



SALEM, OREGON

Community Greenhouse Gas Inventory

Prepared by
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May 24, 2019



Introduction

Salem is growing. By 2035, the population of Salem's Urban Growth Boundary (UGB) is projected to reach nearly 270,000.¹ This growth will bring jobs, construction, and investment to the region while contributing to a global population expected to surpass 8.5 Billion by 2030².

Along with the benefit that increased human activity can provide, comes a potential cost: climate change. The Intergovernmental Panel on Climate Change (IPCC), the United Nations body that regularly convenes climate scientists, has identified human activity as the primary driver of global climate change³.

Salem is not immune to the impacts of climate change. Everything from the Willamette Valley produce on our table to the Santiam River water flowing from our taps is susceptible to climate change. Recognizing this, the 2017 Salem Strategic Plan identified a GHG inventory as a way to measure the community's impact on the environment.

This Community Greenhouse Gas (GHG) Inventory report was prepared using the "Global Protocol for Community Scale Greenhouse Gas Emission Inventories" (GPC). The GPC is an internationally-accepted method for community-scale GHG accounting that covers a range of emissions sources including transportation, waste production, and energy use. The report provides a snapshot of emissions from human activity within and originating from Salem's city limits and surveys a variety of emissions sources, highlighting areas for further study.

Looking ahead, this inventory will allow Salem to track progress toward any future emissions reduction targets by providing a baseline against which to compare future years of inventory data. Most importantly, this inventory represents the City of Salem's first step toward understanding the community's impact on the environment and mitigating its contribution to global climate change.

1. *Salem Housing Needs Analysis 2015-2035 (2014)*, ECONorthwest







2. *United Nations News Centre (2015)*

3. *IPCC Climate Change 2014 Synthesis Report (2014)*



About the Inventory

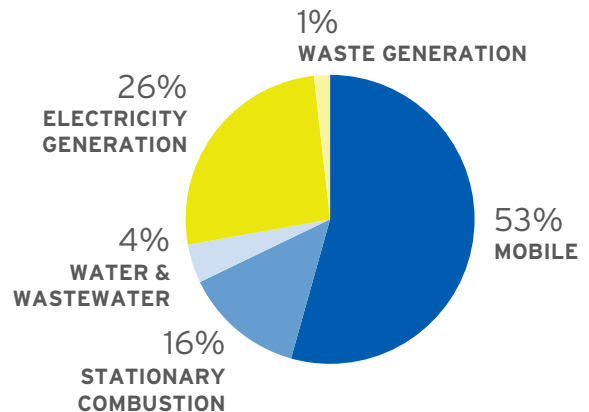
The Salem Community Greenhouse Gas Inventory was prepared in accordance with the Global Protocol for Community Scale Greenhouse Gas Emission Inventories using the EPA's Local Greenhouse Gas Inventory Tool. Inventory data was gathered for the 2016⁴ calendar year from federal, state, and local sources, including utilities. The inventory spans six emissions source categories as shown below. As a community-scale inventory, it accounts for emissions from Salem's residents, employees, and visitors undertaken within or originating from its city limits. It does not include GHG emissions related to the consumption of goods within Salem's city limits that originated elsewhere⁵.

SCOPE 1			SCOPE 2	SCOPE 3	
					
MOBILE EMISSIONS	STATIONARY COMBUSTION	WATER & WASTEWATER	ELECTRICITY GENERATION	AGRICULTURE / URBAN FORESTRY	WASTE GENERATION
Driving within city limits and local flights originating from Salem's airport.	Combustible fuel use, such as natural gas, in residential and commercial buildings.	Water supply and wastewater generation within city limits.	Electricity used by Salem's residential and commercial customers.	Carbon released by agriculture fertilizer and carbon removed by urban tree cover.	Solid waste sent to landfills and waste-to-energy facilities.

Results In Brief

In 2016, the City of Salem's residents, businesses, employees, and visitors produced 1,553,573 Metric Tons of CO₂ equivalent (CO₂e). This equates to roughly 9.59 Metric Tons of CO₂e per capita. Of the six emissions source categories surveyed, mobile emissions made up over half (53 percent) of the CO₂e produced. Electricity generation comprised over one quarter of all emissions, while residential and commercial fuel combustion was the third largest contributor at 16 percent.

CITY OF SALEM GROSS GHG EMISSIONS BY SOURCE* (2016)



* Agriculture and urban forestry not included due to a net reduction in GhG emissions.

