Oregon Energy Strategy Complementary Analysis

August 2025

Prepared for:

Oregon Department of Energy

Evolved Energy Research
Clean Energy Transition Institute
Rockcress Consulting
Sylvan Energy Analytics

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Introduction

Complementary Analysis Builds on and Supplements Energy Modeling Results

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Energy Pathways Modeling Results

Model calculates energy needed to power Oregon's economy, and least-cost way to provide that energy under clean electricity and emissions goals.

Air Quality*

Model calculates how changes in air quality affect health outcomes and estimates economic value of those benefits

Energy Wallet*

Changes in energy spending for different sample households, impact of timing of investing in efficient, electric technologies

Jobs Analysis

Evaluation of the effects of the pathways analysis on direct, indirect, and induced energy sector employment

Geospatial Mapping*

Maps explore community-level energy demographics and socioeconomic disparities – to help interpret energy modeling results, energy wallet analysis, air quality modeling, and employment effects

*The Environmental Justice and Equity Working Group had additional dedicated meetings to inform these analyses

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Air Quality Analysis

Reducing Emissions Brings Health Benefits

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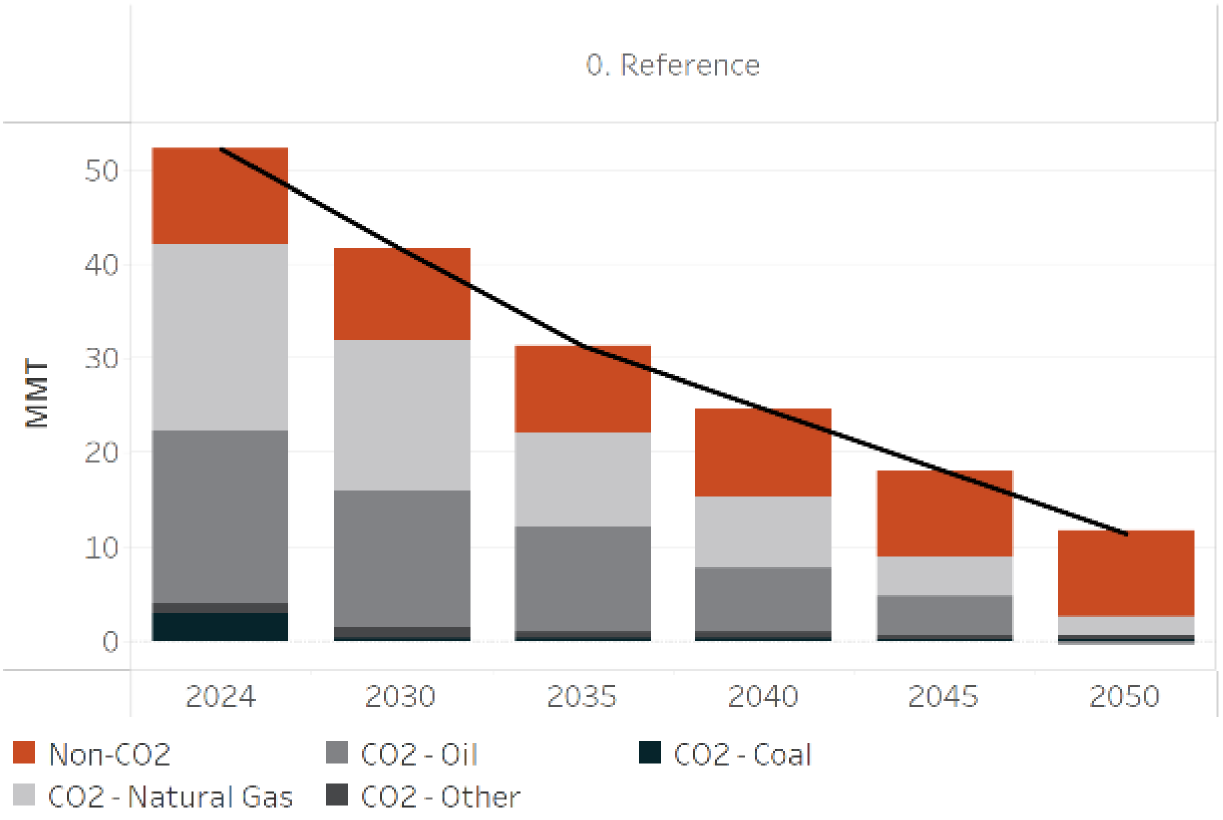
- In addition to the climate benefits from reducing greenhouse gas emissions, reducing pollutant emissions provides health benefits to Oregonians
- Air Quality analysis considers health impacts of changes in fine particulate matter (PM2.5) and secondary particulate matter such as nitrogen oxides (NOx) and sulfur oxides (SOx)

Greenhouse Gas Emissions from 1/31 Presentation by Type and Source



Air Quality Analysis Overview

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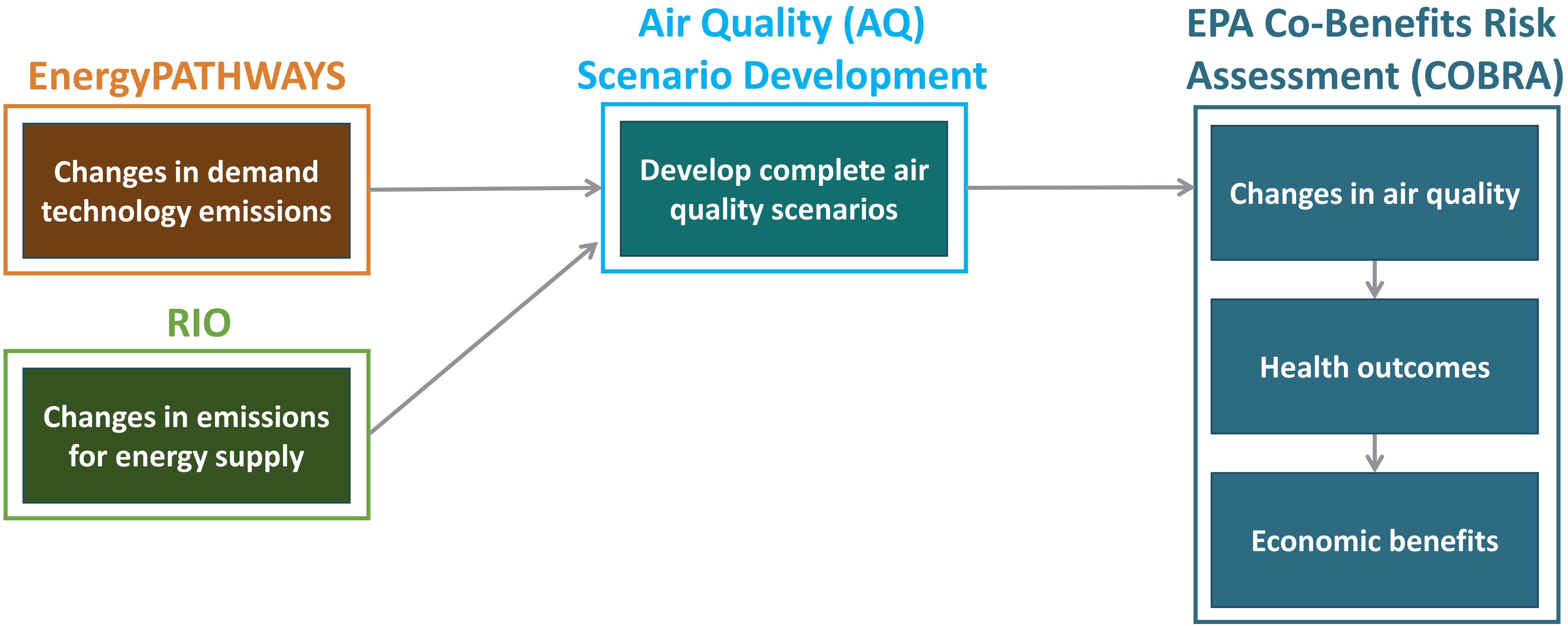


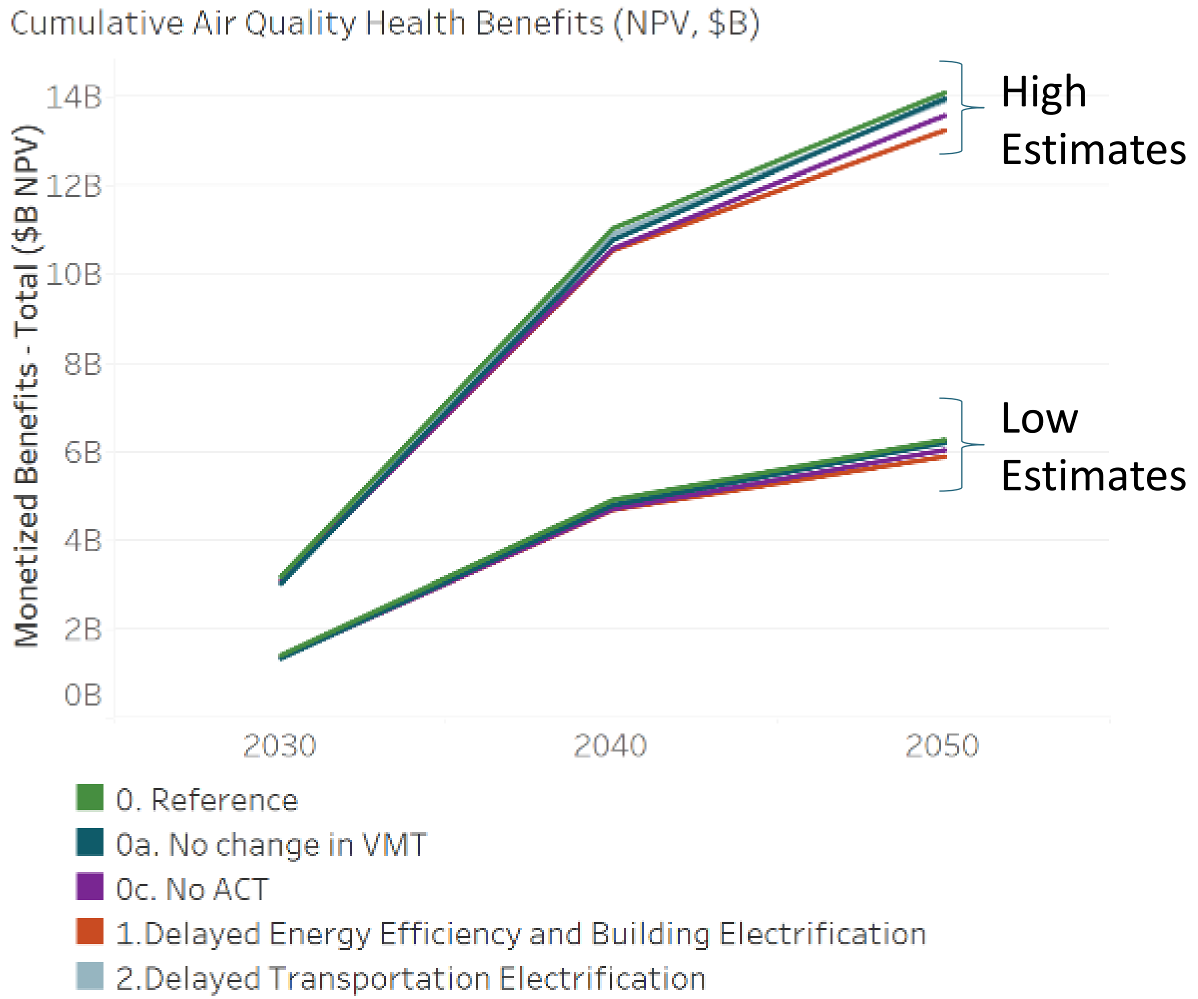
EPA COBRA: https://www.epa.gov/sites/default/files/2017-10/documents/cobra_training_eic_2017.pdf

Key Takeaways

- COBRA analysis indicates significant health benefits associated with achieving Oregon emissions and clean energy targets
  - Between $205M and $461M monetized benefits in 2030
  - Between $538M and $1211M monetized benefits in 2050
  - Cumulative present value benefits of $6.3B to $14.1B over the next 25 years
- Absolute benefits follow population by region, but per capita benefits are higher in the southern regions of the state
- Most monetized dollar health benefits are attributed to reduced mortality based on the high value of a statistical life

Cumulative Benefits

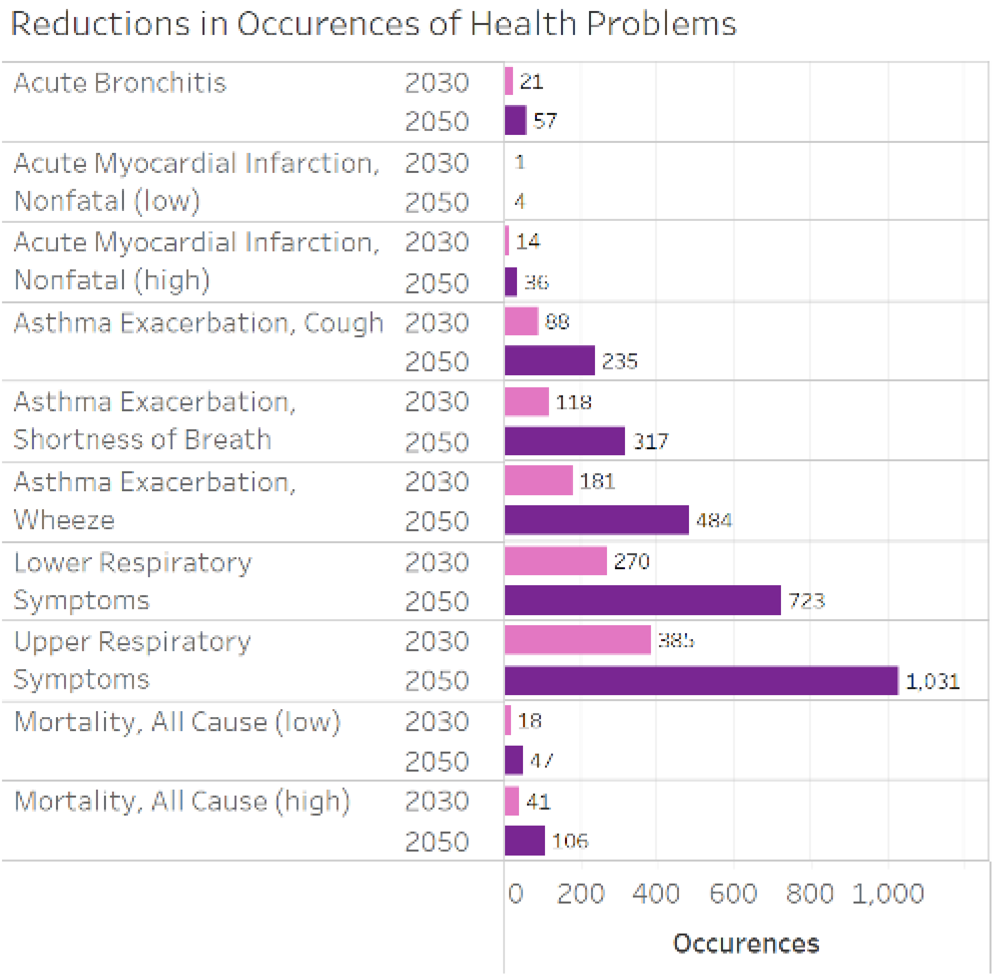
- Benefits are relatively similar across scenarios
  - All achieve emissions reduction goals
- Slightly lower benefits when greater amounts of fuels are burned in buildings and industry or in vehicles
  - Delays in efficiency and electrification have worse health outcomes
- Cumulative benefits range from $6.3B to $14.1B net present value (NPV)
- Benefits relative to air quality in 2023



Present value calculated using a 3% societal discount rate

Impact on Health Metrics and Mortality

- Reduced occurrences of health problems due to reduced pollutant concentrations
- These result in economic benefits such as fewer missed workdays, fewer hospital admissions, and reduced mortality
- Reduced mortality is by far the largest economic benefit
  - Value of a statistical life of $7.4M in 2006 dollars used by EPA
  - Estimates "how much people are willing to pay for small reductions in their risks of dying" - EPA mortality risk valuation



Impact on Lost Workdays, Hospital Admissions, and Mortality

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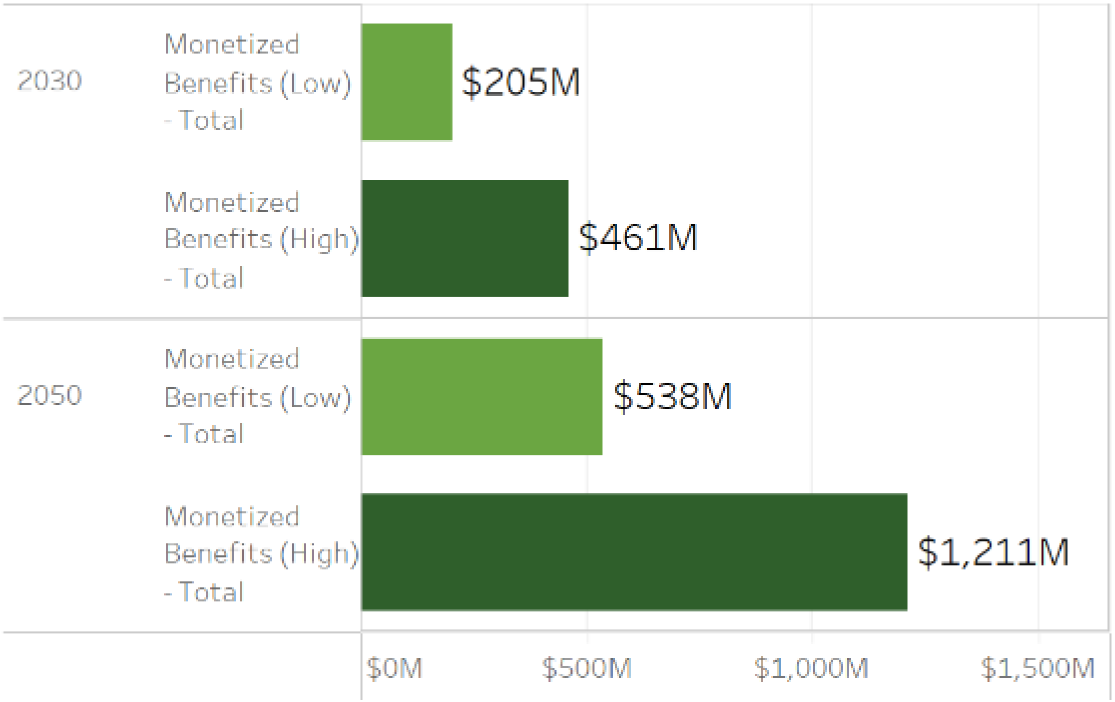
- Outcomes include fewer days of work lost, hospital admissions, and mortalities

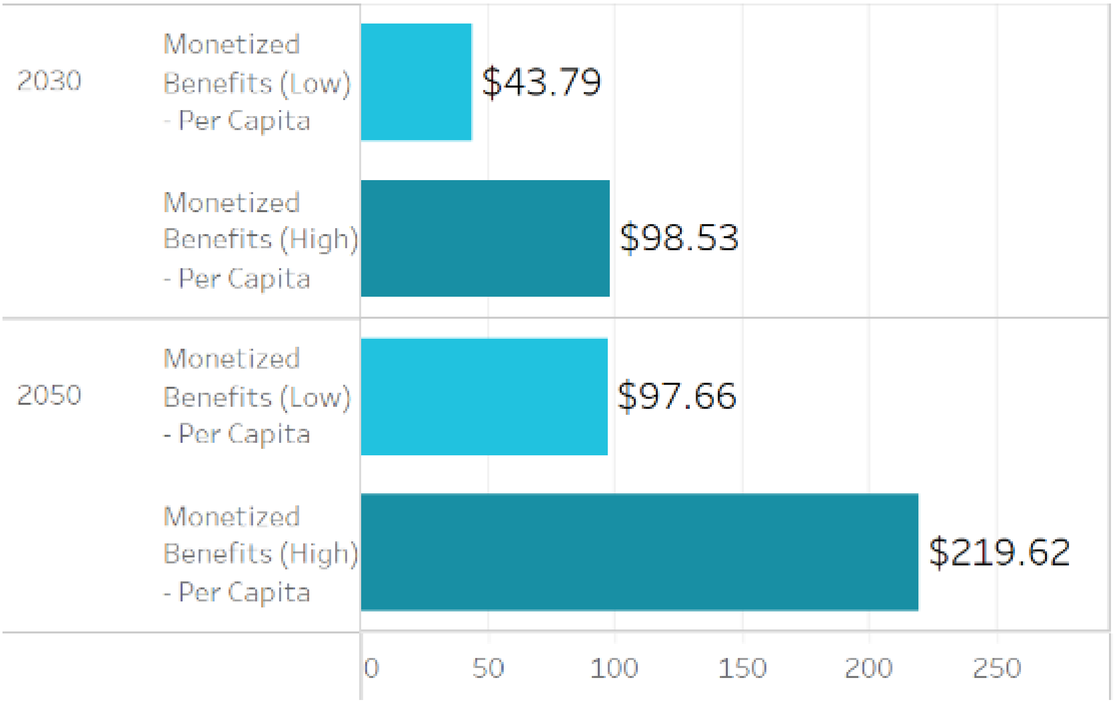
Outcomes	2030	2050
Fewer days of work lost per million people	403	918
Fewer hospital admits per million people	1.1	2.5
Fewer mortalities per million people (high)	8.7	19.3
Fewer mortalities per million people (low)	3.8	8.5

Benefits Attributed to Annual Pollutant Emissions Reductions in the Reference Scenario

Total Benefits attributed to Pollutant Emissions Reductions ($M)

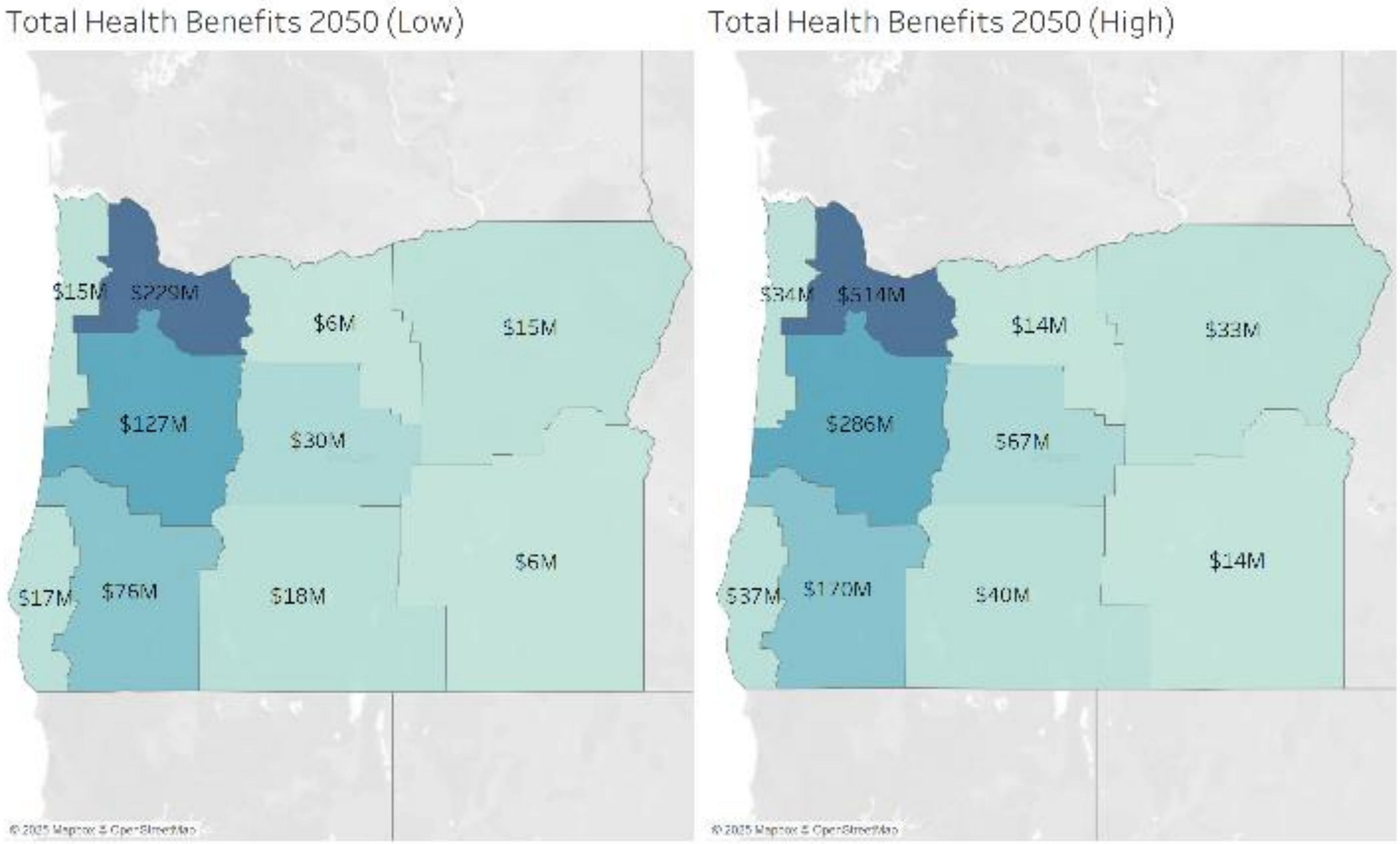


Total Benefits attributed to Pollutant Emissions Reductions ($/Capita)



