# Modeling Study on Program Options to Reduce Greenhouse Gas Emissions

State of Oregon
Department of Environmental Quality

**Office of Greenhouse Gas Programs**
700 NE Multnomah St.
Suite 600
Portland, OR 97232
Phone: 503-229-5696
800-452-4011
Fax: 503-229-6124

www.oregon.gov/DEQ

DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

## Frequently Asked Questions

**May 18, 2021**

### 1. What is the purpose of this study? How does it support development of the Climate Protection Program?

The Department of Environmental Quality has identified the primary goals of the Climate Protection Program to be achieving significant greenhouse gas emissions reductions, while prioritizing equity and containing costs for businesses and consumers.

The contracted study can help inform the development of the Climate Protection Program by providing information on how different program designs might best support these goals.

DEQ has contracted with ICF to assess different program designs, referred to as modeling scenarios, for information on:

- Forecasted greenhouse gas emissions;
- Equity, air quality, and public health co-benefits; and
- Macro-economic effects on Oregon's economy.

### 2. What is the tentative timeline for this study?

The study timeline supports the development of the Climate Protection Program and connects with the overall rulemaking schedule:

- **Fall 2020**: Invited written comment on reference case assumptions.
- **January 2021**: Received comments at rulemaking advisory committee (RAC) meeting. Proposed three initial policy scenarios.
- **February 2021**: Present reference case results at RAC meeting.
- **March - April 2021**:
  - Present emissions, economic, health, co-benefits and equity results for these initial three policy cases at RAC meeting(s).
  - Develop fourth policy scenario informed by initial policy scenario findings, RAC feedback, and public input.
- **June 2021**: Share all final results and key takeaways at RAC meeting.

### 3. Where can I find more information on the study?

More information is available at: www.oregon.gov/deq/ghgp/Pages/modelingstudy.aspx.

### 4. How can I participate in the development of the Climate Protection Program?

More information about the rulemaking to develop the program is available at: www.oregon.gov/deq/Regulations/rulemaking/Pages/rghgcr2021.aspx.

Rulemaking advisory committee (RAC) meetings are open to the public and offer an opportunity for the public to comment. Written comments and questions may also be

submitted to GHGCR2021@deq.state.or.us. Sign up to receive program development updates here.

### 5. What is the general approach for the modeling study?

This study uses both qualitative and quantitative methods. DEQ and its consultant, ICF, developed the approach and selected specific modeling tools for a variety of reasons including:

- Assessing multiple sectors and scopes of emissions;
- Understanding program effects not only on greenhouse gas emissions, but also co-pollutants, public health outcomes, and equity and macro-economic impacts; and
- Timeliness, along with budget and resource considerations.

ICF will model a reference case to serve as a baseline to project future conditions based on existing regulations. Then different program options across four policy scenarios will be modeled and compared to the reference case to inform the development of the Climate Protection Program. The study is intended to directionally assess the potential effects of a new program on emissions, equity, and macro-economics. The modeling includes sectors that will not be regulated by the new program. These additional sectors are included to be comprehensive, as they may be indirectly affected.

The modeled scenarios will not incorporate every design element relevant for the program and are not intended to represent the final program. Rather, the modeling and results of this study are a useful tool to inform the program development process. The Climate Protection Program design will be developed by DEQ, as informed by the advisory committee and the public, and will be considered by the Environmental Quality Commission as part of the rulemaking.

### 6. What modeling tools are being used in the study?

A suite of modeling tools that are under ICF's umbrella decarbonization planning platform called $CO_2$Sight© will be relied on to assess emissions, public health, and economic impacts. The suite of tools includes the following:

- Argonne National Laboratory's VISION Model for transportation;
- EPA's Motor Vehicle Emissions Simulator (MOVES) model for on-road vehicle emissions;
- ICF's Integrated Planning Model (IPM) for electricity;
- ICF's demand side planning tools for residential and commercial energy demand;
- ICF's multi-sector model for estimating greenhouse gas emissions, air quality emissions, and costs;
- Impact Analysis for Planning (IMPLAN) model for macro-economic results; and
- EPA's Co-Benefits Risk Assessment (COBRA) for public health impacts.

