City of Eugene
Decarbonization by 2045 for
Existing Buildings

Policy and Program Best Practices Review and
Recommended Roadmap

PART 1: Residential Buildings—Draft

Presented by
Joshua Proudfoot, Principal
Aaron Toneys, Senior Associate

July 20, 2022

Project Overview & Purpose

► What does our existing building supply look like –
  Residential, Commercial and Industrial (to follow).
► What are the best practices to decarbonize our existing
  buildings and how do we look out for those that need extra
  help? (Low Income and/or BIPOC)
► What policies and programs exist and is there money to be
  found to support the transition?
► Where are the gaps in programs?
► Where could the city act?
Eugene Community GHG Emissions
~1 million MT CO2e annually

- Transportation: 53%
- Refrigerant Loss: 7%
- Waste: 8%
- Buildings (residential): 11%
- Buildings (commercial/industrial): 21%

Eugene Emissions - Building Energy

Building Energy Emissions by Year

- Other Commercial and Industrial Fuels
- Commercial and Industrial Natural Gas
- Commercial and Industrial Electricity
- Other Residential Fuels
- Residential Natural Gas
- Residential Electricity
Building Stock Characteristics

- Data from American Community Survey and Energy Trust of Oregon
- Roughly 76,000 total housing units
  - Type: 59% single family; 38% multifamily; 3% mobile home
  - Ownership: 51% owned; 49% rented
  - Age: 65% of housing built before 1990
  - Primary heating fuel: 73% electricity (vs 51% OR av.); 22% natural gas; 3% wood; all other fuels 2% (fuel oil, propane)
BM0  Show the graph for this but leave the citation
Beth Miller, 2022-07-01T20:05:02.297
Housing Units, GHGs and End-Uses

Eugene 2019 Residential Building Emissions

MT CO2e

- Cooking & Other
- Clothes Dryers
- Refrigerators & Freezers
- TVs & Electronics
- Lighting
- Water Heating
- Space Heating
- Air Conditioning

Housing Unit Emissions – Annual and Area

MT CO2e / unit per year  MT CO2e / 1,000 sq. ft.
Summary of Existing Policies

► Climate Protection Program
  - 90% emissions reduction by 2050
  - Applies locally to use of natural gas and other fossil fuels
  - NWN planning to use a combination of demand-side and supply-side action for compliance purposes

► Clean Energy Targets Bill (HB2021)
  - EWEB not regulated under the bill
  - EWEB and NWN will be publishing their Integrated Resource Plans late summer/fall 2022

Northwest Natural Gas – Vision 2050

[Graph showing emissions reduction over time]
Energy Supply Context

Energy Supply – EWEB Electricity

Here in Eugene, we are fortunate to have one of the cleanest power portfolios in the nation, with almost no electricity sourced from fossil fuels. About 90 percent of your power comes from carbon-free resources.

Existing Policy Benefit – Decreased NWN Load

- Non-NWN Sales
- Industrial
- Commercial
- Residential
Energy Supply Context

**Existing Policy Benefit - Increasing Renewables**

Percent Renewable Fuel Supply

<table>
<thead>
<tr>
<th>Year</th>
<th>Electricity</th>
<th>Natural Gas</th>
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<tbody>
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<td>2045</td>
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Existing Policy Benefit – Decreasing Emissions

Oregon’s Climate Protection Program and EWEB’s 95% Renewable by 2039 Goal are forecast to reduce emissions 67% by 2045 and 82% by 2050.
Best Practice: Approach

Pillars of Deep Decarbonization

- **Energy efficiency & conservation**
  - Smart-growth driven VMT reductions
  - Whole-home retrofits & new construction codes
  - Electric heat pumps displacing resistance heat

- **Electrification**
  - Electrification of industry OR buildings
  - Electrification of passenger vehicles
  - Electrification of trucks and freight transportation

- **Low-Carbon Energy**
  - Low-carbon electricity
  - Low-carbon biofuels
  - Potentially renewably produced hydrogen

- **Reduce non-combustion GHGs**
  - Methane reductions
  - Replacement of high global warming potential gases
  - Industry process emissions reductions

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

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Best Practice: Energy Efficiency

**Natural Gas – Cost-Effective Opportunities**

- Data from Northwest Natural, Energy Trust of Oregon, and National Renewable Energy Lab
  - Water heating appliance upgrades, including heat pumps
  - Space heating appliance upgrades, including heat pumps
  - Space heating controls (such as smart thermostats)
  - Weatherization of building envelope
**Best Practice: Energy Efficiency**