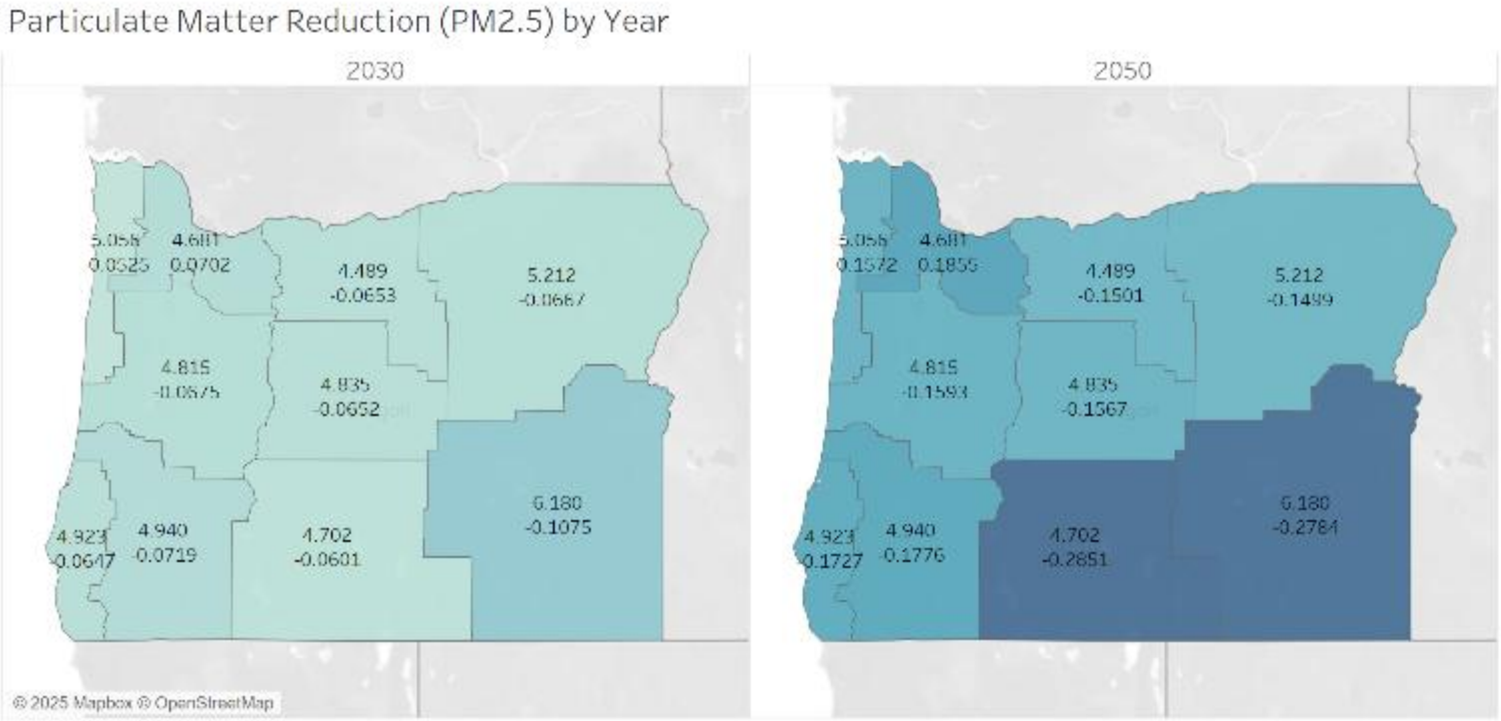
Total Health Benefits by Region in 2050: Reference

- Distribution of health benefits follows population
  - Largest benefits in Portland metropolitan area
- Benefits relative to health impacts of particulate matter exposure in 2023
- Presented for AQ regions developed with the EJ and Equity working group and public input



Particulate Matter Concentrations: Reference

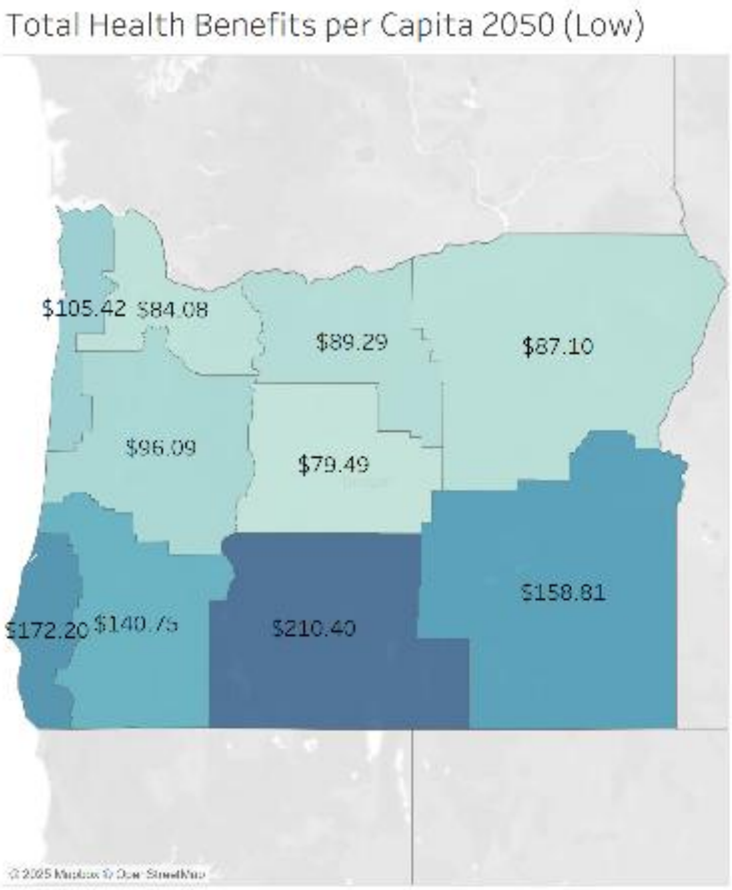
- COBRA calculates the change in PM2.5 concentrations and their impact on health outcomes
- The adjacent maps show the baseline PM2.5 concentrations in 2023 and the change in that baseline by 2030 and 2050
- The reduction in PM2.5 concentrations results in better health outcomes

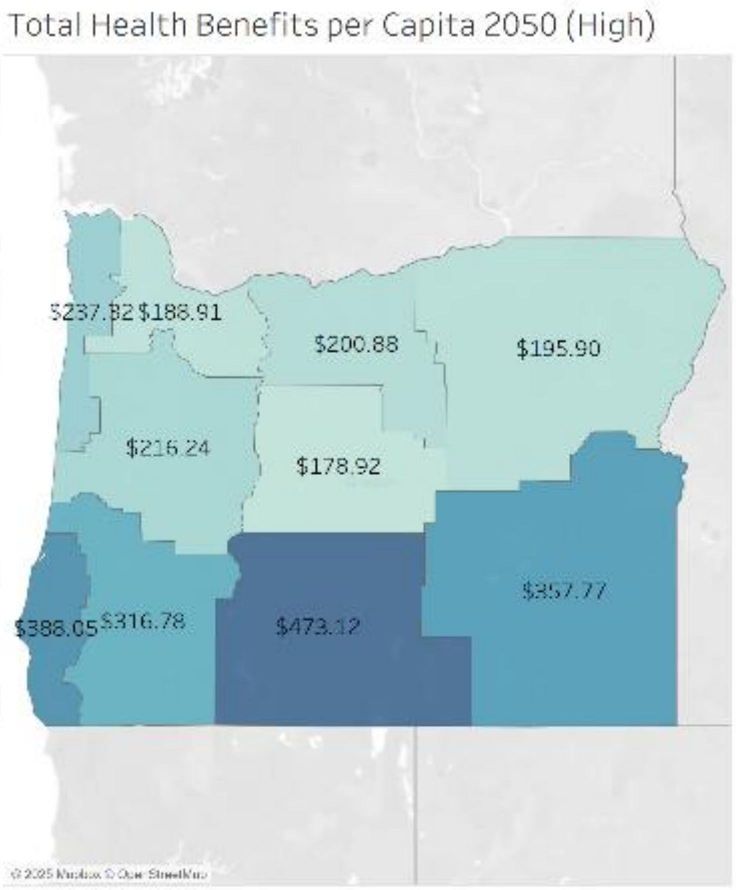


Note: There are two numbers indicated on each region. The top number is Baseline PM2.5 in 2023 (e.g., 4.702), and the bottom number is the Change in PM2.5 from 2023 baseline (e.g., -0.2851)

Health Benefits per Capita by Region in 2050: Reference

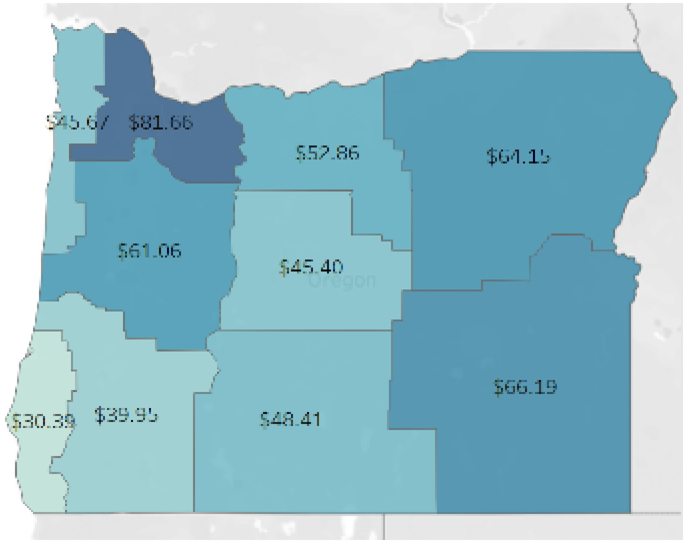
- Per capita benefits greater in the southern regions of the state
  - Relative impacts on PM2.5 differ by region, based on underlying air quality model in EPA COBRA
- ~99% of the benefits come from reduced mortality



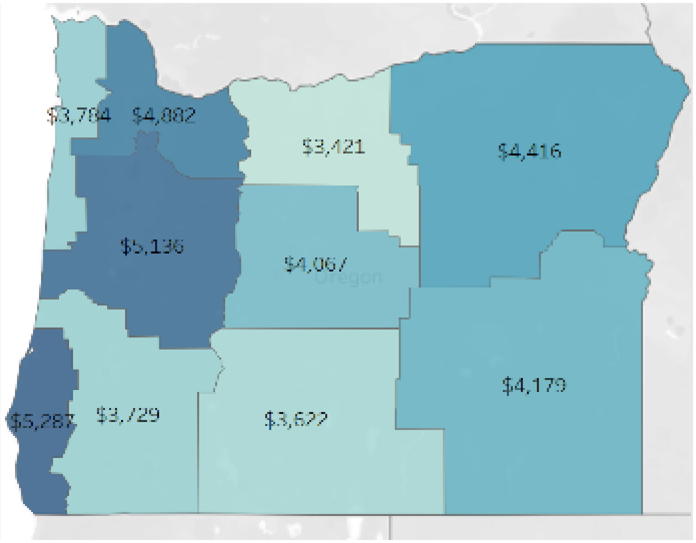


Impact of Different Illnesses $/$M Total Benefits by 2050: Reference

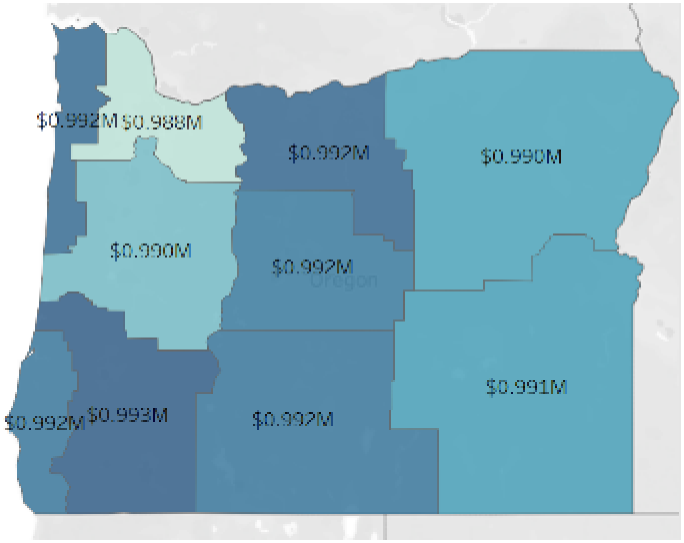
Asthma $ Benefits per million dollars total benefit (High)



Heart Attack (non-fatal) $benefits per million dollars total benefit (High)



Mortality $benefits per million dollars total benefits (High)



- Distributional benefits heavily driven by mortality
- Mortality benefits per $1M of total benefits are even across the state
- Other illnesses are more variable

Air Quality Methodology

Benefits Analysis: Health Impacts

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- U.S. Environmental Protection Agency (EPA) CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) Analysis
- Health impacts of particulate matter from air pollutants including nitrogen oxides (NOx), sulfur oxides (SOx), and direct fine particulate matter emissions (PM2.5)

Air Quality Results from Evolved Models

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EnergyPATHWAYS

Demand technology emission changes

- Database of emissions factors for NOx, PM2.5 and SOx from key technologies
  - Vehicles emission factors taken from EPA Motor Vehicle Emission Simulator
  - Supplemental vehicle emission data from OECD (2020), Non-exhaust Particulate Emissions from Road Transport: An Ignored Environmental Policy Challenge, OECD Publishing, Paris, https://doi.org/10.1787/4a4dc6ca-en.
  - Building technologies adapted from EPA's Air Emissions Inventories for point sources
- Calculates emissions based on technology activity

RIO

Energy supply emission changes

- Database of emissions factors for NOx, PM2.5, SOx and mercury from existing and new power plants
  - Existing plant emission factors taken from EPA Avoided Emissions and Generation Tool (AVERT) and eGRID 2019 data
  - Existing energy conversion technologies (e.g., boilers for steam) are adapted from EPA's Air Emissions Inventories for point sources
  - New power plant data is a combination of NREL ATB data and National Electric Energy Data System data
- RIO calculates emissions based on least cost dispatch

EPA Co-Benefits Risk Assessment (COBRA)

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Develop Scenario

Construct air quality scenario →

COBRA

Changes in Air Quality (Particulate Matter) → **Health Outcomes** → **Economic Benefits**

- Combines data from results and inputs bundled with COBRA to develop AQ scenarios
  - Pollutant results address many but not all categories for COBRA
  - COBRA inputs are scaled or adjusted for missing data categories, with changes made to reflect how each pathway evolves differently.

- Reduced-form air quality model called the Source-Receptor (S-R) Matrix
  - Estimates ambient concentrations of PM by county
- Estimates contribution from each pollutant source to air quality of each county

- Concentration response functions
  - Adult and infant mortality
  - Non-fatal heart attacks
  - Respiratory and Cardiovascular hospital admissions
  - Acute bronchitis and respiratory symptoms
  - Asthma exacerbations and emergencies
  - Restricted activity and work loss days

- Economic costs of health impacts
  - Value of statistical life (VSL)
  - Cost of illness
  - Hospital charges
  - Willingness to pay
    - Symptoms of illness
    - Restricted activity
    - Lost workdays

EPA COBRA: https://www.epa.gov/sites/default/files/2017-10/documents/cobra_training_eic_2017.pdf

Epidemiological Studies Behind COBRA Functions

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- COBRA's concentration response functions are based on epidemiological studies of health outcomes when populations are exposed to changes in PM2.5
- More details can be found in the COBRA user guide and documentation at the following link (source of adjacent table)
  - https://www.epa.gov/system/files/documents/2021-11/cobra-user-manual-nov-2021_4.1_0.pdf

Endpoint	Author	Age
Mortality, All Cause	Krewski et al. (2009)	30-99
Mortality, All Cause	Lepeule et al. (2012)	25-99
Mortality, All Cause	Woodruff et al. (1997)	Infant
Acute Myocardial Infarction, Nonfatal	Peters et al. (2001)	18-99
Acute Myocardial Infarction, Nonfatal	Pope et al. (2006)	18-99
Acute Myocardial Infarction, Nonfatal	Sullivan et al. (2005)	18-99
Acute Myocardial Infarction, Nonfatal	Zanobetti and Schwartz (2006)	18-99
Acute Myocardial Infarction, Nonfatal	Zanobetti et al. (2009)	18-99
HA, All Cardiovascular (less Myocardial Infarctions)	Bell et al. (2008)	65-99
HA, All Cardiovascular (less Myocardial Infarctions)	Moolgavkar (2000b)	18-64
HA, All Cardiovascular (less Myocardial Infarctions)	Peng et al. (2008)	65-99
HA, All Cardiovascular (less Myocardial Infarctions)	Peng et al. (2009)	65-99
HA, All Cardiovascular (less Myocardial Infarctions)	Zanobetti et al. (2009)	65-99
HA, All Respiratory	Zanobetti et al. (2009)	65-99
HA, All Respiratory	Kloog et al. (2012)	65-99
HA, Asthma	Babin et al. (2007)	0-17
HA, Asthma	Sheppard (2003)	0-17
HA, Chronic Lung Disease	Moolgavkar (2000a)	18-64
Emergency Room Visits, Asthma	Mar et al. (2010)	0-99
Emergency Room Visits, Asthma	Slaughter et al. (2005)	0-99
Emergency Room Visits, Asthma	Glad et al. (2012)	0-99
Acute Bronchitis	Dockery et al. (1996)	8-12
Asthma Exacerbation, Cough	Mar et al. (2004)	6-18
Asthma Exacerbation, Cough	Ostro et al. (2001)	6-18
Asthma Exacerbation, Shortness of Breath	Mar et al. (2004)	6-18
Asthma Exacerbation, Shortness of Breath	Ostro et al. (2001)	6-18
Asthma Exacerbation, Wheeze	Ostro et al. (2001)	6-18
Minor Restricted Activity Days	Ostro and Rothschild (1989)	18-64
Lower Respiratory Symptoms	Schwartz and Neas (2000)	7-14
Upper Respiratory Symptoms	Pope et al. (1991)	9-11
Work Loss Days	Ostro (1987)	18-64

COBRA Methodology

- Reports the benefits attributed to emissions reductions in a single year versus 2023 (the latest year of air quality historical data in the COBRA model)
  - Reporting 2030 and 2050 in this analysis
  - Future gas generation additions are assumed to go into the same counties that have existing natural gas capacity for power plants
  - Benefits are attributed to the emissions reductions over 2023 experienced by the population in 2030 and 2050
- Fewer hospital visits, lost workdays, incidences of illness are determined for the year in which the emissions reductions are experienced
- Mortalities attributed to the emissions in a particular year are assumed to occur over the following 20 years
  - Benefits of emissions reductions are the present valued of reduced mortalities over that time period
  - All attributed to the emissions reductions experienced within a single year
- This analysis does not address indoor air quality changes from the energy transition or the effect on air quality of changing wildfire frequency

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Energy Wallet Analysis

Energy Wallet Overview

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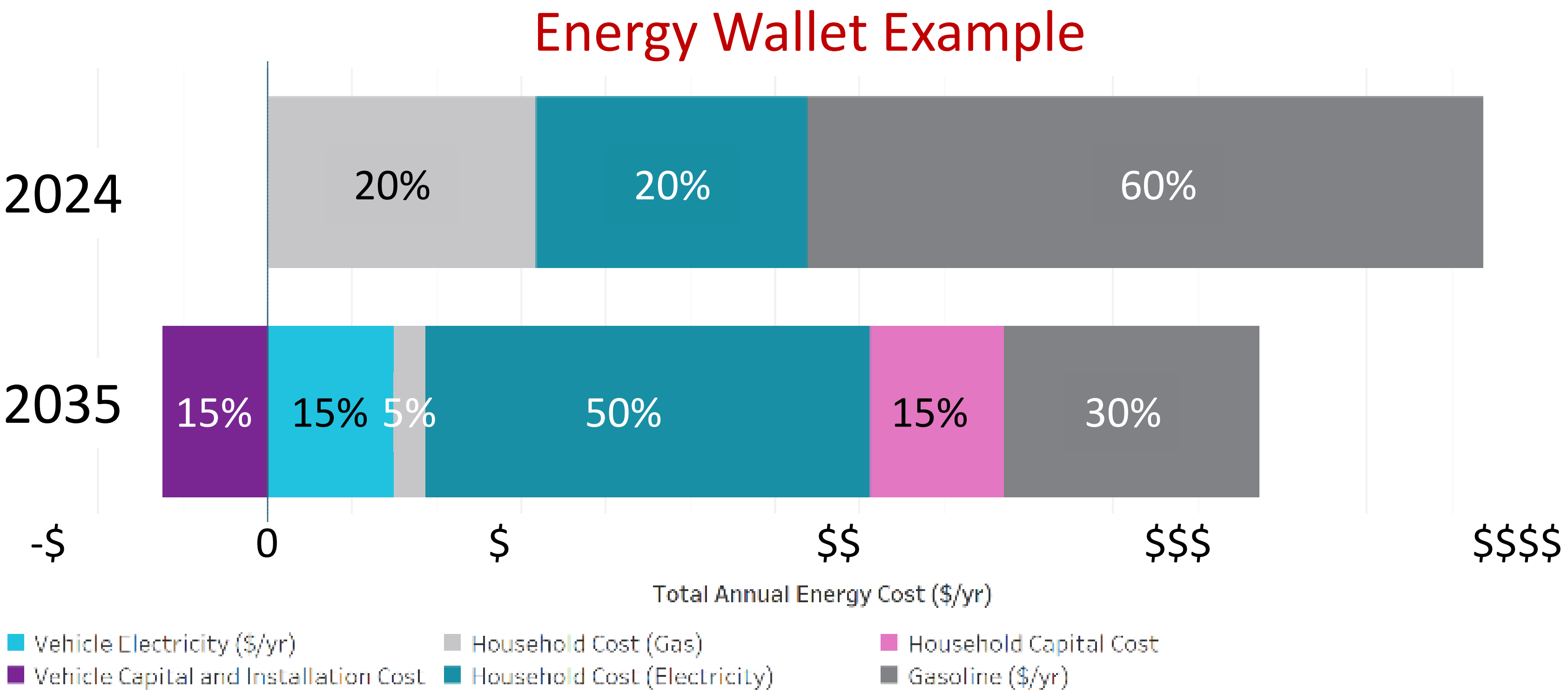
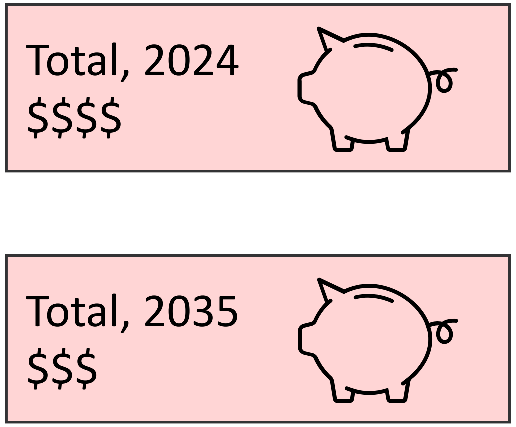
- Energy wallet examines a household's energy use and associated costs as they switch to an electric vehicle (EV) and heat pump
  - Includes household's use of electricity, natural gas, and gasoline
  - Includes all energy spending across fuels, as well the capital cost or savings of buying an EV or a heat pump (compared to buying other replacement technologies)
  - Analysis undertaken for five sample households

Energy Wallet Illustrates How Technology Adoption Affects Household Energy Costs

- Example household buys an EV and a heat pump in 2035. This changes their energy consumption and therefore costs. They must also pay the difference between EVs/heat pumps and conventional technologies.