VISION, IPM, IMPLAN, MOVES, and COBRA are relatively well-known, well-documented, and frequently used modeling tools, especially for greenhouse gas emissions policy analysis. Other models are ICF-developed flexible frameworks that can integrate with other modeling tools and draw from customized data sources and assumptions.

### 7. What results are expected for emissions forecasts and macro-economic results?

ICF's multi-sector model incorporates the above sector-specific modeling results to provide energy demand and emissions projections. Specifically, it looks at sectors of Oregon's economy

that align with the statewide sector-based greenhouse gas inventory and projects emissions out to 2050. The purpose of the multi-sector modeling is to provide a better view of the potential impacts of a new program across Oregon, even though not every sector or source of emissions will be assumed to be regulated. For example, it is of interest to assess changes in the electricity sector because a program that regulates transportation fuel use may encourage transportation electrification. The aggregated results from the multi-sectoral model are then used as inputs for economic and public health modeling.

IMPLAN incorporates custom economic data for Oregon, as well as the outputs from the multi-sector model to estimate the incremental economic impacts of each policy scenario as compared to the reference case. State-level net economic results include changes to jobs, personal income, and gross state product. IMPLAN provides results for direct, indirect, and induced impacts.

IMPLAN does not directly reinvest funds generated as a result of the program, such as community climate investments, nor does it incorporate avoided cost results from COBRA into the economic impacts modeling. Additionally, IMPLAN does not assess certain program impacts, such as potential changes in fuel prices.

**8. What results are expected for public health and the co-benefits and equity assessment?**

COBRA is being used to model the public health impacts and monetized health outcomes of the policy scenarios associated with changes in fuel combustion emissions compared to the reference case. Inputs include fuel consumption activity from the multi-sector model, IPM electricity sector emissions, and on-road fuel consumption from the VISION model coupled with fuel-based emissions factors from the MOVES model. COBRA estimates the public health impacts of changes in co-pollutant emissions by relating changes in emissions of particulate matter ($PM_{2.5}$) and its precursors (nitrogen oxides, sulfur dioxide, ammonia, and certain volatile organic compounds) to changes in air concentrations and changes in health outcomes due to exposure to air pollution. COBRA outputs are in the form of avoided health outcomes as counts and monetized values. In the initial three policy scenarios, results are available at the state-level and will be available at the county-level for the fourth policy scenario. COBRA results do not capture all potential health benefits of the program, but do include impacts such as:

- Avoided hospital visits;
- Reduction in premature mortality; and
- Changes in respiratory impacts, heart attacks and work days lost.

The results from the emissions, economic, and public health modeling inform the co-benefits and equity assessment. This assessment is more qualitative in nature and incorporates results and findings directly from the modeling, and also pulls from other literary and data resources. This allows DEQ and ICF to better analyze equitable outcomes and broader potential program impacts for key indicators described below. The assessment evaluates the indicators for each scenario and summarizes outcomes on a scale from one to five, ranging from significant negative effects on a given indicator, to significant positive effects. The co-benefits piece of the assessment looks at the overall positive (or negative) impacts in a policy scenario, while the equity piece of the assessment looks at the distribution among communities of concern. DEQ coordinated with environmental justice and community-based organizations and ICF on identifying the indicators of interest and the communities of concern.

The equity and co-benefits assessment includes the following indicators:

- **Local air quality (health)**: actions that directly improve human health (e.g. decreasing mortality) by reducing exposure to particulate matter and other air pollutants and improve indoor air quality.
- **Ecosystem health & resilience**: actions that preserve or restore native habitat, increase resilience of natural systems, or reduce environmental exposures.
- **Energy security**: actions that ensure access to reliable and affordable energy for communities.
- **Employment & workforce development**: actions that create and support "green" employment opportunities.
- **Housing burden**: actions that change housing burden, such as decreases in energy or transportation burden.

The equity and co-benefits assessment includes the following communities of concern:

- Communities of color;
- Tribal nations;
- Low-income rural communities;
- Low-income urban communities; and
- Elderly populations.

All of the study results will help inform DEQ and EQC decision-making and program rules development by providing a better understanding of different program design options and associated potential costs and benefits.

