60 gCO2/MJ corn ethanol) and that pool is projected to continue to grow (e.g. California imported 1.5 BGY (billion gallons/ year) in 2015). At the time of the draft report, we are aware that the cellulosic ethanol market has not come to fruition since the LCA report, and include it here as an example pathway that could help to realize a more aggressive LCFS target – many others are likely.

For the heavy duty (diesel) sector, the current price, pathways, and carbon intensities for biodiesel are quite favorable to significant increases. Renewable diesel (a drop-in equivalent) is currently somewhat more expensive, but is expected to be competitive at larger production volumes and with comparable LCFS requirements to California and Oregon.

For the light-duty sector (gasoline), there are not existing pathways that are jointly close in cost, use existing (established) feedstocks/pathways, and have good lifecycle carbon intensities. Nonetheless, the Life Cycle Associates report indicates that the cellulosic feedstock available in-state could produce 260 million gallons per year of cellulosic gasoline and ethanol by 2025-2030. This volume translates into a > 25% carbon intensity reduction for the light-duty on-road sector in 2030. It is assumed that the 25% target could be reached through some combination of 1) generating credits through ZEV/PHEVs, 2) some commercialization success of cellulosic and other recent/new technologies to allow production with local feedstocks with low carbon intensities (e.g. engineered bacteria with switchgrass), 3) availability/expansion of current moderate CI fuels and pathways, and 4) reduction in lifecycle carbon intensities of existing pathways (e.g. corn, sugarcane, molasses).

f) For Action 5: local government alternative fuel rule.

For this Action, the emissions reduction is calculated with a perturbed baseline approach.

Total local government use is about 0.39 MMT CO_2/year, with ferries and transit buses comprising about 90% of this total. These values were obtained from the PSCAA 2015 EI and are assumed to be the same for 2030 for the baseline. A 100% alternative fuel mandate (no fossil fuels) would reduce GHG emissions by ~80% across all local government sectors. This translates into a reduction of about 0.3 MMT CO_2/year.

The Action would be implemented by diesel vehicles converting to electric, or switching to 100% locally produced biofuels (biodiesel (BXX), renewable diesel (RXX), or a mix such as R80/B20). Metro (buses) and the state ferries are evaluating switching to electric, and both have indicated that it appears to be feasible and cost-effective and that they will likely pursue at least a partial transition to electric. While it seems likely that some portion of both fleets will be electric by 2030, it should be expected that some fraction of the buses/ferries will not have favorable economics for conversion. This portion of the bus/ferry fleet could switch to renewable/biodiesel, along with numerous heavy-duty trucks operated by counties and cities.

For the light duty portion of local government fleets, it is assumed they would transition to electric. For charging all electric vehicles, buses, and ferries, the current average grid in the Puget Sound would deliver energy with net GHG emissions of about 20% of that of the corresponding fossil fuels (80% reduction).

g) For Action 6: enhance transit related choices, etc. We used estimates from Puget Sound Regional Council. PSRC modeled GHG emissions reductions associated with their RTP. This amounted to a 24% reduction in transportation emissions (defined more specifically by PSRC) from 2006 to 2040 [3.1 MMTCO2e by 2040]. In addition, they also modeled "above and beyond" emissions reductions that could be possible in each of the RTP categories. For "Choices", they estimated an additional 1-2% emissions reduction in 2040 that could be possible beyond the RTP. For "Land Use", they estimated an additional 2-4% in 2040. We applied these "above and beyond" emissions reductions (total 3-6%) and scaled in half to account for 2030 vs. 2040 time horizon to estimate 0.2 to 0.4 MMTCO2e emission reductions.

h) For Action 7: enhance user fees for road access. We used estimates from Puget Sound Regional Council. PSRC modeled GHG emissions reductions associated with their RTP. This amounted to a 24% reduction in transportation emissions (defined more specifically by PSRC) from 2006 to 2040[3.1 MMTCO2e by 2040]. In addition, they also modeled "above and beyond" emissions reductions that could be possible in each of the RTP categories. For "User Fees", they estimated an additional 5% emissions reduction in 2040 that could be possible beyond the RTP (through a greater charge per mile). We applied this "above and beyond" emissions reductions of 5% both

scaled and unscaled (user fees could be implemented more or less quickly) to estimate 0.3 MMTCO2e to 0.6 MMTCO2e emission reductions.

i) For Action 8: incentivize production of renewable diesel, RNG, or biodiesel

For this Action, the emission reductions are calculated with a perturbed baseline technique.