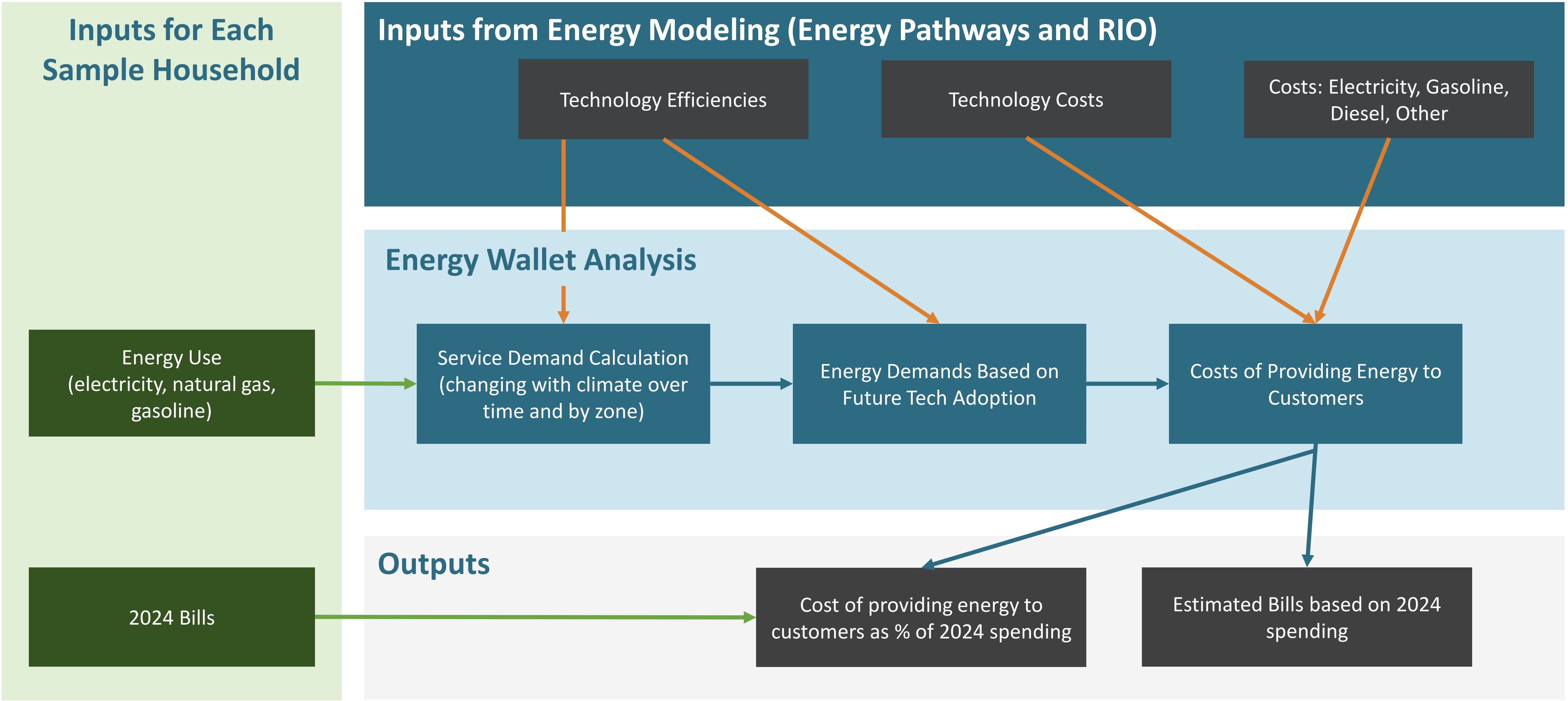




Key Takeaways

- All five sample households save money with vehicle electrification in most circumstances
- All five sample households save energy from electrification of home heating, but not all sample households save money from heat pump installation, absent policy support
- Multiple factors impact how great the cost savings could be from electrification of home heating and transportation
  - Energy prices, cost and access to technology based on household income, technological development, production and supply chain challenges
- Policies are important to enable access to cost savings
  - Education, incentive programs, infrastructure development, access to useable technology, and workforce development
- Upfront costs must be addressed to ensure equal access to the savings from electrification
  - Intentional, explicit policies that ensure environmental justice and equitable solutions are required

Energy Wallet Approach



Meet the Five Sample Households

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Household Characteristic	Jessica's 	Stephanie's 	Ruchi's 	Alan's 	Hugh's 
Building Category	Single Family Detached	Single Family Detached	Single Family Detached	Single Family Manufactured	Multi-family
Region	Urban	Rural Cold Climate	High Priority Area	Rural	Urban
Ownership	Own	Own	Own	Rent	Rent, Below county AMI
Primary Heating Fuel Type	Natural gas	Natural gas	Electricity	Electricity	Electricity
Primary Heating System	Furnace	Furnace	Furnace	Furnace	Baseboard
Primary Cooling System	Central AC	None	Portable AC	Window AC	None
Water Heater Technology	Fossil Fuel Non-Condensing	Fossil Fuel Non-Condensing	Electric Resistance	Electric Resistance	Electric Resistance
Water Heater Fuel	Natural gas	Natural gas	Electricity	Electricity	Electricity
Area (sq. ft.)	3100	1855	1400	1520	[Not available in dataset]
Year	2012	2006	2007	1986	1977
Stove/Oven	Natural gas	Natural gas	Electric	Electric	Electric
Occupants	6	4	2	2	2
Vehicles	2 SUVs	2 SUVs	2 SUVs	2 Cars	1 Car

Note: See pages 60-62 for data sources used to define each sample household

Energy Consumption of Five Sample Households

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Annual Household Usage	Jessica's	Stephanie's	Ruchi's	Alan's	Hugh's
					
Electricity (kWh)	**9,920**	**6,364**	**15,487**	**18,330**	**8,964**
Space heating	-	-	3,954	6,777	3,151
Water heating	-	-	2,754	2,759	1,712
Air conditioning	2,168	-	2,181	2,184	-
Other	7,752	6,364	6,599	6,610	4,101
Natural Gas (therms)	**821**	**1,023**	**-**	**-**	**-**
Space heating	430	712	-	-	-
Water heating	314	250	-	-	-
Other	76	61	-	-	-
Vehicle Miles Traveled (VMT)	**16,823**	**22,113**	**19,833**	**20,743**	**13,555**

Notes on Sample Households

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- Energy consumption varies among sample households
- Housing characteristics impact a household's energy use, but they are not the only factors (e.g., behavior can also play a significant role)
- All households use either natural gas or electricity as the primary heating fuel
  - Does not capture the full range of heating fuels used by Oregonians (e.g., propane, oil, wood)
  - Considered additional fuels and found that natural gas and electricity are the most commonly used primary heating fuels
- Five sample households in this analysis describe a range of possible Oregon households but are not necessarily representative of Oregon's population
- Furthermore, each sample household is not necessarily representative of all households of the same type (e.g., all single family detached homes), rather it is just one example

Uncertainties Underpin the Analysis

Input to the Analysis	Uncertainty
Electricity rates: $0.10/kWh, $0.15/kWh, $0.20/kWh, $0.40/kWh • 2024 rates estimated to range between $0.10/kWh and $0.20/kWh. We also looked at a high electricity rate, double the highest estimate in 2024 at $0.40/kWh • $10 monthly charge • Public charging rate for EVs: $0.43/kWh (source: Axios)	• T&D infrastructure cost changes over time are uncertain and will have an effect on electricity rates • Rate design varies by utility, and volumetric kWh charges may constitute a larger or smaller portion of a customer's bill over time
Gas rates: $1/therm, $1.25/therm, $1.50/therm • 2024 rates estimated to range between $1/therm and $1.50/therm, based on average revenue per kWh sold to residential customers by utility type in Oregon Utility Statistics reports for 2022 and 2023 • Conservatively assumed no higher gas rates, presenting a lower bound on the economic benefits of heat pump adoption due to avoided gas bills • $10 monthly charge	• Large uncertainties on future gas costs as volumes decrease • Will there be a managed decommissioning of gas infrastructure or will infrastructure costs remain similar to today, recovered from fewer and fewer natural gas sales? • How will costs be recovered? Cost recovery across electric rates? Through taxes? Fully though gas sales? Low-income rates?
Gasoline rates: $3.79/gallon • Held flat at today's gasoline price	• Large uncertainties on gasoline prices • Exposure to global market volatility • Refining and delivery network costs for lower gasoline volumes
Costs for appliances and vehicles: ACEEE and ICCT • Assumed average cost from databases, American Council for an Energy Efficient Economy (ACEEE) and the International Council on Clean Transportation (ICCT)	• Capital costs play a large role in customer economics • Large distribution around reported costs, particularly for heat pumps
Efficiencies: EPA and EIA • Assume miles per gallon (MPG) of internal combustion engine (ICE) vehicles increases in the future. Forecasted heat pump efficiency improvements	• Forecasted efficiency improvements in conventional internal combustion engine (ICE) vehicles and heat pumps have both technological and policy uncertainties

Cost Assumptions for EVs

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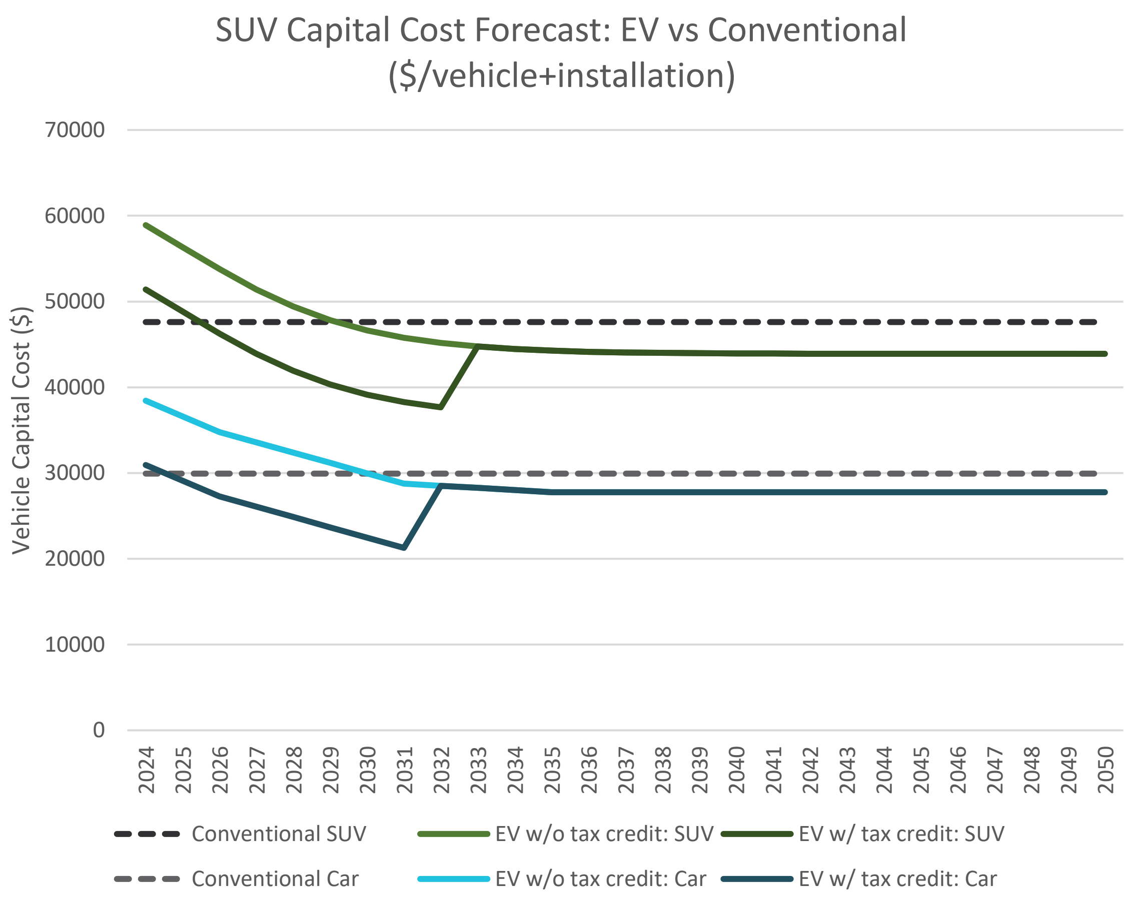
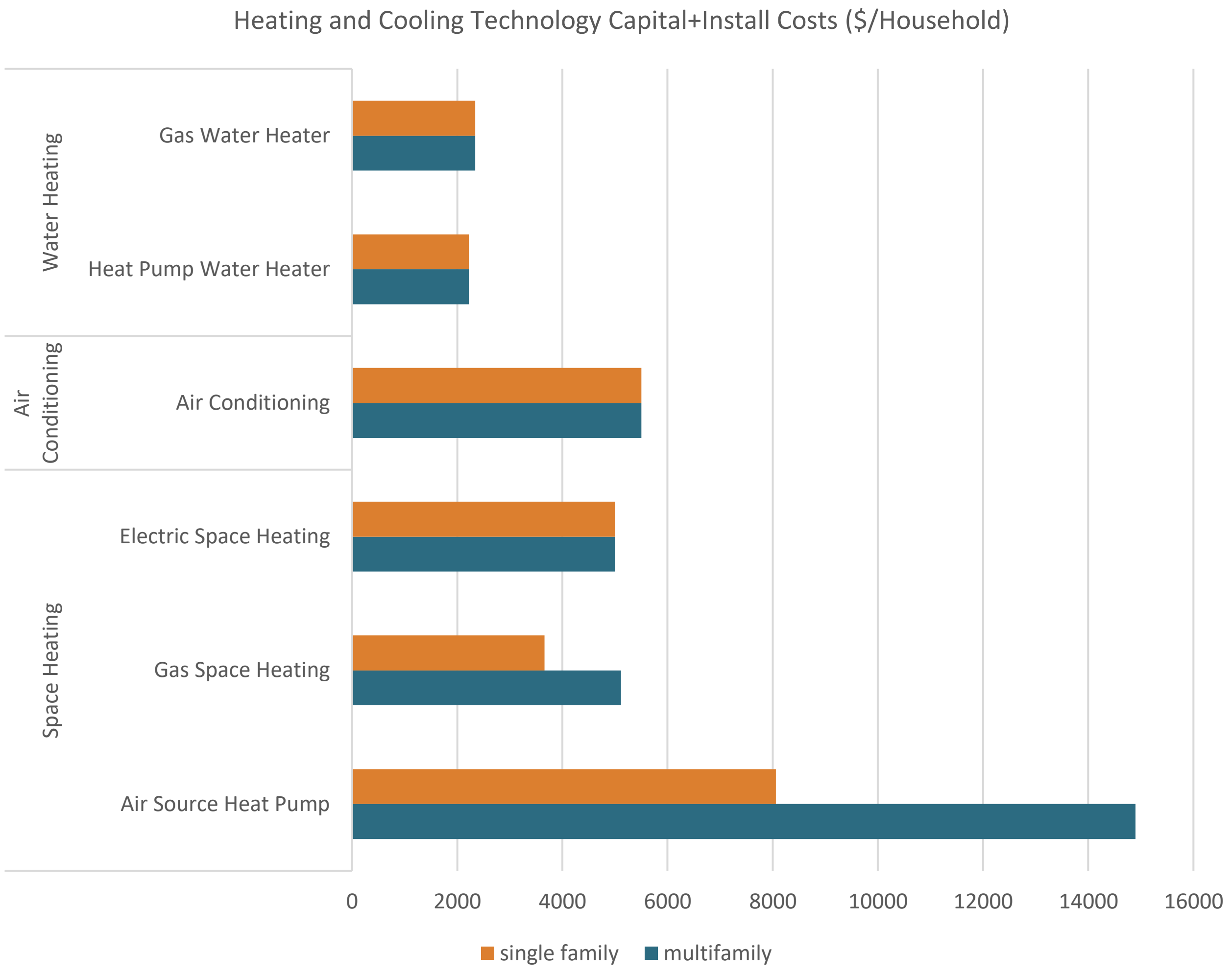
- Vehicle cost assumptions from ICCT
  - theicct.org/wp-content/uploads/2022/10/ev-cost-benefits-2035-oct22.pdf
- SUVs
  - Without Inflation Reduction Act (IRA) tax credits, the capital cost crossover point is forecasted for 2029
  - With IRA, the crossover point is forecasted for 2026
- Cars
  - Without IRA tax credits, the crossover point is in 2030
  - With IRA, the crossover point is 2025



Cost Assumptions for Heat Pumps

- Heating and cooling technology costs from ACEEE
  - https://www.aceee.org/sites/default/files/pdfs/b2205.pdf
- Large uncertainties in installed costs for heating and cooling. We use these costs recognizing they can vary significantly household to household



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Vehicle Purchases

Fundamentals

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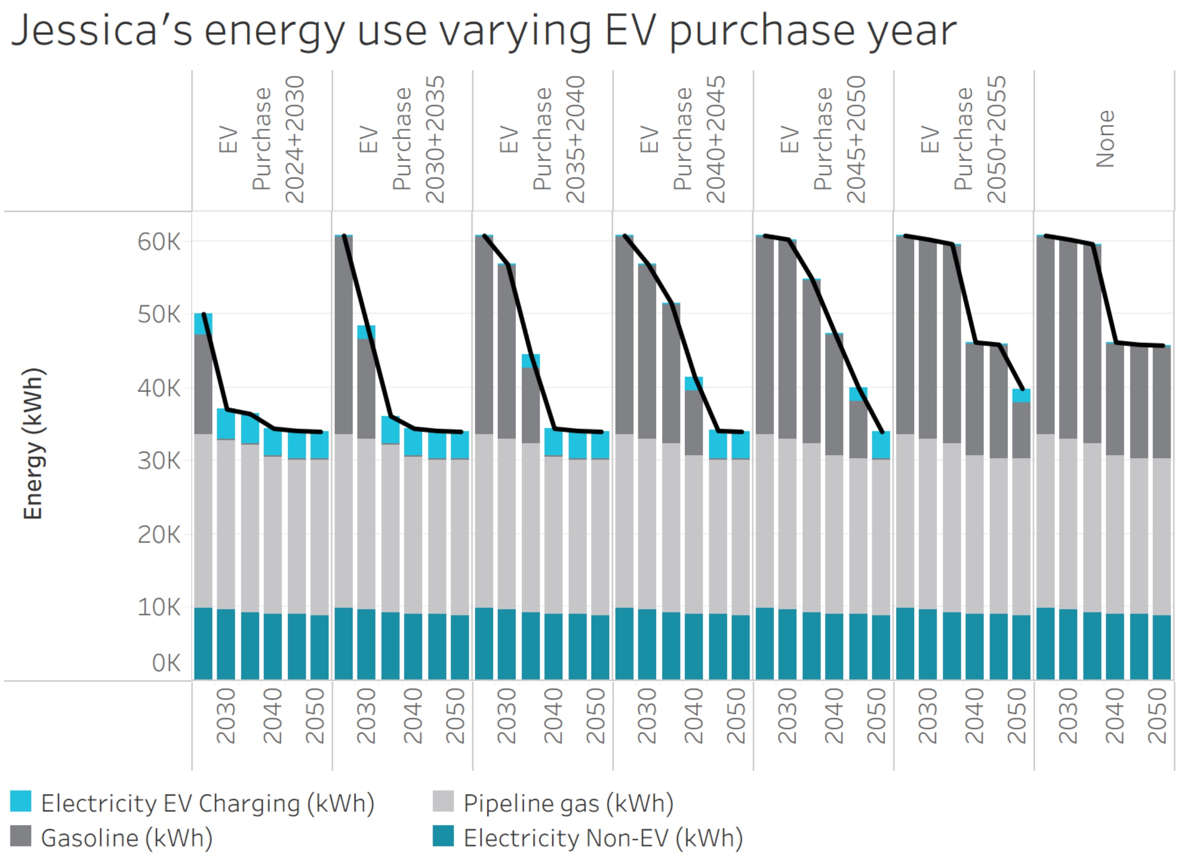
- All results in the analysis are presented in real dollars (2022)
- Assumes gasoline prices at the pump remain flat at $3.79/gallon
- All technology replacements assumed to happen at the end of useful life
    - For example, households replacing a vehicle in 2030 are assumed to have bought their previous one in 2016 for a 14-year lifetime
    - Replaced technology has the average efficiency from the year of purchase
- Where households have 2 SUVs or 2 cars, both contribute half of the total household VMT
- Vehicle and household technology financing assumes a 7% loan rate over seven years
- The following vehicle results assume no heat pump purchase
    - When heating and cooling systems come to the end of their lives, they are replaced with the same, but more efficient technology, because it’s newer

EVs significantly reduce energy demand

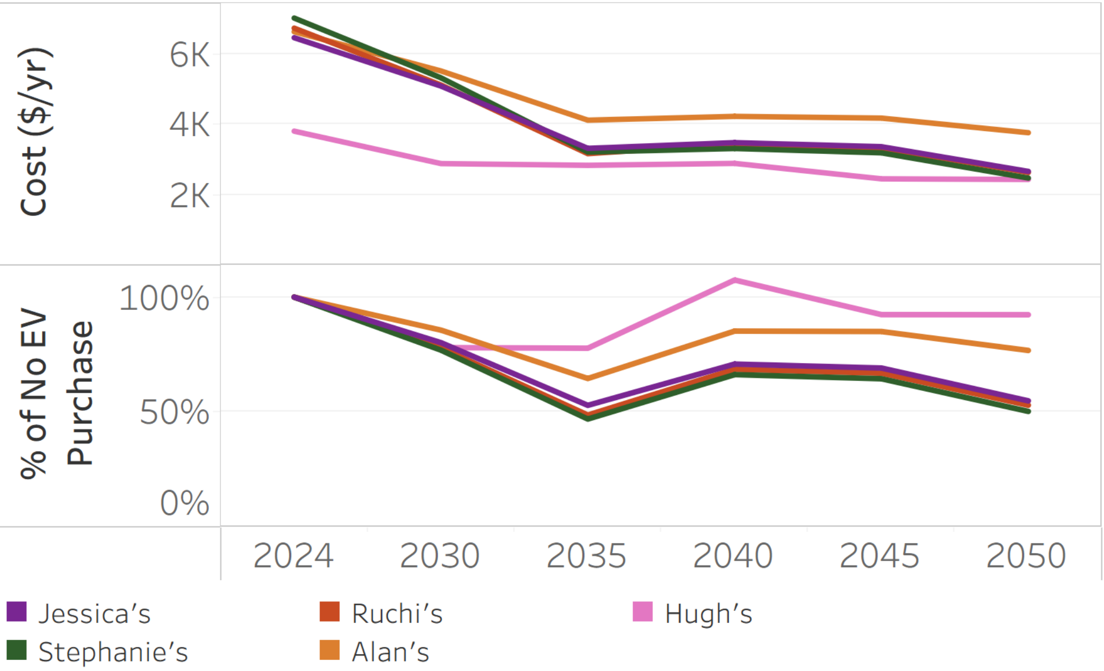
- Electric motor efficiency significantly reduces customer demand for transportation energy
  - Assuming EV: 98 mpge vs. ICE: 26 mpg in 2024, and EV: 119 mpge vs. ICE: 31 mpg in 2030 for an SUV
- Reduced gasoline use from 2 EV SUV purchases cuts Jessica's total energy use by ~37% in 2035 and ~24% in 2050 relative to continuing to drive ICEs
- Hugh's demand reductions are even greater, at up to 55%



Transportation Electrification is the biggest opportunity for energy wallet savings

- With electricity at $0.20/kWh, all households experience savings if replacing their 2 vehicles with an EV in 2030 and 2035 (1 vehicle in 2030 for Hugh's household)
  - Assumes customers do not receive IRA credit for either vehicle
  - Overall energy-related spending reduced by up to 52%. Includes the capital cost savings of buying an EV rather than an internal combustion engine vehicle
  - Assumes Hugh's charging happens 80% outside of the home at a rate of $0.43/kWh. Hugh's household could make higher savings with more home charging
- % of No EV Purchase compares energy costs to households retaining an ICE across all years

Savings Across Sample Households ($0.20/kWh, $1.50/therm)



Vehicle electrification saves money even at higher electricity rates

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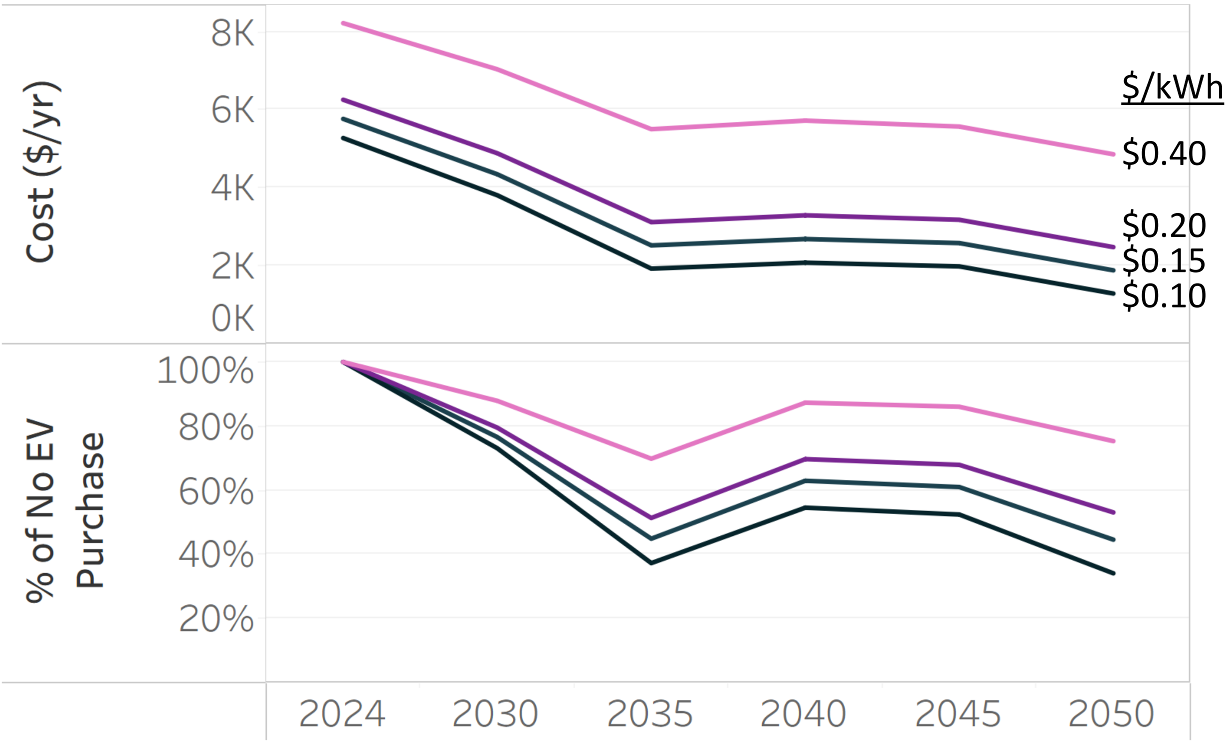
- Focusing on Jessica's single-family home, under varying electric rates she is still better off purchasing an EV than an ICE
- Caveats
  - Compares purchasing a new EV with a new ICE. This may not be the decision a customer makes.
  - Cost assumptions on vehicle capital cost and gasoline prices are uncertain

