



**Eugene City Council**

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# EUGENE CITY COUNCIL AGENDA

July 20, 2022

## 12:00 p.m. CITY COUNCIL WORK SESSION

As the state and community recover from the COVID-19 pandemic, City Council meetings will continue to be held in hybrid format using in-person and virtual meeting technology. Information about online or other options for access and participation will be available at <https://www.eugene-or.gov/3360/Webcasts-and-Meeting-Materials>

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### Meeting of July 20, 2022; Her Honor Mayor Lucy Vinis Presiding

#### Councilors

Claire Syrett, President

Mike Clark

Randy Groves

Jennifer Yeh

Matt Keating, Vice President

Greg Evans

Emily Semple

Alan Zelenka

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## 12:00 p.m. CITY COUNCIL WORK SESSION

### 1. WORK SESSION: DECARBONIZATION ROADMAP

For the hearing impaired, an interpreter can be provided with 48 hours' notice prior to the meeting. Spanish-language interpretation will also be provided with 48 hours' notice. To arrange for these services, contact the receptionist at 541-682-5010. City Council meetings are telecast live on Metro Television, Comcast channel 21, and rebroadcast later in the week.

El consejo de la Ciudad de Eugene agradece su interés en estos asuntos de la agenda. El lugar de la reunión tiene acceso para sillas de ruedas. Se puede proveer a un intérprete para las personas con discapacidad auditiva si avisa con 48 horas de anticipación. También se puede proveer interpretación para español si avisa con 48 horas de anticipación. Para reservar estos servicios llame al 541-682-5010. Las reuniones del consejo de la ciudad se transmiten en vivo por Metro Television, Canal 21 de Comcast y son retransmitidas durante la semana.

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or visit us online at [www.eugene-or.gov](http://www.eugene-or.gov).

July 20, 2022 Work Session

# EUGENE CITY COUNCIL AGENDA ITEM SUMMARY



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## Decarbonization of Existing Buildings

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Meeting Date: July 20, 2022  
Department: Public Works  
[www.eugene-or.gov](http://www.eugene-or.gov)

Agenda Item Number: 1  
Staff Contact: Matt Rodrigues  
Contact Telephone Number: 541-682-6877

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### ISSUE STATEMENT

The purpose of this work session is to share the results of the report “City of Eugene Community Decarbonization by 2045 for Existing Residential, Commercial, and Industrial Buildings Energy Use – Part 1 Residential - Draft”.

### BACKGROUND

The City’s Climate Recovery Ordinance ([Ordinance No: 20567](#)) includes the following goals: 1) the City organization to be carbon neutral by 2020, 2) the City organization to reduce fossil fuel use by 50 percent by 2030 compared to 2010 levels, 3) community-wide reduction of fossil fuel use by 50 percent by 2030 compared to 2010 levels, and 4) reduce community-wide greenhouse gas emissions by 7.6 percent annually through 2100. The City’s Internal Climate Action Plan and the CAP2.0 are the roadmaps to the reaching the CRO goals.

The CAP2.0 was approved by City Council in July 2020 and is the City’s roadmap to achieving goals three and four of the CRO. The full document can be found here: <https://www.eugene-or.gov/4284/Climate-Action-Plan-20>.

In consideration of furthering work towards CAP 2.0 goals to reduce community fossil fuel use and greenhouse gas emissions Council directed the City Manager to prepare a roadmap for how the City can achieve decarbonization of the existing commercial, industrial and residential building stock by 2045 with particular consideration for how low-income and historically marginalized households will be impacted and included in this process. The roadmap will include strategies for decarbonization of rental housing stock.

This work session is to present part 1 of the draft report, completed by sustainability consulting firm Good Company on behalf of the City, focusing on residential housing stock. Parts 2 and 3 focusing on commercial and industrial buildings will be completed and presented to Council in the fall.

The data in this report is based on the best available data at the time. An updated Integrated Resource Plan (IRP) from Northwest Natural to meet the requirements of the State Climate Protection Program requirements of 90% reduction of greenhouse gas emissions by 2050 is

expected in July or August and will provide updated information to inform Parts 2 and 3 of the Eugene Community Decarbonization by 2045 report including updated forecasts on natural gas pricing to reach Climate Protection Program goals.

## **PREVIOUS COUNCIL DIRECTION**

[January 16, 2019](#)

Staff presented an overview of Home Energy Scores and related programs.

[July 29, 2020](#)

City Council approved the CAP2.0.

[December 9, 2020](#)

City Council directed staff to put together a CAP2.0 Implementation Plan.

[September 22, 2021](#)

Staff provided an overview of the CAP2.0 12 Additional Strategies.

[September 27, 2021](#)

This Joint Work Session with City Council and EWEB's Board of Directors included staff presentations on the CAP2.0 and EWEB's Electrification Study.

[November 17, 2021](#)

Council passed a motion to Direct the City Manager to provide Council with a roadmap for how the City can achieve decarbonization of the existing commercial, industrial and residential building stock by 2045 with particular consideration for how low-income and historically marginalized households will be impacted and included in this process. This roadmap must include strategies for decarbonization of rental housing stock. A draft of this roadmap shall be provided to Council before June 30, 2022.

[April 13, 2022](#)

On April 13<sup>th</sup> City Council held a work session on new building electrification and passed a motion to Direct the City Manager to schedule the next work session before July 31 to answer the questions brought forth in this work session and other questions submitted by councilors.

## **COUNCIL OPTIONS**

This work session is for informational purposes.

## **SUGGESTED MOTION**

This work session is for informational purposes.

**ATTACHMENTS**

A. City of Eugene Community Decarbonization by 2045 for Existing Residential, Commercial, and Industrial Buildings Energy Use – Part 1 Residential - Draft

**FOR MORE INFORMATION**

Staff Contact: Matt Rodrigues, Public Works Director

Telephone: 541-682-6877

Staff E-Mail: [mrodrigues@eugene-or.gov](mailto:mrodrigues@eugene-or.gov)



City of Eugene Community  
**Decarbonization by 2045 for Existing  
Residential, Commercial, and Industrial  
Buildings Energy Use  
Part 1: Residential--Draft**





## Acknowledgements

### Consulting Team

Good Company is a sustainability consulting firm based in Eugene, OR. Josh Proudfoot, principal, served as the project manager and provided project guidance, interviews of business owners and operators. Aaron Toney, senior analyst, served as the analytical lead and is the primary author of this report. Claudia Denton and Beth Miller, analysts, provided technical analysis and research and are supporting authors.

### Other Acknowledgements

Good Company consulted with many experts while producing this report. We are grateful for their time and insight.

Melissa Murphy, Regional Solutions Specialist, Business Oregon

Lou Hunter, Managing Director, PACE Equity

Joseph Mankiewicz, AMERESCO

Luis Aguirre-Torres, Sustainability Director, Ithaca, NY

Kevin Young, Senior Urban Planner, DLCD

Travis Reader and Eli Volem, EWEB major accounts

Kandi Young, Public Information Officer, OPUC

Mark Wyman, Energy Trust of Oregon

Genevieve Middleton, City of Eugene

Kristen Karle, St. Vincent de Paul

Dan Elliott, OHCS

Vinh Mason, City of Portland

Esteban Montero Chacon, Homes for Good

Samantha Roberts, Eugene Chamber of Commerce

Twylla Miller, City of Eugene

We also spoke with several business owners and industry representatives



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## Introduction

This report investigates the possible actions the City of Eugene and the Eugene community can take to achieve decarbonization of residential, commercial, and industrial buildings' energy use by no later than 2045. This report summarizes local building stock characteristics, sources of existing greenhouse gas (GHG) emissions in the community, best technology solutions, related costs for various actions policy practices, and recommended actions to fill local gaps in programs.

Information reported herein is a combination of 1) listening/interviews of business owners and operators and professional program managers related to business support services, energy and building use, and funding organizations (see Contributors section) and 2) a literature review of public domain studies and programs to summarize best practices and approaches for existing building decarbonization.

This report is intended to provide decision makers with an explanation of what we have, what we can do, how much it might cost, and when acting early makes sense without undue hardship to our businesses and households.

This goal may seem like an insurmountable task, but the good news is that the State of Oregon and local utilities are required through the Climate Protection Program to produce or have voluntarily produced plans to significantly reduce the climate impacts of energy supplies in Eugene and reduce energy demand. That said – these existing commitments alone will not reach 100% decarbonization by the Eugene 2045 goal across the residential, commercial, and industrial sectors, but they do provide significant benefits toward that goal and highlight what must be done locally to fill the gaps to reach the goal.

\*All data is as of July 2022, and will be revised if necessary, upon receipt of NWN and EWEB's updated information expected late summer/fall 2022

## Eugene Community – Existing Building GHG Emissions

The City of Eugene has a long history of measuring local sources of community climate pollution (community greenhouse gas emissions inventory), which include the emissions from existing residential, commercial, and industrial buildings.<sup>1</sup>

Building emissions in the most recent 2019 community GHG inventory totaled **331,525 MT CO<sub>2</sub>e (32% of the community total)**, primarily coming from local methane combustion and imported electricity consumption locally. Electricity use (kilowatt-hours consumed) decreased by 1.3% between 2010 and 2019 despite population growth. *Yet emissions from that electricity use decreased by 51% across the residential, commercial, and industrial sectors due to an increase in the share of low-carbon electricity generation by EWEB owned sources or purchased by EWEB on behalf of the community.* During this same period, total methane use and the associated emissions increased by 7% (across the residential, commercial, and industrial sectors). The residential sector led the increase, which is attributed to

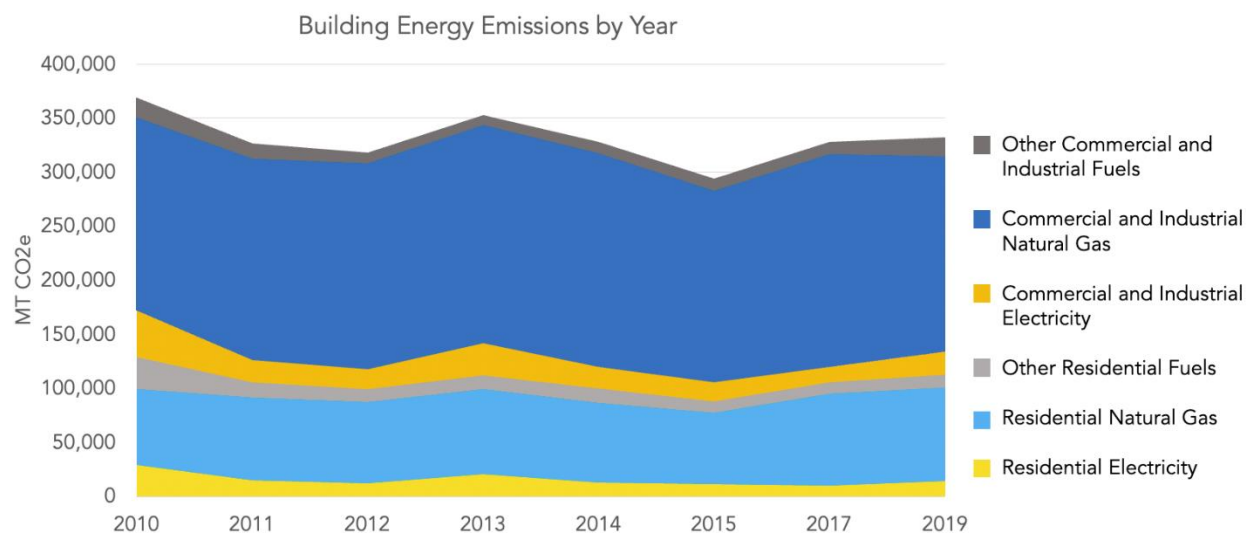
<sup>1</sup> For details visit [https://www.eugene-or.gov/DocumentCenter/View/59286/2019-Eugene-Community\\_GHG](https://www.eugene-or.gov/DocumentCenter/View/59286/2019-Eugene-Community_GHG).



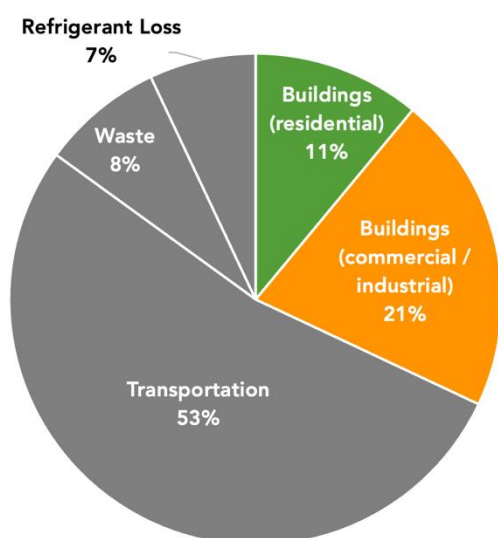


population growth and varying winter temperatures and the need for additional heating in certain years. See Figure 1<sup>2</sup> for a summary of building GHGs.

**Figure 1: Eugene Community Greenhouse Gas Emissions for Buildings, 2010-2019**



**Figure 2: Eugene's GHG inventory emissions breakdown**



Eugene's 2019 sector-based sources of GHG emissions total just over 1 million MT CO<sub>2</sub>e. The largest sources of community emissions include passenger and freight transportation (53%) followed by commercial and industrial buildings (21%) and residential buildings (11%) (Figure 2).

<sup>2</sup> The 2019 Community GHG Inventory is available on the [City's website](#).

## Four Pillars of Deep Decarbonization

This report reviews a variety of existing building decarbonization plans and related documents. Many used a common set of high-level strategies or “pillars” summarized in Figure 3. Deep decarbonization can be summarized by four, high-level categories common to all the produced studies we found.

This report considers the following strategies:

- Energy Efficiency
- Electrification
- Low-Carbon Energy

*Note: The fourth “pillar”, Reduce Non-Combustion GHGs, is being considered in a separate City of Eugene project that will convene local stakeholders in the second half of 2022 to determine readily available and cost-effective actions to reduce loss of **refrigerants** by building systems. This report is focused on decarbonization of building energy. Likewise, the transportation sector and specifically electric vehicles are not addressed in this report which is focused on existing building energy use.*

**Figure 3: Four pillars of deep decarbonization**

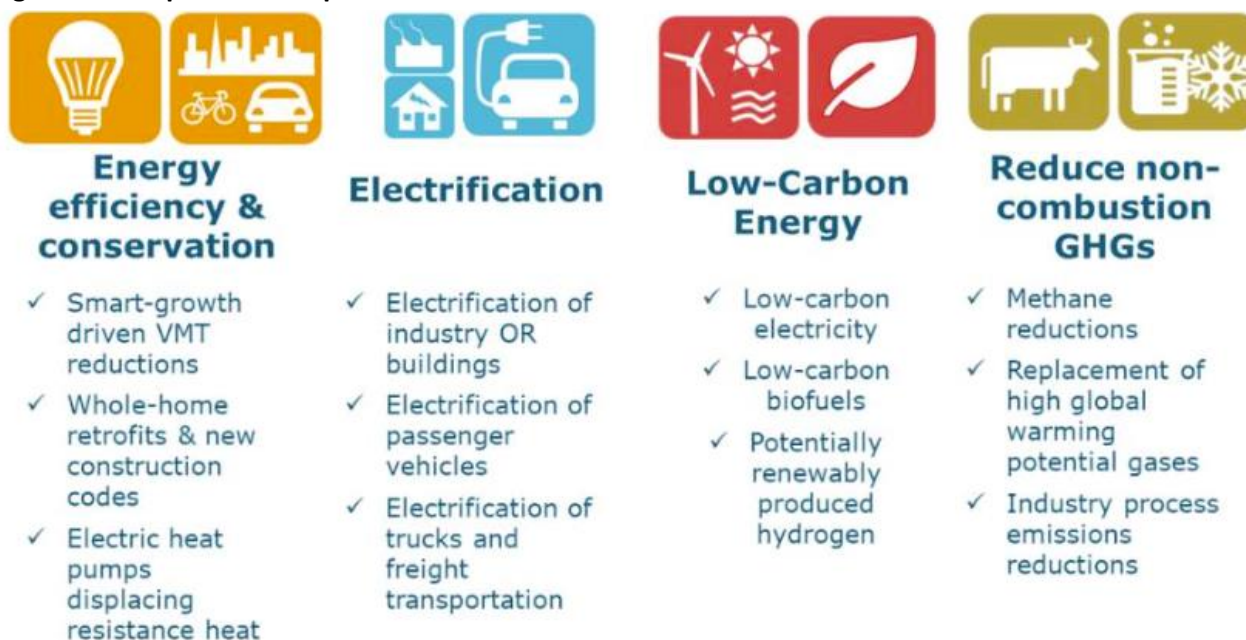


Figure Credit: Energy + Environmental Economics, Four Pillars of Deep Decarbonization