**Natural Gas – Historical Implementation**

![Bar chart showing historical implementation of natural gas measures by year.](image)

*Image Credit: Energy Trust of Oregon*

**Best Practice: Energy Efficiency**

**Electricity – Cost-Effective Opportunities**

- Data from Northwest Power Plan 2021

- Cost Effective
  - Water heating and use upgrades, including heat pumps
  - LED lighting
  - Space heating upgrades, including heat pumps
  - Space heating controls (such as programmable thermostats)
  - Weatherization of building envelope
### EWMB Electrification Study Findings

<table>
<thead>
<tr>
<th>Electrification Scorecard</th>
<th>Carbon Reduced</th>
<th>EWMB Participant</th>
<th>EWMB Ratepayer</th>
<th>Society</th>
<th>1-in-10 Peak Adder</th>
<th>Peak Management Potential</th>
<th>EWMB Engagement Opportunities</th>
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<tbody>
<tr>
<td>Electric Vehicle</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Encourage more charging to avoid peak, increase public and workplace charging opportunities.</td>
</tr>
<tr>
<td>Heat Pump Water Heater</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Consider existing energy efficiency incentive program’s influence on electrification of water heating.</td>
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<tr>
<td>SFD - Standard Heat Pump</td>
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<td>Influence customer space heating technology choices to mitigate peak imports.</td>
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<td>SFD - Cold Climate Heat Pump</td>
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<td>Influence customer space heating technology choices to mitigate peak imports.</td>
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<tr>
<td>SFD - Dual Fuel Heat Pump</td>
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<td>Influence customer space heating technology choices to mitigate peak imports.</td>
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<td>Multi-Family Dwelling Space Heat</td>
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<td>Participant benefits are using, making electrification unlikely. Possible incentive opportunity.</td>
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<td>Small Office Space Heat</td>
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<td>Participant benefits are using, making electrification unlikely. Consider heat design changes.</td>
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</table>

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

### Best Practice: Clean Heat Retrofits

**Clean Heat Retrofit Costs**

- Clean Heat Retrofit = Electric appliances, weatherization, and panel upgrades
- Cost data from EWMB and Homes for Good
### Whole House Retrofit

**Per Household total cost**

![Bar chart showing implementation costs for different scenarios.](chart1)

### Whole House Retrofit

**Community-Wide Total Costs**

![Bar chart showing implementation costs for different scenarios.](chart2)
Implementations Costs

Whole House Retrofit
Community-Wide Marginal Costs

Natural replacement schedule

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<td>$100,000,000</td>
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- Appliance Upgrades
- Electric Panel Upgrades
- Weatherization

Best Practice: Clean Heat Retrofit

Clean Heat, Cumulative Emissions, and Time
~40 MT CO2e saved per HH, 2022 – 2050

Cumulative Residential Building Energy Emissions Per Household

- All-Electric Residence (EWEB)
- Natural Gas Residence with supply and demand reductions (Northwest Natural)
Appliance Retrofit:
*Per HH Costs, by Scenario*

<table>
<thead>
<tr>
<th>Heat Pump Type</th>
<th>Incremental Cost</th>
<th>Electric Bills</th>
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<td>Dual Fuel Heat Pump</td>
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Best Practice: Distributed Renewables

**Residential Solar PV + Battery Backup**

- Provides local resiliency in case of emergency
- Per Unit Costs
  - Data from Northwest Power Plan 2021
  - 5.6 kW system
  - $16,000 (PV system only)
  - $28,000 (PV system + battery backup)
- May be considered to reduce additional load needs
- Example community costs
  - EWEB found the need for 10 aMW to electrify 50% space and 85% water
  - Assuming a capacity factor of 25% for solar PV and average 5.6 kW system
  - Filling the load would require about 7,000 residential systems locally
  - Requiring a rough first cost of $100 million for solar PV systems only; and $200 million for solar + battery back up
BM0  Low priority
Beth Miller, 2022-07-01T20:29:24.254
### Local Services

<table>
<thead>
<tr>
<th>Local Agency/Program</th>
<th>Low-Income Programs</th>
<th>Energy Costs</th>
<th>Home Repairs</th>
<th>Energy Audit</th>
<th>Building Envelopes</th>
<th>Heating/Cooling Systems</th>
<th>Water Heating</th>
<th>Electric Panel Upgrades</th>
<th>Demand Response</th>
<th>Storage</th>
<th>Mobile Home Upgrades</th>
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<td>State Home Oil Weatherization Program</td>
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### Funding