Jessica's savings of EV purchase in 2030 and 2035 with different electric rates



IRA tax incentives help with upfront capital cost

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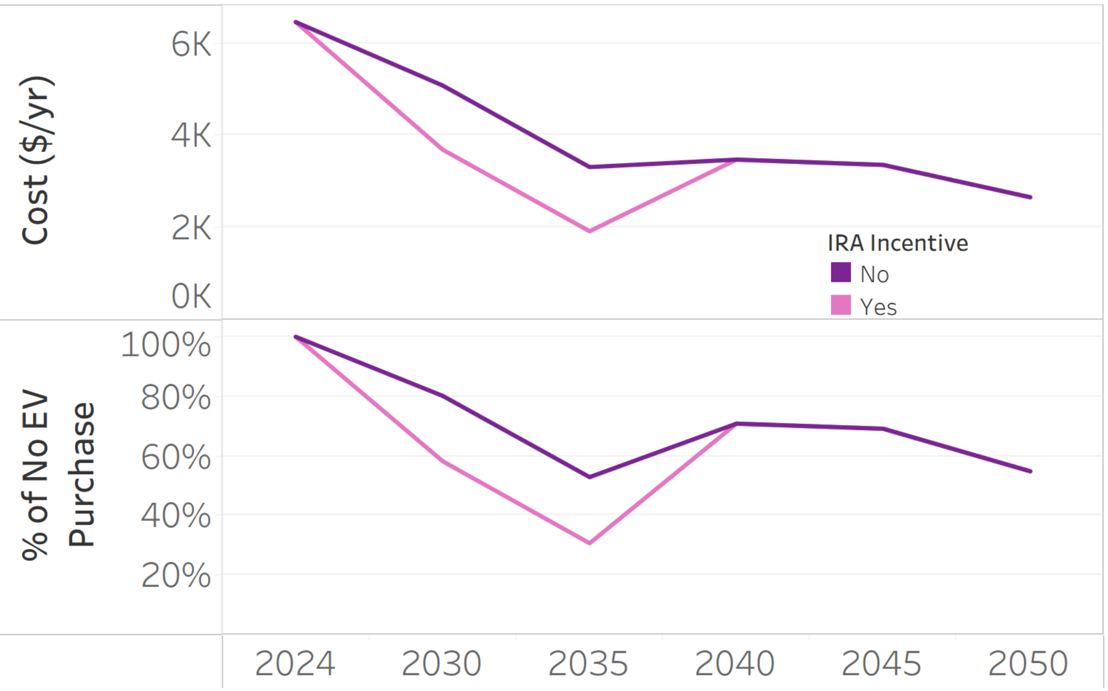
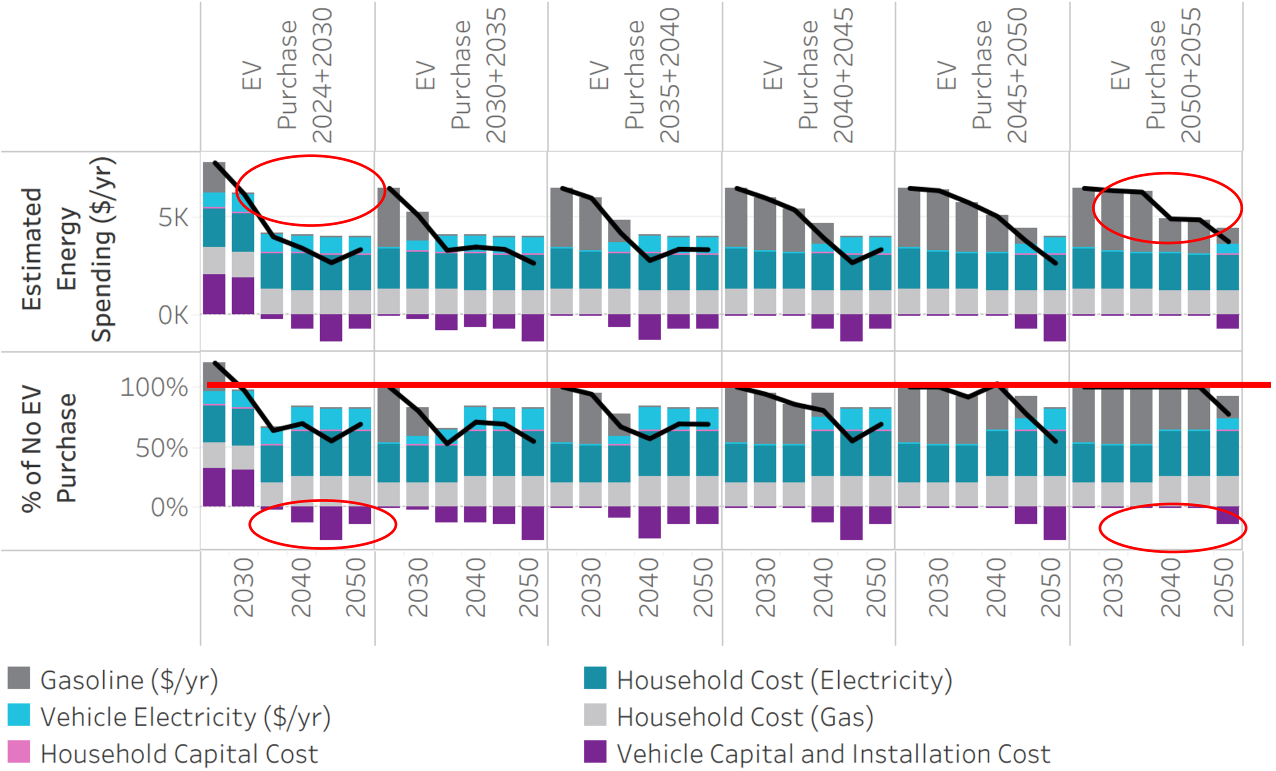
- Focus: Jessica buying one EV in 2030 and another in 2035, at an electric rate of $0.20/kWh and a gas rate of $1.50/therm
- Tax incentive has a large effect, though the EV purchases remain cost effective
- No vehicle cost sensitivities analyzed, but this shows that savings are sensitive to vehicle capital cost



The year of EV purchase matters

- Focus: Jessica's household at an electric rate of $0.20/kWh, $1.50/therm, no IRA tax incentive, and no heat pump purchase
- Replacing with an EV in 2030 and 2035 is more cost effective than replacing later
- Replacing with an EV in 2024 was not cost effective due to higher EV capital costs
  - Whether this is possible depends on age of current vehicle and capital cost

Jessica's estimated energy spending based on EV purchase year ($0.20/kWh, $1.50/therm, No IRA)



Heating and Cooling

Fundamentals

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- All results in the analysis are presented in real dollars (2022)
- All technology replacements assumed to happen at the end of useful life
  - For example, households replacing a furnace in 2030 are assumed to have bought their previous one in 2012 (assuming an 18-year lifetime)
  - Replaced technology has the average efficiency from the year of purchase
- Households can replace space heating, water heating, and air conditioning services with heat pumps
- Household technology financing assumes a 7% loan rate and a 7-year term
- The results in this section assume households make no EV purchase between now and 2050
- Natural gas rates are assumed to remain flat between now and 2050 (at three different levels tested)
  - This is conservative, likely forming a lower bound on benefits of heat pump adoption

Significant energy savings across all households regardless of heating technology and fuel

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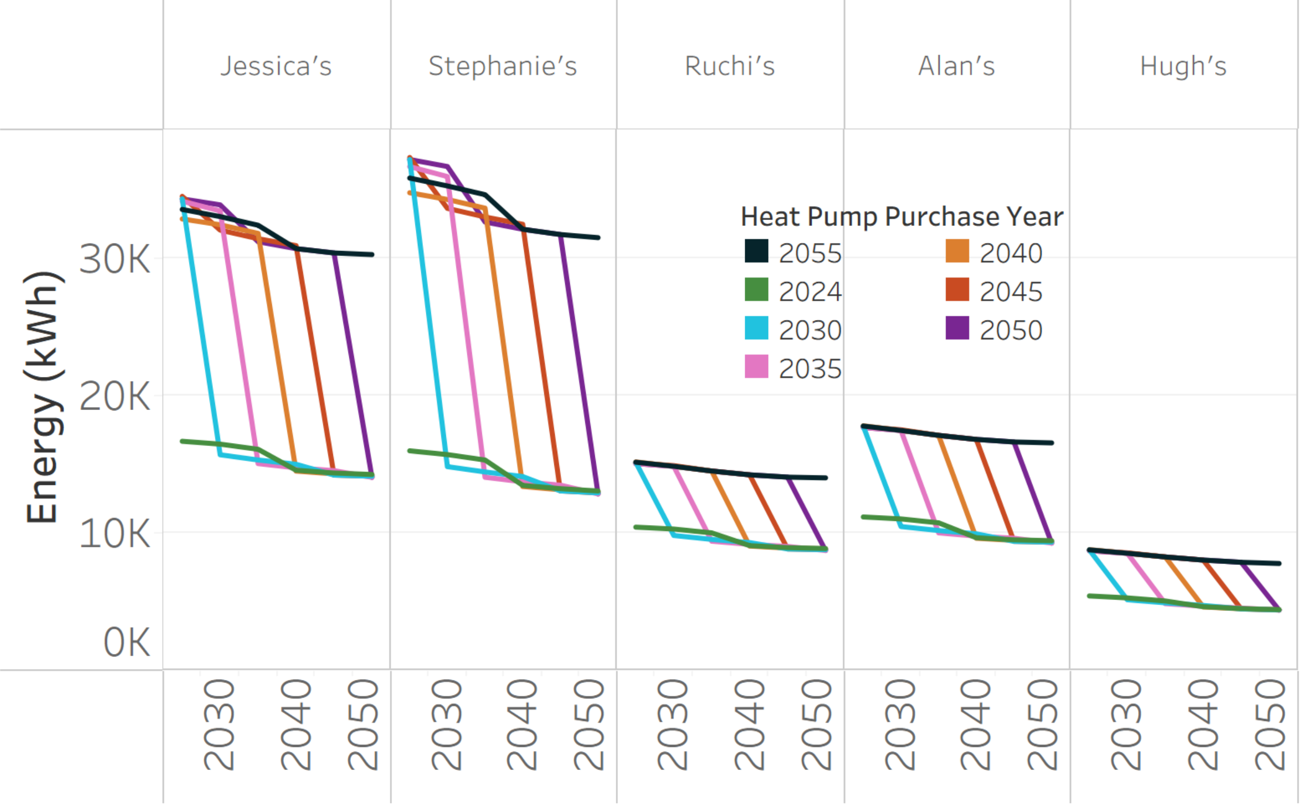
- Energy use for heating and cooling declines significantly regardless of the starting technology
- Newer vintage technologies have greater efficiency across technologies, contributing to a downward trend even with no heat pump purchase
- When a customer can install a heat pump depends on when their current equipment reaches end of life

Energy use excluding vehicles by year of heat pump purchase



Heating cost uncertainty: Savings of heat pumps are rate and technology dependent

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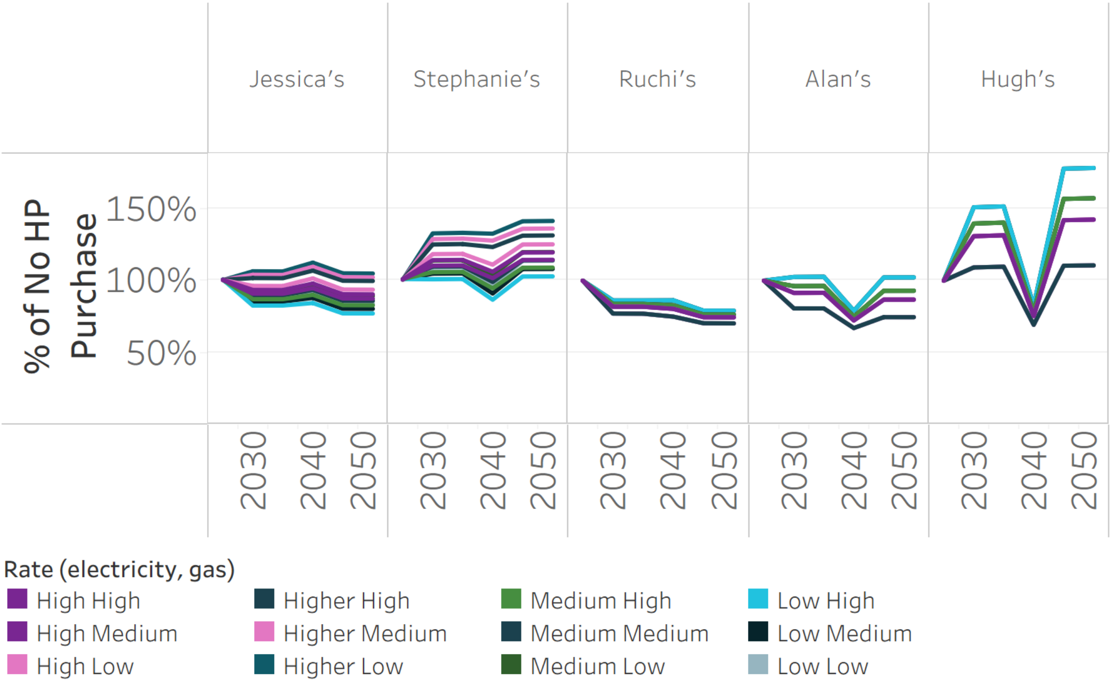
- Whether a heat pump saves a household money or not depends on rate, technology, and service demand
- Customers starting with electric heat save the most with higher electric rates
  - However, Hugh's rental unit has high costs for installation ($14,900/unit) and struggles to save even at the highest electric rates
- Households with gas heating save the most under the lowest electric rates
  - Jessica's household saves in all but the "higher" electric rate
  - Stephanie's household does not have AC so doesn't receive the benefits of avoiding an AC purchase with a heat pump

2030 HP purchase estimated bills as % of no HP purchase (assumes no EV purchase)

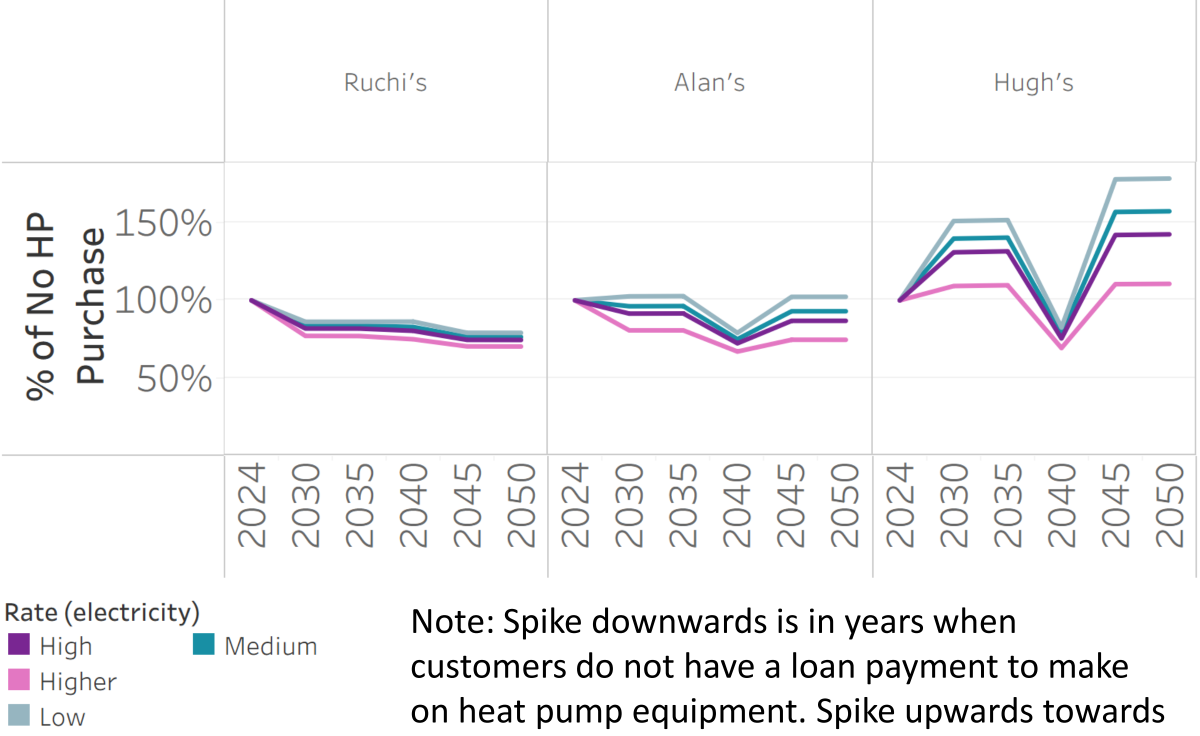


Note: Spike downwards is in years when customers do not have a loan payment to make on heat pump equipment. Spike upwards towards 2050 represents replacement of 2030 HP purchase (18-year life assumed).

Households heating with electricity likely to save money with heat pumps

- Heat pump efficiency far exceeds that of resistance heating
- Assuming ACEEE average technology and installation costs, Ruchi's and Alan's households (which are heated by electricity) save money
  - This does not factor in the large distribution of costs that will vary household by household
- Multifamily ACEEE costs are much higher, assuming retrofit challenges in multifamily buildings, making all but the "higher" electricity rate more expensive for Hugh's household
  - Shows savings are sensitive to capital cost

2030 HP purchase estimated bills as % of no HP purchase (assumes no EV purchase)

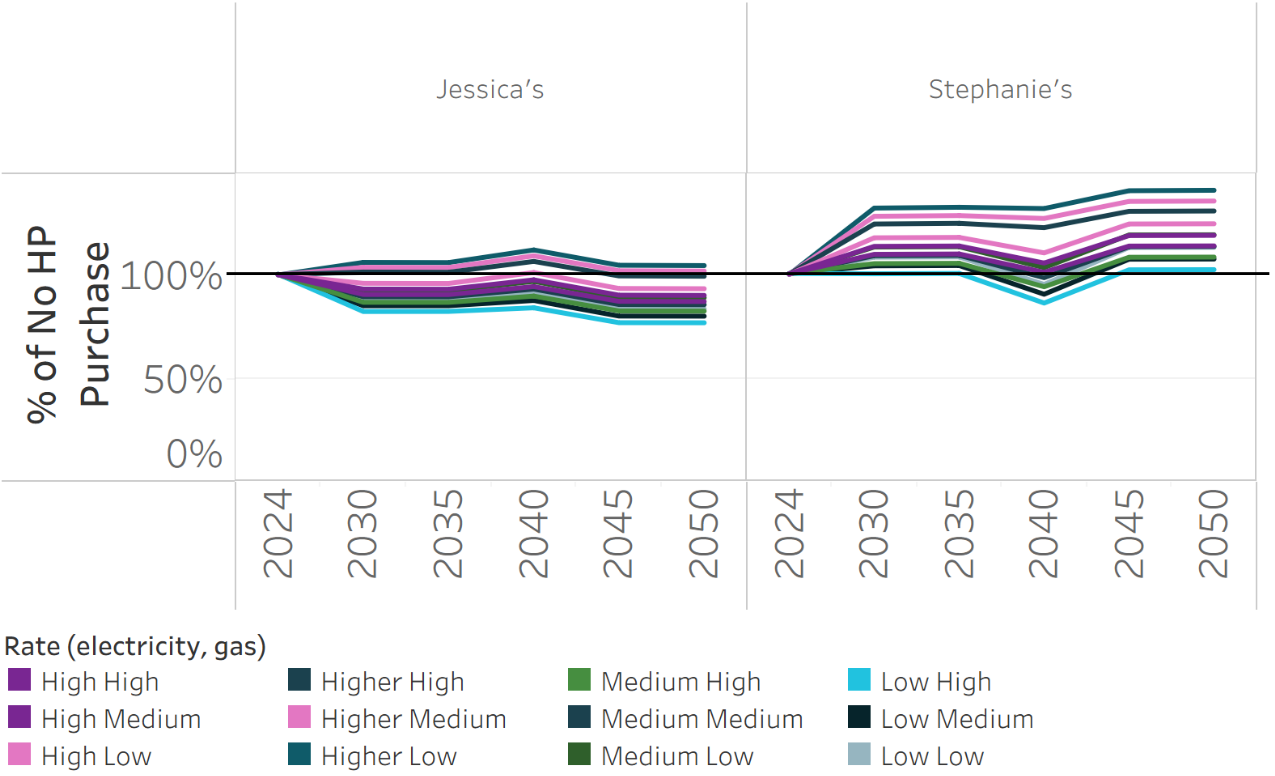


Note: Spike downwards is in years when customers do not have a loan payment to make on heat pump equipment. Spike upwards towards 2050 represents replacement of 2030 HP purchase (18-year life assumed).

Savings for households with gas depend on rates

- Savings for homes with gas depend on both the gas rate and the electricity rate
- Households like Jessica's with both heating and air conditioning (AC) save in most cases, assuming ACEEE costs
  - Higher gas rates/lower electricity rates are more favorable
- Households without AC like Stephanie's are less likely to save money when switching to heat pumps
  - However, homes without AC installing heat pumps will likely benefit from new AC service

2030 HP purchase estimated bills as % of no HP purchase (assumes no EV purchase)



What if electricity or gas rates are higher in the future?

- This analysis looked at a range of estimated rates, including an electric rate that is double the high end of the estimated range of rates in Oregon in 2024
- There is considerable uncertainty about rates in the future, including how the fixed costs of gas service are recovered over fewer total gas sales
  - If these costs are recovered through increases in gas rates over time, savings from heat pumps will be greater and that will incentivize heat pump installations
  - Increases in gas rates may burden households that cannot afford the capital cost of a heat pump
- Households where heat pump installation costs are lower can protect against future gas price uncertainty with heat pump installation
  - Consider two scenarios for Jessica's household: With higher electricity rates (double the estimated 2024 top-end rate) and low gas prices, costs are similar whether purchasing a heat pump or not; Conversely, with higher gas rates and lower electricity rates, savings are significant

The large distribution of install costs will make heating benefits/costs household specific

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- This study uses ACEEE costs of $8,060 for a single-family home and $14,900 per unit for a multifamily home
  - These are averages from past installations; however, the range of costs is large
  - The most favorable homes have existing equipment that can be repurposed and construction that is easy to retrofit
  - Costs may disproportionately reflect homes most conducive to retrofits
  - Some households pay significantly more for installed heat pumps
- Higher capital costs reduce the benefits
  - These benefits are household-specific

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Conclusions

Conclusions

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- Purchasing an electric vehicle saves money in almost all cases
  - Even if electricity costs $0.40/kWh
  - Customers are better off purchasing an EV earlier vs. later starting in 2030, even if households do not receive IRA tax credits
  - Policy that explores readiness for vehicle adoption with charger infrastructure, as well as business models for customer financing, could support EV adoption
- Heat pump adoption lowers energy use, but cost effectiveness depends on several factors
  - Relative electricity and gas rates affect decisions. For Jessica's household with air conditioning and gas heating, heat pump adoption is cost-effective in most cases modeled and protects against uncertain gas rate increases in the future at ACEEE costs
  - The broad range of heat pump installation costs affects cost effectiveness
- Upfront costs must be addressed to ensure equal access to the savings from electrification
  - Many buy their vehicles on the secondhand market. Stretching the lifetime of older vehicles and heating equipment may be more affordable than replacing with EVs
  - Intentional, explicit policies that ensure environmental justice and equitable solutions are required

Biggest challenges

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- Vehicles
  - EV purchase prices are assumed to decrease over time whereas prices for internal combustion engines remain steady
    - This could be affected by technological development, trade policy, commodities markets, etc.
  - Charging infrastructure is needed to make large-scale adoption viable
    - Rate of builds have been slower than expected to date. Challenges with T&D infrastructure support
  - Capital costs of a new vehicle may not be the decision that many households are making
- Buildings
  - The range of capital costs is broad and building-specific
  - Savings are dependent on uncertain future rates
  - High capital costs and split incentive problems for renter

Applicability of Results to a Broader Range of Households

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- Many households will find they have energy consumption similar to one of the example households in this analysis, but others will differ substantially
- The analysis provides key findings that could be applied to different situations (e.g., to an urban household that does not own a vehicle)
  - Households with lower VMT than the sample households in this analysis will avoid fewer gasoline purchases, which would reduce the savings from switching to an electric vehicle, while higher VMT would equate to higher savings
  - The costs/benefits of switching to heat pumps in the home will depend on energy use but also rates and installation costs. Those with air conditioning and installation costs close to those used for a single-family home are more likely to save money under current rates
  - Future increases in gas prices would make heat pumps a good investment for a wider range of households. Factoring in the risk of higher gas prices is important when locking into new heating technology for the lifetime of the system
- Costs/benefits are specific to each household. Resources to support homeowners in making these calculations can help provide the information necessary to make an informed choice