## Low-Carbon Energy – Existing Policy Context

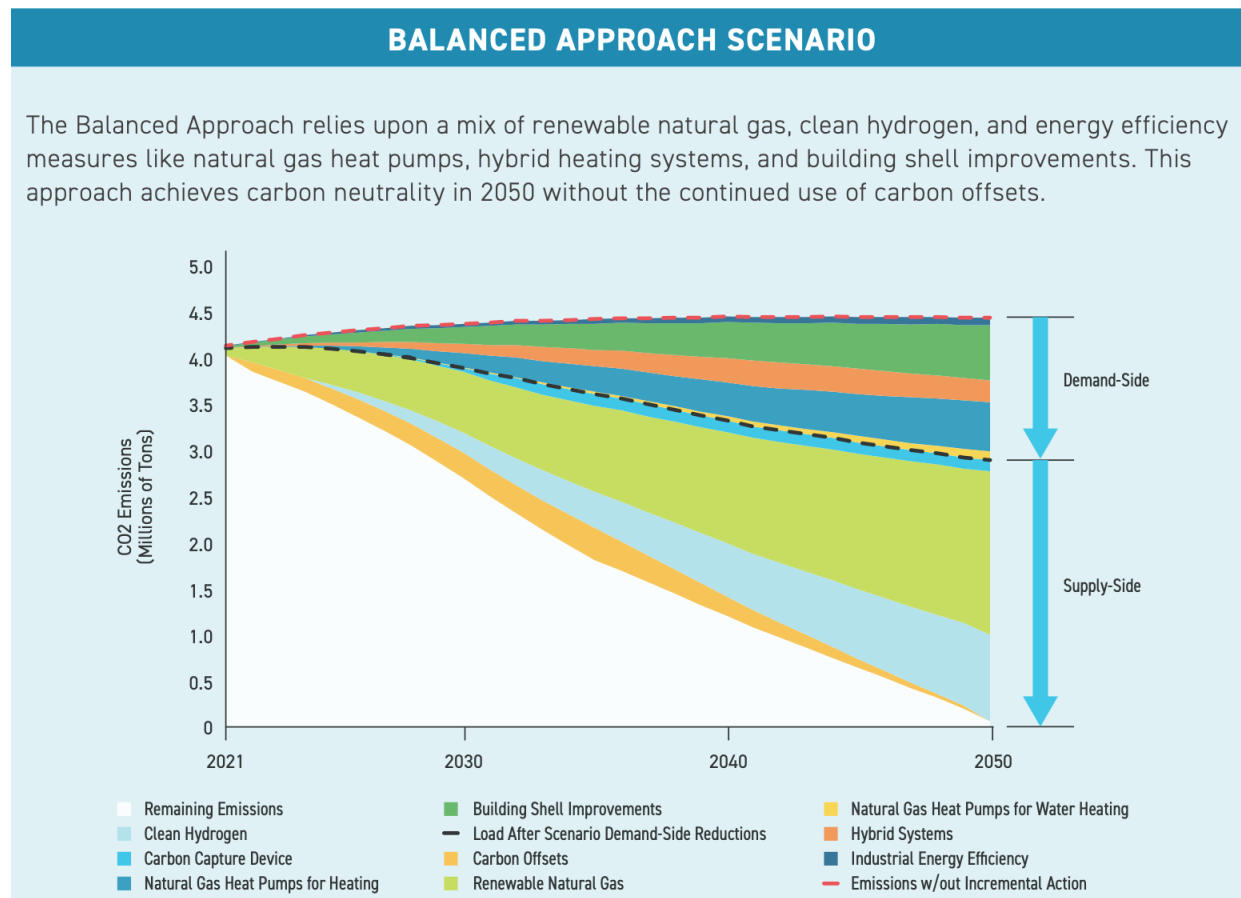
A consistent supply of renewable electricity and other renewable fuels will be critical to reach a goal of decarbonization of existing buildings by 2045. Eugene is fortunate that our electricity supply is already 90% generated by carbon-free resources (hydro, biomass, and wind). The recent Oregon Climate Protection Program rules will require our community's future emissions from fossil natural gas and other fossil fuels to be reduced by 90% between now and 2050.

### Natural Gas Supply

- In 2021 Oregon completed rulemaking for the Climate Protection Program (CPP) which will require natural gas utilities (including Northwest Natural) to reduce emissions by 90% by 2050 – through a combination of actions that reduce demand (with more efficient equipment) and increase supply of renewable substitutes that displace fossil gas. CPP reductions benefit everyone, but the specific interventions may or may not be deployed at an equal rate per capita throughout Oregon, so local benefits are difficult to assess accurately. In March 2022, Northwest Natural Gas joined other natural gas providers, businesses, and the Oregon Farm Bureau to challenge the authority of Oregon Department of Environmental Quality to regulate climate pollution under Oregon's Climate Protection Program.<sup>3</sup>
- Beyond the CPP, Northwest Natural Gas is exploring additional opportunities to exceed the requirements of the CPP and reach zero GHG emissions by 2050. Figure 4 summarizes the actions in *NWN Vision 2050 Destination Zero<sup>4</sup> - Balanced Approach Scenario* which include benefits from an ever increasing substitution of fossil methane supply with biomethane and renewable hydrogen (from electrolysis from renewable electricity), natural gas heat pumps for space and water heating, hybrid heating systems (electric heat pump added to minimize use of existing natural gas furnaces), industrial energy efficiency (beyond current ETO expectations), weatherization of building shells, certified carbon offsets (prior to the 2050 goal), and installation of carbon capture equipment.

<sup>3</sup> For details visit <https://www.nwnatural.com/about-us/the-company/march-2022-customer-letter>

<sup>4</sup> For details visit <https://www.nwnatural.com/about-us/the-company/destination-zero>

**Figure 4: Northwest Natural's Balanced Approach Scenario to reach zero by 2050**

## Electricity Supply

- EWEB's Board has committed to supporting a low-carbon electric power portfolio that maintains, on a planning basis, over 90% of annual energy from carbon-free resources<sup>5</sup> and targets over 95% of annual energy from carbon-free resources by 2030 to the extent possible and practical without distinct adverse impacts to customer-owners Figure 5<sup>6</sup>.
- EWEB's Board has directed the General Manager to participate in local, state, and regional efforts to encourage, develop and **enact measures to minimize and/or mitigate GHG emissions** that contribute to climate change. And to **assist customers with achieving their GHG emission reduction goals** through partnerships, technical assistance, resources, and programs that support, but are not limited to, energy efficiency, alternative fuels, electric and water conservation, electrification, and carbon offsets and sequestration.
- Oregon recently completed rulemaking on the Clean Energy Targets Bill (HB2021)<sup>7</sup> that requires Portland General Electric, PacifiCorp and Electricity Service Suppliers in Oregon to meet the

<sup>5</sup> For details visit <https://www.eweb.org/about-us/power-supply>.

<sup>6</sup> For details visit <https://www.eweb.org/about-us/power-supply>

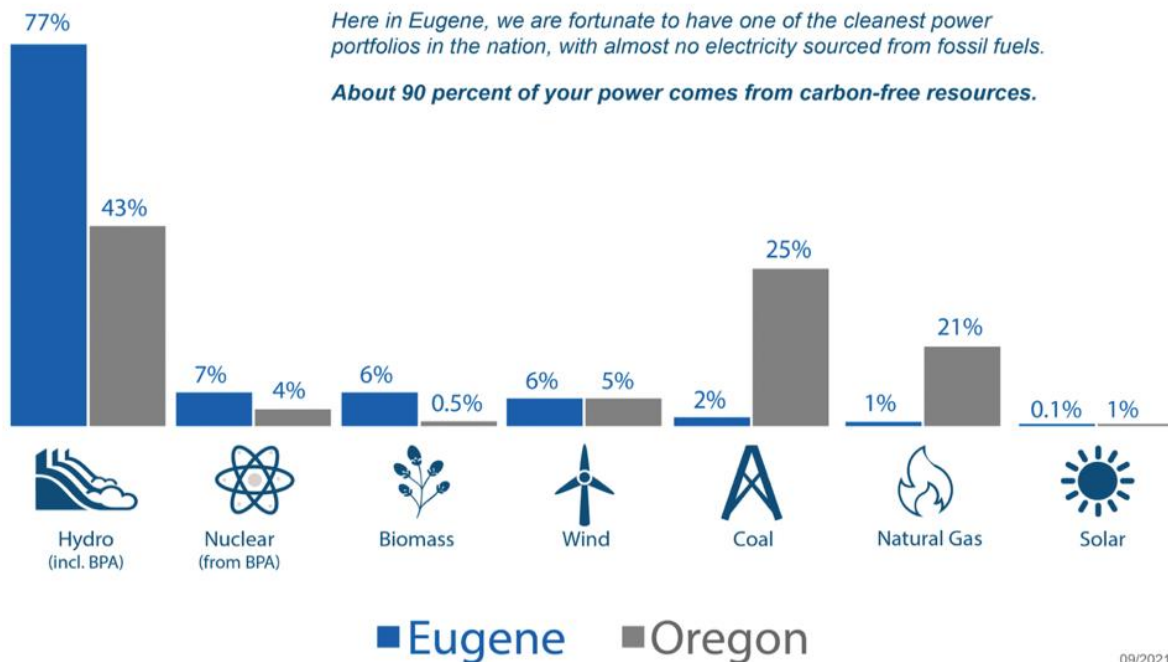
<sup>7</sup> For details visit <https://www.oregon.gov/deq/ghgp/Pages/Clean-Energy-Targets.aspx>



following targets. EWEB is not regulated under this legislation, but as of this writing, already meets the 2035 requirements with its existing owned generation resources and supply contracts.

- 80 percent below baseline emissions levels by 2030;
- 90 percent below baseline emissions levels by 2035; and
- 100 percent below baseline emissions levels by 2040

**Figure 5: EWEB--Where does your power come from graphic**





## Future Climate Benefit from Existing Policies

Figure 6 is a forecast of community emissions from the policies described in the previous sections through 2045 (Eugene's goals currently correspond to 2045, while the state's correspond to 2050). All other fossil fuels used in buildings by the community (fuel oil, propane, etc.) are also regulated by Oregon's CPP and reductions are assumed equal to CPP goals. Figure 6 illustrates that Oregon's existing policies – as aggressive as they are – alone will not result in 100% decarbonization by 2045.

**Figure 6: Eugene's forecast emissions from existing regulatory and voluntary policies**

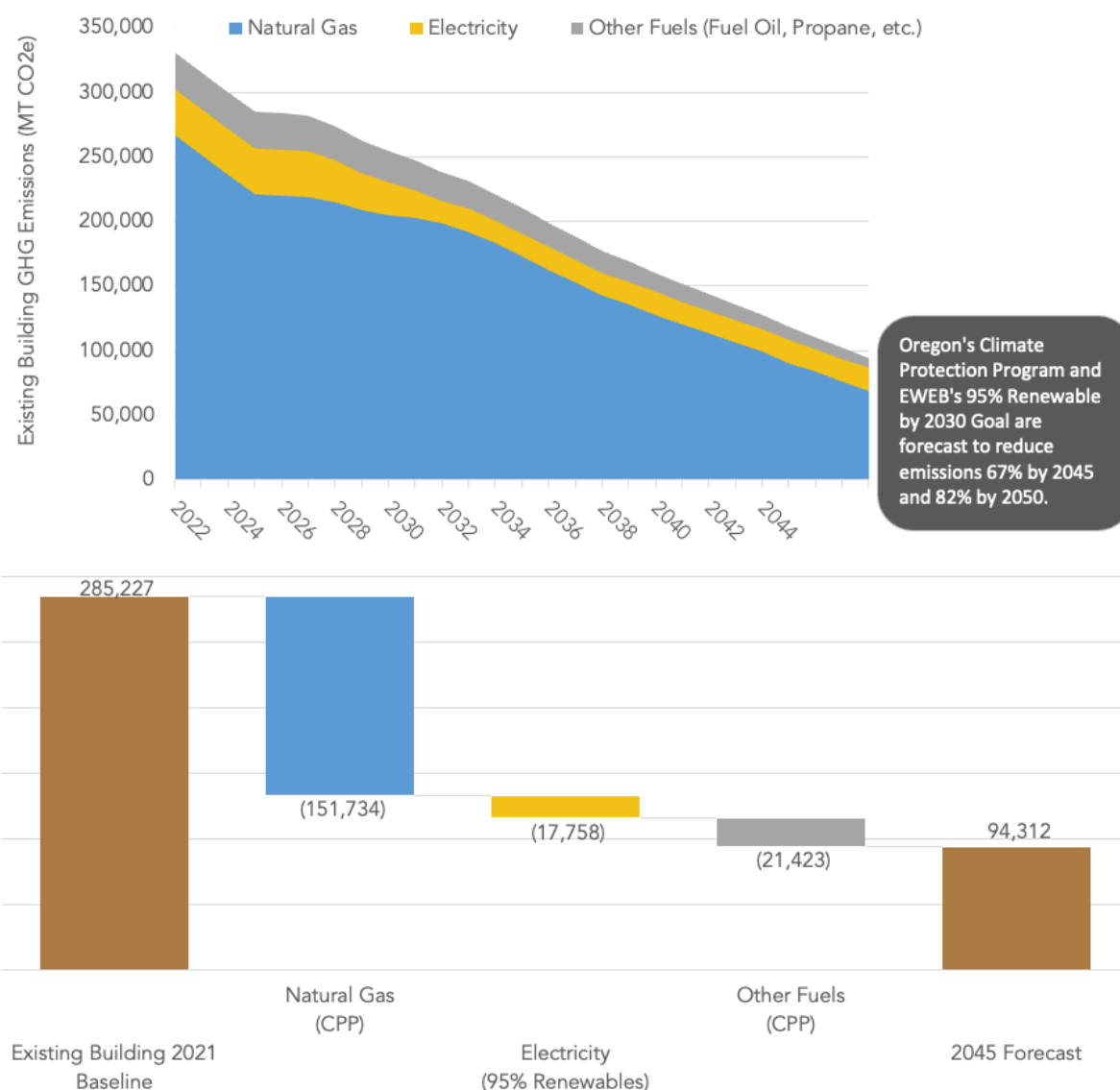
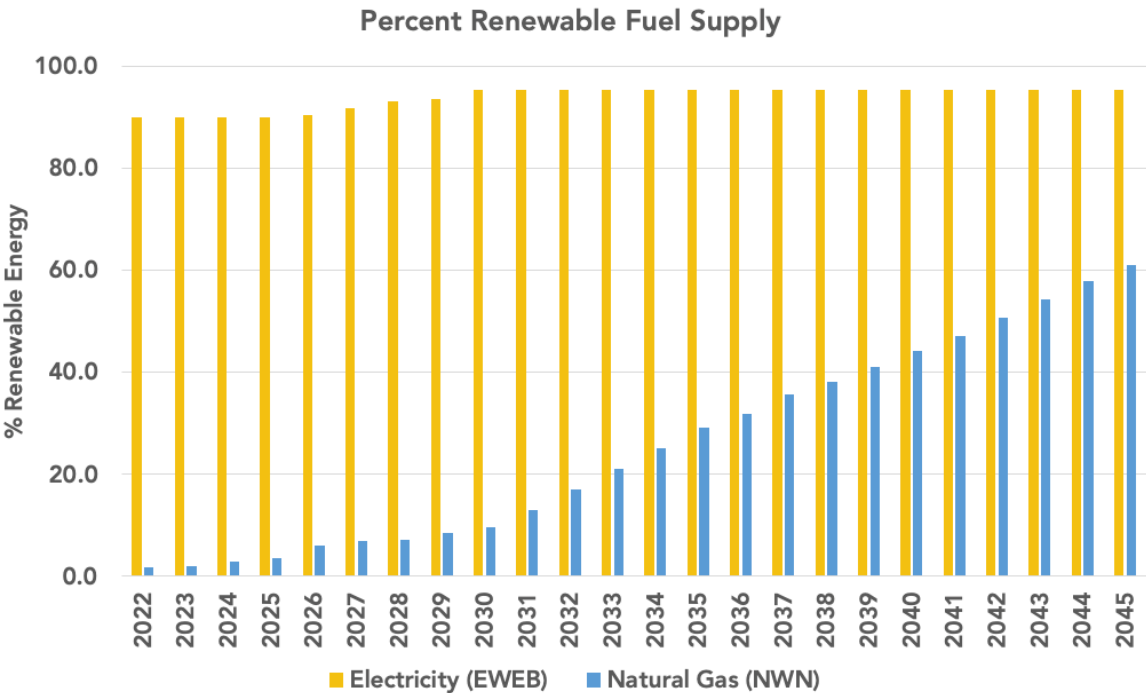


Figure 7: Comparison of renewables in EWEB electricity and Northwest Natural Gas forecasts and compares the percentage of renewables for local supplies of electricity and gas through 2045. Neither electricity nor gas reaches 100% renewables/low carbon during that time. Northwest Natural anticipates achieving 61% renewables by 2045 and 83% by 2050 (the shortfall is made up through purchased credits



from DEQ). EWEB reports 90% renewable and low carbon currently and has a voluntary goal of 95% by 2030. Note that while gas gets to 83% renewables by 2050, NWN has voluntary goals to reduce the rest of the GHGs from its products via a reduction in use from efficiency measures to get to 90% by 2050 and will continue sourcing low carbon gas and efficiency beyond 2050.

Figure 7: Comparison of renewables in EWEB electricity and Northwest Natural Gas



## Part 1: Residential-Sector Buildings

### Building Stock Characteristics

The figures on below give a summary of the existing housing stock as of 2019.