### 9. What does and doesn't this study include?

This study at a high-level uses scenario analysis to understand and compare different emissions reduction cap trajectories and program designs for the Climate Protection Program. The scenarios are compared to a reference case, or a projected world without the program where entities are not required to reduce their greenhouse gas emissions in a Climate Protection Program. The study directionally informs the rulemaking to develop the new program and test different ways in which DEQ could design an emissions reduction program.

The modeled scenarios do not represent complete policy proposals, nor does the modeling capture all the nuance of how a program like this would truly work in practice. Consequently, this study is not a regulatory impact analysis and therefore does not include all potential program implications. Additionally, the study was not designed to develop compliance pathways for individual regulated entities nor prescriptively determine a singular way in which the program should work.

All modeling tools have some limitations and therefore the approach for this study does not capture every potential cost nor benefit associated with a program of this kind. This modeling study is also not a climate change risk assessment nor an assessment of health, ecosystem, or economic costs due to avoided increased extreme weather events or other climate-related risks, however, these costs do exist in reality.

There are many different uses for modeling analyses, different modeling tools that could be used, and numerous ways to study a program of this kind. However, as this program is under development, a study to capture the high-level potential implications seemed the best fit as a first review. Similar topics have been analyzed in relation to other potential emissions reduction programs and policies.

The program is broad in scope in the sectors it covers and the impacts it could cause in Oregon. There are specialized modeling tools and approaches to study nearly all aspects of this. For example, the health analysis could be interpreted as being a conservative estimate of the public health co-benefits that could be achieved from the Climate Protection Program. Given the analytical tools used, the focus was on air quality improvements due to exposure to particulate matter and its precursors, from fuel combustion only. However, there are many other health benefits that can be achieved from a greenhouse gas emissions reduction program, such as relieving health burdens including but not limited to cancer, stroke, diabetes, premature birth, and other respiratory illnesses, as well as monetary benefits associated with each of these.

**10. How does this study account for other programs and policies, such as Cleaner Air Oregon?**

The analysis incorporates complementary policies and relevant investment strategies. Additional resources regarding assumptions can be found linked at the modeling and rulemaking websites.

The Cleaner Air Oregon program is focused on toxic releases at specific facilities. This study does not incorporate this data into the modeling of health impacts as these are two different types of analyses. Cleaner Air Oregon is focused on specific cancer and non-cancer health risks from exposure to air toxics from individual facilities. In this study, the COBRA analysis evaluates avoided morbidity and mortality due to changes in exposure to particulate matter, a co-pollutant closely associated with many activities that also result in greenhouse gas emissions. As described above, the COBRA tool does not analyze changes in health impacts from exposure to toxic air pollutants.

**11. Does the study address potential relocation of businesses or emissions outside of Oregon?**

DEQ understands the importance of evaluating leakage risk, or the potential of businesses or emissions to relocate outside of Oregon as a result of a new regulation. How to handle leakage risk in the program design is part of continuing discussions as DEQ develops the Climate Protection Program.

For this study, DEQ has set a geographic scope to evaluate emissions in Oregon. The modeling will rely on an emissions scope and methodology consistent with the state's current sector-based approach for the statewide emissions inventory. With this approach, the study does not assess leakage outside of Oregon or supply chain emissions that occur outside the state to support in-state activities. However, when there are changes in a given sector, the economic analysis captures different spending and investments in relation to that, which connects to changes in employment, as well. Therefore, while this analysis is assessing changes inside the state only, it can also be inferred what may be happening outside the state due to the macro-economic changes.

**12. What data sources are relied on for the study?**

DEQ and ICF have developed additional background resources available on the modeling website here. Broadly, national and state-specific data sources inform this study. Some data sources include:

- DEQ's Greenhouse Gas Reporting Program historic emissions inventory data and data reported directly to DEQ;
- U.S. Environmental Protection Agency data, primarily relying on the methodology used to compile Oregon's statewide sector-based emissions inventory to inform projections;
- Transportation sector data from Oregon's Clean Fuels Program and from the Oregon Department of Transportation;
- Electric and natural gas utility Integrated Resource Plan data for investor-owned utilities overseen by the Oregon Public Utility Commission to inform Oregon-specific projections of future energy needs;
- Emissions factors in alignment with EPA and with what's currently used for emissions reporting in Oregon; and
- Oregon-specific data including population projections from the Portland State University Population Research Center and Metro, as well as health incidence data from Oregon Health Authority to inform the public health modeling performed in COBRA.

