Oregon Energy Strategy
Key Model Findings

Air Quality & Energy Wallet Analyses

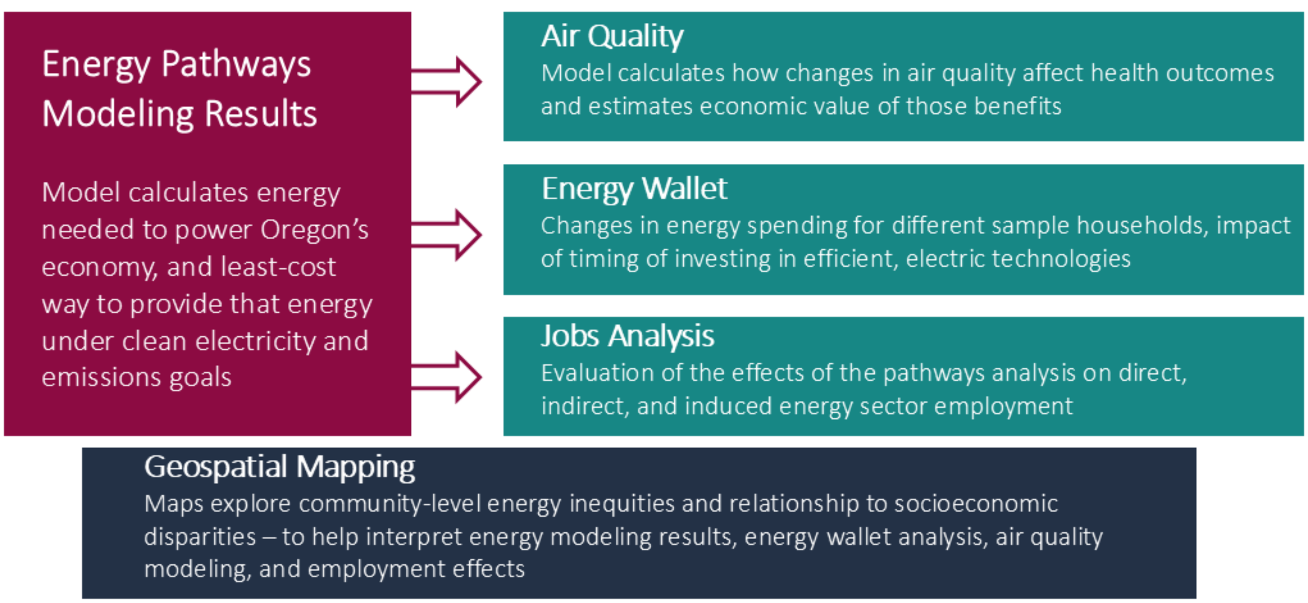
Background: The Oregon Energy Strategy Energy Pathways Modeling and Complementary Analyses

Using input from Tribes, the Energy Strategy's Advisory and Working Groups, particularly driven by feedback from the Environmental Justice and Equity Working Group, staff-to-staff conversations with state agencies and the Inter-Agency Steering Group, and comments from the public, ODOE and its consultants developed scenarios that represent different energy pathways the state could take to achieve its energy policy goals by 2050. The model uses a two-step process:

1) It develops a bottom-up demand model to establish baseline and future energy demand in Oregon's economy from now to 2050.
2) It determines the energy supply needed to meet that demand reliably and at least cost.

The model compares energy pathways from a Reference Scenario to six Alternative Scenarios. The Reference Scenario includes "aggressive but achievable" adoption of demand-side technologies and actions, including energy efficiency and electrification. Assumptions were informed by multiple studies that assessed technologies and strategies to decarbonize the energy sector.[i] The model then selects the least cost portfolio of supply-side solutions to meet this demand over time. Each alternative scenario changes a critical assumption from the Reference Scenario and seeks a least-cost pathway across available resources given the new constraint.

Building on the energy modeling results, the Complementary Analyses evaluate effects of different pathways on energy spending for different households in Oregon, air quality and public health, and employment.[ii] Geospatial mapping provides additional context to understand the modeling results.



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[i] ODOE references some studies in the 2022 Biennial Energy Report: *Charting a Course for Oregon's Energy Future*.

[ii] This document will not include key findings from the employment analysis as the results of that analysis are not yet available.