Figure 8 presents a summary of Eugene's housing stock by type from [American Community Survey](#). As of 2019, Eugene's total housing units equal to 76,076 total housing units with 59% single family; 38% multifamily; and 3% mobile homes. *Energy Trust of Oregon City Report: Eugene 2021*<sup>8</sup> shows that 51% of housing units are owned and 49% are rented.

**Figure 8: Eugene residential housing by type**

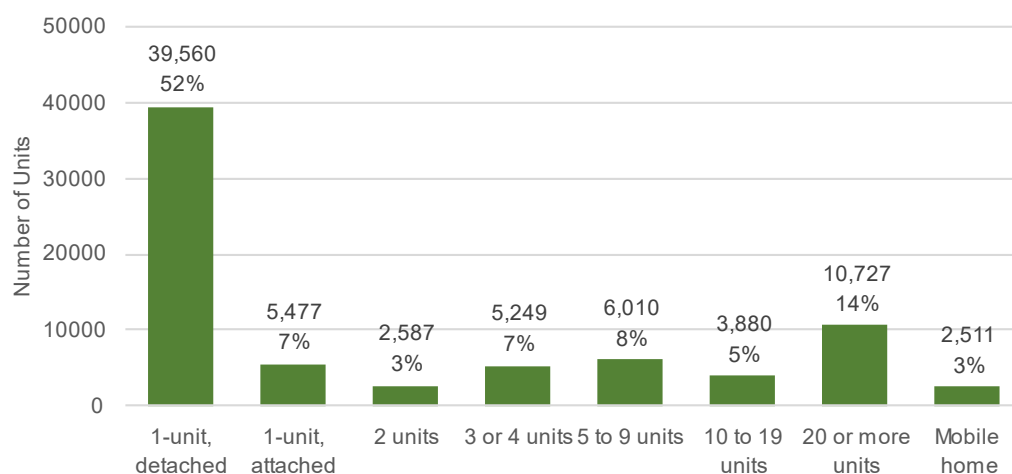


Figure 9 shows housing units by age. Roughly 65% of housing was built before 1990 which is the first year the model energy conservation standards for the residential sector were established.

**Figure 9: Eugene residential housing by construction year**

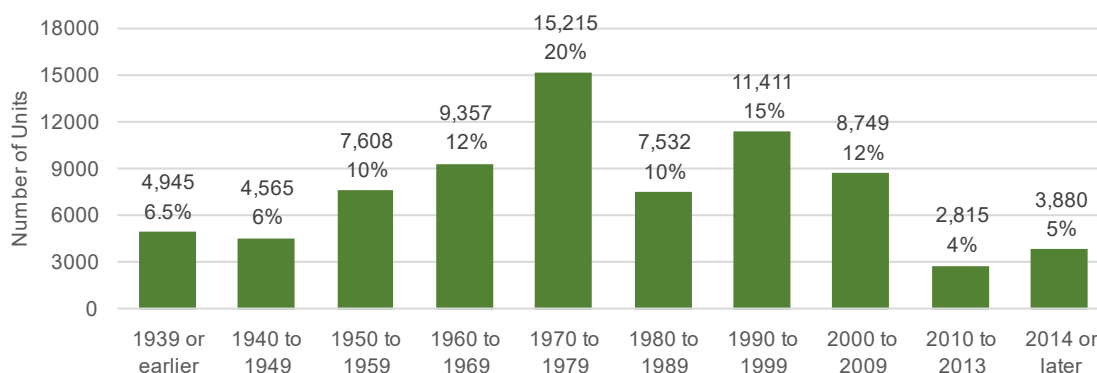


Figure 10 compares primary heating fuel in Eugene. Most houses use electricity, followed by natural gas, wood and other fuels. Energy Trust of Oregon reports that more than 73% of housing units in Eugene use

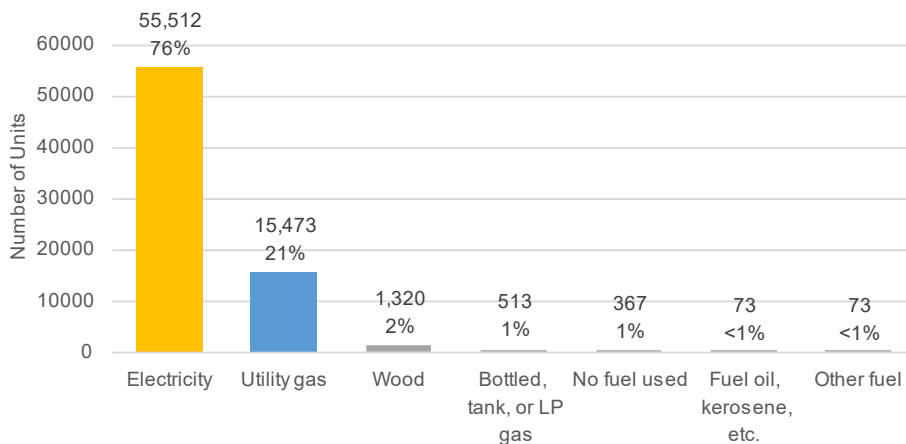
<sup>8</sup> Report is not available online. ETO provided the report to City staff upon request.





electricity as the primary heating fuel (compared to 51% Oregon-wide); while natural gas makes up about 22% (38% Oregon-wide); wood represents 3%; and other fuels (propane) total 1%. Totals do not sum to 100% due to rounding up of the percentages.

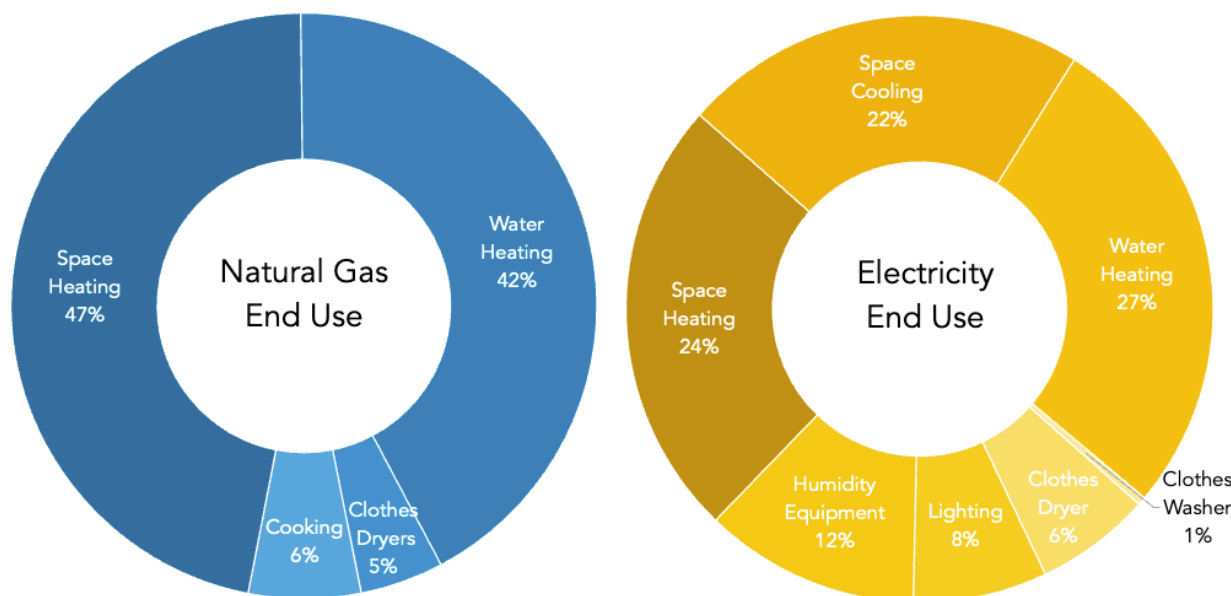
**Figure 10: Eugene residential housing by primary heating fuel**



## Common Energy Uses

Figure 11 (blue, left) compares the various end uses of natural gas at residential properties. The dominant uses are space and water heating. Water heating plays a larger role in residential energy use for homes with pools and hot tubs, but it is unclear from available data how many homes in Eugene include these amenities. Cooking and clothes drying play a relatively smaller role but represent a larger fraction of the total for homes without pools. Figure 11 (gold, right) shows the wide variety of electricity end uses across households. As with natural gas the largest end uses are for space heating and cooling and water heating. Other uses include lighting, clothes dryers, and fans.<sup>9</sup> Cooking is not captured in this data.

**Figure 11: Natural gas and electricity end uses**



## Greenhouse Gas Emissions

Emissions by energy type and housing categories are estimated using data from [Eugene's Community GHG Inventory](#), [American Community Survey](#), and the [Energy Information Administration's Residential Energy Consumption Survey](#).

Housing categories considered include:

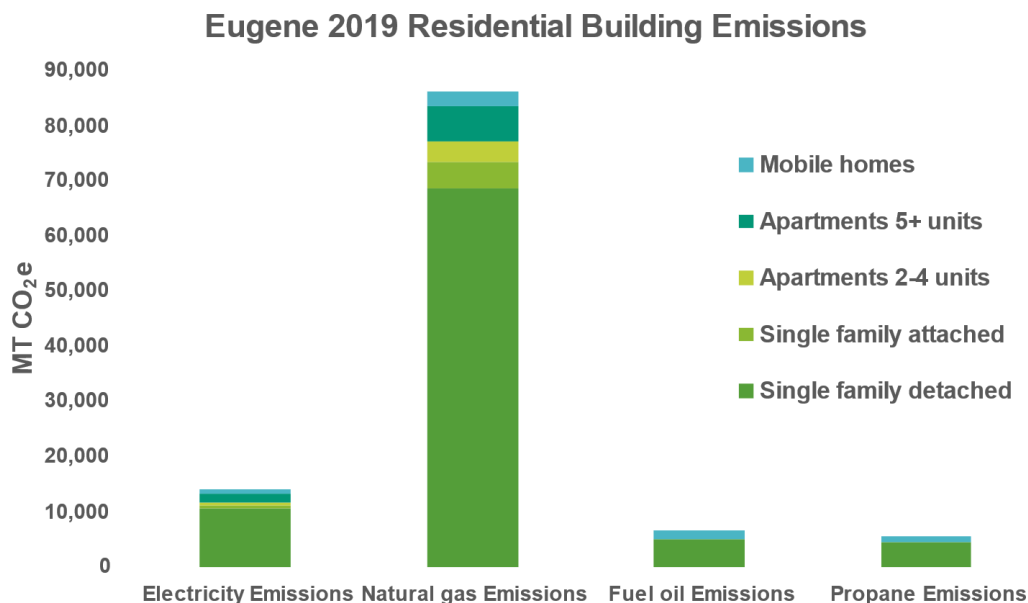
- Single family – detached and attached
- Multifamily – 2-4 units and 5+ units
- Mobile homes

<sup>9</sup> From U.S. Energy Information Administration's Residential Energy Consumption Survey for the Northwest <https://www.eia.gov/consumption/residential/>



Figure 12 shows that residential emissions in the Eugene community are overwhelmingly from single family (detached) homes and more specifically, fossil natural gas consumption.

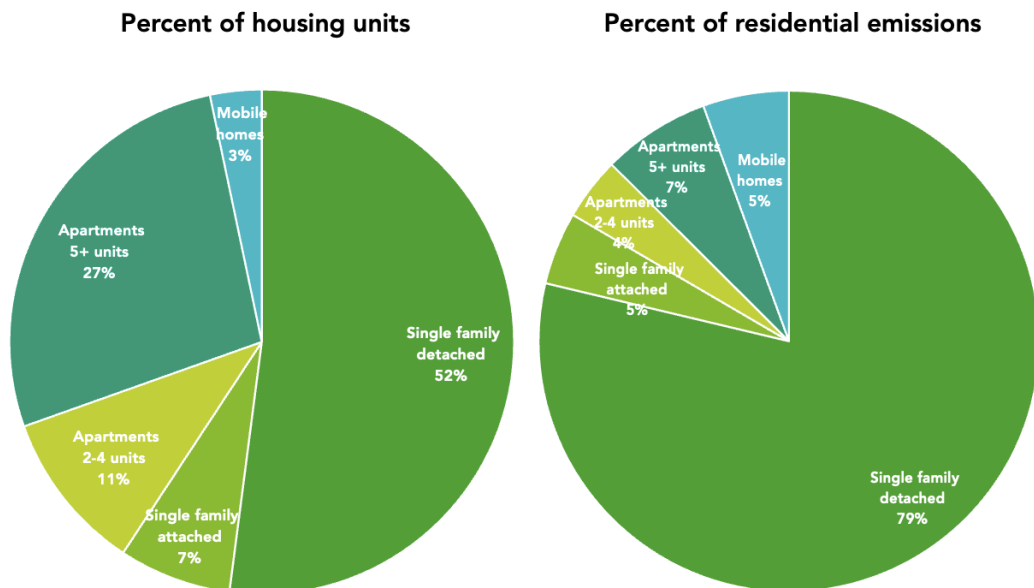
**Figure 12: Eugene's 2019 residential GHG emissions by energy type and housing category**



This is being driven by the fact that single family homes (attached + detached) represent almost 60% housing units in Eugene (Figure 13) and have larger square footages per unit than other housing types and therefore require more fuels and energy to heat and cool the larger spaces.

Figure 14 compares the end-uses driving the energy use and related emissions. Like the prior graphics,

**Figure 13: Comparison of housing units by category to GHG emissions by category**



this shows that single family homes are the largest sources of emissions and specifically space conditioning (heating / cooling), water heating and cooking end uses represent the largest sources of

emissions. It's important to note that for homes with pools – natural gas use increases on average by 25% with hot tubs adding another 8%.

**Figure 14: Comparison of housing units by category to GHG emissions by category**

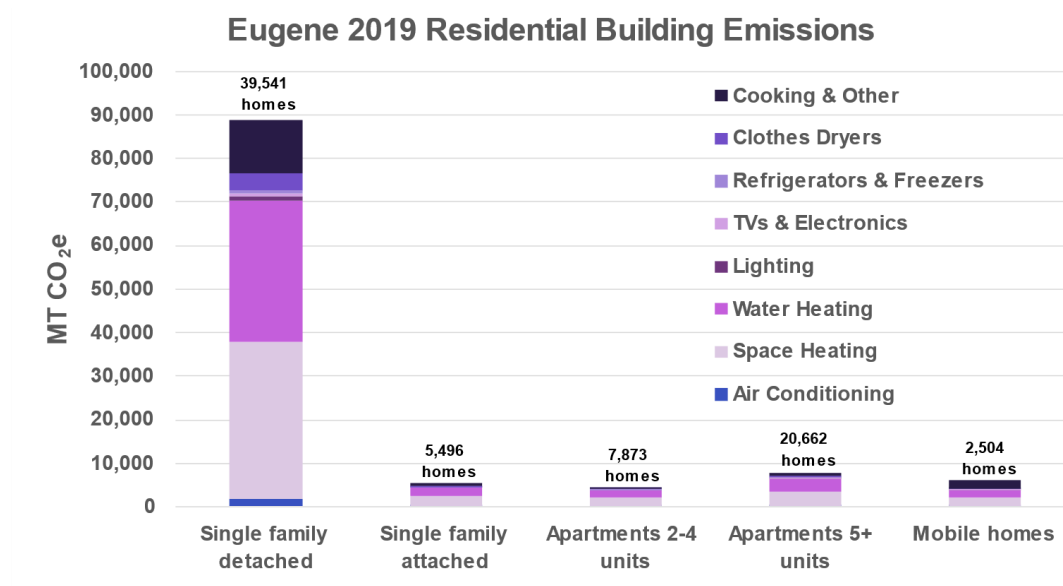


Figure 15 compares average 2019 emissions per type of housing unit. From previous results – it is unsurprising that single family homes represent large average emissions per home. What is more surprising is average emissions per unit for mobile homes. Unfortunately for the residents – mobile homes consume significantly more energy per square foot than other types of housing due to under-insulated envelopes.