Areas for Further Research

- Consider examining additional sample households, e.g.,
  - An urban household with 0 or 1 vehicle and lower VMT than sample households examined in this analysis
  - A household that relies on propane, oil, or wood as a heating fuel (either primary or as back-up secondary heating fuel)
- Consider conducting a sensitivity analysis for financing heat pump installation costs or EV purchases (e.g., a 10-year loan at 5% rather than 7 years at 7% used in the analysis)
- Consider developing an interactive tool for customers to provide their own energy use, current rates, and installation costs to help inform decision making
- Consider developing an interactive tool with a broader range of off-the-shelf household choices that customers can align with their own households
- Consider doing a deeper dive gas system analysis looking at potential future rate outcomes with varying infrastructure investment and decommissioning strategies, as well as policies for fixed cost recovery

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Energy Wallet Methodology

Energy Wallet Sample Household Inputs

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Step 1. Determine **five sample households** to represent in the analysis

Step 2. Characterize the **following energy consumption inputs** for each sample household:

- Electricity (space heating, water heating, air conditioning, other)
- Natural Gas (space heating, water heating, other)
- Gasoline (vehicle miles traveled)

Step 1. Defining Sample Households—Development Process

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Empathize	Define	Ideate	Prototype	Test
Working Groups— Active Listening	**Identify Themes—** Understanding Needs	**Generate Ideas—** Develop Ideas for Possible Sample Households	**Identify Solutions—** Identify Sources and Data	**Partner Feedback—** Share Initial Customer Groups and Seek Feedback
(e.g., Environmental Justice & Equity, Buildings, Land Use & Natural Resources, etc.)	(e.g., energy efficiency, affordable energy)	(e.g., weatherization, rural)	(e.g., NEEA, Oregon's Ten-Year Plan)	(e.g., public comment period, working groups, advisory group)

Implement

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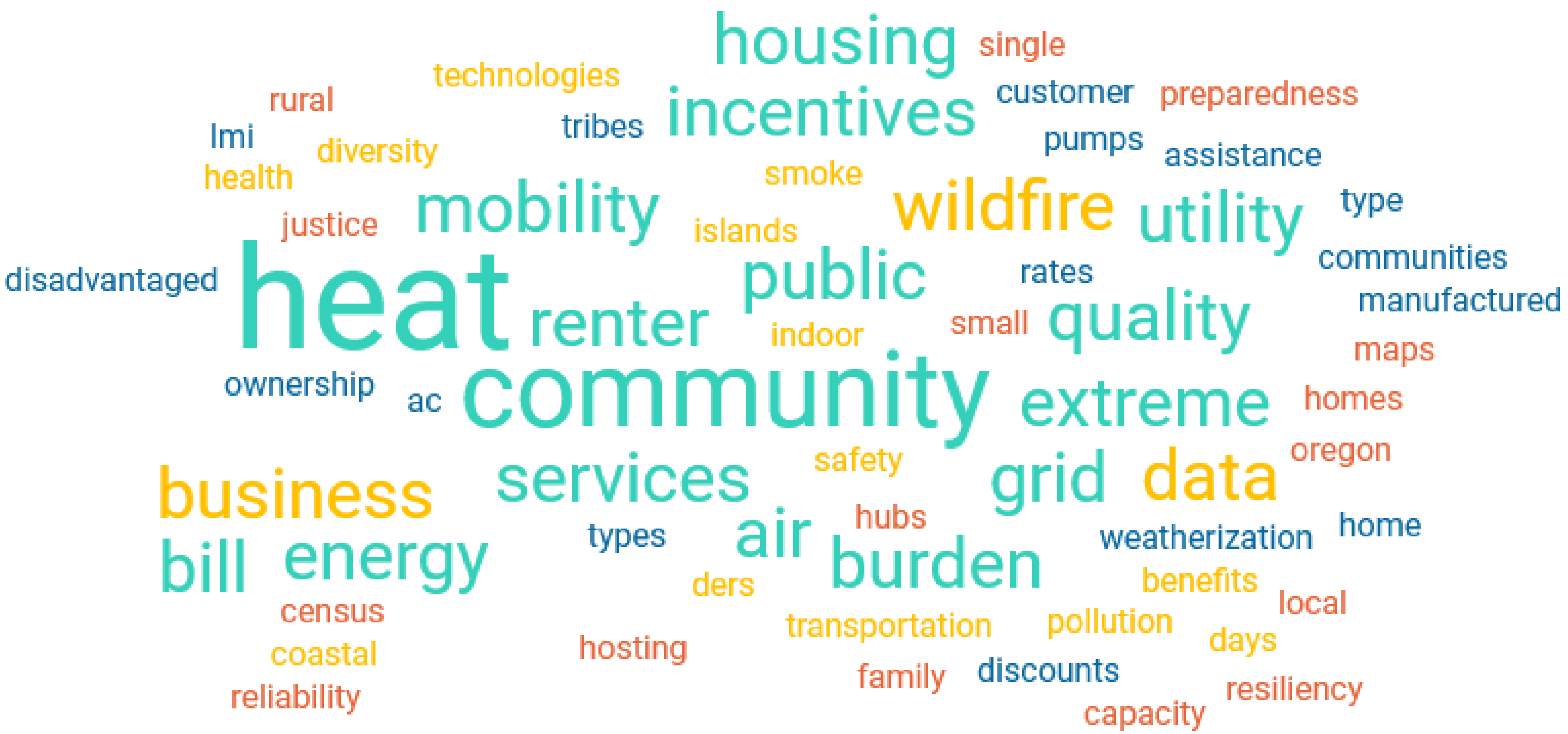
Step 1. Empathize—Word Bubble

- Example: Key themes heard in a Phase 1 Environmental Justice & Equity Working Group session



Step 1. Define & Ideate—Understanding & Solving for "Problem" Statements

We synthesized key themes from partner input to develop a series of "problem" statements, outlining the issues and challenges partners aimed to solve with the sample households.

After collecting our findings, our next step was to develop ideas for possible sample households.

For example, partners expressed concerns about high energy costs for low-income families living in older, inefficient homes. Indoor air quality and safety were also high priorities.

Using this feedback, we explored how energy efficiency improvements could lower costs, enhance indoor air quality, and make homes safer.

This feedback served as a foundation for developing the High Priority Area sample household.

Step 1. Test & Implement—Partner Feedback

- We developed nine initial customer groups, which were presented on 10/9/2024 to the Environmental Justice and Equity (EJ) Working Group (WG), which then ranked and prioritized the initial customer groups
- Based on the EJ WG feedback, we refined our customer groups (documented in a public memo) and gathered feedback through a public feedback process, which ended on 12/2/24
  - Through this process, partners proposed new customer groups, which were shared in the 12/18/2024 EJ WG
- Additional engagement with ODOE and partners during January-February 2025 further refined the definitions and landed with five final sample households

Initial Customer Groups
Presented on 10/9/24

1. Average Homeowner
2. Rural Home
3. Coastal Home
4. High Priority Area Homes
5. Severe Energy Burden
6. Weatherization
7. Manufactured Homes
8. Average Renter
9. Low-income Renter (Multifamily)

Public Memo
Period Ending on 12/2/2024

1. Homeowner
2. Rural Home
3. Coastal Home
4. High Priority Homes
5. Extreme Low-income Single Family
6. Weatherization
7. Manufactured Homes
8. Average Renter
9. Low-income Renter Multifamily

New Proposed Customer Groups
Presented on 12/18/2024

1. Low-income Renter
2. Multifamily
3. Rural and Harsh Climates
4. Willamette Valley Urban Single-Family Homeowners
5. Urban Low-Income Renter Multifamily
6. COU vs IOU
7. Tribal

Final Sample Households

1. Jessica's (single family, owned, urban)
2. Stephanie's (rural, cold climate)
3. Ruchi's (High Priority Area)
4. Alan's (manufactured home)
5. Hugh's (low-income multifamily renter)

Step 2. Identify Sources for Input Data to Develop Each Sample Household

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Data Inputs needed for Energy Wallet:

- Energy Consumption (electricity, natural gas) and associated costs
- Vehicle Miles Traveled (VMT) and associated costs (gasoline)

From there, we worked backward to identify initial sample households that could be developed using publicly available data sources

- Utilized the Northwest Energy Efficiency Alliance's (NEEA) 2022 Residential Building Stock Assessment (2022 RBSA) as a starting point for defining sample households based on building type and energy consumption.
- NEEA's 2022 RBSA has extensive regional data, which includes, but is not limited to: building types, building location, energy consumption, utility information, equipment-level data and self-reported income.
- https://neea.org/data/residential-building-stock-assessment

Step 2. Additional Data Sources to Supplement NEEA RBSA

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Vehicle Miles Traveled (VMT)	VMT by county from the Housing and Transportation (H+T) Affordability Index: https://htaindex.cnt.org/
Area Median Income (AMI)	Oregon Housing & Community Services 2024 Area Median Income: https://www.oregon.gov/ohcs/compliance-monitoring/Documents/rents-incomes/2024/2024-County-Area-Median-Income-Summary.pdf
Region Type (Urban/Rural)	USDA definition of rural/urban (any area other than city or town of greater than 50,000 inhabitants, based on latest decennial census) Map: https://eligibility.sc.egov.usda.gov/eligibility/welcomeAction.do?pageAction=rbs Map layer available to download: https://rdgdwe.sc.egov.usda.gov/arcgis/rest/services/Eligibility/Eligibility/MapServer/11 Note: Zip codes that intersect with an urban area are considered urban. Sites classified as "urban" in the NEEA dataset may be classified as "rural" in this analysis and vice versa.
Heating Zone	Bonneville Power Administration "Regional States Climate Zone Assignments by Utility": https://www.bpa.gov/-/media/Aep/energy-efficiency/interim-solution-2-files/pnw-heating-zones.pdf
High Priority Area Index	As defined in Oregon's 10-Year Plan: https://www.oregon.gov/energy/Get-Involved/Documents/2018-BEEWG-Ten-Year-Plan-Energy-Burden.pdf

Step 2. Determine sample household from NEEA RBSA and supplementary Oregon-specific data

- Filtered NEEA RBSA sampled sites by characteristics determined by five sample household types
- Additionally, excluded from NEEA RBSA dataset:
  - Sites with N/A values for primary fields (electricity/gas usage)
  - Sites that reported electricity in addition to gas for heating (in order to simplify the analysis)
  - Sites with one occupant
  - Sites with unusual large loads (e.g., electric welder)
  - Sites relying on heat pump for heating and/or cooling (since Energy Wallet Analysis examines the switch to a heat pump)
- RBSA data includes *total fuel consumption* and *heating fuel consumption*
  - Developed ratios for breakdown of other fuel consumption between water heating, air conditioning, and other based on Energy Information Administration (EIA) Residential Energy Consumption Survey (RECS)
- Refined household energy consumption inputs based on additional assumptions about air conditioning, fuel used for stove/oven, etc.

EIA RECS Ratios

- Energy Information Administration (EIA) Residential Energy Consumption Survey (RECS) data used to determine relative ratios of air conditioning, other (including refrigerators), and water heating for homes with natural gas and electricity primary heating fuels

Table CE4.5 Annual household site end-use consumption by fuel in the West—totals, 2020

Main heating fuel: Natural Gas			
Total site energy consumption[a] (trillion Btu)			
Electricity		Natural Gas	
Air conditioning	Refrigerators + Other	Water heating	Other
92	329	281	68
21.9%	78.1%	80.5%	19.5%

Main heating fuel: Electricity		
Total site energy consumption[a] (trillion Btu)		
Electricity		
Water heating	Air conditioning	Refrigerators + Other
48	38	115
23.9%	18.9%	57.2%
29.4%	x	70.6%

Notes: Because of rounding, data may not sum to totals. See RECS Terminology for definition of terms used in these tables.
Btu = British thermal units
[a] Consumption and expenditures for biomass (wood), coal, district steam, and solar thermal are excluded. Electricity consumption from on-site solar photovoltaic generation (that is, solar panels) is included.

Data source: U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics, Forms EIA-457A, D, E, F, G of the 2020 Residential Energy Consumption Survey

Jessica’s Household – Input Summary

Jessica’s	
	Annual Usage
Electricity (kWh)	**9919.7**
Space heating	0.0
Other Electricity:	9919.7
Water heating	0.0
Air conditioning	2167.7
Other	7752.0
Natural Gas (therms)	**820.8**
Space heating	430.3
Other Natural Gas:	390.5
Water heating	314.4
Other	76.1
VMT	16823

Site Details	
Building Type	Single Family
Building Category	Single Family Detached
Ownership	Own
Primary Heating Fuel Type	Natural gas
Primary Heating System	Furnace
Primary Cooling System	Central AC
Water Heater Technology	Fossil Fuel Non-Condensing
Water Heater Fuel	Natural gas
Area (sq ft)	3100
Year	2012
Stove	Natural Gas
Oven	Natural Gas
EV charger or large unusual load	None
Occupants	6
Vehicles	2 SUVs

Stephanie's Household– Input Summary

Stephanie's Household	
	Annual Usage
Electricity (kWh)	**6364.2**
Space heating	0.0
Other Electricity:	6364.2
Water heating	0.0
Air conditioning	0.0
Other	6364.2
Natural Gas (therms)	**1023.0**
Space heating	712.0
Other Natural Gas:	311.0
Water heating	250.4
Other	60.6
VMT	22113

Site Details	
Building Type	Single Family
Building Category	Single Family Detached
Region Type	Rural
Ownership	Own
Primary Heating Fuel Type	Natural gas
Primary Heating System	Furnace
Primary Cooling System	None
Water Heater Technology	Fossil Fuel Non-Condensing
Water Heater Fuel	Natural gas
Heating Zone	2
Area (sq ft)	1855
Year	2006
Stove	Natural Gas
Oven	Natural Gas
EV charger or large unusual load	None
Occupants	4
Vehicles	2 SUVs

Ruchi’s Household– Input Summary

Ruchi’s Household	
	Annual Usage
Electricity (kWh)	**15487.4**
Space heating	3953.8
Other Electricity:	11533.6
Water heating	2754.3
Air conditioning	2180.5
Other	6598.8
Natural Gas (therms)	**0.0**
Space heating	0.0
Other Natural Gas:	0.0
Water heating	0.0
Other	0.0
VMT	19833

Site Details	
Building Type	Single Family
Building Category	Single Family Detached
Region	High Priority Area Home Index 3
Ownership	Own
Primary Heating Fuel Type	Electicity
Primary Heating System	Furnace
Primary Cooling System	Portable AC
Water Heater Technology	Electric Resistance
Water Heater Fuel	Electricity
Area (sq ft)	1400
Year	2007
Stove	Electric Coils
Oven	Electric Radiant
EV charger or large unusual load	None
Vehicles	2 SUVs

Alan's Household– Input Summary

EVOLVED ENERGY RESEARCH

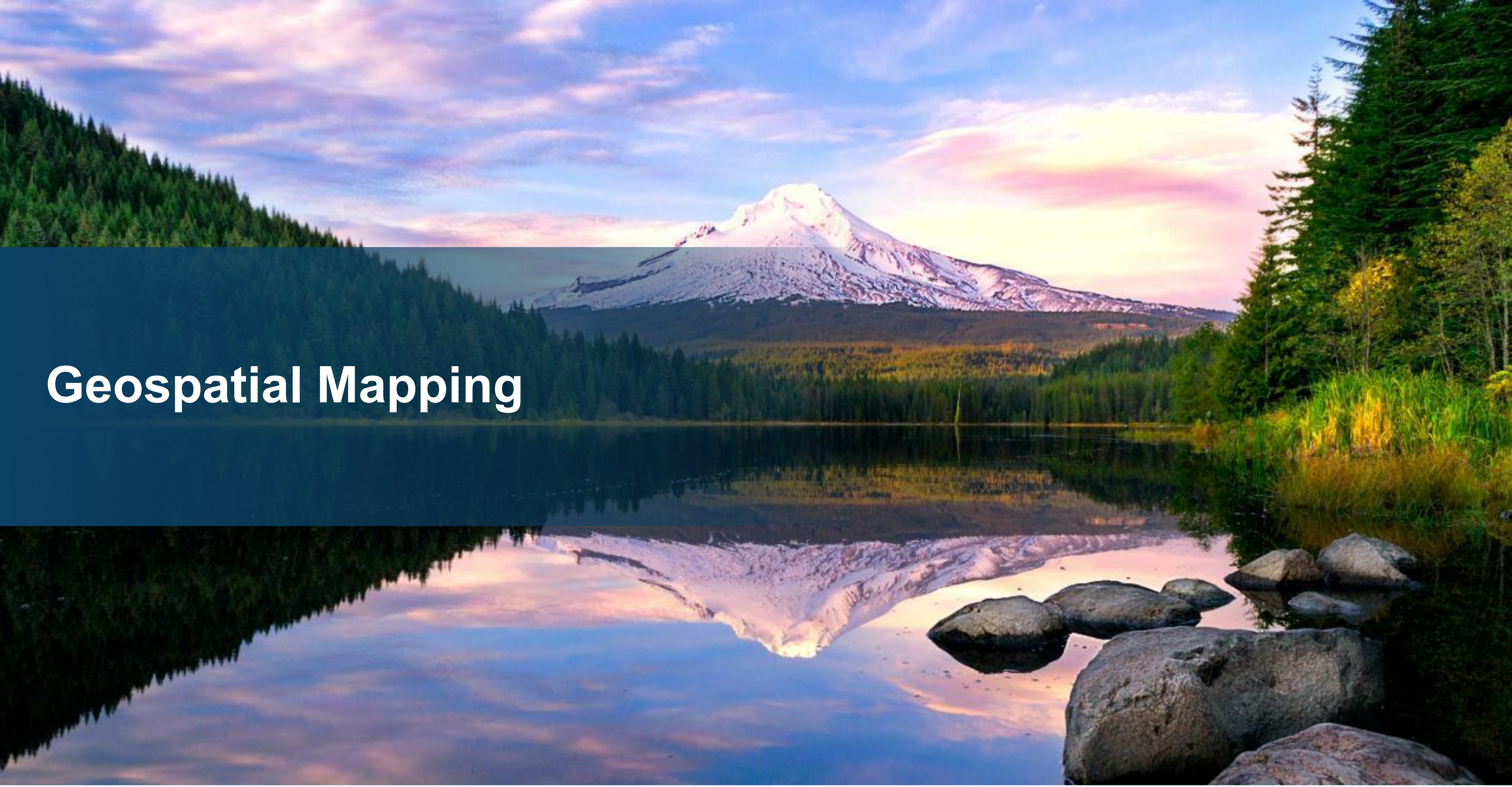
Alan's Household	
	Annual Usage
Electricity (kWh)	**18329.6**
Space heating	6777.3
Other Electricity:	11552.3
Water heating	2758.7
Air conditioning	2184.0
Other	6609.5
Natural Gas (therms)	0.0
Space heating	0.0
Other Natural Gas:	0.0
Water heating	0.0
Other	0.0
VMT	20743

Site Details	
Building Type	Single Family
Building Category	Manufactured
Region	Rural
Ownership	Rent
Primary Heating Fuel Type	Electricity
Primary Heating System	Furnace
Primary Cooling System	Window AC
Water Heater Technology	Electric Resistance
Water Heater Fuel	Electric
Area (sq ft)	1520
Year	1986
Stove	Electric Glasstop
Oven	Electric Radiant
EV charger or large unusual load	None
Occupants	2
Vehicles	2 cars

Hugh's Household – Input Summary

Hugh's Household	
	Annual Usage
Electricity (kWh)	**8963.8**
Space heating	3151.4
Other Electricity:	5812.4
Water heating	1711.6
Air conditioning	0.0
Other	4100.7
Natural Gas (therms)	**0.0**
Space heating	0.0
Other Natural Gas:	0.0
Water heating	0.0
Other	0.0
VMT	13555

Site Details	
Building Type	Multi-family
Building Category	Low-Rise (1-3)
Region	Urban
Ownership	Rent
Below Area Median Income	Yes
Primary Heating Fuel Type	Electricity
Primary Heating System	Baseboard
Primary Cooling System	None
Water Heater Technology	Electric Resistance
Water Heater Fuel	Electricity
Area (sq ft)	Unknown
Year	1977
Stove	Electric Coils
Oven	Electric Radiant
EV charger or large unusual load	None
Occupants	2
Vehicles	1 car



Geospatial Mapping

Geospatial Mapping Overview

- 15 maps created with demographic and socioeconomic variables at the census tract level
- Replicable approach with open-source data
- Identified communities with most pressing needs in the state for potential policy implementation

List of Maps

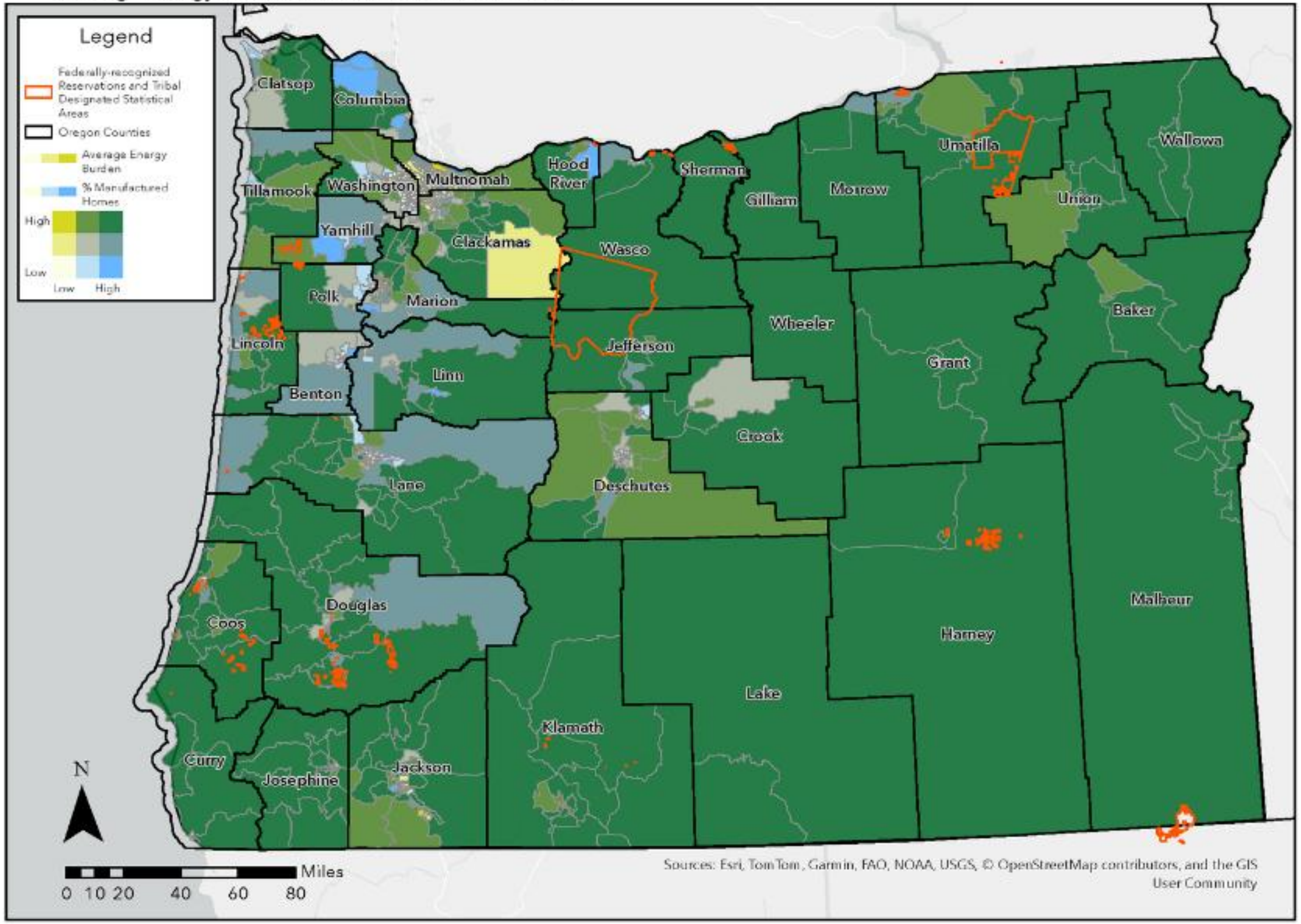
Bivariate indicator maps:

1. Average energy burden & percentage of manufactured homes
2. Projected wildfire risk & percentage of individuals employed in agriculture, forestry, fishing, hunting, and mining
3. Percentage of households prioritized for IRA incentive households (0-80% AMI) & percentage of homeowners
4. Average energy burden & the percent of individuals with a non-institutionalized disability
5. DOT transportation barriers & percent of individuals at or below 150% of the federal poverty line

Univariate indicator maps:

6. Percent of individuals without a HS diploma
7. Percent of adults with asthma
8. Percent of individuals receiving Medicare
9. Percent of individuals who speak English “less than very well”
10. Percent of Black individuals
11. Percent of Hispanic Individuals
12. Percent of Native individuals
13. Percent of Asian individuals
14. Categorical map of rural communities
15. Categorical map of coastal communities