8A. The only relatively complete scenario that could be generated for this option was a rule that required a significant fraction of methane emissions (fugitive, direct, or flared) to be captured and converted to RNG. A WSU/WWCCC report (Jensen, J., 2013) concluded that about 0.7 MMT CO_2e was available just from current landfills and wastewater treatment plants in King, Pierce, Snohomish, and Kitsap counties. Around 0.1-0.2 MMT CO_2e of this gas is already being captured and used (not flared). Assuming the balance of gas could be captured and transferred to displace fossil diesel or fossil natural gas, and this volume is mostly stable for the next 12 years, this would reduce at least 0.5 MMT CO_2e. Assumptions and notes:

- There are some additional smaller sources (such as manure) that could be economically captured and used as RNG.
- The energy and fuel used to process and deliver the captured gas is primarily from near-neutral sources (or same/self) and so doesn't increase the net emissions.
- A sufficient number of NG vehicles or users will exist such that the produced gas displaces what would have otherwise been fossil diesel or fossil natural gas.
- The reduction value does not include the benefit from reduced methane fugitive emissions (e.g. agriculture livestock, which is outside the scope of the mobile sector) which could be substantial due to the global warming potential of methane being 30-80x CO_2.

8B. For this Action, it is assumed that a $0.50/gallon tax would put B20 at price parity or cheaper compared to petroleum diesel. B20 is selected because this is considered the maximum that would be drop-in for most vehicles and applications. A B20 blend would require production of about 120 million gallons per year of 100% biodiesel, which is a bit greater than current production in the Gray's Harbor facility (which is now sold in California). So, this Action would require keeping that fuel in-state or building a new plant, which would be economically viable with the stated tax/subsidy.

8C. See Action 5 for calculations regarding the size of local government fleets.

8D. For this Action it is assumed that either a new plant on the scale of the existing Gray's Harbor facility (100 MGY) is built, or that existing production is retained in-state. If this fuel volume were produced through a low carbon intensity feedstock from WA or the Pacific Northwest, it would reduce emissions by about 80% for the volume displaced.

8E. Same scale as 8D. (above) but different funding structure.

8F. Same scale as 8B (above), different mechanism.

8G. Same scale as 8B (above), different mechanism.

j) For Action 9: implement an Indirect Source Rule (ISR), with two potential variations.

i) The first variation would apply to major airports, ground operations, their landing and take-off operations (LTOs), and the vehicle traffic induced to the airports. This emissions reduction is calculated with a perturbed baseline approach, using SeaTac as a prototype to estimate the magnitude of emissions reductions possible.

The ground operations are assumed to be converted to 100% electric (although a small portion could remain with biofuels).

The LTO portion of aircraft emissions could be reduced through the use of aviation biofuel blends, or some other approaches that the airport identifies including improved efficiency of taxiing. Note that SEATAC, in partnership with Boeing and Alaska Airlines, is already pursuing a plan to supply a significant amount of biofuel. For context, offsetting the LTO portion would require producing and delivering about 30 million gallons/year of (unblended) bio-aviation fuel. United Airlines is currently using up to 5 million gallons/year at LAX and plans to expand to 90 million gallons/year nationally[7], Qantas Airlines has announced it will purchase 8 million gallons/year at LAX by 2020[8], and world-wide usage aviation biofuel is expected to reach 30% of fuel supplied by 2030[9].

The vehicle traffic induced to the airport could be reduced through aggressive mass transit/clean transit initiatives using existing and planned bus and rail service, and also through strengthened incentives for shuttles, ZEVs, car rentals, parking policy, and extended satellite parking.

The ground operations emissions are taken from the 2015 EI and are presumed to drop 100% (to 0%) by 2030. The LTO emissions come from the 2015 EI and are presumed to be reduced by 50%. The induced traffic is calculated from the annual number of passengers originating at SeaTac in 2016 multiplied by the percent using “non-preferred” methods (40%) and typical trip distance. We assume this portion is representative of the VMT induced by the airport that is the easiest to address. This portion is assumed to decrease by 50% by 2030.

ii) The second variation would implement an ISR on major road sections (such as I-5, I-90, or 405) and urban corridors (such as downtown Seattle) and expand the eligible employers and activity centers. The action could be through “congestion fees”, parking space taxes, incentives to employers/employees, a combination of tactics, or other tactics determined by the employers.