4. 2016 was chosen for analysis due to availability of American Community Survey data
 5. It is possible that future inventories could include both consumption and sector-based sources of emissions once data is becomes more readily available.



SCOPE 1

MOBILE EMISSIONS

The majority of Salem’s greenhouse gas emissions (53 percent) are attributable to mobile sources. Of this, over 99 percent came from tailpipe emissions from driving within Salem’s city limits while less than 1 percent came from local traffic through McNary Field, Salem’s municipal airport.

Using data provided the Mid-Willamette Valley Council of Governments (MWVCOG), it was estimated that over 4 million vehicle-miles per day, on average, were traveled within the City of Salem in 2016⁶. That amounts to nearly 1.5 billion vehicle-miles traveled (VMT) annually. Each mile driven within the City of Salem emits roughly 1.2 pounds of CO₂e⁷, totaling over 837,000 metric tons each year.

As the center of commerce for the mid Willamette Valley and Oregon’s state capital, Salem has an abundance of jobs. However, many of the people who hold these jobs do not live in Salem. Of the nearly 90,000 people who work in Salem, over 63 percent commute from somewhere else⁸.

Commuters from outside Salem are only part of the picture. Over 86 percent of Salem’s employed residents commute to work by car, a higher rate than other large Oregon cities and a major contributor to Salem’s mobile emissions.

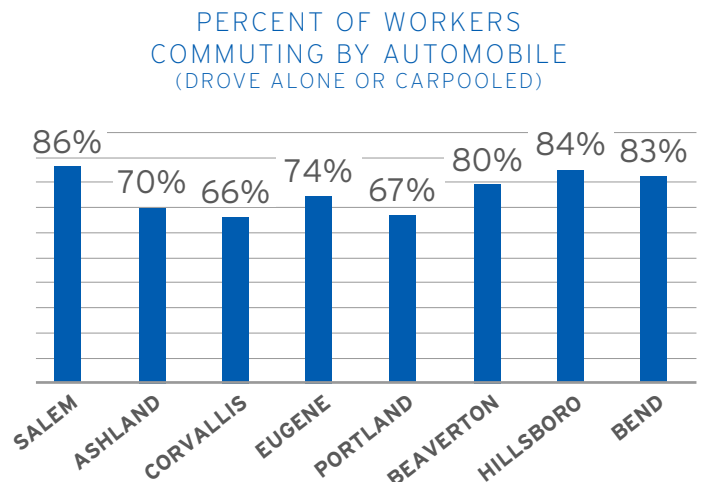
6. MWVCOG SKATS Travel Demand Model (2015), trips starting and/or ending in Salem city limits only
7. ODOT Fuel Economy Survey (2017)
8. Census Longitudinal Employee-Household Dynamics (2015)

MOBILE EMISSIONS: AT A GLANCE

OVER 4 MILLION AVERAGE DAILY VMT
From trips starting and/or ending in Salem limits

11,085 ANNUAL TRIPS
Made by local air traffic from McNary Field

837,185 METRIC TONS OF CO₂e
Released into the atmosphere from this emissions source



Source: 2012 -2016 American Community Survey (ACS) 5-Year Estimates



SCOPE 1

STATIONARY COMBUSTION

Stationary combustion was responsible for just over 14 percent of Salem's annual greenhouse gas emissions in 2016. Stationary combustion includes the use of combustible fuels like natural gas for cooking, heating, and commercial processes. Data from the Oregon Department of Environmental Quality (DEQ), Northwest Natural, and the US Census Bureau were used to estimate stationary combustion within Salem's city limits.

The vast majority of stationary combustion emissions (98 percent) occurred as the result of natural gas use. The remainder was the result of home heating using fuel oil, or propane⁹. Of the natural gas consumption that occurred, the greatest intensity of use came from commercial/industrial users. As the chart to the right shows, the average commercial/industrial customer used roughly 10 times as much natural gas as the average residential customer.

Of the 254,018 metric tons of CO₂e released as a result of stationary combustion, just under 39 percent was attributable to residential heating and cooking while the remainder was the result of combustion for commercial, industrial, or institutional applications.