Average Energy Burden and % Manufactured Homes



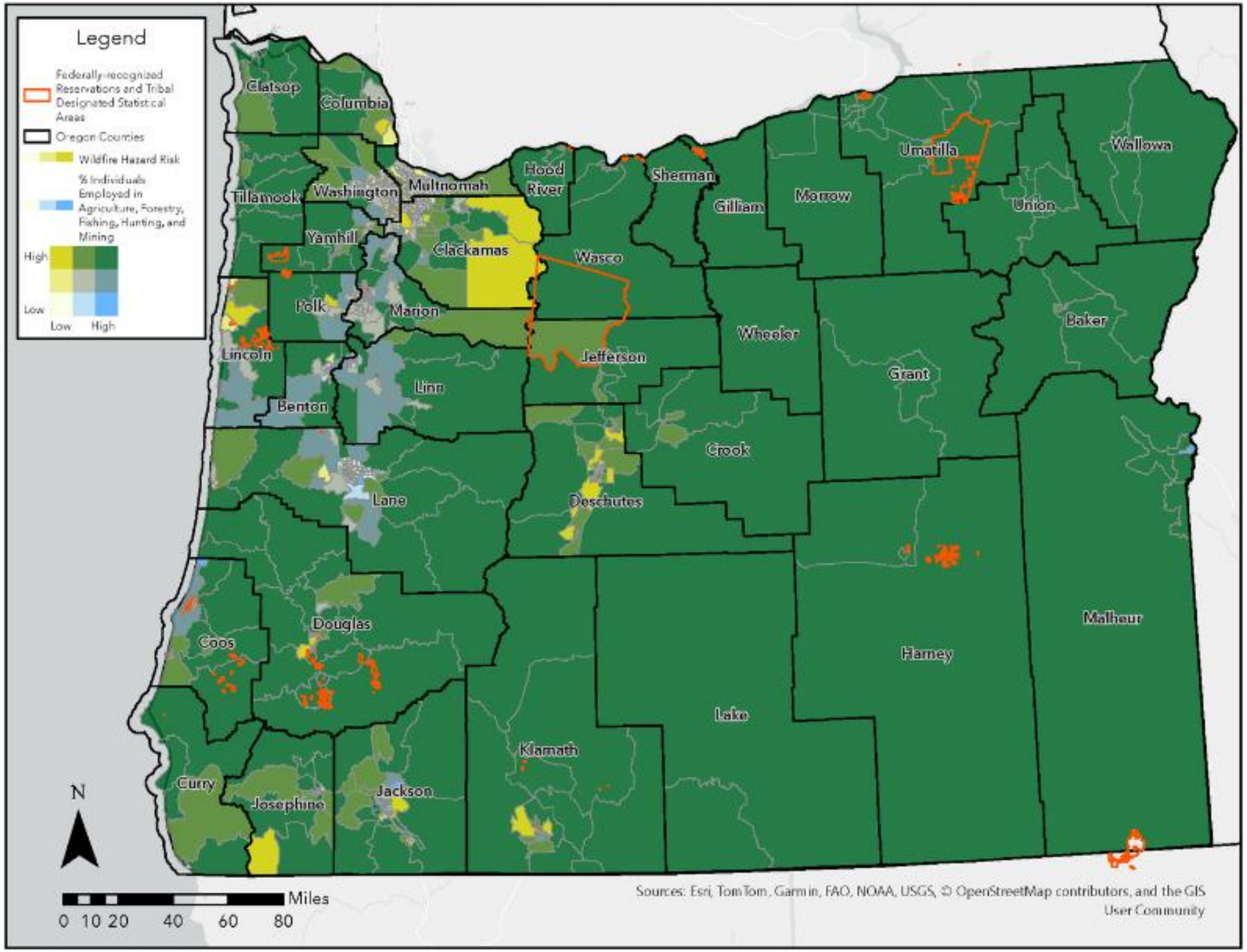
Data sources: U.S. Department of Energy (DOE) Low-income Energy Affordability Data (LEAD) Tool and American Community Survey (ACS)

16.2% of census tracts in Oregon (n = 162) rank in the 75th percentile for average energy burden (>= 5% of annual household income spent on energy bills) and the 75th percentile for percent of manufactured homes (>= 12.8%)

Breaks for Average Energy Burden: 3%, 4%, and 5% (range = 2%=12%)

Breaks for percentage of Manufactured Homes: 0%, 3.2%, and 12.8% (range = 0%-54.5%)

Wildfire Hazard Risk & % Individuals Employed in Agriculture, Forestry, Fishing, Hunting, and Mining



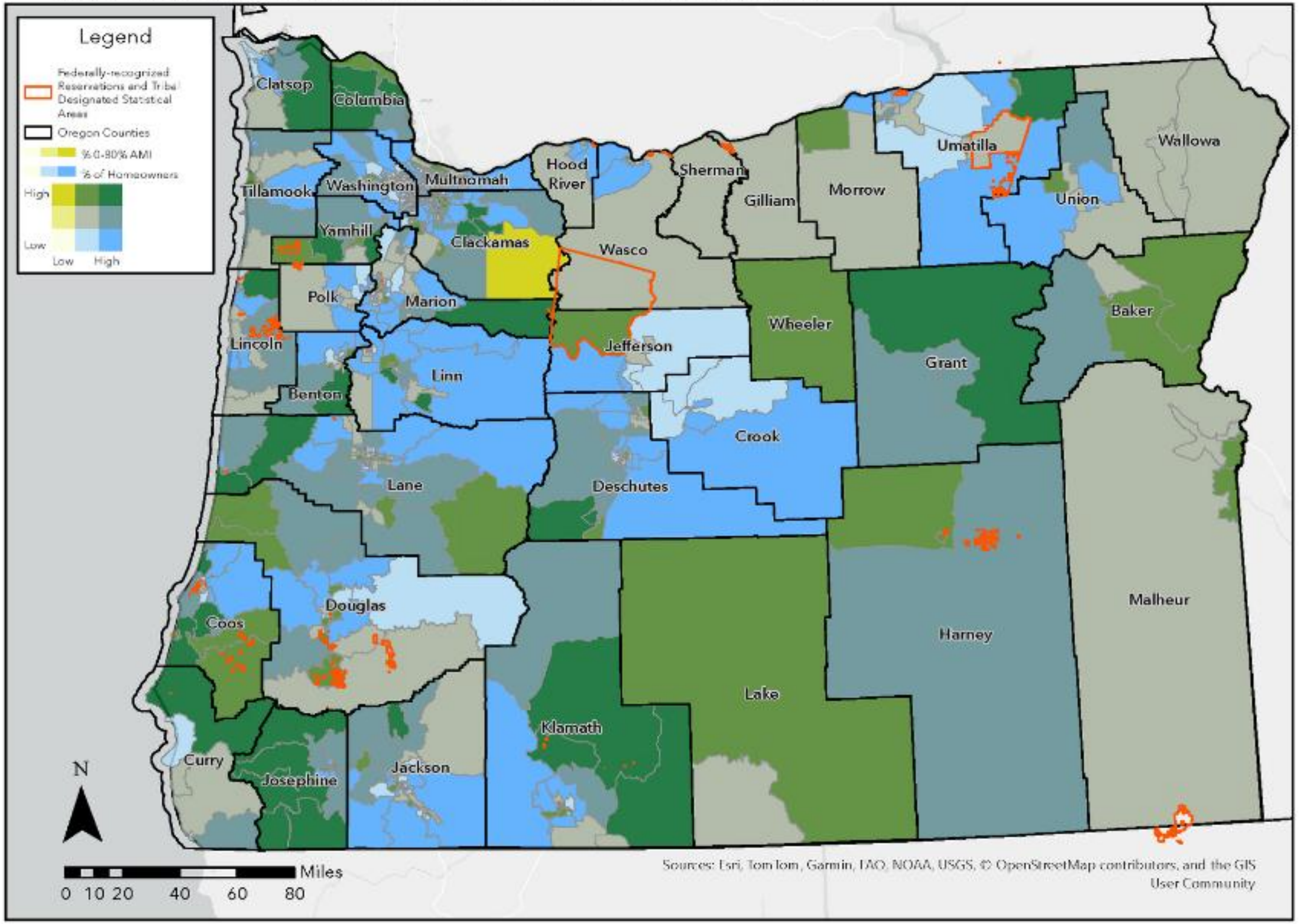
Data sources: Federal Emergency Management Agency National Risk Index and ACS

13.3% of census tracts in Oregon (n = 132) rank in the 75th percentile for wildfire risk score (>= 69.8) and the 75th percentile for percent of individuals employed in Agriculture, Forestry, Fishing, Hunting, and Mining (>= 12.8%)

Breaks for Wildfire Risk Score (percentile-ranked): 30, 48.6, 69,8 (range = 0-99.7).

Breaks for percentage of Individuals Employed in Natural Resources: 0%, 1.45%, 4.48% (range = 0%-35.1%)

% of Individuals Prioritized for IRA Incentives (0-80% AMI) & % of Homeowners



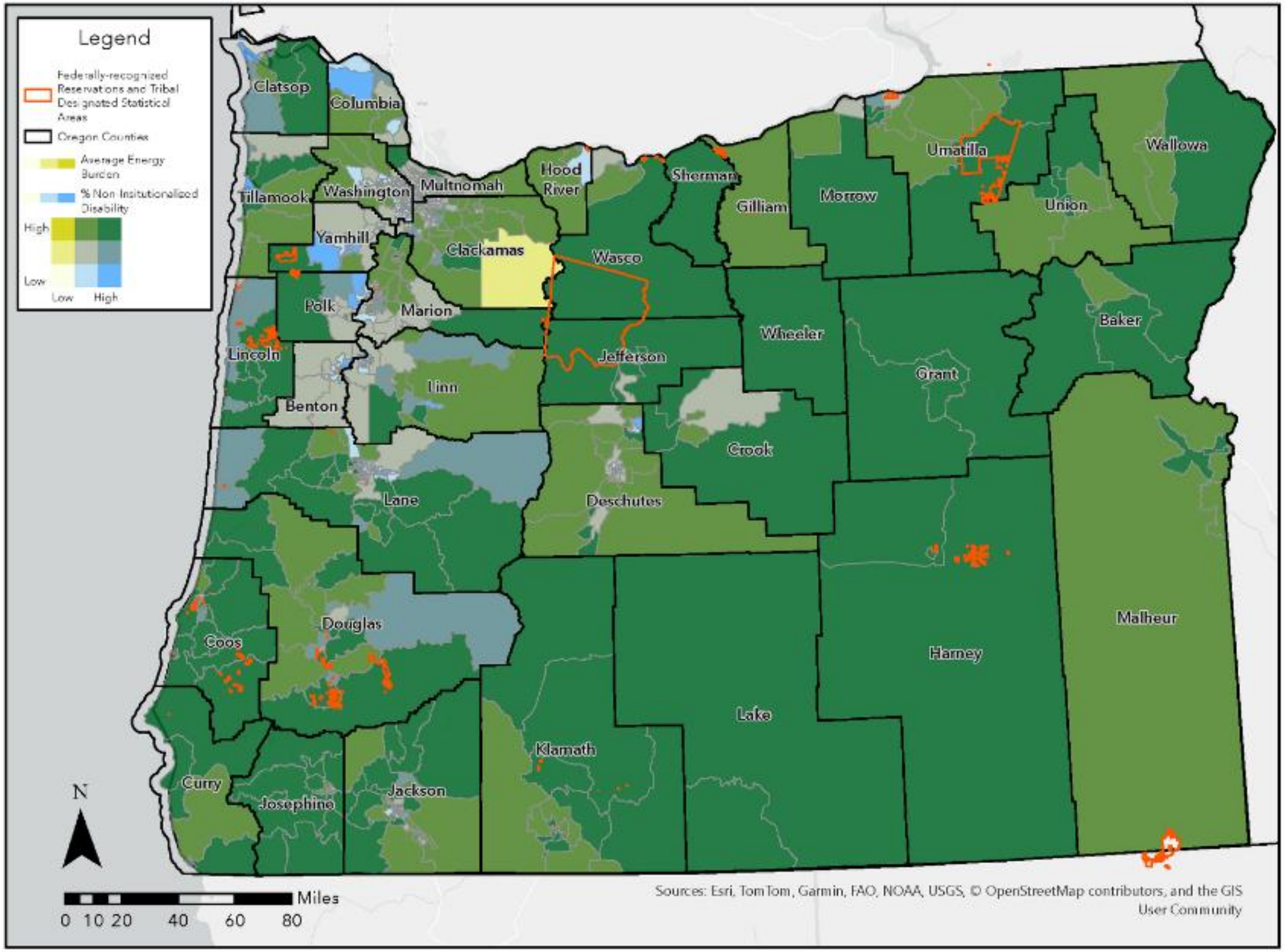
Data sources: DOE LEAD Tool and ACS

2% of census tracts in Oregon (n = 20) rank in the 75th percentile for % of Individuals Prioritized for IRA Incentives (>= 46.4%) and the 75th percentile for Percent of Homeowners (>= 79.7%)

Breaks for Individuals Prioritized for IRA incentives (0-80% AMI): 29%, 37.5%, 46.4% (range = 8.5% - 90.2%)

Breaks for percentage of Homeowners: 0%, 51.7%, 68.1%, 79.7%, (range = 0% - 100%)

Average Energy Burden & % Non-Institutionalized Disability



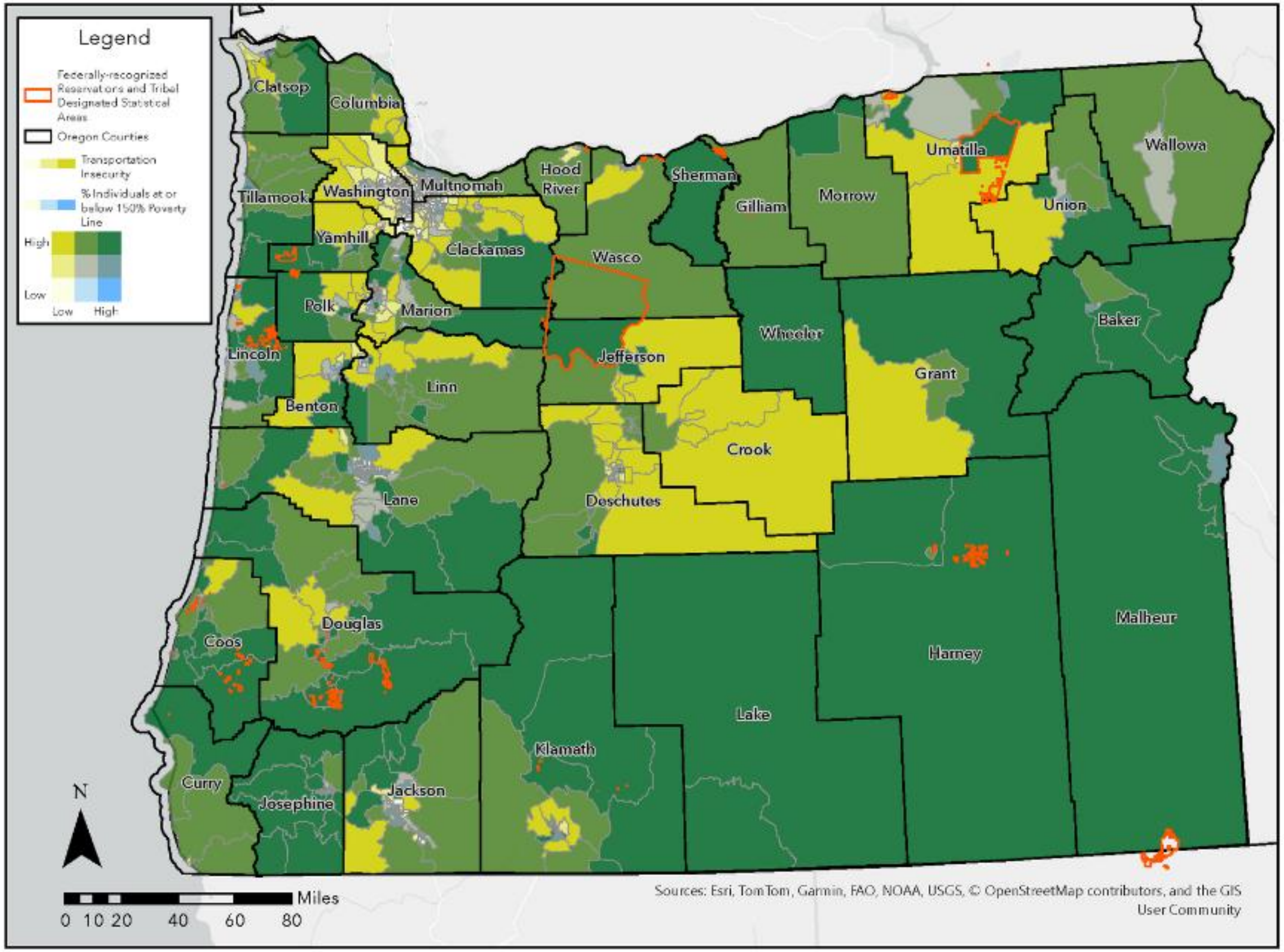
Data sources: DOE LEAD Tool and ACS

12.6% of census tracts in Oregon (n = 125) rank in the 75th percentile for average energy burden (>= 5% of annual household income spent on energy bills) and the 75th percentile for percent of individuals with a non-institutionalized disability (>= 19.3%)

Breaks for Average Energy Burden: 3%, 4%, and 5% (range = 2%=12%)

Breaks for Percentage of Individuals with Non-Institutionalized Disability: 10.8%, 15%, and 19.3% (range = 0%-44.1%)

Transportation Insecurity & % Individuals at or below 150% of Federal Poverty Line



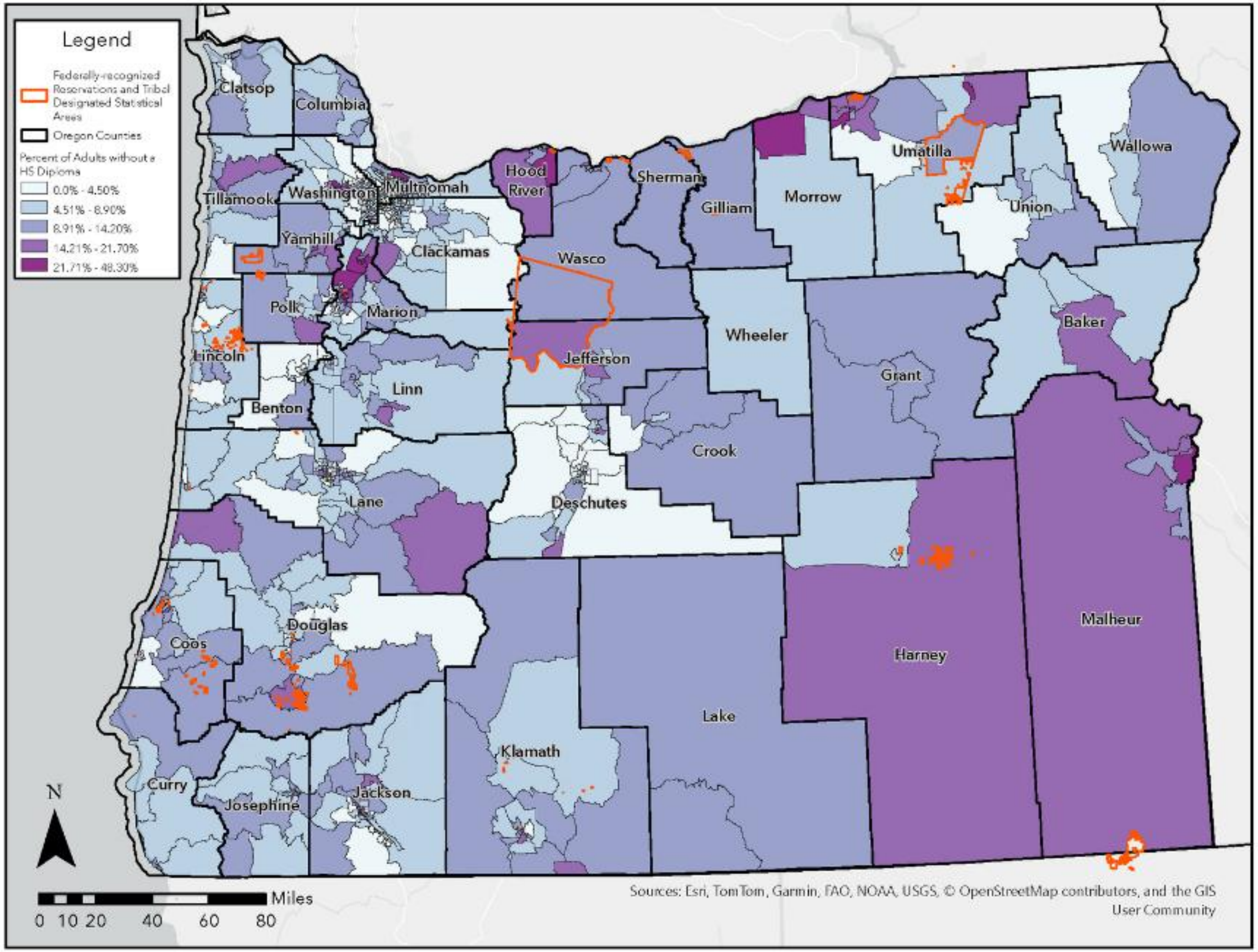
Data sources: Department of Transportation Equitable Transportation Community (ETC) Explorer and ACS

6.4% of census tracts in Oregon (n = 63) rank in the 75th percentile for transportation insecurity (>=75) and the 75th percentile for percent of individuals at or below 150% of the Federal Poverty Line (>= 26.4%)

Breaks for Transportation Insecurity Score (percentile-ranked): 25.1, 50.1, 75, (range = 0.1 - 100)

Breaks for Percentage of Individuals at or Below 150% of Poverty Line: 12.1%, 18.6%, 26.4% (range = 1.1% - 83.4%)

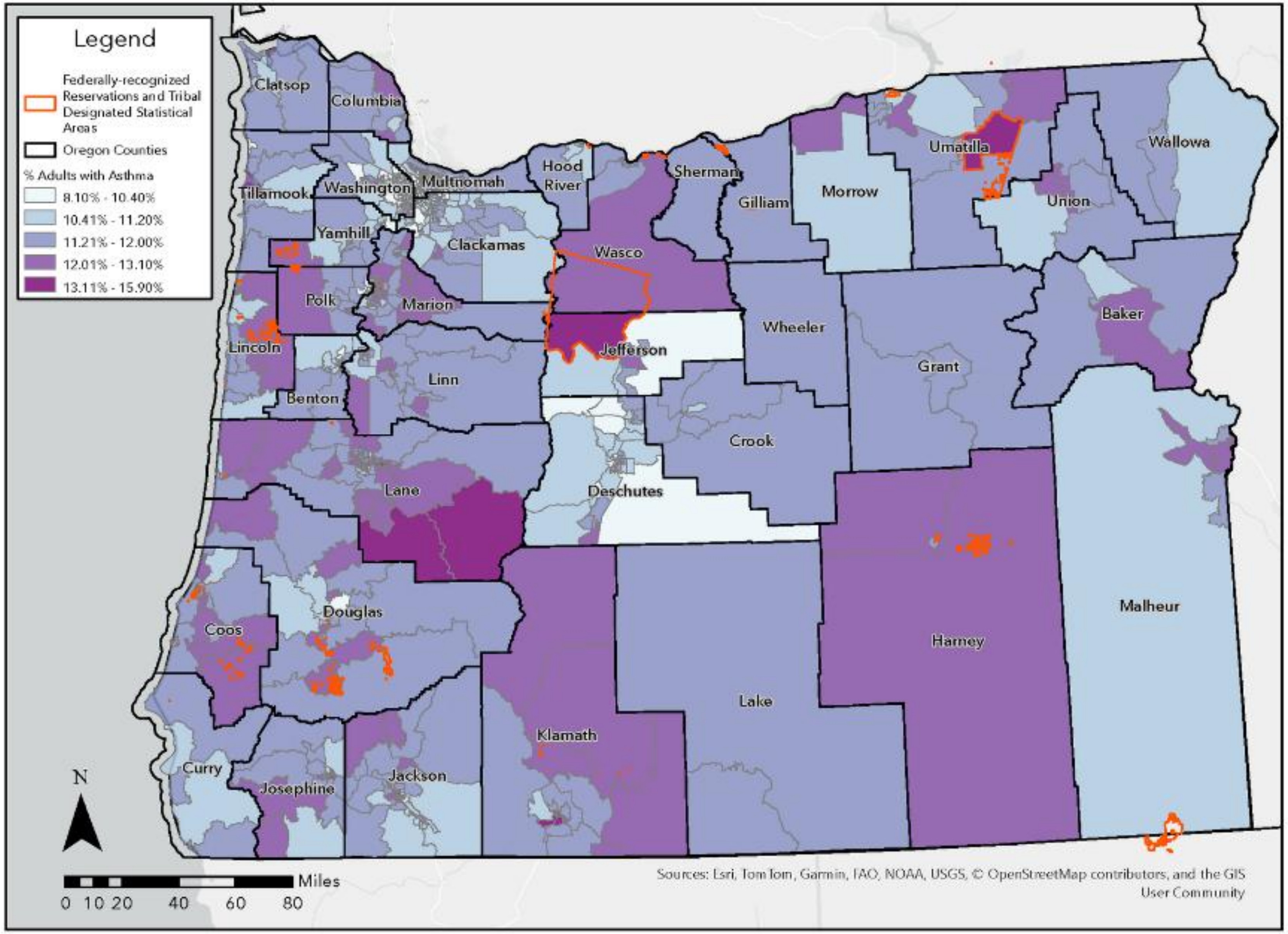
Percent of Adults without a High School Diploma



3.6% of census tracts (n = 36) have more than 21.7% of adults without a High school diploma