The total emissions reduction is the sum of the direct effect through reduced weekday VMT, plus the indirect effect of reduced delays. It is assumed that an additional reduction of 20-30% in day-time and peak commuting would largely eliminate the congestion and wasted emissions. This is based on comparisons of peak-hour flow rates during congested vs free-flowing hours and published data on free-flow maximum capacity. The scenario is quantified by assuming that that total VMT for drive alone commuters would be required to be reduced by 20% by 2030.

The number of potential employees at employers with 50+ employees comes from WA state employment data[10], about 1.2 million. The drive alone rate for the greater Puget Sound jurisdiction is about 70%, estimated from census data[11], national surveys[12], and the Seattle commute survey[13] (using the rate for zones furthest from downtown which have the least transit options and noting that national averages are much higher).
The direct emissions reduced would be the product of the number of daily commuters, average commute distance, an annual scaling-up factor of 290, and the fuel consumed per mile. The reductions from reduced congestion come from INRIX estimates[14] of the annual wasted fuel per commuter[15] and an assumption that the vast majority of congestion is mitigated due to the plans.

k) For Action 10: GHG requirements for operation of on-road heavy-duty similar to California and EPA SmartWays.

For this Action a perturbed baseline approach is used. The baseline emissions come from the 2015 EI. The reductions are then the product of the current heavy-duty emissions, the fraction to which the regulation would be applicable, and the reduction for that sector.

This assumes that there is little change in the baseline emissions from present. The 2030 emissions are difficult to predict because an increase in truck VMT is expected to occur faster than population growth, while heavy-duty truck standards will reduce the emissions per vehicle. Both factors are similar in magnitude and could be altered by a range of other policy and technology changes. So, for the sake of simplicity we assume little change in the net by 2030.

l) For Action 11: Incentivize use of aviation biofuel apart from an Indirect Source Rule.

For this Action it is assumed that some combination of voluntary offset/surcharges, funding for subsidies, or funding/backing/assistance for fuel production is obtained. The effect of these funds is to lower the price or price difference between biofuel and fossil fuel. It is assumed that a 20% blend of biofuel is achieved, and the biofuel has an 80% reduction in carbon intensity. The emissions reduction is applied to the 2015 LTOs from SeaTac.

m) Action Appendix: Cash for Clunkers, Synergies, and miscellaneous smaller actions

i) Several of the Actions under consideration were not large enough or did not have clear constraints and so were not considered good candidates for primary, separate, consideration. The miscellaneous/small ZEV actions were quantified under Action 1 vii). Additionally, the idea of cash-for-clunkers was raised in a planning meeting. Since the model for making the calculation for cash-for-clunkers had already been set up for other Actions, it was evaluated because it took very little additional time. The previously described minor ZEV actions (Action 1, vii) will be combined with cash-for-clunkers to form a Miscellaneous/Synergies wedge.

2) Historical Emissions

a) Historical emissions inventory data is helpful for understanding the context of the current GHG emission reduction work, and it is critical for tracking progress. The Agency's targets are set with respect to 1990 to maintain consistency with our previous targets and for comparability to other targets. But, comprehensive (jurisdiction wide) inventories are not a routine part of the Agency's work, and have only been done for the calendar years 2005 and 2015. Washington State has conducted GHG/climate pollutant inventories more frequently, but these are not always broken down by county and may have differing methodologies. So, it was deemed necessary to estimate historical emissions, and particularly 1990.

Since little historical activity information is available, the most efficient method for obtaining an emissions value for 1990 and intervening years was to extrapolate or interpolate when possible from other inventories. The historical emissions were estimated by averaging data or proxy data from four sources: PSCAA inventories (2015 and 2005 only), Puget Sound Regional Council (PSRC) published annual VMT data, Washington State transportation sector inventory, and the Washington State overall GHG inventory.