For more information about how the energy pathways model works and the key assumptions used for the reference and alternative scenarios, see: Energy Strategy Modeling Assumptions and Sources. For more information about the complementary analyses modeling methodology, see: Complementary Analysis: Energy Wallet, Air Quality, and Geospatial Mapping.

Air Quality Analysis

The energy pathways modeling identifies least-cost actions to reduce Oregon's greenhouse gas emissions. The air quality analysis considers how those least-cost actions might reduce other air pollutants that negatively affect public health. This analysis builds off the energy pathways modeling results using the U.S. Environmental Protection Agency's Co-Benefits Risk Assessment (COBRA) model.

The COBRA model measures changes in public health outcomes, such as asthma symptom exacerbation, occurrences of respiratory symptoms, and changes to all-cause[iii] mortality. It also estimates the economic value of these health benefits. It focuses on the effects of the energy pathways modeling outcomes and does not measure the effects of changes in wildfire smoke or indoor air quality. For more information about the EPA's COBRA model, see: https://www.epa.gov/cobra.

Key Finding 1: Achieving Oregon's energy policy objectives could provide significant public health and economic benefits.

The air quality analysis suggests that Oregonians could see significant health benefits if it were to achieve the energy pathways that the Oregon Energy Strategy modeling exercise produced. The air quality model shows reductions in occurrences of asthma and respiratory symptoms as well as substantial reductions in annual all-cause mortality. The model estimates that the transition may lead to between 18 and 47 fewer lives lost in 2030 and 41 to 106 fewer mortality incidents in 2050 (see Figure 1).[iv] The cumulative economic value of these health benefits is large, ranging from a lower bound of $6.3 billion to a high of $14.1 billion (net present value[v]). These benefits are estimated to range from roughly $44 to $99 per Oregonian in 2030 and $98 to $220 in 2050 (see Figure 2). These results provide strong evidence of potential health savings from achieving Oregon's emissions and clean energy targets, but they do not capture the full suite of potential health benefits. For example, other health benefits associated with the modeled energy pathways may include improvements in indoor air quality and home temperature regulation. In the long run and with coordination from other jurisdictions, reducing Oregon's greenhouse gas emissions can also help mitigate future climate change-related public health challenges such as reduced air quality from wildfires and increased days of extreme heat.

[iii] All-cause mortality refers to the total number of deaths from any cause.

[iv] The EPA COBRA model reports low and high estimates to reflect the range of findings in the epidemiological studies of health outcomes used in the modeling.

[v] Net present value is calculated using a 2 percent societal discount rate.

Figure 1: Estimated Annual Reductions in All-Cause Mortality

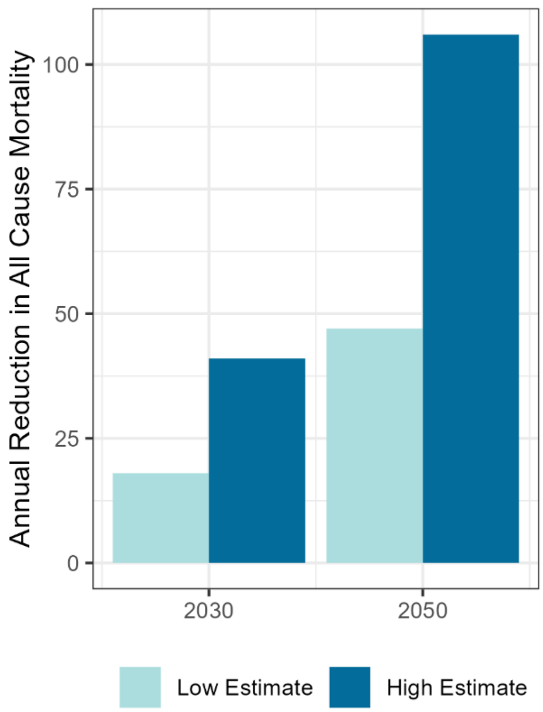
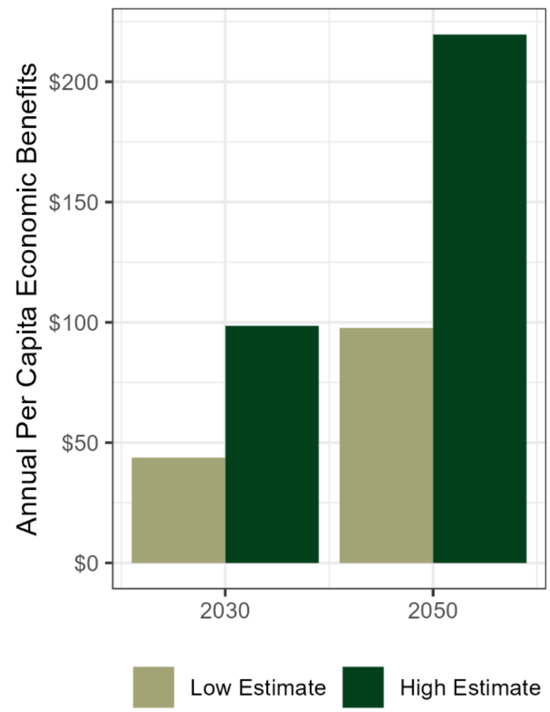