#### Available Options

**► Community-Scale**
- Energy Efficiency Block Grants (USDOE, Q4 of 2022)
- Sales Tax or Surcharge (Portland Clean Energy Fund)
- Private Equity / Energy Performance Contact (Ithaca, NY)
- Climate/Green Bonds
- Social Impact Bonds
- Affordable Housing Bonds With County and Utility
- Special Assessment Districts
- General Obligation Bond – Public vote

**► Home and Building Owners**
- Utility-sponsored programs
- Government-sponsored programs
- Property Assessed Clean Energy (PACE) Financing
- Energy Savings Performance Contract (ESPC)
Focus on Equity

**Equity Considerations and Best Practices**

- **Need permanent, effective cooling for health and safety**
- **Needs exist beyond available funding, long waitlists**
- **Programmatic Stacking of funds is always required**
- **Serving fully from all programs requires case management**

**Focus on oldest mobile and single-family homes**

- Greatest emissions per year and per square foot
- Aggressive outreach and targeted marketing needed to reach those who are unaware of existing programs
- Funding is needed to address issues that prevent upgrades – repairs, contamination (lead/asbestos), ownership
- Allocate % of funding to disadvantaged households

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**Recommendation 1**

**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 Climate Protection Program, the bulk of the emissions are in the current housing supply up until 2050.
Recommendation 2

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

- Single family homes make up the largest portion of emissions
- Mobile/manufactured homes have the largest per unit and per square foot emissions, due largely to their building envelopes.
- Low-income single-family homes represent a significant equity and emissions reduction opportunity
- Low-income apartments need permanent cooling

Recommendation 3

Finance, outreach, and project management are critical

- The financing required for administering such a large acceleration in decarbonization would likely come from private debt
  - An ESCO organization could aid in securing funding.
- Coordinated outreach needs amplification.
  - There are many agencies and service providers, but they do not coordinate in messaging or in practice.
  - A central messaging resource would let all parties 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.
  - A project manager could connect consumers and contractors to accelerate the current ad-hoc process
  - Or take a greater managerial role as in the Ithaca example.
Recommendation 4

Align timelines (but not goals) with the State’s

- Aligning the timepoints will make compliance and reporting easier for companies and agencies.
- 100% by 2050 pushes beyond the State's goal of 80% by 2050 but with less paperwork

Questions
Best Practice: Energy Efficiency

Supporting Action – Home Energy Score

► Voluntary scoring already promoted by ODOE/City
► Low-income already supported by UO/City
► Could be made mandatory at the point of sale/rental

<table>
<thead>
<tr>
<th>Energy/</th>
<th>Energy Efficient Characteristics</th>
<th>Home Energy Score</th>
<th>Energy Audit</th>
<th>Educational Information</th>
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<td>Minneapolis, MN</td>
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<td>San Francisco, CA</td>
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</table>

Implementation Costs

Natural Gas – Forecast Cost, by Sector

Image Credit: Energy + Environmental Economics, Four Pillars of Deep Decarbonization
### Best Practice: Energy Efficiency

#### NREL Analysis Efficiency Opportunities

**Oregon Top 10 Improvements**

<table>
<thead>
<tr>
<th>Oregon Utility Bill Savings (electricity, gas, propane, and fuel oil)</th>
<th>Statewide Annual Consumer Savings</th>
<th>Average Annual Savings (per household)</th>
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<tbody>
<tr>
<td><strong>Enclosure</strong></td>
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<tr>
<td>Drill-and-fill wall cavity insulation</td>
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<td>$377</td>
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<tr>
<td><em>High-efficiency heat pump (replace electric furnace at wear out)</em></td>
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<td>$898</td>
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<tr>
<td><strong>Enclosure</strong></td>
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<tr>
<td>R-10 crawlspace walls</td>
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<td>$228</td>
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<tr>
<td><strong>HVAC</strong></td>
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<tr>
<td>Ductless heat pump (displaces electric baseboard)</td>
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<td>$720</td>
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<td>HVAC</td>
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<tr>
<td>Duct sealing &amp; insulating</td>
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<td>$134</td>
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<td><strong>Enclosure</strong></td>
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<tr>
<td>R-6 insulated wall sheathing (at siding replacement)</td>
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