All data sources/proxies required some scaling or other correction to make them comparable values. Each data source was scaled, with its own factor, to the 2015 PSCAA EI value (so all data sources had same value for 2015). Additionally:

i) The PSCAA inventory data from 2005 and 2015 used different methodologies. The 2005 inventory scaled up on-road emissions from daily to annual with a multiplier of 365, while the 2015 inventory used 290, which is more accurate. So, the 2005 on-road portion was scaled down by a corresponding factor.
Also, the 2015 inventory assigned the emissions from non-road sources (output from the NON-ROAD model) to industrial, commercial, and residential sectors while many of these were included as transportation in our 2005 inventory. So, for the 2015 inventory, these respective sectors were shifted back to the transportation.

ii) For the VMT data from PSRC: VMT data were available for 1990, 1995, and 2000 to 2015. While the annual VMT is a reasonable proxy for overall economic activity, for GHG emissions a factor accounting for vehicle fuel economy must also be applied. The fleet average fuel economy was obtained from national average fuel economy data.

b) For each historical year, the four data sources were averaged. From 2001-2014, the annual averages were then smoothed with a running three-year average.

3) Future Projections and Scenarios
   a) Overview
      i) In order to evaluate scenarios and project future emissions, baseline emissions were calculated and future Actions summed into scenarios. While other agencies and partners have set goals based on various years, ours is plotted with reference to 1990 (1990 is 0%), and with 2015 as the starting year for future scenarios. A "population" line is plotted to reference how current emissions would project into the future if no changes occurred in current practices, but the population grew. Since many changes in emissions are expected due to regulations currently in place, a second reference line, "On-the-Books" (OtB) was also generated to capture the emissions trend if no additional or new actions occurred, beyond those already on-the-books. Two scenarios are also shown to highlight what additional reductions could be obtained above those already on-the-books.
      ii) We are aware of only one detailed projection of OtB transportation emissions for our region, from PSRC. PSRCs RTP modeling included a detailed account of fleet turnover, land-use changes, and transit growth and is the best projection that we have.

   b) Population

      The population line is projected into the future using the population growth projections from WA State Office of Financial Management. The projections are for annual growth above 1% for the short term and then declining to less than 1% per year by 2025. This projection intentionally misses a number a major reductions that are all but certain, including: 1) fleet turnover of on-road passenger vehicles due to the fact that new vehicles already have significantly better fuel economy than the current in-use fleet and the average for new vehicles will increase though 2025, and 2) significant expansion of transit service.

   c) On-the-books (OtB)

      The "On-the-books" line represents the emissions projection when including the full range of regulations, agreements, and plans that have already been formally adopted. As mentioned above, this includes the CAFE standard and fleet turnover, and expanded transit service. And, it also includes a number of other actions including land-use planning, commute reduction programs, tolling or road-use charges, and pedestrian and bike infrastructure. These actions are all part of PSRCs RTP, and have been modeled for emissions reductions. There is little else that we are aware of that could be considered "on-the-books" for impacts in the transportation and mobile sector.

      The original RTP projected emissions from 2006. For the purposes of future planning, we draw the OtB line from the latest PSCAA inventory (2015) to the 2040 target and interpolate a target for 2030.

d) Scenarios: Strong and Ambitious (maximum)

To generate plausible scenarios for actions in addition to the OtB projection, we must choose a set of Actions in a manner that doesn't double count effects or create duplicative or similar policies (e.g. carbon tax on fuels based on life cycle carbon intensity and a low carbon fuel standard). Also, it is useful to generate a lower end scenario involving weaker actions and fewer actions, and also a maximally ambitious scenario to evaluate the upper limit.

Three overlapping sets of Actions that were grouped were:

- ZEV mandate actions, a stronger fuel economy standard, and a tax/surcharge/credit based on vehicle GHG emissions. The overlap is because an approach for meeting a fuel economy standard and the impact of charges on vehicle GHG emissions would almost certainly rely heavily on increasing the number of ZEVs and PHEVs.
- A fuel carbon intensity tax/surcharge/subsidy, a low carbon fuel standard, or a biofuel mandate. These would produce similar impacts and it would be highly unlikely that more than one would be implemented.
- Enhancement above and beyond PSRC RTP actions regarding land-use planning, user fees, and transit choices; an indirect source rule regarding peak trips and congested corridors; the scenarios evaluated by OTAQ TEAM. The implementation of the ISR would likely be very similar to the actions that would be simply strengthening the RTP and similar to the reductions modeled by OTAQ TEAM. It is highly unlikely that these could operate independently.