Figure 2: Estimated Annual Per Capita Economic Benefits of Improved Health



Energy Wallet Analysis

As noted above, the energy pathways modeling gives us a sense of the least-cost economy-wide pathways to decarbonize. The energy pathways modeling identified that electrification of vehicles and buildings are key elements of a least-cost pathway, but it does not provide insights to inform potential costs, benefits, and barriers at a household level. The energy wallet analysis serves to bridge the gap between economy-wide insights and household-level insights by answering questions such as:

- How might household bills be affected with changes in technology?
- How does this compare to keeping technologies consistent?
- Does the year of adoption matter?
- Is there a difference in household energy spending over time for households with different characteristics?
- How does the cost of electricity and natural gas affect the cost of technology change?

The energy wallet analysis examines a household's energy use and associated costs as they switch to an electric vehicle (EV) and heat pump. The analysis does not represent any specific home. Rather, it is based on public comments and a review of household profiles[vi] to develop five realistic sample homes. These homes are referenced by the hypothetical head of household: Jessica, Ruchi, Alan, Hugh, and Stephanie.

[vi] For this analysis, the technical team relied heavily on the Northwest Energy Efficiency Alliance (NEEA)'s 2022 Residential Building Stock Assessment (RBSA).

The findings from the energy wallet do not represent a particular utility service territory or rate structure, nor do they represent all potential shifts that may increase or decrease the upfront and operating costs of different technologies, such as changes to supply chain costs, changes in federal policy, or cost pressures on electricity and natural gas prices outside of the energy pathways modeled changes.

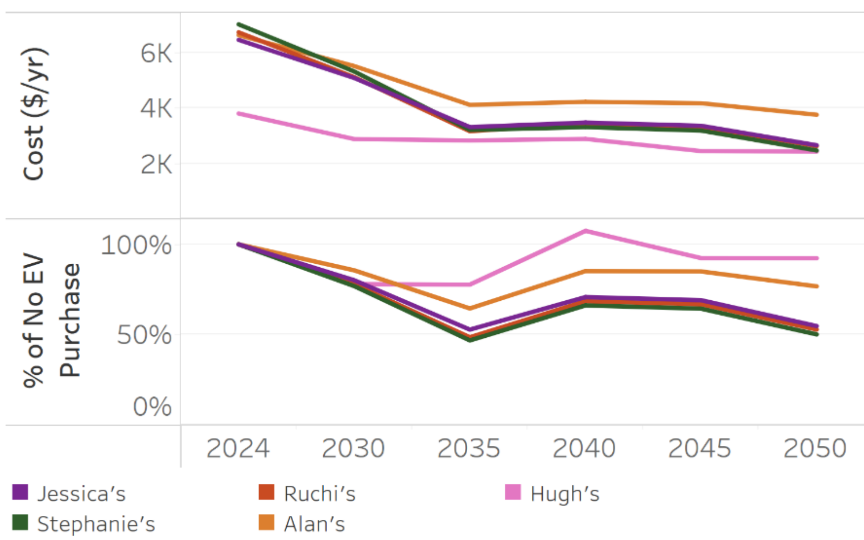
Key Finding 2: Multiple factors impact the extent of potential savings from electrification of homes and transportation. Developing inclusive policies will be important to enable access to cost savings.