STATIONARY COMBUSTION:

AT A GLANCE

OVER 50% OF SALEM HOUSEHOLDS

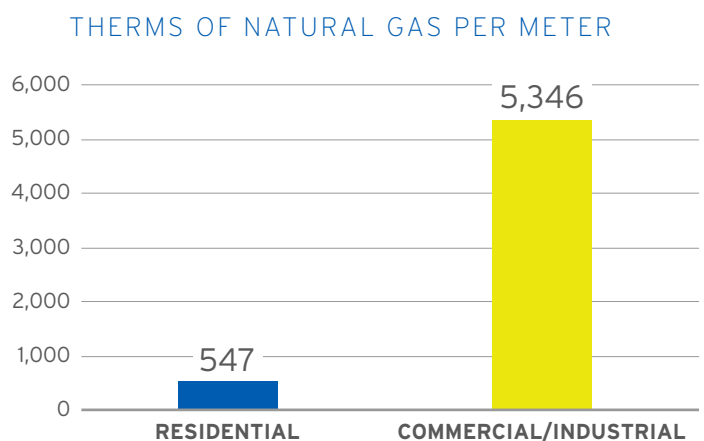
Heat their homes through stationary combustion

OVER 28 MILLION THERMS OF NATURAL GAS

Delivered to residential and commercial customers

254,018 METRIC TONS OF CO₂e

Released into the atmosphere from this emissions source



9. 2012 - 2016 American Community Survey (ACS) 5-Year Estimates



SCOPE 1

WATER & WASTEWATER

Water delivery and wastewater treatment accounted for roughly 4 percent of Salem’s annual GHG emissions in 2016. Because Salem receives water from the North Santiam River watershed, the only emissions associated with its delivery are the result of electricity used by pump stations. This is captured in Scope 2: Electricity Generation.

The sole source of emissions captured within this emissions source category is the treatment of wastewater at the Willow Lake Wastewater Pollution Control Facility. Each day, Willow Lake processes up to 200 million gallons of wastewater¹⁰.

The primary greenhouse gas produced as a byproduct of the wastewater treatment process is methane. Specifically, of the 360,000 cubic feet of biogas produced by Salem’s wastewater treatment processes each day, 61 percent is methane¹¹.

While the metric tons of CO₂e produced by Salem’s wastewater treatment plant reflect operations as of 2016, it should be noted that upgrades are currently being made to the Willow Lake plant. As of this writing, the City of Salem is working with Energy Trust of Oregon to install a new co-generation facility that will convert much of the methane produced as a result of wastewater treatment into energy.

10. www.cityofsalem.net/Pages/willow-lake-wastewater-treatment.aspx

11. Interview with City of Salem Public Works (October, 2018)

WATER & WASTEWATER:

AT A GLANCE

NEARLY 98% OF SALEM HOUSEHOLDS

Are served by sanitary sewer

360,000 CUBIC FEET OF BIOGAS

Produced daily by Salem’s wastewater treatment plant

66,736 METRIC TONS OF CO₂e

Released into the atmosphere from this emissions source



Willow Lake Wastewater Treatment (Source: City of Salem)



SCOPE 2

ELECTRICITY GENERATION

At just over 26 percent, electricity generation contributed the second largest share of Salem's greenhouse gas emissions in 2016.

Salem's residents and businesses are served by two electric utilities: Salem Electric, a publicly owned cooperative, and Portland General Electric (PGE), an independent public utility. Salem Electric serves roughly 13,000 customers primarily in West Salem, while PGE serves over 60,000 customers in the Marion County portion of Salem's city limits.

Just over half (54 percent) of Salem's annual electricity demand is from commercial / industrial users who make comprise roughly 18 percent of the electric meters served by Salem Electric and PGE.

Salem has some of the cleanest electric power in Oregon, but each kWh delivered to Salem's rate payers is not created equal. That is because Salem Electric purchases all of its electricity from the Bonneville Power Administration (BPA) as hydropower.¹² Portland General Electric, as the chart to the right shows, generates electricity from plants it owns as well as power it purchases from the wholesale market¹³. This includes a mix of wind, hydropower, natural gas, and Oregon's last remaining coal-fired power plant, located in Boardman¹⁴.