**Figure 15: Comparison of building energy GHG emissions in 2019 per housing unit (dark green) with GHG emissions per 1,000 square feet (light green), by housing category**

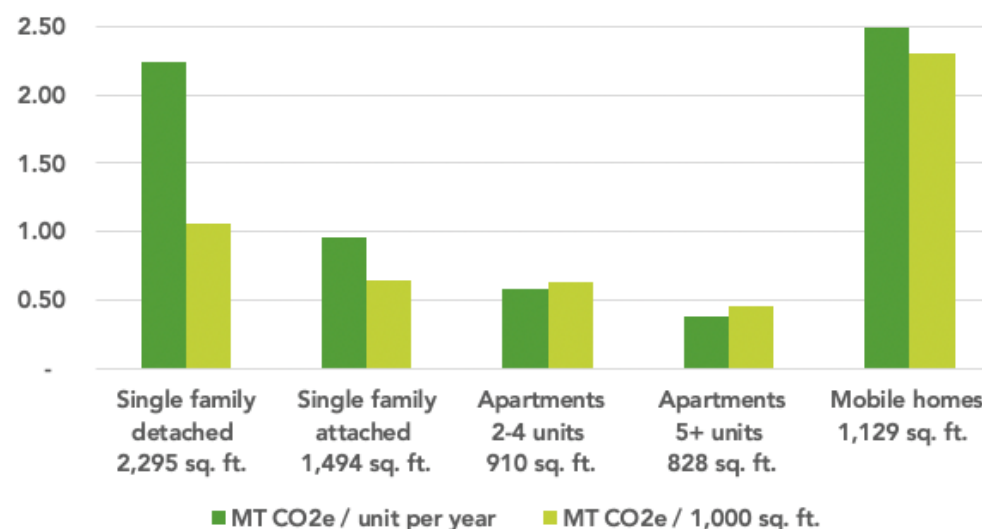
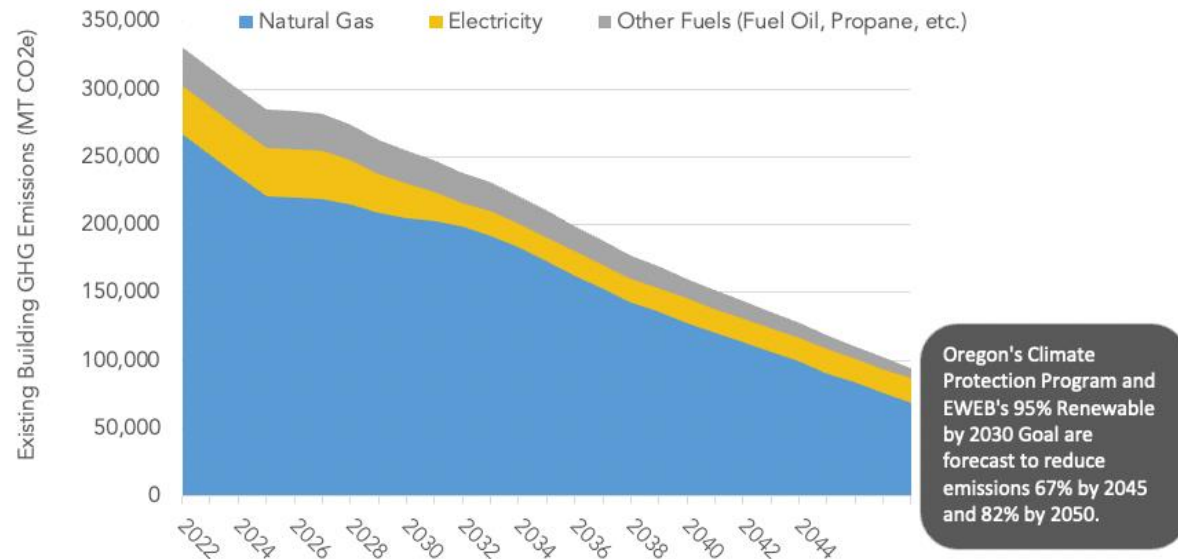


Figure 16 presents Eugene's forecast emissions for residential buildings within the urban growth boundary. Compared to other sectors (commercial, industrial, and transportation) residential emissions are projected to decline at a faster rate, driven by load reductions for natural gas. By 2045 residential emissions for all fuel types are anticipated to be reduced to about 30,000 MT CO<sub>2</sub>e in 2045 compared to

roughly 100,000 MT CO<sub>2</sub>e. Emissions by 2050 are forecast be about 15,000 MT CO<sub>2</sub>e because of continued Climate Protection Program compliance by Northwest Natural and other fuel distributors.

**Figure 16: Eugene UGB residential forecast emissions reductions from existing policies.**



## Technical Best Practices & Strategies

This section of the report reviews the best technical practices, including:

- Energy Efficiency
- Electrification (including dual-fuel systems)
- Renewable energy supplies

These three “pillars” of decarbonization for the residential sector are often combined and discussed within a combined approach towards the ideal of “Net-Zero Buildings” which have all cost-effective energy efficiency upgrades implemented; electrify all systems possible; and use renewable energy and fuel supplies for remaining needs which is ideally generated and stored onsite with solar photovoltaic panels and batteries. “Clean Heat Retrofit Programs” are also commonly discussed as a combination of efficiency upgrades and appliance electrification with other comfort and safety upgrades.

### Energy Efficiency & Conservation

Energy efficiency and conservation include a wide-ranging suite of equipment upgrades and behavior changes that reduce the amount of energy required to do a given quantity of work. Efficiency opportunities are often referred to as “measures” and can include individual technology upgrades or bundles of similar measures. These measures are focused on the largest energy uses and opportunities where a technological upgrade returns “cost effective” energy savings that at a minimum pays back the initial investment. ***The greatest return on energy efficiency investments almost always comes at the end of equipment life and moment of “natural replacement”.***



## Natural Gas

For natural gas, cost-effective energy efficiency measures for existing homes include:

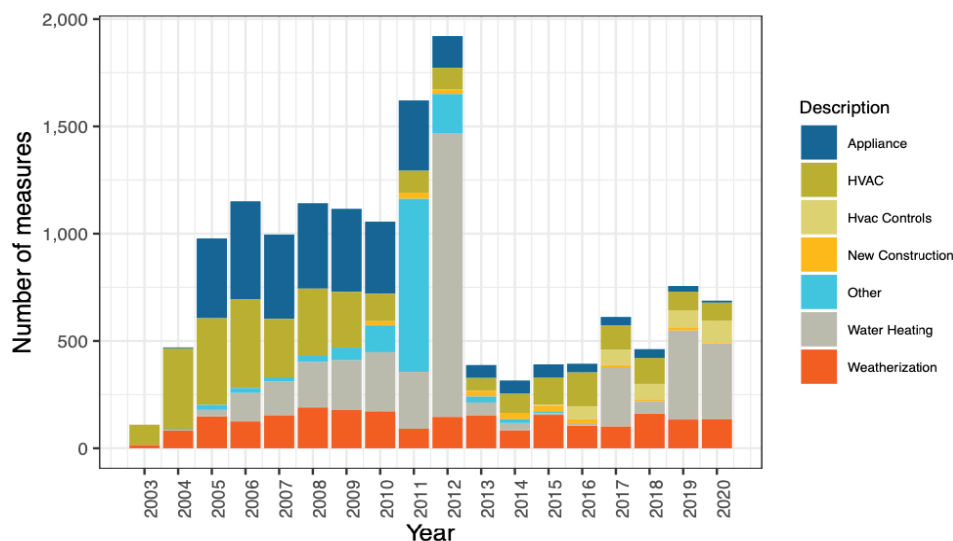
- Water heating upgrades, including heat pumps
- Space heating upgrades, including heat pumps
- Space heating controls (such as programmable and smart thermostats)
- Weatherization of building envelopes

Historic energy efficiency installations in Eugene by Northwest Natural Gas through Energy Trust of Oregon (ETO) programs are shown in Figure 17. Installation over the past 5 years have focused on the measures listed above with a recent focus on water heating. *ETO data also shows that 32% of residential units in Eugene have already benefited from ETO programs as of 2020* (8,142 participants out of 25,651 total). Energy Trust of Oregon offers a variety of financial incentives and other resources for natural gas appliances and weatherization at their website <https://www.energytrust.org/residential/>.

### Emerging Technology: Natural-Gas Heat Pump

Northwest Natural Gas states in their Vision 2050 - Destination Zero report that:

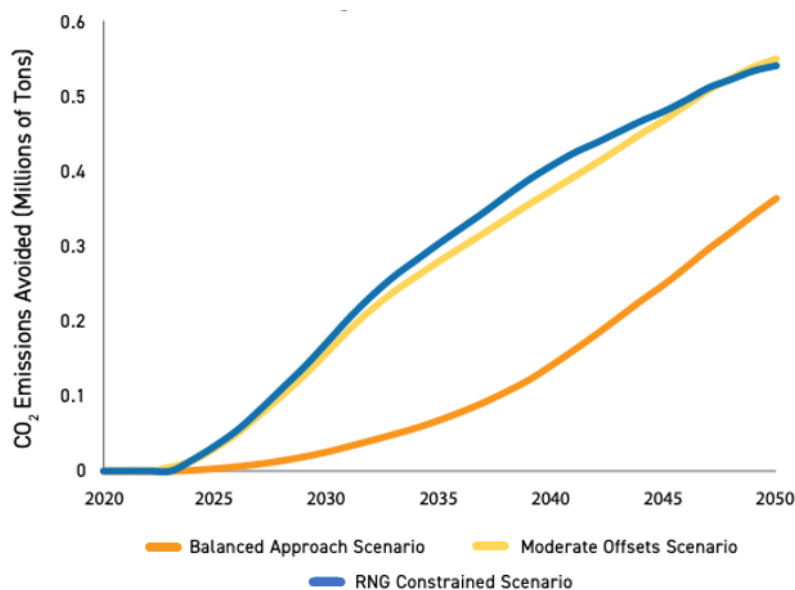
**Figure 17: Residential natural gas measures installed as reported by ETO**



*“Natural gas heat pumps offer the single greatest opportunity to reduce natural gas consumption while maintaining equipment performance in cold weather. A 2019 American Gas Foundation report prepared by Enovation Partners indicates that these new technologies have the potential to reduce energy use by 40% or more (replacing a split heating / cooling system), while maintaining a consistent level of service.”*

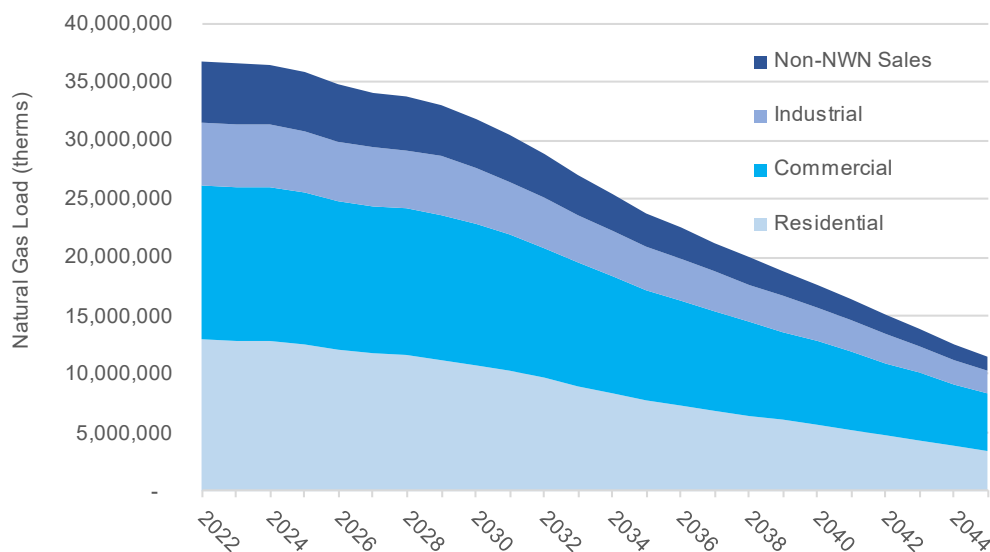
The U.S. Department of Energy reports that this technology is mainly used in industrial and commercial setting, but also are available for large residential homes (>4,000 square feet).<sup>10</sup> It should be noted, however, that the use of natural gas heat pumps for cooling would increase consumer’s use of natural gas in the summer relative to conventional electric air conditioners or heat pumps. Figure 18 offers NWN’s forecast of emissions reductions and timing within their service territory.

<sup>10</sup> For details visit <https://www.energy.gov/energysaver/absorption-heat-pumps>

**Figure 18: Forecast GHG reductions and timing for gas heat pumps. Source: NWN Vision 2050**

### *Demand Side Forecast*

Northwest Natural Gas provided a high-level forecast of load by sector for this report. Figure 19 shows the results for the sector within the City of Eugene’s geographic boundary. Residential and non-NWN gas distributed through NWN pipes sectors provide the greatest reductions in load by 2045, 73% and 76% respectively. The commercial and industrial sectors are anticipated to both be reduced by 63% between now and 2045. Overall gas load is anticipated to be reduced by 69% across all sectors by 2045.

**Figure 19: NWN forecast of Eugene residential fossil gas consumption through 2045, by sector**

### **Electricity**

For electricity, “cost-effective” energy efficiency (EE) measures for existing homes include:

- Water heating and use upgrades, including heat pumps



**Figure 20: Cost effective residential electricity efficiency measures from Northwest Power Plan, values represent the potential average mega-watt reductions available in the northwest region**

Cost-Effective EE Potential (aMW)				
End-Use Bundle	2027	2032	2041	Description
Clothes Washers	22	60	135	ENERGY STAR and CEE rated clothes washers
Lighting	13	41	88	LED screw-in and pin-based lamps and integral fixtures
Water Saving Devices	25	56	83	Showerheads, aerators, thermostatic restriction valves
Electronics	11	37	55	ENERGY STAR laptop computers and Efficient TVs
Dryer	8	22	42	ENERGY STAR dryer
Weatherization*	9.3	26	34	Insulation, duct sealing
Refrigeration	4.8	13	31	Certain ENERGY STAR refrigerator/freezers and chest freezers
Smart Thermostats	6.2	14	17	Thermostats installed in heat pump homes that have lockout temperature settings and occupancy controls
HVAC Equipment	0.6	3.1	11	Air source heat pump upgrades in manufactured homes and single family high efficiency air conditioners
Circulator Controls	0.2	1.2	4.7	Controls for domestic hot water circulator pumps
Food Preparation	0.1	0.5	2.3	High efficiency ovens

- LED lighting
- Space heating and cooling (if it is already present) upgrades, including heat pumps
- Space heating controls (such as programmable and smart thermostats)
- Weatherization of building envelope

The recently released, 2021 Northwest Power Plan includes a detailed list of cost-effective electric equipment and appliance upgrades opportunities. Figure 20 shows specific types of equipment upgrades found to be most cost effective (equal to or provides savings over the equipment lifecycle – as compared to first costs for equipment and installation).

Significantly more achievable potential was identified by the Northwest Power Plan, particularly for HVAC systems, but at a greater cost per unit (>\$40 / average megawatt (aMW)). These measures include:

- Ductless heat pumps
- Weatherization
- Clothes dryers

For more details on the scale of residential efficiency measures by cost visit [https://www.nwcouncil.org/2021powerplan\\_residential-technical-achievable-efficiency/](https://www.nwcouncil.org/2021powerplan_residential-technical-achievable-efficiency/).

The U.S. Dept. of Energy's National Renewable Energy Lab (NREL) recently released a state-level study evaluating efficiency opportunities for electricity<sup>11</sup>. Results for Oregon are shown in Figure 21. A notable difference between these findings and NWPP is that NREL's study found many opportunities for various weatherization measures and heating system upgrades. While these findings are different in prioritization