Data source: ACS

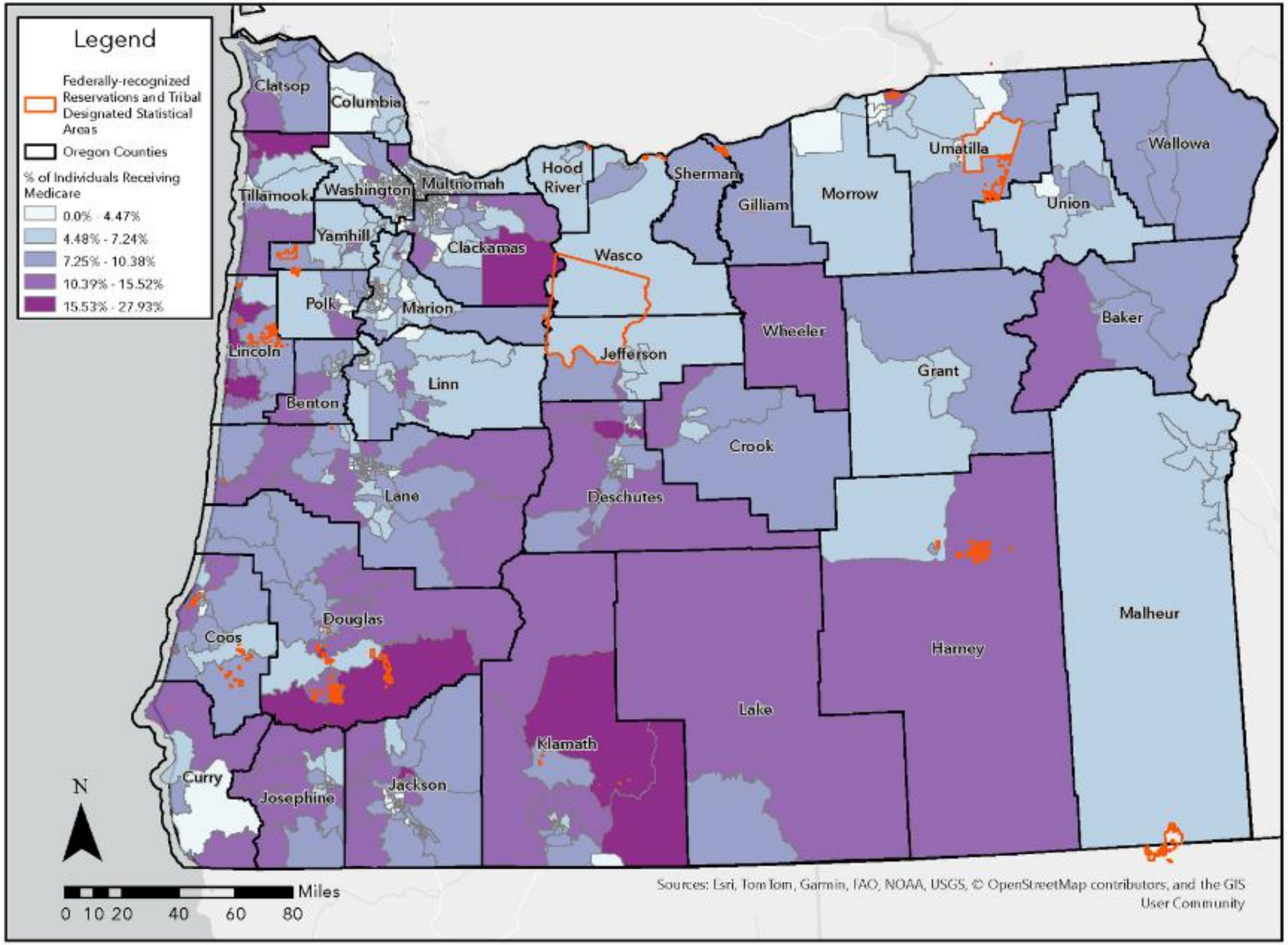
Percent of Adults with Asthma



Data source: Center for Disease Control PLACES dataset

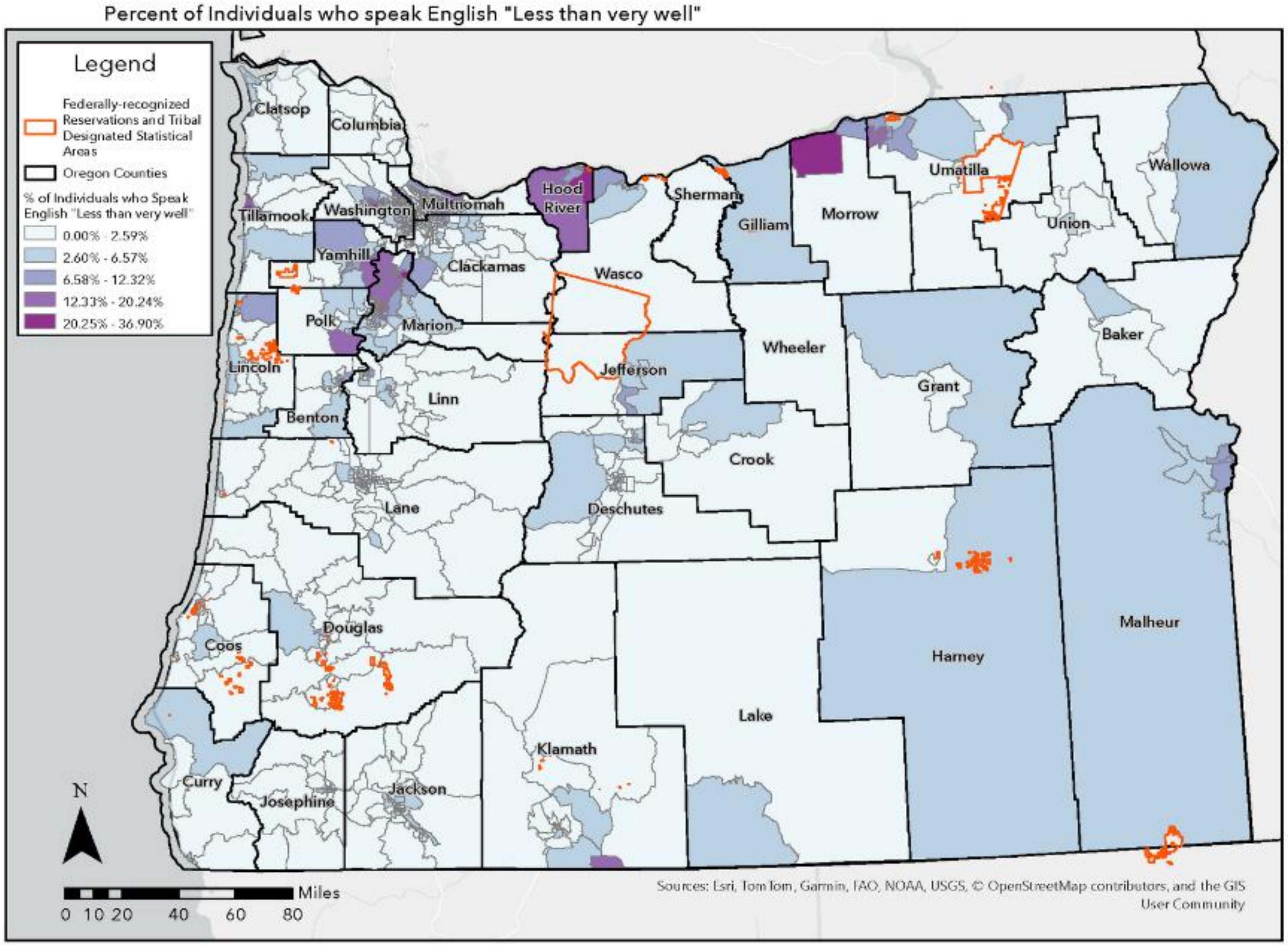
2.9% of census tracts (n = 29) have more than 13.1% of adults with Asthma

Percent of Individuals Receiving Medicare



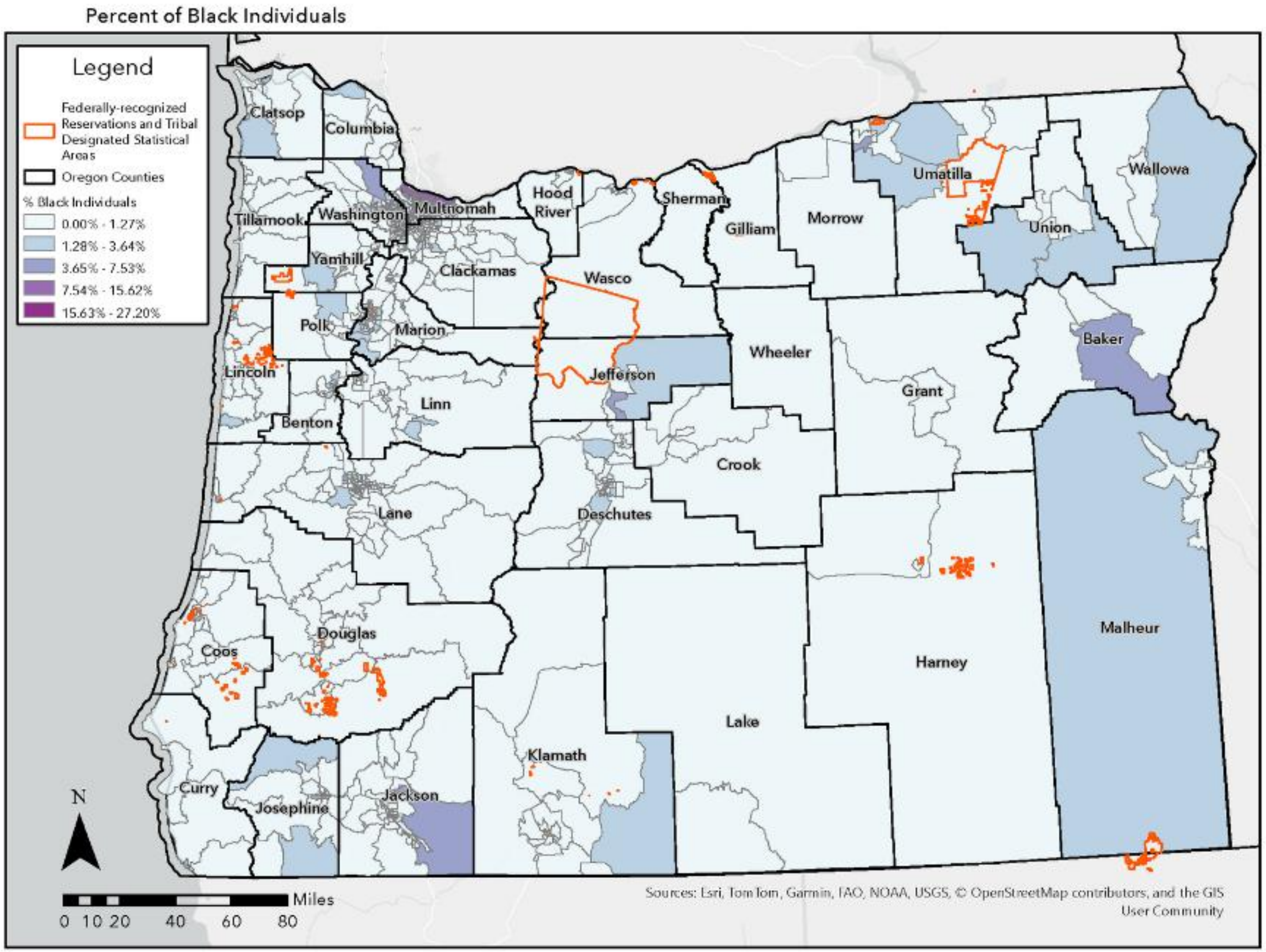
Data source: ACS

1.7% of census tracts (n = 17) have more than 15.52% of Individuals receiving Medicare



2.4% of census tracts (n = 24) have more than 20.24% of Individuals who speak English "Less than very well"