12. www.salemelectric.com/cooperative/faq

13. Includes power purchased from the Covanta Marion Waste-to-Energy Facility

14. www.portlandgeneral.com/our-company/energy-strategy/how-we-generate-electricity

ELECTRICITY GENERATION:

AT A GLANCE

OVER 54% OF SALEM'S
ELECTRICITY USE

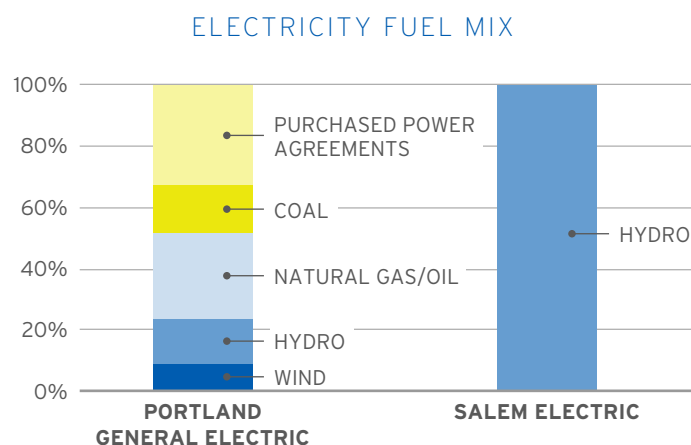
Is the result of commercial or industrial activities

1.28 BILLION KILOWATT HOURS (kWh)

Delivered to Salem residents and businesses in 2016

400,814 METRIC TONS OF CO₂e

Released into the atmosphere from this emissions source





SCOPE 3

AGRICULTURE / URBAN FORESTRY

Agriculture and urban forestry play a unique role in greenhouse gas emissions inventories. On the one hand, agriculture can release greenhouse gases into the atmosphere through the use of certain fertilizers. On the other hand, the plants that comprise some agricultural activities and the trees and shrubs that grow in urban areas are a source of carbon sequestration - the long-term storage of carbon in plants, soils, and water bodies.

Because there are relatively few farms or other agricultural uses within Salem's city limits and because Salem has a robust tree canopy, this emissions source category produces a net reduction in CO₂e for the city of Salem. The 7,045 acres of urban forest within Salem's city limits sequesters 23,312 metric tons annually, or roughly a 1 percent reduction in citywide greenhouse gas emissions.

The annual net reduction from carbon sequestration was calculated using data from the city of Salem's 2014 Community Forestry Strategic Plan¹⁵.

AGRICULTURE AND URBAN FORESTRY

AT A GLANCE

7,045 ACRES

Of urban tree canopy in Salem city limits

NEARLY 18% OF SALEM'S LAND AREA

Is covered by urban tree canopy

23,312 METRIC TONS OF CO₂e

Absorbed into Salem's urban tree canopy annually



Credit: Ron Cooper

15. www.cityofsalem.net/citydocuments/community-forestry-strategic-plan.pdf



SCOPE 3

WASTE GENERATION

Solid waste generated by Salem residents, visitors, and businesses accounted for roughly 1 percent of citywide GHG emissions in 2016.

The vast majority of Salem's solid waste is sent to two locations: the Coffin Butte Landfill (Benton County) and the Covanta Waste-to-Energy Facility (Marion County). The way these two facilities process waste is very different. At Coffin Butte, waste is landfilled, and some of the resulting methane is burned for power. At Covanta, solid waste is incinerated to produce power resulting in ash byproduct which is then sent to Coffin Butte.

Using data from Oregon DEQ, Republic Services, and the Mid-Valley Garbage Recycling Association, it was estimated that the city of Salem sent 46,469 metric tons of solid waste to the Coffin Butte Landfill in 2016 resulting in 2,376 metric tons of CO₂e. For Covanta, it was estimated that 46,250 metric tons of the solid waste it received in 2016¹⁶ came from the city of Salem leading to net emissions of 15,744 metric tons of CO₂e.

16. *Mid-Valley Garbage Recycling Association*

17. *Case Study: Marion County Waste to Energy Facility, Governmental Advisory Associates (2013)*

18. *Salem's share of these emissions proportional to amount of solid waste sent to the Covanta WTEF.*

WASTE GENERATION

AT A GLANCE

92,719 METRIC TONS OF
SOLID WASTE

Generated within Salem city limits in 2016

93,506 MEGAWATT HOURS GENERATED

By the Covanta WtEF in 2016¹⁷

18,120 METRIC TONS OF CO₂e

Released into the atmosphere from this emissions source

WHAT'S THE DEAL WITH COVANTA MARION?

Marion County is unique in how it manages solid waste. Instead of decomposing in landfills, waste is used to generate electricity. Waste sent to the Covanta WtEF emits little to no landfill gas, but as a result of incineration, still results in GHG emissions.