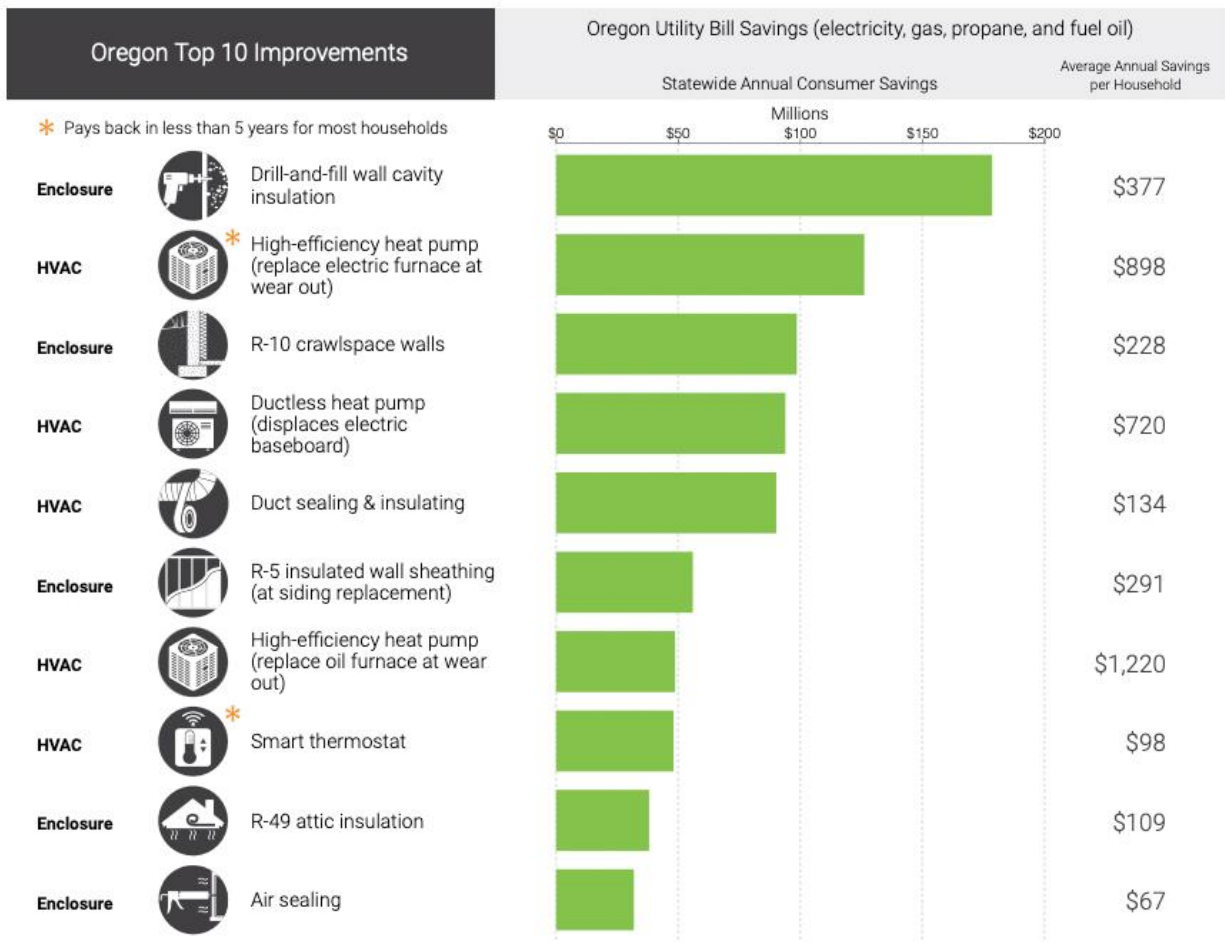
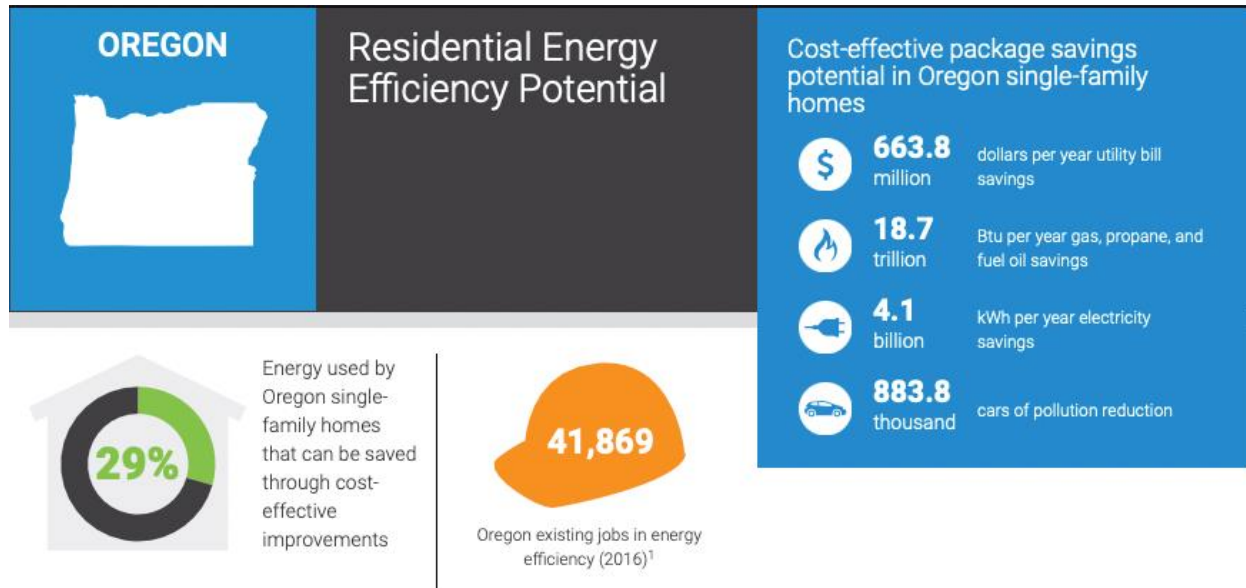
<sup>11</sup> For details visit <https://www.nrel.gov/docs/fy18osti/68670.pdf>





from NWPP – it's important to note that NWPP also found significant opportunity for the same types of measures but used different means to test cost-effectiveness.

**Figure 21: Oregon's top 10 energy efficiency measures from National Renewable Energy Laboratory assuming a cost of \$40/average megawatt hour.**



Source Document: <https://www.nrel.gov/docs/fy18osti/68832.pdf>



### Supporting Action: Home Energy Score Program

A Home Energy Score (HES) is a value given to a home by a contracted inspector that estimates the energy-related use, associated costs, and cost-effective solutions to improve the home's efficiency. HES are used during a home's sales process to provide important cost and comfort information to all parties. **The adoption of a HES program has the potential to provide a market-based incentive for homeowners to invest in energy efficiency improvements.** Oregon Department of Energy provides technical support and community resources for local governments interested in a community-wide program (like Portland's) or for homeowners interested in getting their home scored.<sup>12</sup> HES audits had a cost of \$150-200 in Portland (2019).

Beyond Portland there are other examples of cities and states requiring some form of energy or efficiency disclosure at the time of sale.<sup>13</sup> See Figure 22 and the following bullets for examples.

**Figure 22: Summary of other jurisdictions that require energy disclosures at the time of sale.**

	Energy/ Utility Costs	Energy Efficient Characteristics	Home Energy Score	Energy Audit	Educational Information
Chicago, IL	✓				
Minneapolis, MN	✓	✓			
Kansas		✓			
South Dakota		✓			
Portland, OR			✓		
Berkeley, CA			✓	✓	
Montgomery County, MD	✓				✓
Alaska	✓				
Hawaii	✓				
Massachusetts					✓
Austin, TX				✓	
San Francisco, CA				✓	

- **Austin, TX – Energy Conservation Audit and Disclosure Ordinance** - The ordinance requires energy audits and disclosures for all homes and buildings at the time of sale which are served by Austin Energy and located within Austin city limits.
- **Berkeley, CA Energy Saving Ordinance (BESO)** - BESO requires exiting building owners to complete and publicly report comprehensive energy assessments to uncover energy saving opportunities at the time of sale. The assessments are conducted by registered energy assessors who provide tailored recommendations on how to save energy and link building owners to incentive programs for energy efficiency upgrades.

<sup>12</sup> For details visit <https://www.oregon.gov/energy/save-energy/pages/heps.aspx>

<sup>13</sup> From the Midwest Energy Efficiency Alliance [https://www.mwalliance.org/sites/default/files/meea-research/energy-disclosure-fact\\_sheet.pdf](https://www.mwalliance.org/sites/default/files/meea-research/energy-disclosure-fact_sheet.pdf)



- **Boulder, CO – SmartRegs for Rental Housing** - Requires all licensed rental housing in the City of Boulder to meet a basic energy efficiency standard. Approval depends on the results of required inspections that determine whether a property complies with standards for health/safety, mechanical systems, and energy efficiency. SmartRegs is the energy efficiency component of the inspection and approval process.
- **Chicago, IL Energy Cost Disclosure** - In July 2013, the City of Chicago became the first municipality in the country to disclose residential energy costs (gas and electric) when a home was listed for sale via a multiple listing service (MLS).
- **Minneapolis, MN - Truth in Sale of Housing** - In 2020, Minneapolis added energy efficiency to its disclosure requirements. This requirement applies to all 1-2 unit properties, townhomes, and first-time condo conversions.<sup>14</sup>

## Renewable Energy

While adopting efficiency equipment and practicing conservation offer a tremendous opportunity to improve comfort, reduce costs, and offset future load from community growth and electrification – energy efficiency alone cannot decarbonize existing buildings by 2045. Developing renewable energy and fuel sources will be essential to achieving a goal of 100% decarbonization of existing buildings by 2045 is critical.

## Electricity

### *Utility Supplied*

EWEB currently delivers at least 90% renewable electricity and has an internal goal to reach 95% renewable generation by 2030 delivered to Eugene. EWEB plans to release a new Integrated Resource Plan in December of 2022 that will offer details and an assessment of various options for our community to further decarbonize. Based on what is known as of this writing – EWEB will need to acquire another 5-10% of low-carbon supply to allow for 100% decarbonization of existing buildings in Eugene by 2045. EWEB may also choose to pursue more aggressive and higher cost energy efficiency measures for existing buildings to further reduce electrical demand and allow for existing supply contracts to cover our community's demands with existing renewables.

### *Distributed Power (solar + battery storage)*

EWEB's upcoming integrated resource plan (IRP) may provide insight on their view of the future role, scale, and location of distributed energy generation (solar PV) and storage in Eugene. EWEB's owned resources and contracted power are already generated with low carbon resources. Local generation and storage would also increase community energy resilience in the event of a major event (like earthquake, extreme weather, or fire). Northwest Power Plan found costs for a typical unattached single family home for a 5.6 kWh solar PV system at roughly \$16,000 and \$28,000 with li-ion battery back up.<sup>15</sup>

<sup>14</sup> TISH energy efficiency guide <https://www.minneapolismn.gov/resident-services/property-housing/buying-selling/tish/energy-disclosure-report/>

<sup>15</sup> For details visit [https://www.nwcouncil.org/2021powerplan\\_behind-meter-solar-battery/](https://www.nwcouncil.org/2021powerplan_behind-meter-solar-battery/).



## Natural Gas

Renewable natural gas is already being produced within Eugene at MWMC's wastewater treatment plant and Short Mountain Landfill used for vehicle fuel production and electricity generation. Renewable natural gas and renewable hydrogen have a carbon footprint that is significantly lower than fossil natural gas.<sup>16</sup> As previously mentioned, Northwest Natural is regulated under Oregon's Climate Protection Program. To achieve compliance NWN will support efforts to reduce use of conventional natural gas, while providing ever more renewable gas supply. NWN will be releasing their latest IRP in August, 2022 and may show more than what is shared in this report.

## Wood

For this study – wood is assumed to be a carbon neutral fuel, which is aligned with the approach used in Oregon's Climate Protection Program and greenhouse gas protocols. That said – considerable effort has been taken in Oregon to convert heating away from wood to reduce sources of criteria air pollutants, like particulate matter. Criteria air pollutants do not include greenhouse gases – so wood represents a conundrum and a challenging trade off. During power outages, or after a major earthquake, this may be our only source of heat as nearly all linear infrastructure – roads, bridges, water and gas pipelines and power corridors will be broken in so many pieces that they will be inoperable for nearly a year.

## Other Fuels

Renewable propane or renewable diesel provide a non-fossil option for households that use these fuels for home heating. Other fuels have greater impacts than natural gas and should be considered first for substitution with a heat pump. These two fuels are widely available in Oregon as of late 2022.

## Electrification

Many communities around the U.S. are turning to electrification of new and existing residential buildings to reduce climate impacts. This action is supported by research from a wide-variety of groups including State<sup>17</sup> and Local Governments<sup>18</sup>, American Council for an Energy Efficiency Economy, and the Sierra Club<sup>19</sup>. This is particularly true for new residential construction as electrification costs for a new building versus retrofit are in favor of electrification. The economics of retrofitting older homes is different as there may be electric system upgrades needed as well as additional weatherization depending on the homes' age and features.

There are various heat pump technologies that increase the efficiency of space conditioning:

- Standard Heat Pump: Lower cost, but may not perform on the coldest days of the year.

<sup>16</sup> The carbon footprint of fuels can vary dramatically depending on the energy feedstock and processing.

<sup>17</sup> Maryland Building Energy Transition Plan. Online at <https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Documents/2021%20Annual%20Report%20Appendices%20FINAL.pdf>

<sup>18</sup> Energize Denver Taskforce Recommendations. Online at <https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directories/Climate-Action-Sustainability-Resiliency/News-Events/News/2021/Energize-Denver-Task-Force-Recommendations>

<sup>19</sup> Building Electrification Action Plan. Online at <https://www.sierraclub.org/sites/www.sierraclub.org/files/Building%20Electrification%20Action%20Plan%20for%20Climate%20Leaders.pdf>



- Cold Weather Heat Pump: Higher cost, but greater performance at lower temperatures.
- Dual-Fuel Heat Pump: Standard electric heat pump with second fuel as back up for the coldest days of the year.
- Natural Gas Heat Pump: Heat pump that operates on natural gas for both heating and cooling needs. This technology – which is a good fit for industrial/commercial loads - is still emerging for general residential use, but may be suitable for homes >4,000 sqft.

These systems may be ducted or ductless. Costs for ductless systems are typically less than a ducted system as there is less system complexity and components.

EWEB recently completed an electrification study that considers the costs and benefits of ducted electrification of homes space and water heating systems for existing single family and multi-family homes.<sup>20</sup> See Figure 23 for a summary of findings. The report found that the greatest electrification benefits - across all stakeholders (EWEB participants, EWEB ratepayers, and Society) – are broadly from heat-pump water heaters and for single-family homes, heat pumps (electric heat pump with a backup fuel like natural gas or wood). Use of standard and cold weather heat pumps was found to be unlikely without additional financial incentives or mandates as electrifying will likely result in a net-cost increase for homeowners if pursued completely before 2030. Other findings include:











































- A combination of ample, clean energy resources and a strong legacy of energy efficiency programs puts EWEB in a strong position to support electrification.
- While EWEB has near-term capacity to handle additional load from electrification, under the highest forecasted electrification rates, EWEB might have to purchase additional power resources or build additional infrastructure to meet electricity needs.
- Without significant policy incentives, upgrading gas space heating systems to electric has a net cost to the customer over the equipment lifetime, making it less likely that customers will retrofit existing buildings. However, all the heat pump technologies studied provide significant carbon reduction benefits, and some customers may feel that the climate benefits outweigh the costs.

<sup>20</sup> For details download the report at <https://www.eweb.org/about-us/power-supply/electrification>

- Even with additional incentives, space heat electrification from current gas systems for existing multi-family dwellings and small offices is likely to remain financially prohibitive as lifecycle energy cost savings are not anticipated to payback over the equipment lifespan.

### Existing Climate Policies, Electrification, and Timescale Urgency

**Figure 23: Summary graphic from EWEB's Electrification Study. Deep green colors indicate greater benefits, while red colors indicate lower benefit or cost.**

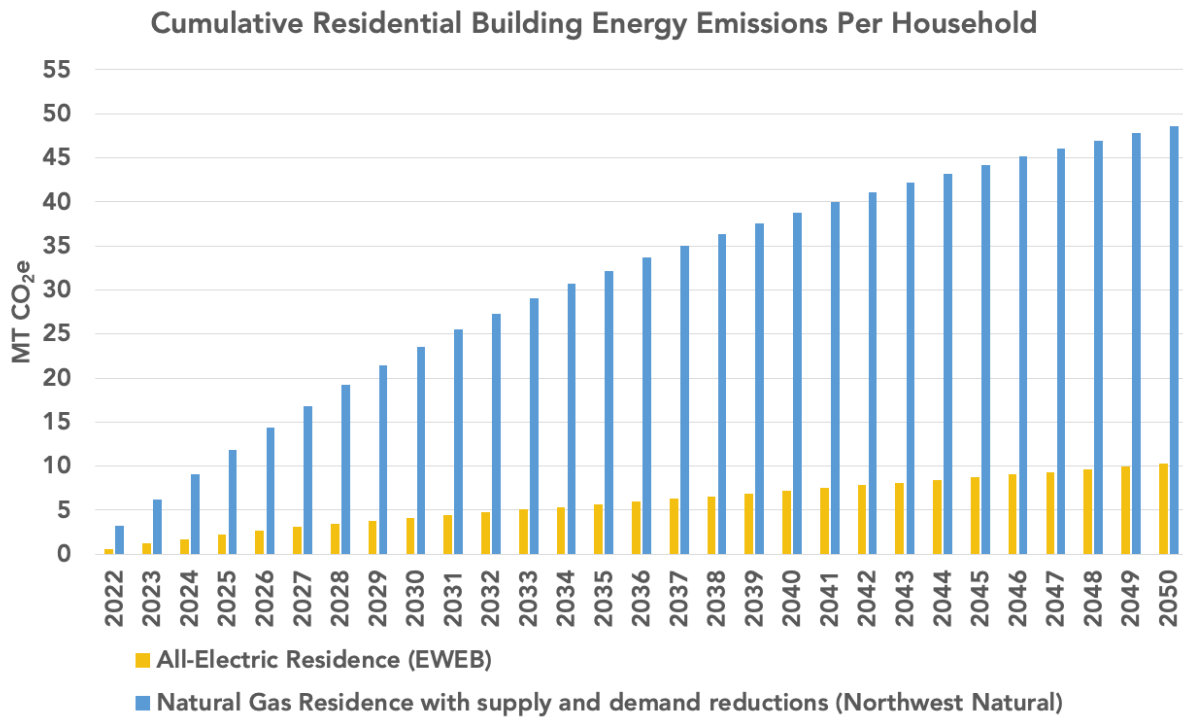
Electrification Scorecard	Carbon Reduced	Aggressive Carbon Reduction 2030			1-in-10 Peak Adder	Peak Management Potential	EWEB Engagement Opportunities
		EWEB Participant	EWEB Ratepayer	Society			
Electric Vehicle							Encourage managed charging to avoid peak, increase public and workplace charging opportunities
Heat Pump Water Heater							Consider existing energy efficiency incentive program's influence on electrification of water heating
SFD - Standard Heat Pump							Influence customer space heating technology choices to mitigate peak impacts.
SFD - Cold Climate Heat Pump							Influence customer space heating technology choices to mitigate peak impacts.
SFD - Dual Fuel Heat Pump							Influence customer space heating technology choices to mitigate peak impacts.
Multi-Family Dwelling Space Heat							Participant benefits are lacking, making electrification unlikely. Possible incentive opportunity.
Small Office Space Heat							Participant benefits are lacking, making electrification unlikely. Consider rate design changes for commercial electrification.