The Strong scenario (lower end) is then the follow set:

1. The lowest reduction of the ZEV options was selected (the value for a weaker ZEV mandate)
2. The lowest of the fuel carbon intensity Actions (the value from a carbon intensity tax)
3. The local government alternative fuel rule
4. Methane regulations
5. Commercial airport reductions
6. California heavy-duty in-use standards (SmartWays)

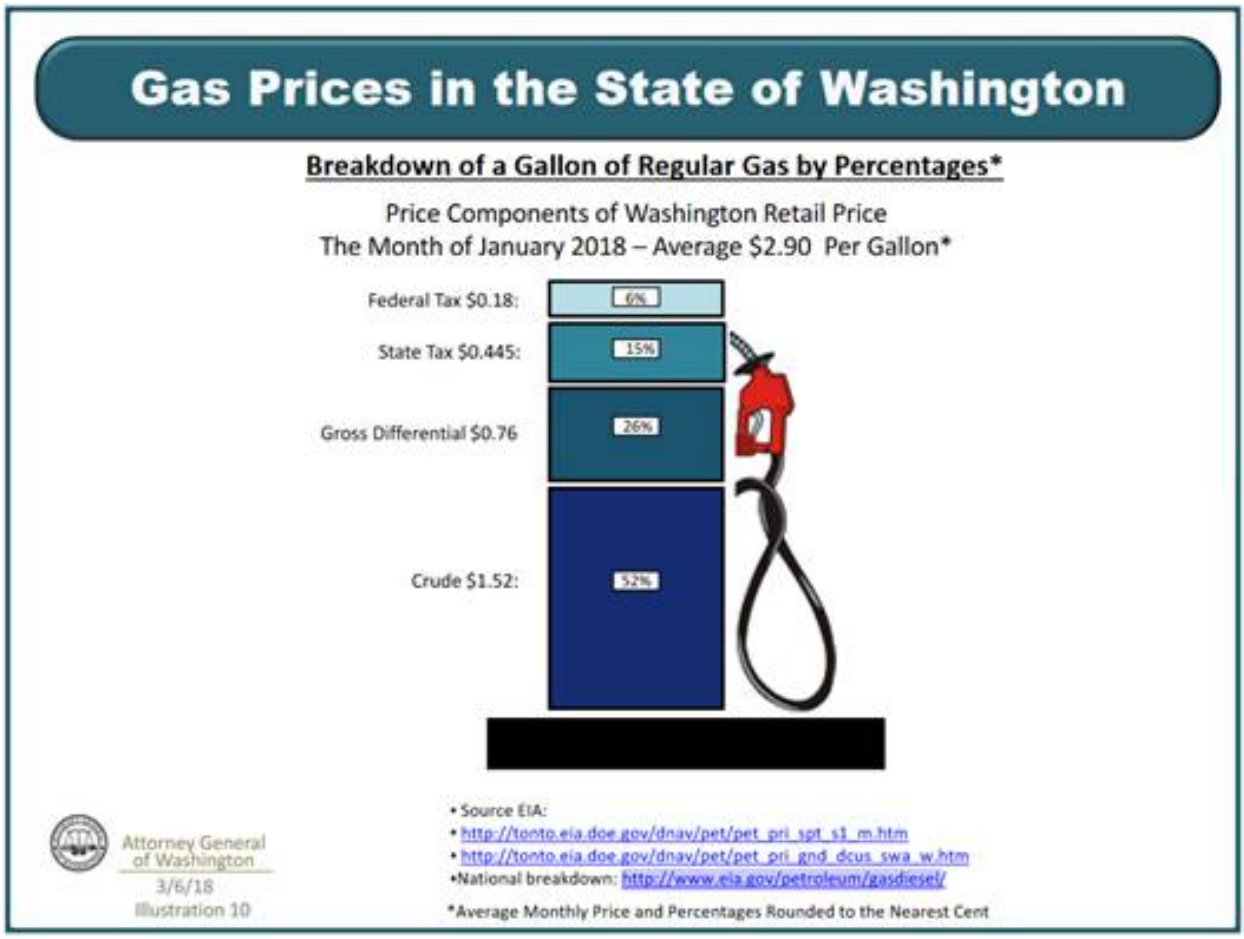
The Ambitious (maximum) scenario is then the Strong scenario plus:

- Substitute the maximum ZEV impact Action for #1
- Substitute the maximum fuel carbon intensity Action for #2
- An enhanced land-use, user fees, transit choices portfolio (like ISR for congested corridors) from the estimates of PSRC
- A number of smaller supporting actions that are likely to enhance the main Actions

4) Fuel Cost Assumptions:

The following assumptions are estimates on the how much money from conventional fuel and low carbon fuel purchases leave Washington State and in particular our four-county region (King, Kitsap, Pierce, Snohomish).