Though the GPC does not require communities to account for emissions from energy generation outside their municipal boundary, a portion of the emissions generated by the Covanta WtEF were included in this inventory. That portion is the difference between the emissions Covanta Marion produced and the emissions that a reasonable source of alternative power, such as natural gas, would emit to generate the same amount of electricity¹⁸.

How do other cities compare?

In 2016, Salem emitted 9.57 metric tons of CO₂e per capita. This puts Salem squarely in the “middle of the pack” compared to other Oregon cities. In order to better understand what drove Salem’s 2016 Greenhouse Gas Emissions Inventory performance, it is helpful to break apart the key components of total emissions.

When compared to other cities based on per capita emissions from energy generation alone, Salem performs among the best. This is due to the relatively clean mix that Salem Electric and PGE provide to Salem’s residents and businesses. Only Eugene has lower per capita emissions, likely owing to the fact that over 80 percent of its electricity comes from hydropower.

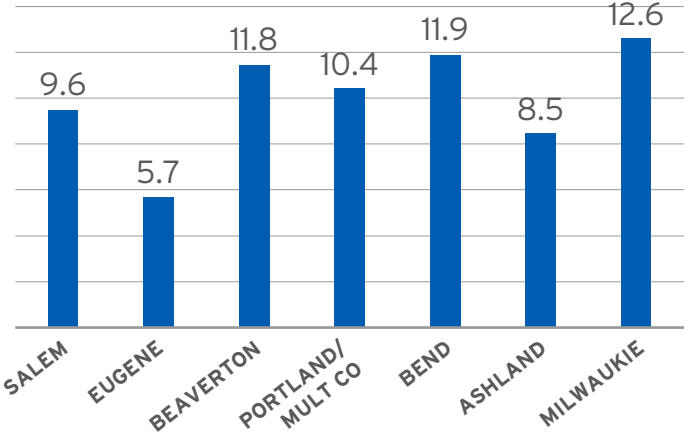
Transportation emissions per capita tell a different story. With 5.2 metric tons of CO₂e per capita, Salem ranks among the biggest emitters of mobile emissions among major Oregon cities. As discussed previously, this is due in large part to the driving habits of residents and the commute patterns of workers who live elsewhere.

What's next?

We are in a defining moment. With the completion of this Community GHG Inventory, Salem now has a better understanding of its emission sources and its environmental impact. This inventory will help Salem set emission reduction goals, track progress toward those goals, and prepare a Climate Action Plan.

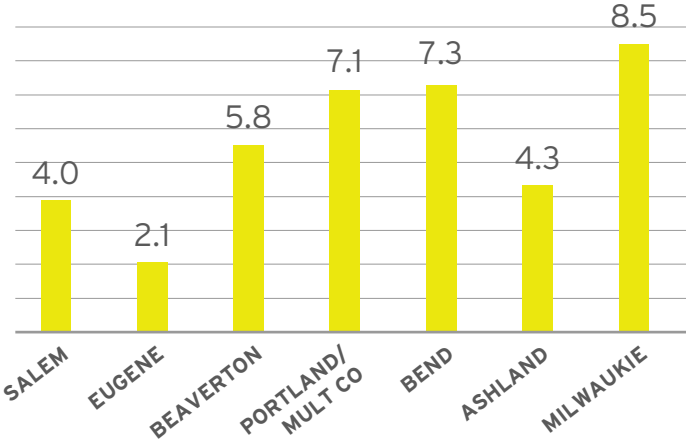
Salem is also in the midst of updating its Comprehensive Plan, which will guide future growth and development in the area. Salem can use this inventory to inform policies about how the city grows, which can have a major impact on community-scale GHG emissions.