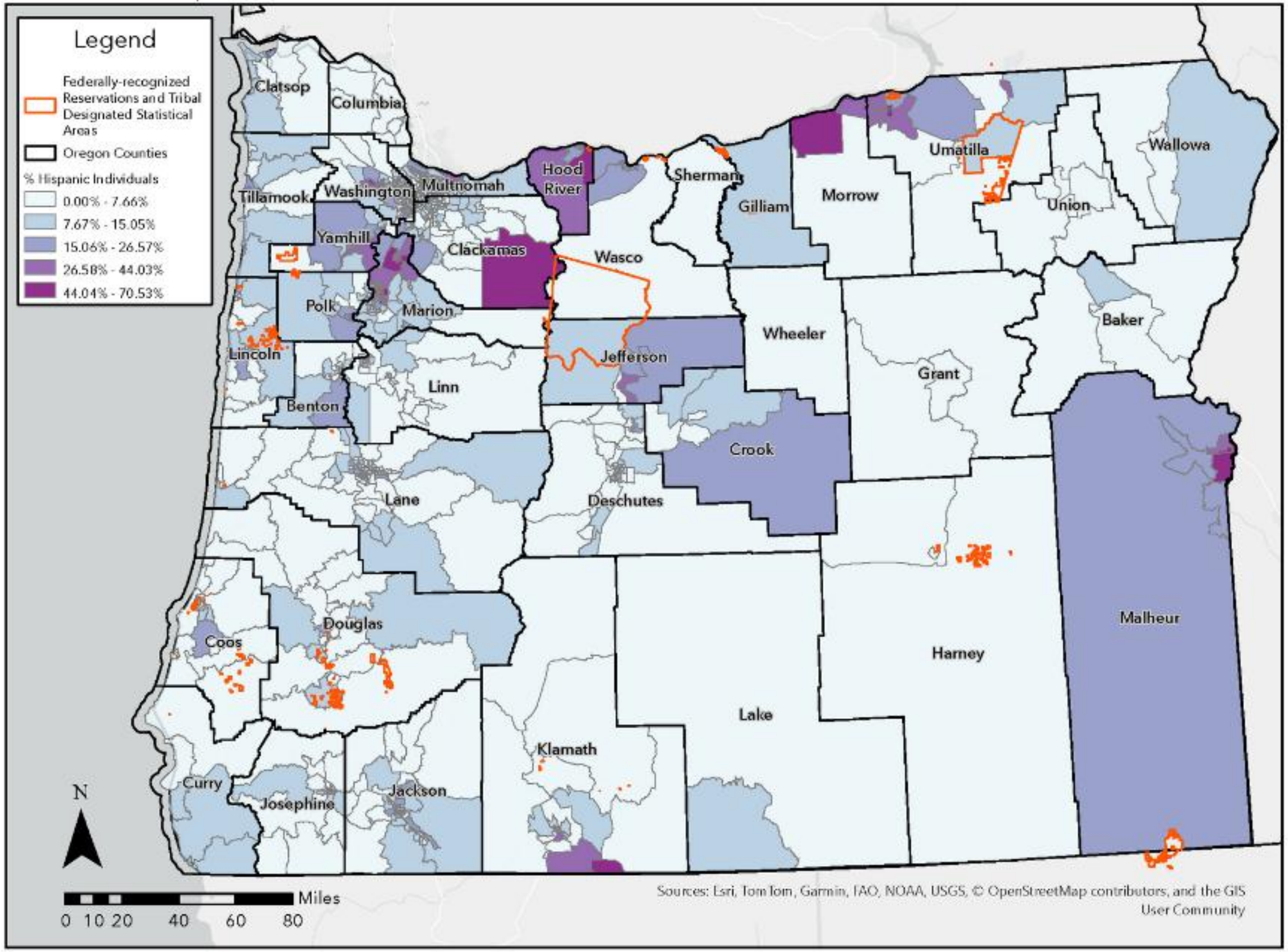
Data source: ACS



Less than 1% of census tracts (n = 9) have more than 15.62% of Black Individuals

Data source: ACS

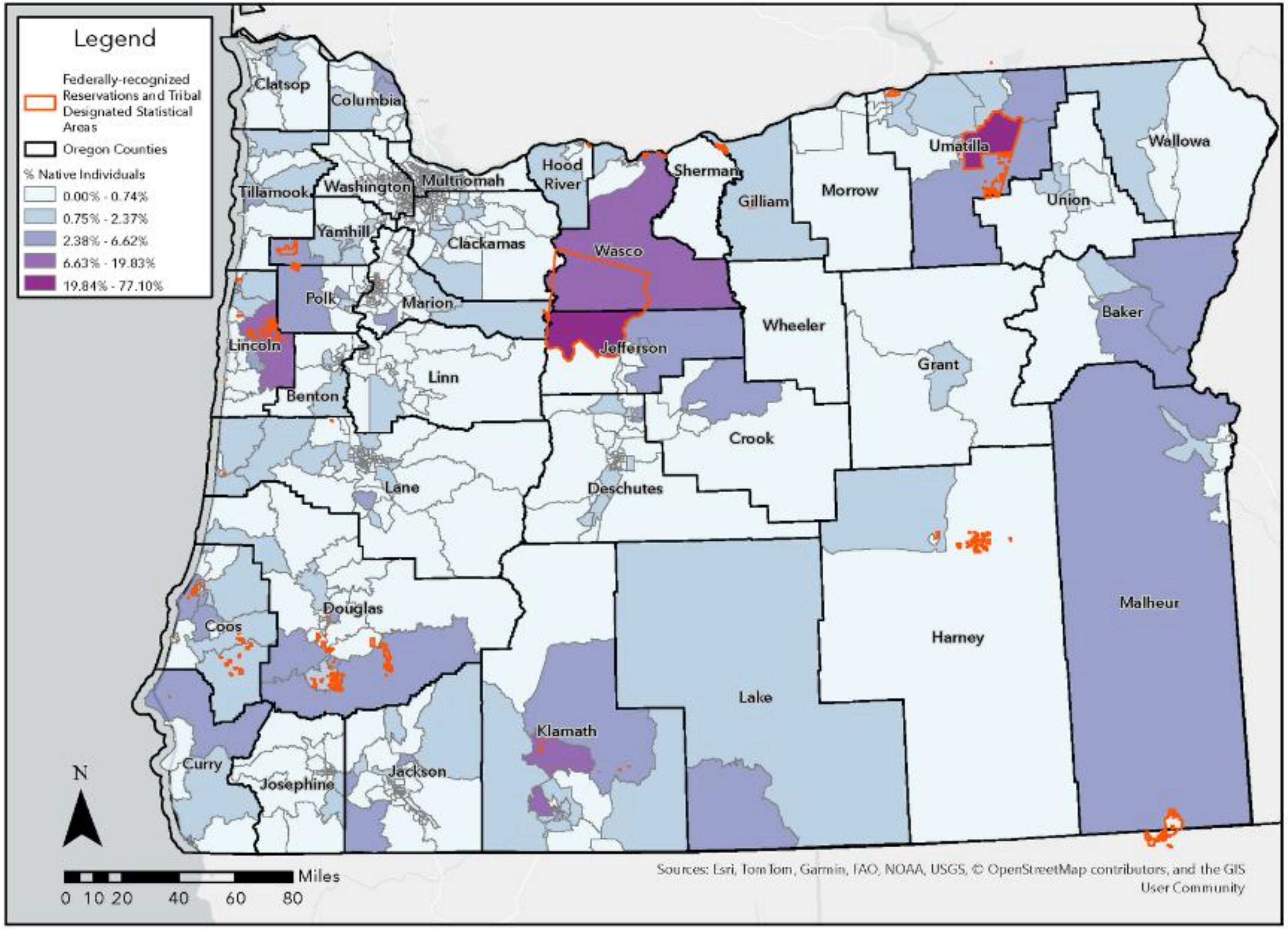
Percent of Hispanic Individuals



Data source: ACS

2.8% of census tracts (n = 28) have more than 44.03% of Hispanic Individuals

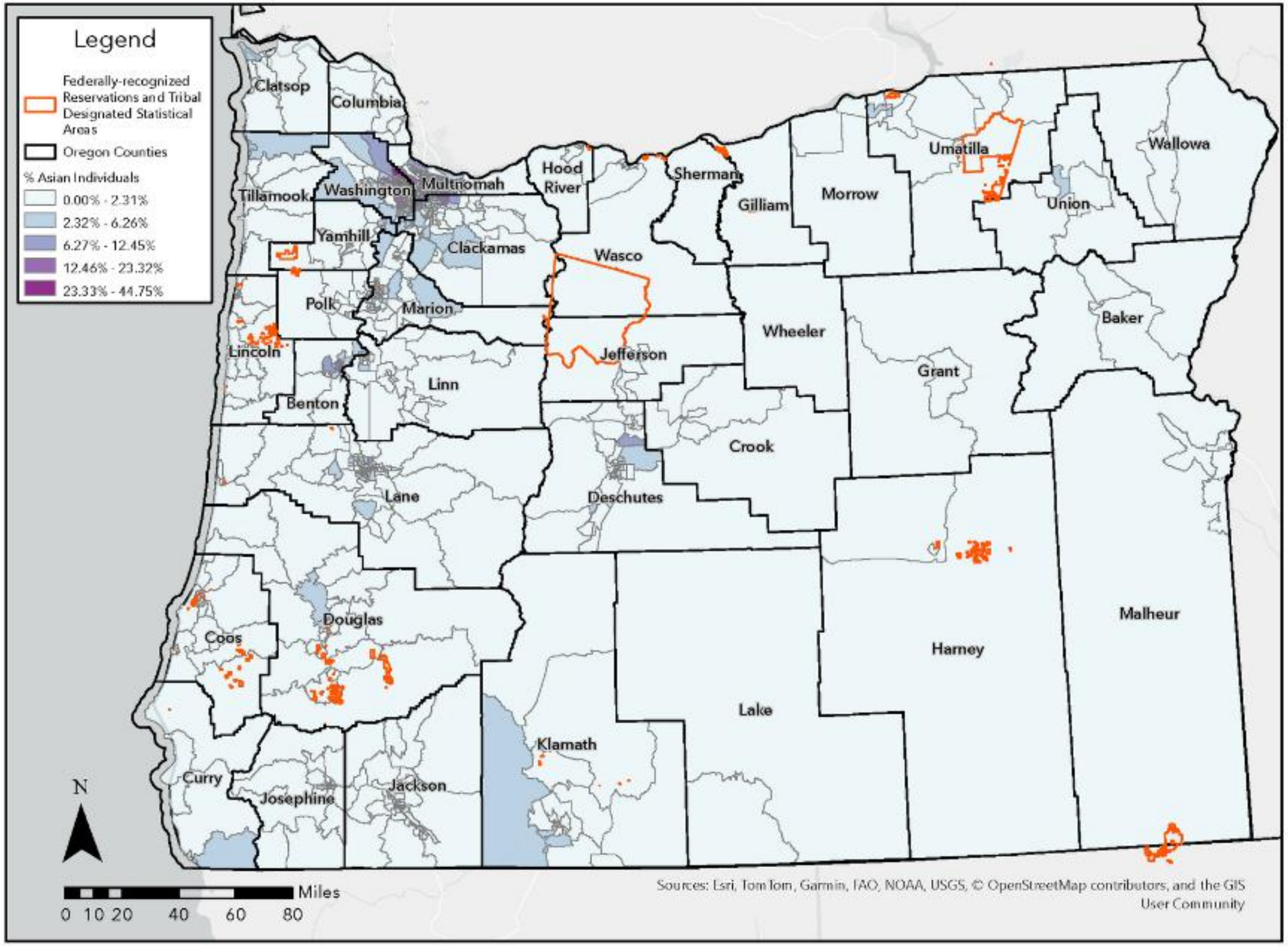
Percent of Native Individuals



Less than 1% of census tracts (n= 3) have more than 19.83% of Native Individuals

Data source: ACS

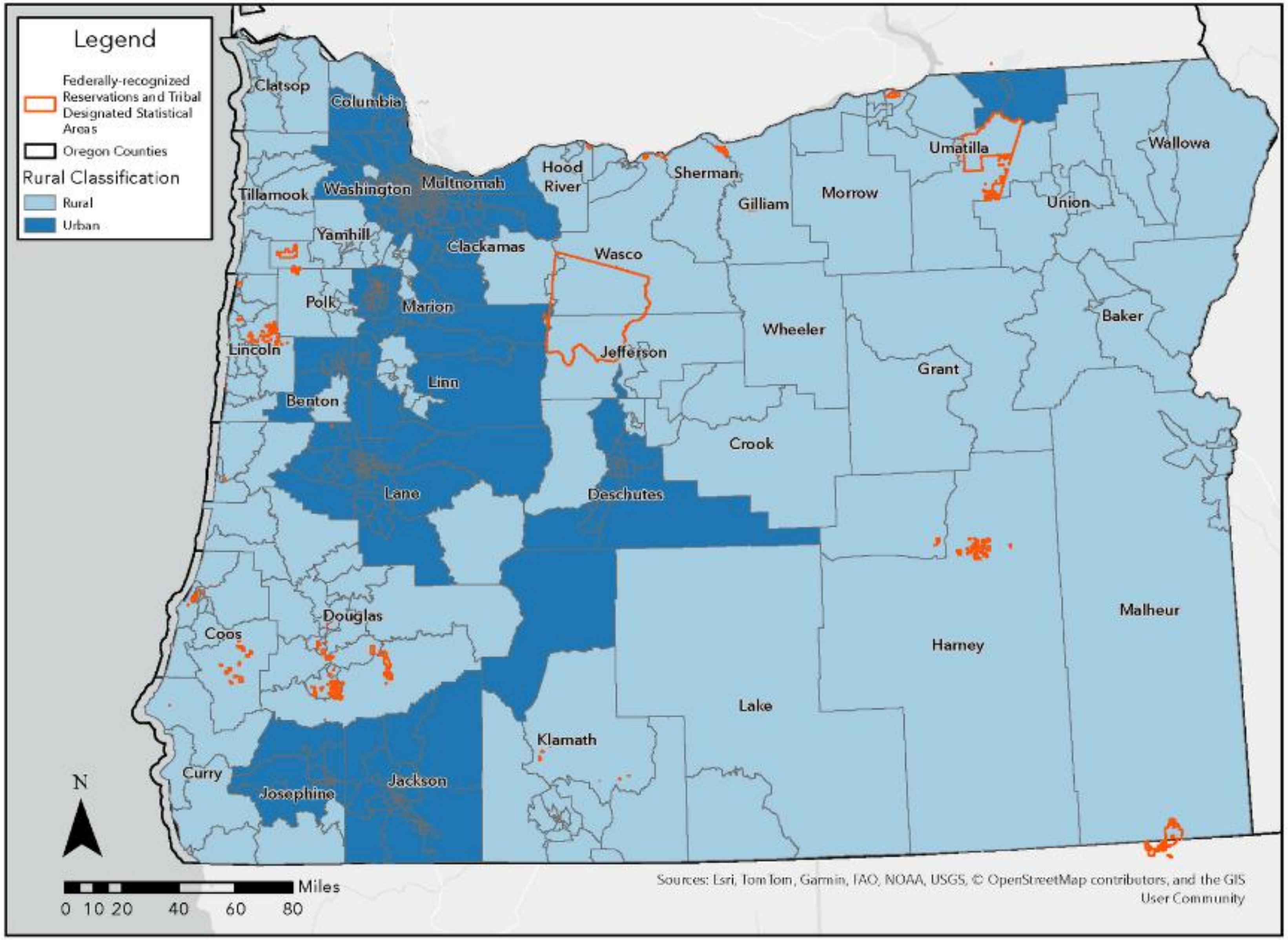
Percent of Asian Individuals



1.5% of census tracts (n= 15) have more than 23.32% of Asian Individuals

Data source: ACS

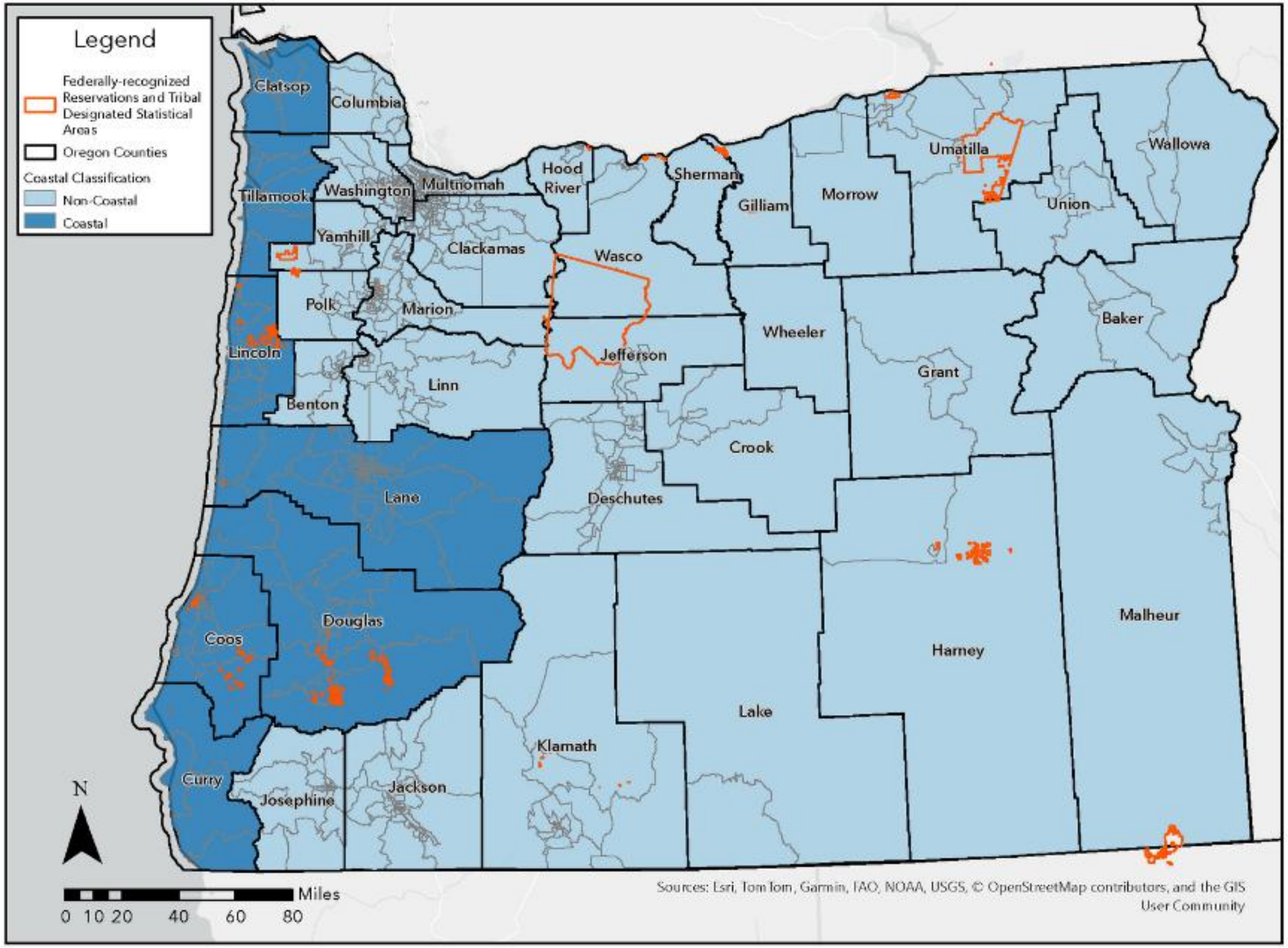
Rural Census Tracts



27.1% of census tracts (n= 834) are rural

Data source: U.S. Department of Agriculture (USDA) Rural Urban Commuting Areas (RUCA) Codes

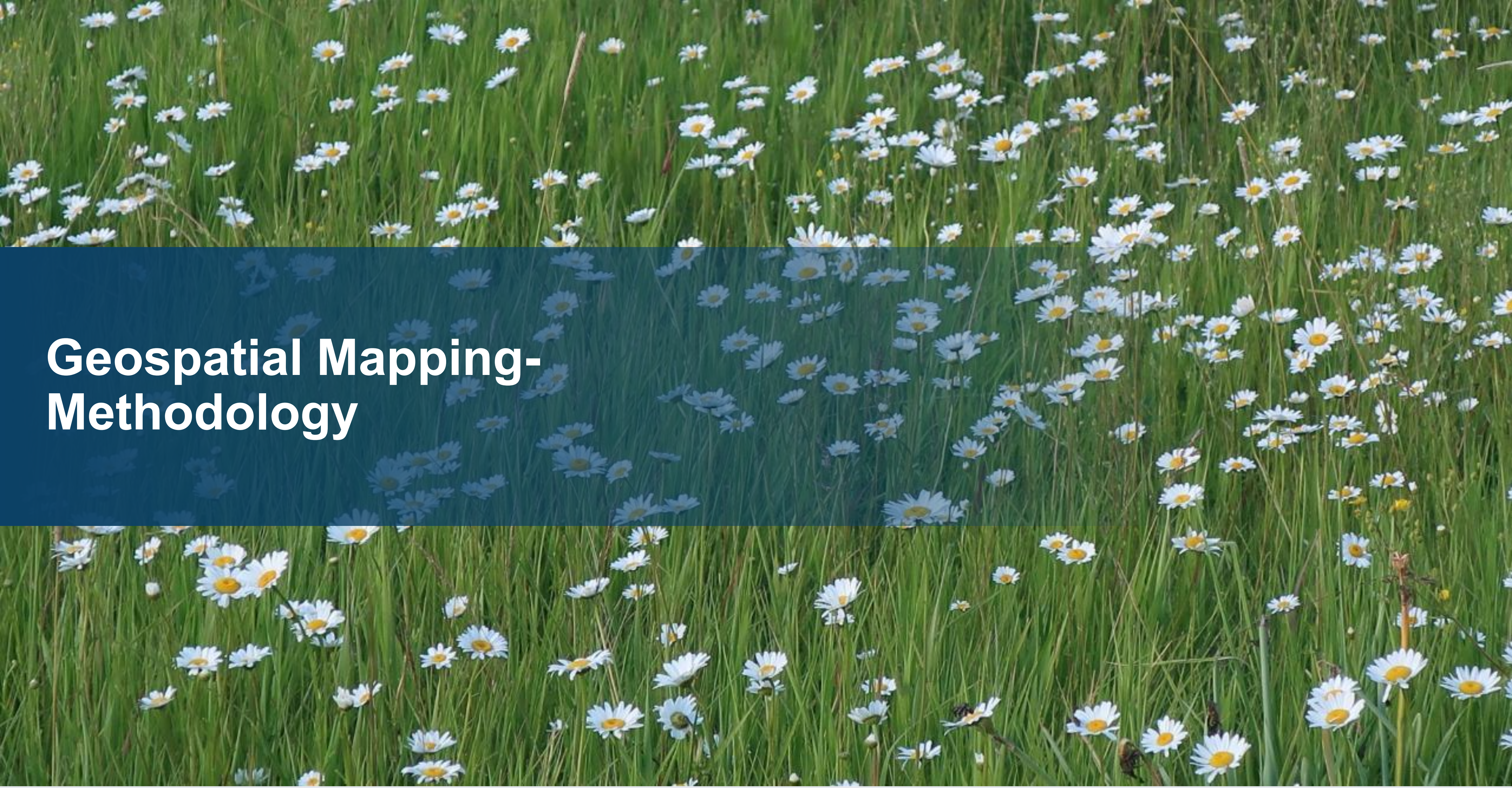
Coastal Census Tracts



19% of census tracts (n= 188) are coastal

Data source: National Oceanic and Atmospheric Administration (NOAA) "Defining Coastal Counties" Report

Geospatial Mapping-Methodology



Data Sources

- The geospatial mapping approach uses data sources that are publicly available datasets from state and federal agencies. This ensures consistency across spatial and temporal aspects of geographies. When available, the datasets represent census tracts in Oregon from 2018 to 2022.
- For sociodemographic and housing characteristics, 5-year estimates from the American Community Survey (ACS) are queried as raw counts using the TidyCensus package. Data on energy burden, household IRA rebate eligibility, and "Disadvantaged" categorization from the Climate and Economic and Justice Screening Tool (CEJST) are made available from the Department of Energy (DOE).
  - See full list of Data Sources in Appendix 1: Shapefile Data Dictionary
- Data sources were chosen based on:
  - Feedback from partner input through the Oregon Energy Strategy Phase 1 engagement process, which suggested indicators related to Tribal communities, rural communities, the percentage of individuals employed in natural resources, indicators of poverty, those without health insurance, race and ethnicity, air quality, and average energy burden as priorities for geospatial mapping.
  - Environmental justice and energy justice-related literature
  - Relationship to Oregon community benefits (Customer and System Resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing)
  - Oregon environmental justice community definition outlined in HB 4077 (including but not limited to: "communities of color, communities experiencing lower incomes, communities experiencing health inequities, Tribal communities, rural communities, remote communities, coastal communities, communities with limited infrastructure and other communities traditionally underrepresented in public processes and adversely harmed by environmental and health hazards, including seniors, youth and persons with disabilities")

Data Processing

- All data processing was conducted in RStudio (v.4.4.0). Census-tract level datasets were joined using the unique GEOID and processed when necessary to reflect a single aggregate value (e.g., the percentage of families living at or below the 150% federal poverty level, rather than raw estimates of the number of households at or below 50%, 100%, and 150% of the federal poverty level) (Appendix 1).
- Nine census tracts were removed from the analysis because they had a population of 0 (all located on the coastline of the Pacific Ocean).
- Once all the values were summarized to reflect a single Census Tract, the dataset is joined to a 2022 TIGER/Line census tract shapefile and exported as a single shapefile.
- The final dataset includes 44 columns representing 41 justice-related variables for 992 census tracts.

Geospatial Mapping- Appendix 1: Shapefile Dictionary

Appendix 1: Shapefile Data Dictionary

Column	Variable Name	Oregon Community Benefits	Oregon EJ Mapping Themes	Source	Processing	Geography
TotalPop	Total Population	N/A	N/A	ACS Table B01001: Sex by Age	N/A	2018-2022 Census Tract
PrcWhte	Percent of Non-Hispanic White Individuals	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains "Communities of color"	ACS Table B03002: Hispanic or Latino Origin by Race	(B03002_003E/ B01001_001E) * 100	2018-2022 Census Tract
PrcHsp	Percent of Hispanic Individuals			ACS Table B03002: Hispanic or Latino Origin by Race	(B03002_012E/ B01001_001E)*100	2018-2022 Census Tract
PrcBlck	Percent of Non-Hispanic Black Individuals			ACS Table B03002: Hispanic or Latino Origin by Race	(B03002_004E/ B01001_001E)*100	2018-2022 Census Tract
PrcNtve	Percent of Non-Hispanic American Indian and Alaska Native Individuals			ACS Table B03002: Hispanic or Latino Origin by Race	(B03002_005E/ B01001_001E) * 100	2018-2022 Census Tract
PrcAsn	Percent of Non-Hispanic Asian Individuals			ACS Table B03002: Hispanic or Latino Origin by Race	(B03002_006E/ B01001_001E) * 100	2018-2022 Census Tract
PrcOthr	Percent of Non-Hispanic Other Individuals			ACS Table B03002: Hispanic or Latino Origin by Race	(B03002_008E/ B01001_001E)*100,	2018-2022 Census Tract
PrcNoHSDplma	Percent of individuals without a HS diploma	Economic, Health and Wellbeing	Environmental Justice Community definition contains "communities experiencing lower incomes" and "communities traditionally underrepresented in public processes".	ACS Table B15003: Educational Attainment for the Population 25 Years and Over	((B15003_002E + B15003_003E + B15003_004E + B15003_005E + B15003_006E + B15003_007E + B15003_008E + B15003_009E + B15003_010E + B15003_011E + B15003_012E + B15003_013E + B15003_014E + B15003_015E + B15003_016E)/B15003_001E) *100	2018-2022 Census Tract
PrcESL	Percent of Individuals who speak English "less than 'very well'"	Economic, Health and Wellbeing	Environmental Justice Community definition contains "communities traditionally	ACS Table C16001: Language Spoken at Home for the Population 5 Years and Over	((C16001_005E + C16001_008E + C16001_011E + C16001_014E + C16001_017E + C16001_020E + C16001_023E + C16001_026E +	2018-2022 Census Tract

Column	Variable Name	Oregon Community Benefits	Oregon EJ Mapping Themes	Source	Processing	Geography
			underrepresented in public processes" and "communities of color".		C16001_029E +C16001_032E + C16001_035E + C16001_038E)/ C16001_001E) *100	
PrcPvrty	Percent of Individuals at or below 150% of the Federal Poverty Line	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains "communities experiencing lower incomes".	ACS Table C17002: Ratio of Income to Poverty Level in the Past 12 Months	((C17002_002E + C17002_003E + C17002_004E + C17002_005E)/ C17002_001E)*100	2018-2022 Census Tract
PrcUnmploy	Percent of unemployed individuals	Economic	Environmental Justice Community definition contains "communities experiencing lower incomes".	ACS Table B23025: Employment Status for the Population 16 Years and Over	(B23025_005E/ B23025_003E)*100	2018-2022 Census Tract
Prc65	Percent of individuals >= 65 years old	Customer and system resiliency, Economic, Health and wellbeing	Environmental Justice Community definition contains "seniors".	ACS Table B01001: Sex by Age	((B01001_020E + B01001_021E + B01001_022E + B01001_023E + B01001_024E + B01001_025E + B01001_044E + B01001_045E + B01001_046E + B01001_047E + B01001_048E + B01001_049E)/ B01001_001E)*100	2018-2022 Census Tract
PrcDsablty	Percent of non-institutionalized individuals with a disability	Customer and system resiliency, Economic, Health and wellbeing	Environmental Justice Community definition contains "persons with disabilities".	ACS Table B18101: Sex by Age by Disability Status	((B18101_004E + B18101_007E + B18101_010E + B18101_013E + B18101_016E + B18101_019E + B18101_023E + B18101_026E + B18101_029E + B18101_032E + B18101_035E + B18101_038E)/ B18101_001E)*100	2018-2022 Census Tract
PrcNoHlthInsr	Percentage of Individuals without Health Insurance	Economic, Health and wellbeing	Environmental Justice Community definition contains "communities experiencing lower incomes".	ACS Table B27010: Types of Health Insurance Coverage by Age	((B27010_017E + B27010_033E + B27010_050E + B27010_066E)/ B27010_001E)*100	2018-2022 Census Tract
PerCapIncm	Per Capita Income	Economic	Environmental Justice Community definition contains "communities	ACS Table B19301: Per Capita Income in the Past 12 Months	N/A	2018-2022 Census Tract

Column	Variable Name	Oregon Community Benefits	Oregon EJ Mapping Themes	Source	Processing	Geography
			experiencing lower incomes".	(in 2022 Inflation-Adjusted Dollars)		
Prc17	Percent of individuals <= 17 years old	Customer and system resiliency, Health and wellbeing	Environmental Justice Community definition contains "youth".	ACS Table B01001: Sex by Age	((B01001_003E + B01001_004E + B01001_005E + B01001_006E + B01001_027E + B01001_028E + B01001_029E + B01001_030E)/ B01001_001E)*100,	2018-2022 Census Tract
PrcSnglPrnt	Percent of single parent-headed households with children under 18 present	Economic, Health and wellbeing	Environmental Justice Community definition contains "youth" and "communities experiencing lower incomes".	ACS Table B09002: Own Children Under 18 Years by Family Type and Age	(B09002_008E/ B09002_001E)*100,	2018-2022 Census Tract
PrcSupSI	Percent of Individuals Receiving Supplemental Security Income	Economic, Health and wellbeing	Environmental Justice Community definition contains "communities experiencing lower incomes".	ACS Table B19056: Supplemental Security Income (SSI) in the Past 12 Months for Households	(B19056_002E/ B19056_001E)*100	2018-2022 Census Tract
PrcSSI	Percent of Individuals Receiving Social Security Income	Economic, Health and wellbeing	Environmental Justice Community definition contains "communities experiencing lower incomes".	ACS Table B19055: Social Security Income in the Past 12 Months for Households	(B19055_002E/ B19055_001E)*100	2018-2022 Census Tract
PrcSNAP	Percent of Individuals Receiving SNAP benefits	Economic, Health and wellbeing	Environmental Justice Community definition contains "communities experiencing lower incomes".	ACS Table B22010: Receipt of Food Stamps/SNAP in the Past 12 Months by Disability Status for Households	(B22010_002E/ B22010_001E)*100,	2018-2022 Census Tract
PrcMedcr	Percent of Individuals Receiving Medicare	Economic, Health and wellbeing	Environmental Justice Community definition contains "communities experiencing lower incomes".	ACS Table B27010: Types of Health Insurance by Age	((B27010_006E + B27010_022E + B27010_038E + B27010_055E + B27010_066E)/ B27010_001E)*100	2018-2022 Census Tract

Column	Variable Name	Oregon Community Benefits	Oregon EJ Mapping Themes	Source	Processing	Geography
PrcVct	Percent of Vacant homes	Economic, Environmental	Environmental Justice Community definition contains "adversely harmed by environmental and health hazards"	ACS Table B25002: Occupancy Status	(B25002_003E/ B25002_001E)*100,	2018-2022 Census Tract
PrcHmwnrshp	Percent of Individuals who own their home	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains "adversely harmed by environmental and health hazards"	ACS Table B25003: Tenure	(B25003_002E/ B25003_001E)*100,	2018-2022 Census Tract
PrcHs1980	Percent of homes built <= the year 1980	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains "adversely harmed by environmental and health hazards"	ACS Table B25034: Year Structure Built	((B25034_007E + B25034_008E + B25034_009E + B25034_010E + B25034_011E)/ B25034_001E)*100	2018-2022 Census Tract
PrcNoIntrt	Percent of households with no Internet	Customer and system resiliency	Environmental Justice Community definition contains "adversely harmed by environmental and health hazards"	ACS Table B28002: Presence and Types of Internet Subscriptions in Household	(B28002_013E/ B28002_001E)*100	2018-2022 Census Tract
PrcNoWtr	Percent of households without running water	Customer and system resiliency, Health and Wellbeing	Environmental Justice Community definition contains "adversely harmed by environmental and health hazards"	ACS Table B28002: Plumbing Facilities for All Housing Units	(B25047_003E/ B25047_001E)*100	2018-2022 Census Tract
PrcMoblHms	Percent of Manufactured Homes	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains "adversely harmed by environmental and health hazards"	ACS Table B25024: Units in Structure	(B25024_010E/ B25024_001E)*100	2018-2022 Census Tract
PrcMltUnt	Percent of Multi-family homes (10 + units)	Customer and system resiliency, Economic,	Environmental Justice Community definition contains	ACS Table B25024: Units in Structure	((B25024_007E + B25024_008E + B25024_009E)/ B25024_001E)*100	2018-2022 Census Tract

Column	Variable Name	Oregon Community Benefits	Oregon EJ Mapping Themes	Source	Processing	Geography
		Environmental, Energy Equity, and Health and Wellbeing	"adversely harmed by environmental and health hazards"			
PrcPsrcDpdnt	Percent of Individuals Employed in Agriculture, Forestry, Fishing, Hunting, and Mining	Customer and system resiliency, Economic, Environmental, and Energy Equity	Environmental Justice Community definition contains "adversely harmed by environmental and health hazards"	ACS Table B08126: Means of Transportation to Work by Industry	(B08126_002E/ B08126_001E)*100	2018-2022 Census Tract
PrcAltFuels	Percent of Homes Dependent on Bottle, Tank or LP Gas, Fuel oil or Kerosene, Coal or coke, or Wood	Customer and system resiliency, Economic, Environmental, and Energy Equity	Environmental Justice Community definition contains "adversely harmed by environmental and health hazards"	ACS Table B25040: House Heating Fuel	((B25040_003E + B25040_005E + B25040_006E +B25040_007E) /B25040_001E)*100	2018-2022 Census Tract
EnrgyBrdn	Average Energy Burden	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains "communities experiencing lower incomes".	DOE LEAD Tool	N/A	2018-2022 Census Tract
perc_AMI_0_80	Percent of homes at 0-80 % AMI (i.e., prioritized IRA incentives)	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains "communities experiencing lower incomes".	DOE LEAD Tool	Calculated percentage by dividing the total households in 0-80 .csv by total households in 0-150+ .csv.	2018-2022 Census Tract
perc_AMI_80_150	Percent of homes at 80-150% AMI (IRA incentive eligibility)	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains "communities experiencing lower incomes".	DOE LEAD Tool	Calculated percentage by dividing the total households in 80-150 .csv by total households in 0-150+ .csv.	2018-2022 Census Tract
perc_AMI_150	Percent of homes at 150% AMI (IRA incentive	Customer and system resiliency, Economic,	Environmental Justice Community definition contains	DOE LEAD Tool	Calculated percentage by dividing the total households in 150+ .csv	2018-2022 Census Tract

Column	Variable Name	Oregon Community Benefits	Oregon EJ Mapping Themes	Source	Processing	Geography
	eligibility, albeit slightly reduced)	Environmental, Energy Equity, and Health and Wellbeing	"communities experiencing lower incomes".		by total households in 0-150+ .csv.	
J40_eligbl	Binary Categorization for "Disadvantaged Community" and therefore eligible for Justice40 funds, as defined by CEJST.	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains "communities experiencing lower incomes" and "adversely harmed by environmental and health hazards"	DOE LEAD Tool	N/A	2018-2022 Census Tract
trans_access_pr	Percentile-ranked transportation insecurity composite score	Health and wellbeing, environmental, economic	Environmental Justice Community definition contains those "adversely harmed by environmental and health hazards"	Department of Transportation Equitable Transportation Community (ETC) Explorer	N/A	2020 Census Tract
WFIR_RISKS	Percentile-ranked wildfire risk	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains those "adversely harmed by environmental and health hazards"	Federal Emergency Management Agency National Risk Index	N/A	2020 Census Tract
asthma_rate	Crude prevalence (%) of Adult Asthma	Health and wellbeing, environmental	Environmental Justice Community definition contains those "adversely harmed by environmental and health hazards"	Center for Disease Control PLACES dataset	N/A	2020 Census Tract
Rural	Binary categorization for Rural, as defined by the USDA.	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains "rural communities"	USDA RUCA	Rural (1) classified as codes 4-10, Urban (0) classified as codes 1-3.	2010 Census Tract

Column	Variable Name	Oregon Community Benefits	Oregon EJ Mapping Themes	Source	Processing	Geography
Coastal	Binary categorization for coastal communities, as defined by NOAA.	Customer and system resiliency, Economic, Environmental, Energy Equity, and Health and Wellbeing	Environmental Justice Community definition contains "coastal communities"	NOAA "Defining Coastal Counties" Report	Used list of Shoreline Counties in report to classify (1) coastal census tracts and (0) non-coastal census tracts.	2010 County

THANK YOU

Clean Energy Transition Institute

EVOLVED ENERGY RESEARCH

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SYLVAN ENERGY ANALYTICS