The approach to this report is fuel neutral. Both of Eugene's local utilities have regulatory compliance requirements or voluntary commitments that will reduce the climate impact of their products between now and 2030 on the way to fewer emissions in 2050. It is not the intent of this study to give preference to one energy form over another – given that both suppliers are committed to sustained and significant GHG reductions. That said, the fastest route to reduced emissions is the safest route for the reduction of physical impacts from climate change. This must also be balanced with a transition that does not inadvertently harm many in the transition – whether that be individuals or groups of people that have been historically underserved, or the largest companies that keep an important number of families employed and taken care of.

The speed of a transition must be considered when considering residential decarbonization alongside other important factors. Eugene's electricity is already very low carbon (90% low carbon/renewable) and electrification equipment is already readily available. Heating equipment – the largest use of energy in the residential sector, has a lifespan of 15-20 years. Over the next 20 years significant cumulative emissions can be saved if electrification of homes is pursued instead of waiting for the Climate Protection Program requirements to achieve reductions in household gas use.

Figure 24 provides an example comparison of cumulative emissions for an average Eugene household served by electricity only versus a gas residence. A household electrified tomorrow would result in a savings of more than 40 MT CO<sub>2</sub>e between now and 2050.



**Figure 24: Residential building emissions through 2050**





## CASE STUDY – ITHACA, NEW YORK COMMUNITY-SCALE ELECTRIFICATION

Ithaca, New York recently secured private funding to retrofit 1,000 existing residential units and 600 existing commercial units to include enhanced weatherization; electrification of all building systems; ready the structures for EVs and solar PV; along with electric system upgrades needed to support these changes. A second phase will include another 3,500 residential units and 900 commercial units. To estimate funding needs – Ithaca assumed a maximum all-in cost of \$50k per residential upgrade but believe the average cost to range from \$35-40k per residential upgrade and \$70k per commercial upgrade. By doing such a large swath of the housing at once (more than half of existing buildings), Ithaca hopes to reach economies of scale and drive down prices further. Instead of providing loans and incentives to the homeowners, Ithaca found that it was a more efficient use of the money for the City to administer the retrofit service, and then recoup the cost of the loans across the homeowners energy bills. One notable distinction with Eugene is that Ithaca has a single municipal utility that provides both electricity and gas service, and so the utility still collects revenue from the fuel switching and the savings to customers shows up on a single bill.

### Carbon Offsets

Purchased carbon offsets provide financial support to projects that reduce or store additional carbon that would have not otherwise been financially viable. Carbon offset projects must follow existing protocols to establish the project, monitor its benefits, and verify the benefits for sale. There are a variety of carbon offset providers in the marketplace that produce credits of varying quality. The highest quality being regulatory grade credits like those used in the California Cap-and-Trade program. Project types vary and can be related to things like landfill gas capture, avoided deforestation, dairy methane capture and use, etc. Northwest Natural has partnered with a regionally respected offset provider, The Climate Trust, to offer on-bill carbon offsets from projects that capture renewable methane from dairies. In 2021, the Eugene community (individual households) voluntarily purchased offsets for over 15,000 MT CO<sub>2</sub>e which is the equivalent for about 8% of total community natural gas emissions.

While there is much debate about the validity of carbon offsets and their place in decarbonization; what is true in climate action is that the technologies and policy tools are not always available fast enough, or at the moment of replacement to meet the rapid pace required by climate goals. Until the availability and price of technologies keep pace with the GHG reductions required to reach climate goals – there will be a need for offsets. And even after all mitigation opportunities are maximized over time, there will still be a place for offsets and other forms of “negative emissions or removals.” These negative emissions from offsets will be needed to go beyond a zero carbon future to maintain average global temperature increases within globally agreed upon goals and will be achieved through natural sequestration of trees or through new technologies. Our first need is to stop producing emissions, our second need is to start going negative with emissions through biological and technological means.

### Implementation Costs

The following sections describes estimated costs for equipment and labor as well as projections for future energy costs.



## Appliance and Installation Costs

Accurately estimating costs for community-scale electrification is challenging. The following high-level estimates are provided for sense of scale but are subject to significant change depending on the assumptions made. These calculations are purposefully kept at a high level to allow for full transparency and are meant to facilitate discussions of costs and the various components to be considered. These costs are large in scale and will have impacts on households across Eugene as they are implemented, but these costs also represent significant economic opportunity and job creation for local businesses who will support this massive transition over the next 20 years. Further, as any appliances age out, households will be replacing these systems anyway.

Costs were estimated for the various “pillars” of the decarbonization strategy, including:

- **Appliance upgrades (HVAC and hot water):** Costs for installed HVAC and hot water are aligned with EWEB’s Electrification report.<sup>21</sup>
  - Heating and Air Conditioning
    - Natural Gas Baseline
      - Gas Furnace: \$4,800
      - Split Air Conditioner: \$6,100
      - Gas Storage Hot-Water Heater: \$1,500
    - Electrification Options
      - Standard Heat Pump (ductless): \$7,000 (3 head)
      - Dual Fuel Heat Pump (ducted): \$11,000
      - Cold Weather Heat Pump (ducted): \$16,400
      - Standard Heat Pump (ducted): \$9,800
      - Electric Heat-Pump water heater: \$2,700
- **Electric service upgrades:** A cost of \$2,000 per household is aligned with EWEB’s electrification report. This cost is assigned to households currently using natural gas and other fuels as their primary heating fuel. Households currently using electricity as a primary heating fuel are assumed to have the circuits required for heat pump upgrades.
- **Weatherization upgrades:** A cost of \$7,800 was provided by Homes for Good as the average cost of per household efficiency upgrades as of 2020. Values in other studies were similar or less than this value as an average per household, but do not consider the recent inflation on construction goods. Weatherization cost is allocated to the number of households built prior to 1990 and further adjusted based on the number of households that have already participated in Energy Trust of Oregon programming. These costs are assigned to all fuel types.

Figure 25 below compares costs for Baseline natural gas systems replacement with electric heat pumps (HP) for space heating / cooling (HP) and Heat Pump Water Heaters (HPWH) along with costs for electric panel upgrades (to support electrification) and weatherization. Appliance costs are focused on the largest energy end uses within residential – space and water heating. *Weatherization will not be needed in all households – adjustments are made in the following figures to focus on homes built prior to 1990 that*

<sup>21</sup> For details visit <https://www.eweb.org/about-us/power-supply/electrification>



*have not already participated in Energy Trust of Oregon programs and incentives.* The electrification scenarios, which include electric panel upgrades and weatherization, range in per household cost compared to baseline natural gas split systems (with no envelope upgrades), between \$5,600 (standard HP + HPWH) to \$16,500 (cold weather HP + HPWH).

**Figure 25: Per household cost to install Gas and AC system or other alternatives**

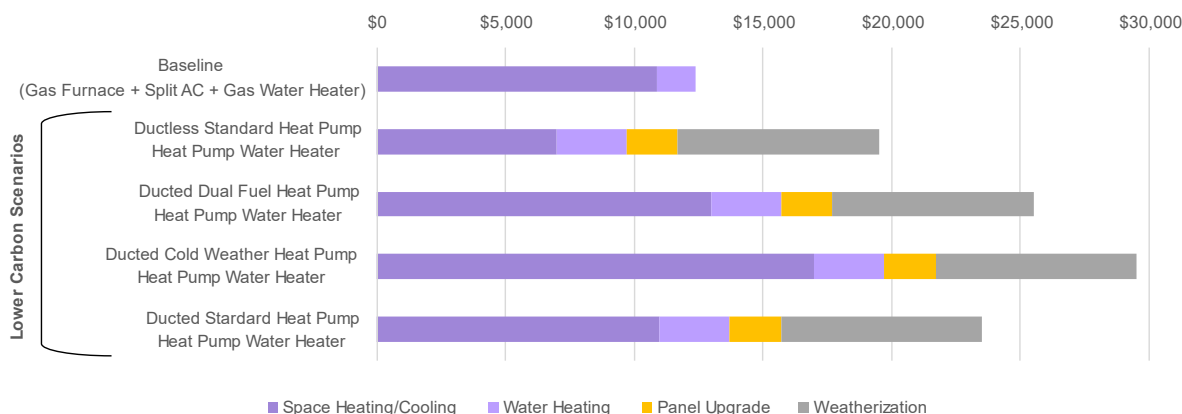


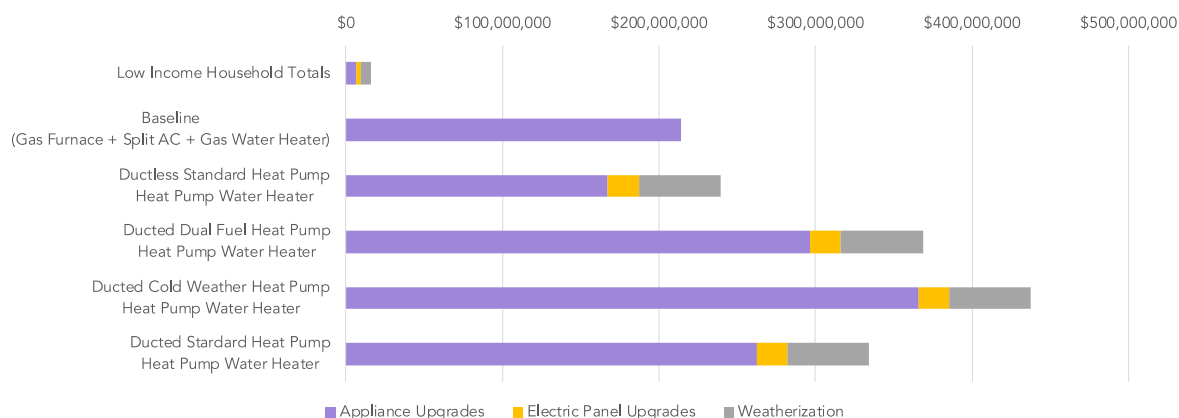
Figure 26 presents the cost for retrofitting all households currently on gas or other high-carbon fuel all at once. Figure 27 shows marginal costs per household for these components. Costs for low income households on these graphics are split from all other households, note that this only includes those low-income households currently using gas or other high-carbon fuel and assumes standard ductless heat pumps and heat pump water heaters.

Total costs include appliance and installation costs. Marginal costs assume appliance upgrades are made at the point of natural replacement of the existing systems (e.g. furnace with split air conditioner and gas water heater) and therefore costs for the baseline system are subtracted from the costs of the other appliance technology options.

There are 570 households that receive public assistance and have gas or other carbon fuel as their primary heat source. The total costs for these low-income households equal roughly \$16 million dollars (in 2021 dollars) and between \$240 million and almost \$440 million dollars for all 17,249 other households depending on the heat pump technology installed.

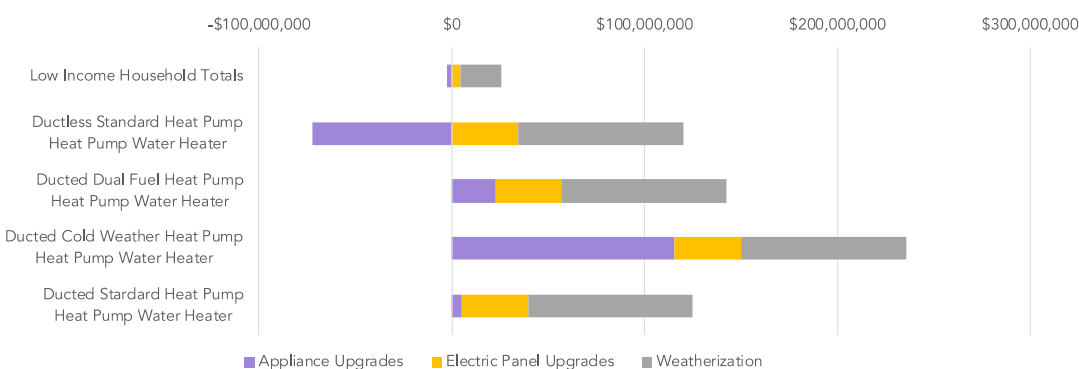


**Figure 26: Total cost for all at once clean heat retrofits for all low-income and all other households, by heat pump technology type.**



Marginal costs are reduced significantly relative to total costs, between \$130 to \$220 million (or about \$6 - \$10 million per year over the next 22 years). Not all clean heat retrofit component costs have an incremental benefit – electric panel upgrades and weatherization expenses are not included in the original system cost. Weatherization expenses will vary from home to home significantly and are expected to be cost effective and payback over time (depending on the type of measure installed).

**Figure 27: Total marginal costs for clean heat retrofits for low-income and all other households, by heat pump technology type, at natural time of replacement.**



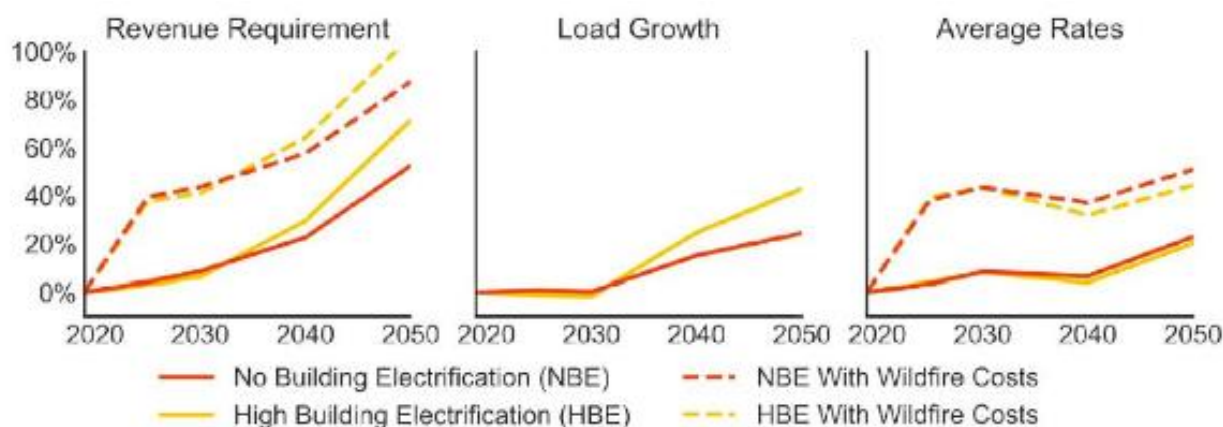
## Energy and Fuel Costs

Future energy prices are difficult to accurately forecast with a myriad of possible futures that may come to pass. Regarding forecasting future rates, EWEB's electrification study references a report titled *The Challenge of Retail Gas in California's Low Carbon Future*.<sup>22</sup> This report found that electricity rate increases in California were forecasted to be moderate because of increasing renewable energy and fuels for the electric sector (20 – 40% by 2050) while natural gas rates could increase by 300% over the same period. Figures 28-31 summarize the findings through 2050 for natural gas and electricity. Note that in **Error! R**

<sup>22</sup> "The Challenge of Retail Gas in California's Low Carbon Future", authored by E3 and University of California, Irvine, Advanced Power and Energy Program Engineering Laboratory Facility for the California Energy Commission, April 2020, CEC- 500-2019-055-F.



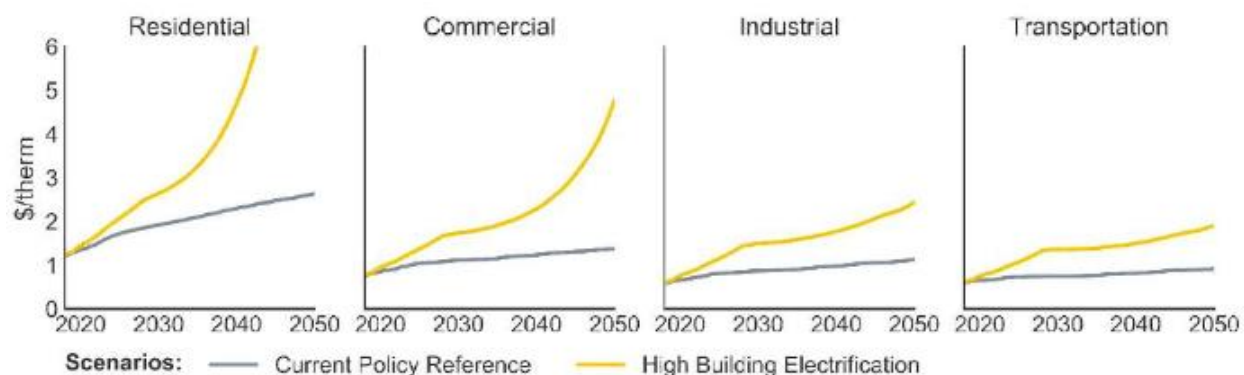
Figure 29: Forecast EWEB rate increases



**reference source not found.** residential and commercial natural gas rates are anticipated to increase significantly more through 2050 because of building electrification.

Recently, natural gas utilities (including Northwest Natural) were required by public utility commission to model the impacts of potential future policy scenarios and bundles to determine how each might impact residential rates.<sup>23</sup> Northwest natural found similar residential rate increases (i.e., between 300%–400%). These rate increases were attributed to high-electrification assumptions in the modeling and the associated customer losses which results in increased distribution system charges spread across a smaller customer base.