Gasoline & Diesel -
The image below is from the Washington State Attorney General's office, which gives an estimation of the breakdown of the retail price components of a gallon of gas. Additionally, a report from the Union of Concerned Scientists, 'Where Your Gas Money Goes' states that only 3-5 cents per gallon of gas goes to gas stations as revenue.[16]



In the above diagram Gross Differential accounts for the refining, marketing and distribution of gasoline. Already we see that 58% (Crude + Fed Tax) goes out of state. If we assume the majority of gross differential leaves the region in the form of refining and distribution (these profits usually go back to the oil companies), and then estimate about 5% stays in region for gas station revenues and other profits, that gives about 20% (State tax + assumed local revenue) that stays in region versus 80% that likely leaves out region. Our 5% estimation is based on the information discussed above, and may be an overestimation since, outside of gas station owners, little money of the marketing and distribution of gasoline stays in the state of Washington. We make similar assumptions of diesel fuel since these conventional fuels share many of the same pathways for refining and distribution.

Washington State consumes about 1.1 billion gallons of diesel and 2.7 billion gallons of gasoline per year, approximately a 30% (diesel) to 70% (gas) use.[17]

Ethanol –
We assume no production of ethanol in Washington State. All ethanol used as transportation fuel must be produced and transported to the state. From the information above, we can also assume a very small "price-per-gallon" goes to the retailer. Because of this we conservatively assume all ethanol revenues go out of state.

Biodiesel –
There is already a significant market for biodiesel along the West Coast. There is also production of biodiesel already occurring within the state of Washington. We make the assumption that if biodiesel use is mandated or regulated within our State that local production would increase and fully cover the demand for biodiesel. This would keep all money that would have been spent on conventional diesel within Washington State.

Electricity –
Our utilities in the four-county area have large hydro-power profiles. We make the assumption that money spent on ZEV charging stays within the state.

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Appendix C: Social Cost of Carbon and Health Co-benefits

Social Costs of Carbon Summary:

The social costs of carbon (SCC) is an economic metric intended to provide a comprehensive estimate of the net damages—that is, the monetized value of the net impacts, both negative and positive—from the global climate change that results from a small (1 metric ton) increase in carbon dioxide (CO_2) emissions.

Scientists estimate the social costs of carbon using models that represent our society, the world's climate and the ways they interact. This is a marriage of physics and economics. There are three main integrated assessment models in use – DICE, FUND and PAGE.[1,2]

These integrated assessment models (IAMs) join together four elements:

- First, there are socioeconomic projections: How many people will be alive in 2150? How fast will the economy grow next century? How much CO_2 will humans emit?
- Second, there is a "climate module": How will the climate change in response to CO_2 emissions? How quickly will sea levels or temperatures increase? What about rainfall patterns and extreme weather events?
- Third, benefits and damages: How will climate change affect crop yields? What is the cost of living with, or adapting to sea level rise? How do increased temperatures affect labor productivity or energy use for heating and cooling? How can we value non-market impacts, such as loss of species and habitats?
- Finally, the fourth element uses discounting to value future benefits and costs in today's money. Future damages tend to dominate SCC estimates, because CO_2 persists in the atmosphere for thousands of years and damages increase as temperatures rise. As a result, discounting has a big impact, see below for more.

Social Costs of Carbon – Discount Rates:

A key variable in calculating the social cost of carbon is the "discount rate." The discount rate reflects the challenge of capturing the time factor in climate policy. It contains three assumptions: (1) that humans prefer to receive benefits in the present rather than the future, (2) that future generations will be richer and a dollar worth less to them as a result, and (3) the opportunity cost of capital (that there are a variety of investment options for any given sum).