PER CAPITA EMISSIONS (MTCO₂e)*



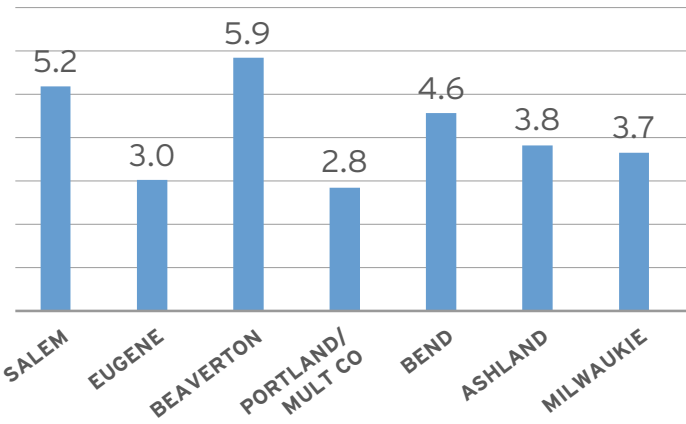
*Comparison inventory years vary (Eugene: 2015, Beaverton: 2013, Bend: 2016, Portland: 2008, Ashland: 2015, Milwaukie: 2016)

PER CAPITA ENERGY EMISSIONS (MTCO₂e)*



*Stationary energy use from electricity, natural gas, and other fuels.

PER CAPITA TRANSPORTATION EMISSIONS (MTCO₂e)



Glossary

Anthropogenic Emissions

Emissions that are associated with human activities, of greenhouse gases, greenhouse gas precursors, and aerosols. These include burning of fossil fuels for energy, deforestation, and land-use changes that result in net increases in emissions.

Biogenic

Produced, or brought about by, living organisms. Biogenic emissions occur as the result of combustion or decomposition of biological materials.

Carbon Sequestration

A natural or artificial process, by which carbon dioxide is removed from the atmosphere and held in solid or liquid form. Trees, for example, sequester carbon over the lifetime of the tree by turning atmospheric carbon into wood, leaves, and other parts of the tree.

CO₂ Equivalents

A measure of how much global warming a given type and amount of greenhouse gas may cause, or its Global Warming Potential (GWP), using the functionally equivalent amount or concentration of carbon dioxide (CO₂) as the reference. For example, the GWP for methane over 100 years is 34, and for nitrous oxide is 298. This means that emissions of 1 million metric tons (MMT) of methane and nitrous oxide respectively is equivalent to emissions of 34 and 298 MMT of carbon dioxide.

Greenhouse Gas

A gas that contributes to the greenhouse effect by absorbing infrared radiation, such as carbon dioxide, methane, and chlorofluorocarbons.

Kilowatt Hours (kWh)

A measure of electrical energy, equivalent to the consumption of 1,000 watts of power for 1 hour.

Scope

The extent of the area or subject matter that something deals with or to which it is relevant. For GHG emissions reporting and inventory purposes,

GHG emissions are classified into three 'scopes'.

- **Scope 1** emissions are direct emissions from sources located within the city boundary.
- **Scope 2** emissions are indirect emissions from the generation of purchased energy, or otherwise occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the city boundary.
- **Scope 3** are all other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary.

Urban Forestry

The planting, care, and management of single trees and tree populations in urban settings for the purpose of improving the urban environment, and providing the benefits of trees and tree cover to urban human and wildlife populations.

Urban Growth Boundary (UGB)

A land use planning line used to control urban sprawl by mandating that the area inside the boundary be used for urban development and the area outside be preserved for farm and forest lands.

Vehicle-Miles Traveled (VMT)

A measure of the amount of travel by vehicles over a given period of time, typically a one-year period, but also reported daily, and sometimes cumulatively over a period of many years.

Waste-to-Energy Facility (WtEF)

Waste-to-energy (WtE) or energy-from-waste (EfW) is the process of generating energy in the form of electricity and/or heat from the primary treatment of waste, or the processing of waste into a fuel source. A WtEF is a physical facility that conducts energy recovery activities fueled, at least partially, by solid, liquid, and/or gaseous waste.

ACKNOWLEDGMENTS

CITY OF SALEM

Norman Wright, *Director, Community Development Department*

Lisa Anderson-Ogilvie, *Deputy Director, Community Development Department*

Eunice Kim, *Senior Planner, Community Development Department*

Keith Garlinghouse, *Utilities Engineer, City Of Salem Public Works*

Jason Pulley, *Utilities Planning Coordinator, City Of Salem Public Works*

Ben Haney, *Engineering Program Manager, City Of Salem Public Works*

John Paskell, *Manager, Salem Municipal Airport*

MARION COUNTY

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PUBLIC UTILITIES

Brendan McCarthy, *Portland General Electric*

Wendy Veliz, *Portland General Electric*

Brittni Davidson, *Salem Electric*

Erik Voice, *Salem Electric*

Bruce Anderson, *NW Natural Gas*

Rick Hodges, *NW Natural Gas*

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