Figure 28: Forecast Natural gas rate increase through 2050



### Net Costs for Homeowners

A variety of studies that consider the first, incremental and net-lifecycle costs have come to similar conclusions – *that electrification retrofits will likely result in a small, but net cost to homeowners.*

<sup>23</sup> For details visit UM 2178 - Natural Gas Fact Finding Draft Report  
<https://edocs.puc.state.or.us/efdocs/HAH/um2178hah155046.pdf>



EWEB's Electrification study found that costs outweigh savings across all the space heat pump technologies (Figure 30). If costs for electric panel upgrades (over 20 years) combined with equipment costs *additional costs for households are on the order of between \$2,800 - \$5,800 (\$180 to \$380 per year over 16 years) without additional financial support and incentives or a decrease in equipment costs over time*. Weatherization costs are assumed to be 100% cost effective over the equipment lifespan and are only installed if they payback. Another important aspect of heat pump technology is that it includes relatively inexpensive cooling, increasingly necessary as recent heat waves have proven deadly.

**Figure 30: Comparison of Costs for Decarbonization of HVAC Systems**

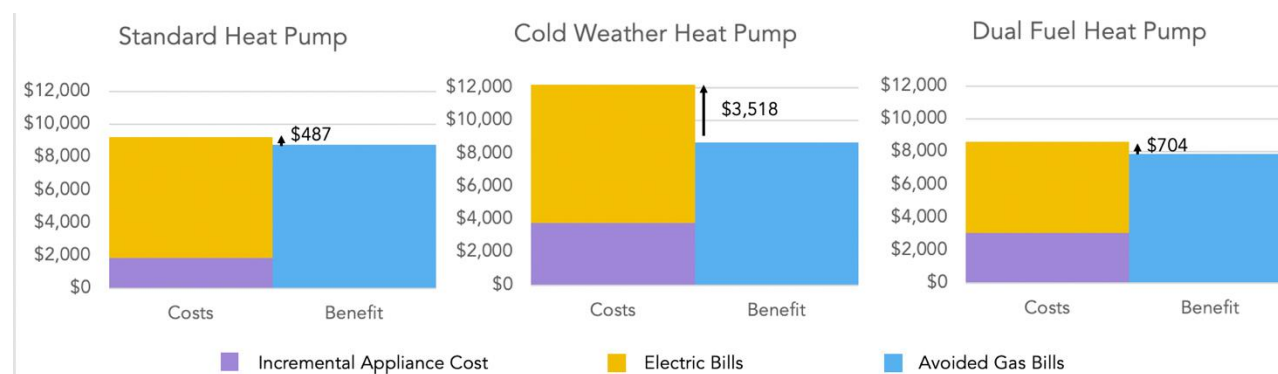
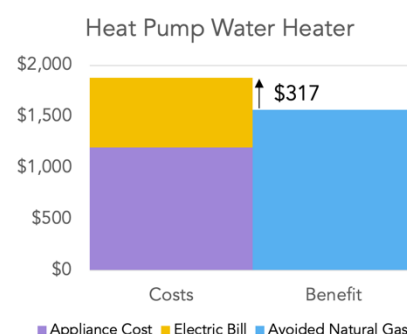


Figure 31 compares costs and benefits for a heat pump water heater. Like the previous, heat pump water heaters (using 2021 costs) result in a net cost to the homeowner until equipment costs decrease and/or natural gas residential rate's increase relative to electricity rates.

**Figure 31: Cost Comparison for Heat Pump Water Heater**



## Funding Options

Depending on the city's policy choices, the funding structure could either come directly to the city to fund existing building decarbonization or be implemented in a more diffuse manner to aid homeowners in decarbonization projects. The city need not be the sole (or primary) administrator of a decarbonization program, an alternative program manager could be entrusted with the funding.



## Community-Scale Decarbonization of Existing Buildings

Without a larger scale intervention, it is likely that decarbonization will rely on consumer choice, individual homeowner motivation, natural turnover rate, and market forces. This could be slow and inefficient; it also runs the risk of not reaching all residents. Instead, the city could follow the path of Ithaca, NY and take a broader scale proactive approach that would decarbonize much more quickly without requiring homeowners to pay upfront for the upgrades. The increased speed of decarbonization comes from upgrading many homes at once, without waiting for existing gas appliances to reach the end of their natural life. Ithaca's program modeling found it to be a more efficient use of funds to finance the efficiency and electrification directly instead of providing incentives and rebates to homeowners.

Taking this option would require bringing on experts such as AMERESCO, Johnson Controls, McKinstry, Siemens, or a similar [Energy Services Company](#) (ESCO) to administrate a large-scale program. Such a program would also avoid the equity challenges associated with requiring individual homeowners to finance all or part of their electrification/efficiency upgrades. Residents are responsible for repaying the debt-financed upgrades, but repayment schedules can be spread equitably among residents without being strictly governed by the cost for any building. By aggregating 1000+ homes at once, the risk of insufficient energy savings to help repay the loan is spread among the different homes, thereby decreasing the risk for investors. Further, with a prescribed set of interventions that are known winners, the ESCO can achieve economies of scale that reduce the costs of equipment and installation. This approach would also be a significant job creating program for our community.

The following describe various approaches for funding community-scale programs:

- **Energy Efficiency and Conservation Block Grant Program**

The US Department of Energy is awarding \$550 million in block grants to communities for a variety of energy efficiency programs. They expect to open applications by Q4 2022. Its purpose is "To assist states, local governments, and Tribes to reduce energy use, reduce fossil fuel emissions, and improve energy efficiency." This program would align well with Eugene's needs, providing funding for all parts of the residential program discussed in this report including developing a strategy, retaining technical assistance, conducting audits, establishing financial incentive programs, providing grants to nonprofits, developing programs for energy efficiency in buildings and transportation, developing building codes, community interest raising, onsite renewable generation for government buildings, and financing retrofit and energy efficiency programs.

- **Sales Tax or Surcharge**

Denver, CO instituted a 0.25% sales tax to fund their building decarbonization project. This tax provides about \$40 million a year to the city's Climate Protection Fund. The funds will offset electrification costs by 80%. This funding provides up-front rebates that cover a large proportion of the price of electrification upgrades. Rebates are up to \$9,000 for a heat pump, \$3,200 for a heat pump water heater, \$4,000 for home solar, \$2,750 for battery storage, \$2,000 for electrical panel upgrades, \$1,000 for EV charging, and \$400 for an ebike. Many of these sums are increased for income-qualifying residents.

### CASE STUDY: PORTLAND, OREGON CLEAN ENERGY FUND





Portland's Clean Energy Fund is supported by a 1% surcharge on large retailers (such as Target or Lowes). To be subject to the surcharge a business must have \$1 billion or more in U.S. sales and at least \$500 thousand in Portland sales (excluding grocery, medicine, health care services, and other exemptions). This is not intended to be a sales tax, but many retailers are adding a fee to customer's purchases. Portland uses these funds to support small projects that advance clean energy development for underserved communities. The anticipated revenue for this in Portland is between \$44 - \$61 million per year. The fund is currently awarding small (\$5,000) grants to non-profits to advance clean energy projects that center marginalized communities.

- **Private Equity Funds (Ithaca, New York)**

Ithaca, NY did not have access to existing finance (like a Property Assesses Clean Energy (PACE) program, see description below), so instead they gathered private equity funds to finance a weatherization and electrification retrofit program for residential and commercial buildings. They employed an investment firm to secure funding and an ESCO, Bloc Power, to manage the installation. In addition, the project improved the city's debt rating, making borrowing cheaper for project participants.

- **Climate/Green Bonds**

A financial instrument designed to raise money for climate and environmental projects, which function the same as other government-issued bonds. They are verified by a third party (such as the [Climate Bonds Initiative](#)) to assure their climate benefit and the buyer often gets a tax benefit for investing. \$50 billion in green bonds were issued domestically in 2020. The term "climate bonds" is sometimes used interchangeably with "green bonds", but "climate bonds" also implies direct climate benefits, and greenhouse gas reductions. Tesla Motors issued \$600 million in green bonds in 2013. The city of Asheville, NC issued green bonds in 2016 to pay for infrastructure upgrades and water system improvements.

- **Social Impact Bonds**

Social impact bonds are similar to Climate/Green bonds but are intended to finance social change. The bond pays for better social outcomes that result in desired savings (lower correctional spending or energy savings) and pays back investors out of those savings. The bonds only repay if the desired results are achieved. Therefore these bonds have greater risk for the investor. Santa Clara, CA issued social impact bonds to reduce homelessness in their community. Salt Lake City, UT issued bonds to pay for early childhood educational interventions to increase educational achievement and decrease the need for later interventions. Find a database of social impact bonds around the world here: <https://sibdatabase.socialfinance.org.uk/>

## Funding for Home and Building Owners

### Utility Sponsored Energy Efficiency Programs

- EWEB offers rebates and zero interest loan programs for ducted and ductless heat pumps, heat pump water heaters, and efficiency. They offer both standard rebates and loans and low-income loans which offer up to **\$3,800** in rebates and up to **\$4,000** plus **\$1,500** per head in zero interest





loans for ductless heat pumps. Visit this link for current incentives:

<https://www.eweb.org/residential-customers/rebates-loans-and-conservation>.

- Northwest Natural offers rebates for the installation of new gas furnaces and water heaters including a **\$1,000** incentive for a 90% annual fuel utilization efficiency gas furnace for eligible moderate-income households. All current incentives can be found here: <https://www.energytrust.org/residential/incentives/>.
- **On Bill Financing/Repayment:** This is a system whereby the utility pays for all/part of an upgrade and then the recipient pays it back over time by paying a charge on their electricity bill per kwh saved that is less than the market rate.
  - *Example: If the upgrade saved 100kwh/month then the customer would pay some amount that is more than their actual energy usage, but less than they would have paid without an upgrade.*
  - There are variations on this theme depending on who invests the initial money. See ESPC (below) for a more general definition. For example, an ESCO company may provide the financing

### Property Assessed Clean Energy (PACE) Financing

PACE loans are backed by the local government or some other partner to pay upfront costs for energy upgrades. Then the loan is repaid with property taxes. The financing remains with the property, not with the borrower, so selling will also transfer responsibility for repayment. This kind of financing can present obstacles to selling a house. Both commercial and residential PACE programs are legal in Oregon, but there are no residential programs currently offered. There is some concern that PACE financing ties people to high interest loans and because the loan is tied to property taxes it can increase the risk of foreclosure. For this reason, residential PACE is rare (only California, Florida and Missouri have active programs).

### Energy Savings Performance Contract (ESPC)

An energy service company (ESCO) coordinates installation and maintenance of energy efficiency equipment in a customer's facilities and is paid from the associated energy savings. The ESCO typically provides a savings guarantee. The improvements are usually owned by the customer and may be installed with little or no upfront cost if the ESPC is financed. ESPCs are suited for larger (\$1 million+), more complex projects with high upfront costs, though they have sometimes been used for smaller projects. ESPCs are also called energy performance contracts (EPCs).

### OHCS Cooling Funding

Recently passed in House Bill 1536, the state appropriated \$15 million dollars to go toward a residential heat pump fund to aid landlords and homeowners in getting permanent cooling into low-income homes. The program is not yet deployed, but it is intended to come online in the 2023.

### Local Best Practice Programs and Funding Opportunities

Figure 32 summarizes local organizations that provide financial assistance for low-income residents and other community members for energy efficiency and weatherization and appliance upgrades.



- More local, flexible funding for low-income household programs is needed
- Interviews noted that a central staff person coordinating services between groups and programs would make the local system more efficient.

Follow the links below for a wealth of additional information about programs, specific opportunities, eligibility, applications, and program contact information.

- City of Eugene: <https://www.eugene-or.gov/852/Emergency-Minor-Home-Repair-Program>;
- Eugene Water and Electric Board (EWEB): <https://www.eweb.org/residential-customers/rebates-loans-and-conservation>
- Habitat for Humanity: <https://habitatlane.org/home-repair/>
- Lane County/Homes for Good: <https://homesforgood.org/programs/weatherization>
- Low Income Home Energy Assistance Program (LIHEAP): <https://www.lanecounty.org/cms/One.aspx?portalId=3585881&pageId=4213698>
- Northwest Natural / Energy Trust of Oregon: <https://www.energytrust.org/residential/>
- Oregon Department of Energy: <https://www.oregon.gov/energy/Incentives/Pages/default.aspx>
- Oregon Health and Community Services (OHCS): <https://www.oregon.gov/ohcs/energy-weatherization/Pages/weatherization-services.aspx>
- St. Vincent De Paul of Lane County: <https://www.svdpc.org>
- State Home Oil Weatherization Program: <https://www.oregon.gov/ohcs/energy-weatherization/Pages/show.aspx>

**Figure 32: Summary of local organizations/programs that support best practices through technical assistance and financial support**

Local Agency or Program	Low-Income Programs	Energy Costs	Home Repairs	Energy Audit	Building Envelope	Heating / Cooling Systems	Water Heating	Electric Panel Upgrades	Onsite Renewables + Storage	Mobile Home Upgrades
City of Eugene	✓		✓	✓						✓
EWEB / BPA	✓	✓		✓	✓	✓	✓	✓	✓	✓
Habitat for Humanity	✓		✓							✓
Lane County / Homes for Good	✓		✓		✓	✓		✓		✓
Low Income Home Energy Assistance Program	✓	✓	✓		✓					✓
Northwest Natural Gas / Energy Trust	✓				✓	✓	✓			✓
Oregon Department of Energy	✓					✓			✓	✓
Oregon Health and Community Services	✓		✓		✓	✓	✓			✓
St. Vincent de Paul of Lane County	✓									✓
State Home Oil Weatherization Program					✓	✓				✓
Catholic Community Services/ Oregon Energy Fund		✓								

## Equity Considerations

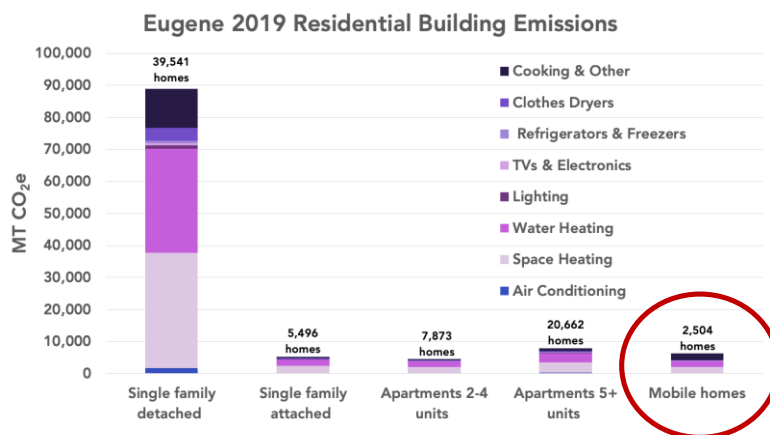
Equity is an important consideration for community programming, especially given rising housing costs in the community and beyond. Rental single-family homes are less energy efficient than others, on average consuming 15% more energy per square foot than owner-occupied homes, per the American Council for an Energy-Efficiency Economy (ACEEE). According to the Eugene Springfield Comprehensive Plan, households paying more than 30% of household income toward housing are considered to have a 'housing cost burden', with 55% of all renters in Eugene considered housing cost burdened, and 27% of Eugene homeowners considered housing cost burdened. **Overall, 46% of all Eugene households are housing cost burdened.**

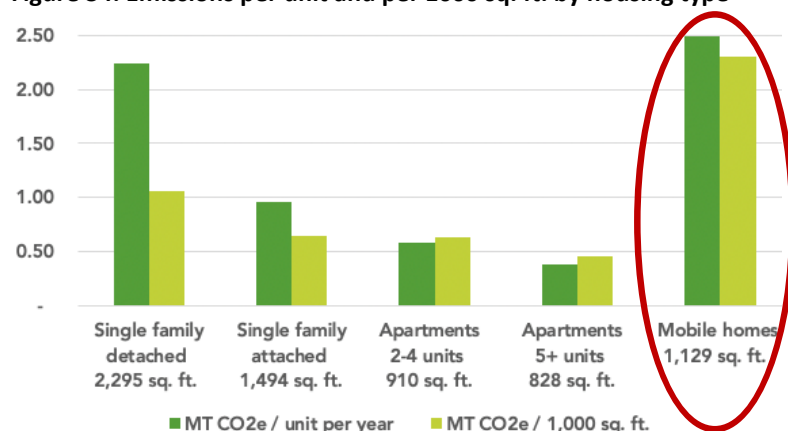
In addition to household income, equity considerations include race and ethnicity, particularly BIPOC community members; age, including seniors and youth; health and disability; LGBTQIA+ people, and more. These communities may have lower assistance/adoption rates, need more assistance, or face higher risks related to their housing situation (e.g. heat wave health risks, wood smoke health risks, or exposure to environmental hazards). In addition, renters and mobile home residents face additional challenges.

### Manufactured and Mobile Homes Highlight

The roughly **2,500 mobile homes in Eugene represent 3% of all homes, but 6% of residential building emissions**. As shown in Figure 33, single family homes account for the largest portion of GHG emissions from residential buildings. Mobile homes, on the other hand, make up a small proportion of the total emissions, but have a very high per unit and per square foot intensity as seen in Figure 33. This data highlights an opportunity to expand programs to reduce energy use and associated costs for people living in mobile homes while increasing comfort and resilience to heat events – which generally means total replacement due to modern insulation standards.