The transportation sector modeling in VISION aligns methodology, data, and assumptions, as appropriate, with the baseline projections for a separate study on the Oregon Clean Fuels Program. For this separate study, DEQ has contracted with ICF to develop fuels forecasts to assess options for expanding the Clean Fuels Program beyond its current 2025 target.

In addition to the above data sources, DEQ coordinated with environmental justice and community-based organizations to inform the approach for the more qualitative co-benefits and equity assessment. The co-benefits and equity indicators incorporate results and findings from the modeling directly, and also pull from other literary and data resources.

**13. How are Community Climate Investments incorporated into the study?**

One potential key Climate Protection Program element is community climate investments. Regulated entities could reduce emissions to achieve compliance with the program, but they could also have this alternative way to comply. DEQ could establish a certain dollar amount that a regulated entity could pay to a third-party in order to earn a credit, allowing them to emit one ton of emissions. The funds would be invested in projects that reduce emissions and support equity by prioritizing projects in environmental justice and other impacted communities. To learn more about this program feature, visit DEQ's rulemaking website linked above on page 1.

Community climate investments are available in the emissions modeling to use toward compliance, but the potential economic and monetized health impacts of the investments are not included in the modeling study. Some assumptions regarding types of projects that could be funded with community climate investments were included in the co-benefits and equity assessment, based on initial project types found to be of interest to environmental justice and community-based organizations.

**14. How does the study account for technology changes over time?**

There is inherent uncertainty in future technologies and costs that could influence actual program outcomes. It is difficult to incorporate assumptions regarding new or emerging technology into a modeling study as there are many uncertainties regarding costs and commercial viability, thus not every potential technology is incorporated. Current available cost information for technically achievable emissions reductions were incorporated into the model for some technologies, where it made the most sense to include them. Some examples include, but are not limited to:

- Energy efficiency;
- Fuel switching, such as to renewable natural gas or hydrogen for transportation purposes;
- Electrification; and
- Destruction, removal, or recovery of industrial process emissions.

However, there are likely areas where additional emissions reductions could be achieved with improved technology performance or new technologies. For example, pipeline hydrogen was not modeled, though this could offer opportunities for reductions in the future.

**15. Where can I find the initial modeling results and more information on data sources and assumptions? What other details regarding the modeling will be provided?**

DEQ has posted resources with summary results and additional background information and assumptions on the modeling website linked above on page 1. DEQ and ICF have been working swiftly to package and present results to the public as soon as they are available. Therefore, DEQ and ICF continue to work together to determine the best way to provide additional results and data for the public, while also continuing the modeling analysis with a fourth scenario.

**16. How are small business impacts assessed?**

Assessing impacts to small businesses is an important piece of the fiscal impacts statement that DEQ is required to include as part of the formal rulemaking process. DEQ and ICF continue to work to understand the results of the study and any details regarding impacts to small businesses, however these impacts will also be investigated in other ways for the fiscal impacts statement, outside the modeling study.

**17. How do the subset of regulated sectors interplay with the economy-wide emissions inventory?**

The study looks at sectors of Oregon's economy that align with the statewide sector-based greenhouse gas emissions inventory, which includes estimates of emissions associated with imported electricity that was generated in other jurisdictions but imported to serve Oregon load.

The initial policy scenario results indicate that the subset of sectors that are regulated in the program and required to reduce emissions can meet declining caps through a number of ways, including different combinations of improved energy efficiency, switching to renewable fuels, electrification of end-uses, and community climate investments.

Not every sector modeled out to 2050 is in the cap program. For example, there are no changes to emissions from waste or agriculture in any scenario because the program will not impact those sectors or emissions. Another example of a sector that is not regulated in the cap program is the electric sector. However, modeling emissions associated with this sector is informative because electrification is an important way to reduce other sector emissions to meet program caps and also influences the public health analysis.

## Alternative formats

DEQ can provide documents in an alternate format or in a language other than English upon request. Call DEQ at 800-452-4011 or email deqinfo@deq.state.or.us.