In calculating cost-benefit and SCC, the choice of discount rate influences whether economists recommend investing in greenhouse gas reductions today or much later. From this perspective, the higher the discount rate, the less significant future costs become. The choice of discount rate for investments in managing greenhouse gas emissions ignited intense debates in the economics profession. Stern used a low discount rate, approximately 1.4%, compared to William Nordhaus, a professor at Yale University, who currently uses a discount rate of about 3%.

Three percent values an environmental cost or benefit occurring 25 years in the future at about half as much as the same benefit today.[3]

Puget Sound Clean Air Agency Determination on the Use of the Social Cost of Carbon:

The analyses within this report used both the 5% and 2.5% discount rates to give a range of potential cost saving benefits associated with the social cost of carbon. The Washington State Department of Ecology used the social cost of carbon for their analysis of the Clean Air Rule and stated that,

> "Comments received on past rulemaking analyses involving the SCC expressed concern that global emissions contribution was not an appropriate measure of the benefits of this rule. Ecology believes, however, that while it is not possible to specify the local benefits to climate change resulting from control of local emissions, it is appropriate to acknowledge that local emissions contribute to the global pool of GHGs that cause global impacts including local impacts. These impacts affect local ecology, people, industry, agriculture, and infrastructure. Establishing a direct 100-percent relationship between local emissions and local impacts is inherently impossible. This is precisely why Ecology and other government agencies have chosen to represent the costs of GHG emissions and the benefits of reducing them on a global scale."[4]

When we measure the costs and benefits of polices that impact CO_2 emissions, identifying high costs through the SCC can help us identify financial investments today that will be justified in reducing the impacts of climate change in the future.

Example calculation:
The table below is from the Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866 (May 2013, Revised August 2016) developed by the Interagency Working Group on Social Cost of Greenhouse Gases.[5]

Social Cost of CO2, 2015-2050 (in 2007 dollars per metric ton CO2)

	Discount Rate and Statistic			
Year	5% Average	**3% Average**	2.5% Average	High Impact (3% 95th percentile)
2015	$11	**$36**	$56	$105
2020	$12	**$42**	$62	$123
2025	$14	**$46**	$68	$138
2030	$16	**$50**	$73	$152
2035	$18	**$55**	$78	$168
2040	$21	**$60**	$84	$183
2045	$23	**$64**	$89	$197
2050	$26	**$69**	$95	$212

The values of this table were used to assess the social cost of carbon from the GHG emission reductions (in metric tons of CO_2e) estimated for each candidate action. A low (5% discount) and high (2.5% discount) were calculated to give a range of cost-benefits from the SCC in 2030.

For example, candidate action 3 states that a differential charge on fuels, based on the carbon intensity, would reduce emissions by approximately 0.9 $MMTCO_2e$.

First, you convert 0.9 million metric tons (MMT) to metric tons (MT), which equals 900,000 metric tons. Then, these costs were converted to 2015 US dollars using the Consumer Price Index Ratio (2015/2007)

5% discount rate, $16 per metric ton

900,000 metric ton x $16/metric ton = $14,400,000 * (CPI ratio) = $16.5 million

2.5% discount rate, $73 per metric ton
900,000 metric ton x $73/metric ton = $65,700,000 * (CPI ratio) = $75.1 million

Health co-benefits from improved air quality

To estimate air quality health benefits from candidate actions, the Agency used EPA's Co-Benefits Risk Assessment (COBRA) Health Impacts Screening tool.[6] This tool estimates changes in air quality based on emissions information that's included in the tool, as well as information the user provides on particular energy or air quality policies. The tool then translates changes in air quality to corresponding changes in health impacts based on peer-reviewed health studies. It provides a mid-range of health impacts (e.g. not worst case scenarios). Last, the tool monetizes results, applying costs of medical care, as well as applying an approved value of a statistical life (VSL) to early mortality estimates.

COBRA has been extensively peer-reviewed, and used as part of multiple EPA regulatory impact analyses (RIAs), as well as several evaluations of various air quality and energy policies.

For our candidate actions, the main pollutant screened by the COBRA model is PM2.5. Air toxics pollutants (e.g. benzene) are not included in the COBRA model, many of which would see associated emissions reductions with candidate actions. So, the COBRA screening model likely doesn't adequately capture the entire health co-benefit of several candidate actions.

The COBRA tool provides two discount rates, 3% and 7%, as part of its economic estimates. We present both in our analysis to provide readers a range.

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