**Figure 33: Absolute emissions associated with different housing types**



**Figure 34: Emissions per unit and per 1000 sq. ft. by housing type**

Mobile homes use more total energy and energy per square foot compared to an average sized single-family home, creating high utility bills which in turn can increase need for energy assistance programs. Per OHCS, in FY2018, 32% of Lane County homes receiving Low Income Weatherization Assistance were mobile homes.

The **Energy Trust of Oregon** has used fixed-price campaigns in partnership with vendors, outreaching to mobile home manufacturers and parks, and considers this a growing strategy. This strategy creates economies of scale to update many small homes in a small area. ETO puts out requests for pricing in trade ally network, vendors respond and get zero-cost customer acquisition with some built-in advertising. There is a struggle with price commitment amid inflation and supply chain issues, but overall this strategy is working well.

Many existing programs rely on community awareness of the programs, and homeowner initiative to start a process. Documentation can be cumbersome and income thresholds strict. Eugene should focus on targeted outreach, using the information in this report to approach older, energy burdened, manufactured and single-family homes in the census tracts in need. Equity cannot rely on underserved groups coming to the table; rather, the City must join them at their table.

### Equity disparities in Eugene

Disparities become more challenging over time as we address real impacts of climate change. For example, as the climate changes there will be increased demand for cooling. Housing with poor weatherization and no cooling will not only experience higher energy needs and utility bills, but will also be at increased risk for negative health impacts. The following maps were provided by Oregon Housing and Community Services<sup>24</sup> and show various housing and energy disparities within the City of Eugene by census tract that help us see which neighborhoods should be made a priority for support. Figure 35 and Figure 36 show the census tracts where residents of color and with low income live, respectively. Figure 37 shows the census tracts where the residents are at a disproportionate risk of rising energy costs, a function of need for cooling and socio-economic factors. Finally, Figure 38 shows the census tracts where

<sup>24</sup> Maps accessed at

<https://osugisci.maps.arcgis.com/apps/webappviewer/index.html?id=189e21ea4f694168ad519a18ef99ef60> and <https://njcep.maps.arcgis.com/apps/webappviewer/index.html?id=18c4e8f1082e4a039f69401386e06e32>



energy efficiency will be most cost effective in low income housing, giving a guide to where the city could begin to focus attention. (Maps on following page.)

Figure 35: Percent people of color by census tract

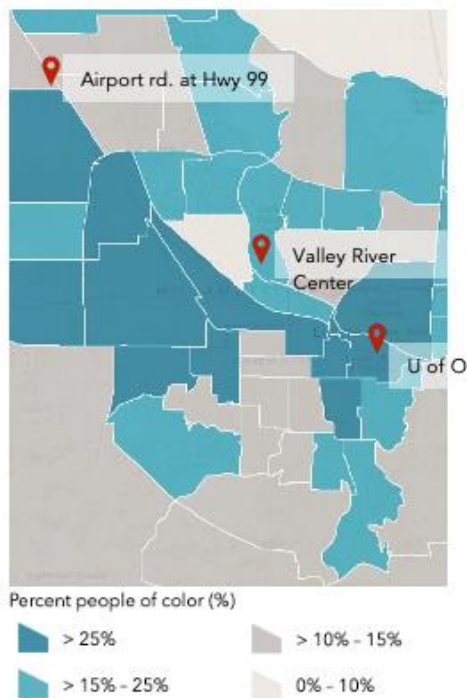


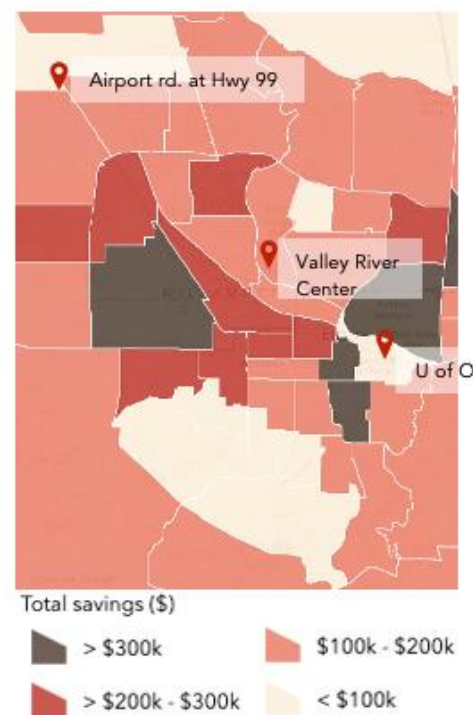
Figure 36: Percent low-income households by census tract



Figure 37: Census tracts experiencing energy cost risk based on Energy Use Intensity, income, and racial makeup



Figure 38: Cost-effective energy savings in low-income housing





## Gaps in access and assistance

- **Limitations on which houses can get funding**
  - OHCS and other partners can't provide services on **homes with lead and asbestos**, meaning no work on homes **built before 1976**. These older homes are likely to be less efficient and require more updates
  - **Some programs aren't available in Eugene**. Saint Vincent de Paul has a Regional Housing Rehabilitation Loan Program for home repairs for health and safety but is only available to rural households.
- **Limitations on which people can get funding**
  - **While the focus on low-income households is good, there are strict all-or-nothing cutoffs for state and federally funded programs**. Lower-income households making just \$20 over the thresholds don't qualify for any assistance through most programs. The funding requirements are too rigid **and require a lot of documentation** with no tiered assistance. **Sample requirements include household income max 200% of federal poverty level (FPL), 60% of state median income (SMI), or 80% of SMI depending on the funding source**
  - **Renters are not able to apply for assistance programs**. Rental units are underserved as there is little incentive for landlords
  - OHCS's **Manufactured Home Replacement Program** for mobile homes built before 1980 currently **can only serve landowners**, not those that lease the land the home is on.
- **Difficulties applying and long waits**
  - **Programs exist, but the need exceeds available funding and creates long waiting lists**. For example, OHCS funding can currently only serve 17.8% of eligible households. Their score-based program focuses on elderly, disabled, families with young children, and households with high energy burden

## Equity opportunities and suggestions

### Takeaways from local stakeholders and research

- **Funding**
  - **Existing programs need funding – flexible, local funding**. Each situation is unique and may not fit into a one size fits all program. Federal and state funding is often too restrictive and leaves out a lot of homes, and federal funding can typically only go to existing federal projects, not private housing.
  - **Designate funding to where it is needed**. This applies both to energy users and equity needs, which are not always in alignment.
    - The City of Ithaca designated at least 50% of the economic, social and environmental benefits to **disadvantaged communities**. Similarly, OHCS's score-based system for programs focuses on elderly, disabled, families with young children, and households with high energy burden.
    - For Eugene, focus on **mobile homes and older single-family homes** that use more energy per unit and per square foot.





- **Duplexes and single-family homes** are historically **slow to participate in energy efficiency programs**. We know that these homes use more energy both per unit and square footage than other housing types, other than mobile homes.
- **Reaching more households**
  - There is a clear need for servicing **low to middle income households that don't meet income or documentation requirements (such as tax returns)** for home repairs, energy efficiency, and weatherization. For those that don't meet the typical income requirements, **consider different rates for the private costs** based on income instead of an all-or-nothing approach.
  - Incentives are typically based on income, which doesn't work with **rental homes**. **Transact directly with landlords and don't base it on tenants' income**. Simply have the landlord fill out an application.
  - **Create private financing convenience**. Consider options with on-bill financing, where costs are billed with their utility bill. Work with local lenders to provide loans with better terms for electrification or home efficiency projects, especially those that will provide utility bill savings.
- **Protecting our community members**
  - **Address the need for permanent, effective cooling**. While HB 1536 will address this need for rental units over time, owner-occupied units will need additional support.
  - **Protect Naturally Occurring Affordable Housing (NOAHs)**. Have a goal to maintain existing housing stock while preserving against blight. Work against increasing rents and real estate prices while improving existing building stock. The City has several Housing and Human Services Plans that align with building energy equity.
- **Aligning our efforts**
  - **Current building code can lead to less energy efficient design**. For example, requiring ~15% of residential façade to have glass which has lower heat retention. There is a host of requirements and design standards that are aimed at protecting community character that does not align with energy efficiency and resiliency.

## Recommendations for the City to Act

### Prioritize actions for existing buildings

Existing buildings represent a large proportion of Eugene's current emissions and will continue to do so for the foreseeable future. All future buildings will be built to higher standards so there is less opportunity for measures to reduce emissions. Even with the substantial emissions decreases expected from the Climate Protection Program, the bulk of the emissions are in the current housing supply up until 2050, which is two full appliance replacement cycles away.

### Mobile/manufactured and single family homes hold the most reduction potential

**Mobile/manufactured homes** have the largest per unit and per square foot emissions, due largely to their building envelopes. Retrofitting these homes also serves a sizeable low income population. Single family homes make up the largest portion of emissions, with the second highest per unit and per square foot



emissions. Although in general these homeowners are middle and upper income, **low income single family homes** represent a significant equity and emissions reduction opportunity. All other types of dwellings are both more efficient and a lower portion of the total housing stock. Multi-family homes are generally much more efficient than other housing types, but HVAC retrofit programs that provide heat pumps for summer cooling is an important safety and health measure.

### Finance, outreach, and project management are critical

Provision of financing for residential emissions reduction projects, programs to perform aggressive outreach, and project management to implement large scale programs is needed. While these services are provided by a number of agencies and organizations, there is currently no central organizing body. To facilitate an accelerated transition the City could take on these roles, partner with other agencies, or contract for provision of these services.

The **financing** required for administering such a large acceleration in decarbonization will likely have to come from private debt financing, not necessarily administered by the city. An ESCO organization could aid in securing funding.

Coordinated **outreach** is lacking. There are many agencies and service providers, but they do not coordinate in messaging or in practice. The leaves everyone scrambling for information and services. A central messaging resource would let residents, HVAC companies, and contractors know about all the potential financial and practical services available for low-carbon retrofits.

**Project management** is crucial. A central project manager would streamline and troubleshoot the application processes, increasing access. It could also connect consumers and contractors to accelerate the current ad-hoc process or take a greater managerial role as in the Ithaca example.

### Align timelines (but not goals) with the State's

Eugene should still press ahead with more ambitious total decarbonization goals, but by aligning the timepoints will make compliance and reporting easier for companies and agencies. By setting the goal at 100% by 2050, Eugene would still be pushing beyond the State's goal of 80% by 2050 but with greater access to relevant data and less time required to adjust information to a different timeline.

## Part 2: Commercial Sector

To be completed in a Phase 2 of the project.

## Part 3: Industrial Sector

To be completed in a Phase 2 of the project.



## Bibliography

To be completed in a Phase 2 of the project.



## Appendix A: ACEEE – Electrification Policy Recommendations

American Council for an Energy-Efficient Economy (ACEEE) is well known and respected thought leader on many subjects related to energy. The following content is provided from their report, *Building Electrification: Programs and Best Practices*.

*Typical utility-run electrification programs usually involve technology-based rebates to residential customers. Nonutility program administrators are more likely to offer more comprehensive program models, including whole-home retrofit programs, financing for upgrades, workforce training programs, low- and moderate-income programs, market development, and other strategies.*

*Where possible, electrification programs, measures, and incentives should be braided into existing energy efficiency programs to increase their reach and engagement with hard-to-reach customer groups such as low-income and multifamily households.*

*Contractors play a key role in building electrification. Expanding the workforce and educating and motivating contractors to install and service heat pumps is a critical strategy for scaling up capacity for electrification in buildings.*

### State legislatures

- *Include explicit building electrification targets within larger climate plans, and prioritize access to resources and support for marginalized communities when setting goals*
- *Provide consistent funding streams for building electrification programs, particularly whole-building retrofits for underserved communities*
- *Capture electrification opportunities in new buildings through building codes and standards, such as requiring new buildings to be all-electric or “ready to electrify”*
- *Enact a price on carbon via a tax or by joining a regional carbon cap-and-trade market. Utilize revenues to create sustainable funding streams for building decarbonization programs*

### Regulators

- *Enable a rapid and smooth transition to a carbon-free power supply*
- *Ensure that the grid has adequate transmission/distribution capacity for additional load*
- *Allow program managers to offer fuel-switching measures and incentives*
- *Set targets for utilities to provide building electrification incentives to their customers, including performance-based incentives where appropriate*
- *Establish fuel-neutral impact tracking and reporting methods*
- *Consider nonenergy benefits (e.g., environmental impacts) in cost-effectiveness testing and evaluations for building electrification programs*
- *Encourage utilities to explore the integration of building electrification technologies with the grid in order to increase variable renewable energy resource utilization and reduce systemwide costs*
- *Develop a transition plan for gas utilities, including gas distribution system downsizing and zero net carbon alternatives to natural gas*



- *Consider impacts on electric rates, particularly for energy-burdened customers, and require utilities to offer programs specifically targeting hard-to-reach sectors*

#### Utilities

- *Incorporate building electrification into the integrated resource planning process*
- *Develop pilots and expand existing building electrification program offerings*
- *Incorporate demand response, distributed generation, energy storage, and other demand-side resources to mitigate grid impacts of electrification*
- *Combine electrification incentives with existing in-home energy efficiency programs to streamline the delivery progress*
- *Offer incentives for electric panel and service upgrades to support electrification*
- *Phase out incentive programs for fossil fuel equipment*

#### Manufacturers/ distributors

- *Expand production and distribution of building electrification technologies, particularly for whole-home systems designed for use in cold climates and for homes with hot-water distribution systems.*
- *Provide contractor education programs and work with installers to broaden understanding and expertise in heat pump technologies for buildings*
- *Ensure that heat pump equipment is widely available and stocked in distribution centers to allow replacement of fossil fuel equipment on an emergency basis*

#### Contractors, Builders, Architects, and Engineers

- *Participate in education, job training, and certification programs to incorporate building electrification technologies in building design and installations*
- *Develop specialized product and service offerings to integrate heat pump technologies into existing business models and sales processes*
- *Join business groups to share knowledge and receive support for building electrification*
- *Combine electrification with efficiency to reduce system and ongoing energy costs*
- *Educate customers on heat pump technologies, incentives, and benefits*

#### Homeowners and Property Managers

- *Learn about building electrification technologies and share this information with neighbors and peers*
- *Understand the local utility incentives for building electrification measures*
- *Plan to replace existing fossil fuel equipment as it nears the end of its useful life span to avoid an emergency replacement when existing equipment fails*
- *Implement energy efficiency measures, such as improving building envelopes, along with building electrification to reduce lifetime energy cost and improve comfort*

ACEEE provides multiple useful tools, guides, and research documents, including an Energy Equity for Renters, an initiative for affordable, energy-efficient housing for renters. They also provide a Policy



Tracker and guide for local governments with actions governments can take and design, implement, and evaluate equitable policies.

- Tool: [Energy Equity for Renters Policy Tracker](#)
- Document: [A New Lease on Energy: Guidance for Improving Rental Housing Efficiency at the Local Level](#). Sections include [resources on best practices](#) to expand energy efficiency investments for households with low incomes and more.

## Appendix B: NWN Vision 2050 Technologies & Measures

Figure 39 below is from Northwest Natural's Vision 2050 Analysis summarizes the rate of implementation of various technologies and measures. For example, they considered up to 40% dual-fuel heating systems by 2040 (33% by 2030) if RNG supplies are constrained; and 30% efficiency increases beyond ETO expectations for the industrial sector as well as 30% reduction as a result of weatherization and building shell improvements.

**Figure 39: NWN assumptions for various technologies and measures through 2050**

SUPPLY SIDE MEASURES				
	YEAR	BALANCED APPROACH SCENARIO	MODERATE OFFSETS SCENARIO	RNG-CONSTRAINED SCENARIO
Decarbonized gas supplies (dekatherms)	2050	52.2M	47.4M	35.2M
Renewable Natural Gas		34.2M	34.2M	14M
Clean Hydrogen or Clean Hydrogen Derived Synthetic Gas		18M	13.2M	21.2M
DEMAND SIDE MEASURES				
Natural gas heat pumps as a percentage of natural gas space heating equipment installed in year	2025	3%	4%	3%
	2030	17%	12%	17%
	2050	72%	55%	60%
Hybrid heating systems as a percentage of natural gas space heating equipment installed in year	2025	9%	8%	18%
	2030	16%	8%	33%
	2050	0%	0%	40%
Natural gas heat pumps for water heating as a percentage of new gas-fired water heating equipment installed in year	2025	7%	4%	7%
	2030	36%	15%	36%
	2050	91%	65%	91%
Industrial energy efficiency increase (percentage) beyond current Energy Trust of Oregon expectations	2050	23%	13%	30%
Percentage reduction in building heating requirements, due to building shell improvements	2050	21%	13%	30%
CARBON OFFSETS AND CARBON CAPTURE				
Certified carbon offsets used to account for conventional gas supply not yet decarbonized	2025	4.2%	7.1%	2.7%
	2030	7.5%	11%	8%
	2050	0%	25%	0%
Natural gas supplies decarbonized with CARBiN-X carbon capture equipment (dekatherms)	2025	38k	37k	38k
	2030	0.8M	0.8M	0.8M
	2050	2.3M	2.8M	1.7M