When considering the adoption of an electric vehicle or a heat pump, numerous factors affect the potential cost savings for any given household. Some of the factors likely to affect levels of potential cost savings include: energy prices, cost and access to technology based on household income, technological development, timing of adoption, and production and supply chain challenges.

The energy wallet analysis considers some of these factors, but many could not be included. Further research and resources will likely be necessary to ensure that households can make informed decisions about electric technology adoption and be supported when these uncertainties create barriers to accessing potential cost savings.

Key Finding 3: All five sample households in the energy wallet analysis show cost savings with vehicle electrification in most circumstances.

Figure 3: Energy Wallet Costs for Households Replacing Two Vehicles with EVs in 2030 and 2035



Note: Customers are assumed not to receive and IRA credit. Assumes customers make no heat pump purchase.

The five sample households in the energy wallet analysis show differences in potential savings for different technologies. In most circumstances, the sample households all suggest savings from adopting electric vehicles compared to continuing to use and purchase internal combustion engine vehicles. Figure 3 shows potential savings for the five sample households if they replace their two vehicles with EVs in 2030 and 2035 (with Hugh's household replacing its one vehicle in 2030). The energy wallets shown here assume an electricity rate of $0.20/kWh, natural gas rate of $1.50/therm, a gasoline rate of $3.79/gallon,[vii] and that customers do not receive IRA incentives. The energy wallet for Hugh's household, which is a multifamily apartment unit, assumes that 80 percent of Hugh's charging occurs outside the home at a rate of $0.43/kWh. In the top panel, which shows costs over time, the

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[vii] All prices for the energy wallet are shown in real terms, meaning that they are adjusted for inflation.

model results suggest that all sample households experience some level of cost savings out to 2050. The bottom panel indicates how these costs compare as a percentage of an alternative where the household purchases internal combustion engine vehicles instead of EVs when their current vehicles reach the end of their life.

These results show that transportation electrification may provide an opportunity for energy wallet savings across all five sample households, but with the extent of savings varying based on household characteristics. For example, Hugh's household could experience higher savings from switching to an EV if they did more EV charging at home with a residential electricity rate.

Key Finding 4: Not all sample households save money from heat pump installation.

Not all sample households see cost savings from adopting a heat pump, as can be seen in Figure 4.

Figure 4: Energy Wallet Costs for Households Replacing their Home Heating Technology with an Electric Heat Pump in 2030

Note: Rates for electricity are Low: $0.10/kWh, Medium: $0.15/kWh, High: $0.20/kWh, Higher: $0.40/kWh. Rates for gas are Low: $1.00/therm, Medium: $1.25/therm, High: $1.50/therm. Assumes customers make no EV purchase. Spike downwards is in years when customers do not have a loan payment to make on heat pump equipment.

These savings depend on considerations such as electricity and natural gas prices—shown in the figure as different colored lines for each household—and capital costs for current technology relative to heat pump technology. While Ruchi's and Alan's households show cost savings in most cases, Jessica's household shows cost savings in only some of the wallets tested, and Stephanie's household rarely sees cost savings. Hugh's household shows no savings regardless of energy prices tested in the energy wallet because of the high prices for heat pump technology in multifamily homes, based on the source used for this analysis.[viii]

Key Finding 5: Because the energy wallet analysis shows that there are potential savings for those able to afford upfront investments, there is a risk that Oregonians unable to afford these investments, particularly those in already marginalized communities, could be left behind.

Key Findings 3 and 4 outline the potential for cost savings shown in the energy wallet analysis. For households to realize these cost savings, they need to have access to capital or credit to cover the upfront cost of the investment in new technology. Households with lower levels of wealth or less access to affordable lines of credit may not be able to benefit from these cost savings. If those households are unable to make these investments, they may fall farther behind more-resourced households, leading to greater inequalities in wealth and energy burden over time. Policy recommendations aimed at facilitating technology adoption must be intentional and explicitly use an environmental justice and equity lens to develop solutions that avoid creating, perpetuating, or exacerbating disparate outcomes.

[viii] Heating and cooling technology costs were sourced from the American Council for an Energy-Efficient Economy (ACEEE): https://www.aceee.org/sites/default/files/pdfs/b2205.pdf