GREENHOUSE GAS FORECASTING/PLANNING ASSUMPTIONS AND DATA SOURCES

NOVEMBER 2021

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The following section includes the assumptions and data sources that were used to conduct the greenhouse gas (GHG) forecasting described in the Greenhouse Gas Emissions Forecast chapter of this plan.

Baseline Forecast Assumptions
Salem developed three baseline forecasts from which to measure emissions reductions. These forecasts provide a range of possible business-as-usual (BAU) outcomes and provide a qualitative estimate of forecast certainty.

The baseline forecasts that were developed provide three projections for possible future GHG levels, assuming no proactive steps were taken by Salem to reduce emissions through its Climate Action Plan. In the end, the Mid-Range forecast (described below) was used for further modeling. The other two scenarios provide context on the range of possible forecasted futures. These forecasts are not an estimate of where Salem *will* be, because they exclude actions that Salem will take to reduce GHG emissions. Rather, these baseline forecasts provide possible scenarios for Salem's GHG emissions if no strategies from this Climate Action Plan are implemented.

Labeled as "Pessimistic," "Mid-Range," and "Optimistic," the following baselines are built on varying degrees of assumptions about changes in transportation and stationary emissions (e.g., like those from power plants) intensity in the future (see Table 1). For example, the Pessimistic forecast assumes no change in fuel efficiency of onroad passenger vehicles. Although that assumption may seem extreme, new vehicle MPG has increased slowly through much of the last few decades[1] and those increases are diluted by older vehicles on the road and the market prevalence of SUVs in recent years.[2] Whereas the Mid-Range and Optimistic baselines include a 5% annual efficiency improvement that aligns with Obama-era regulations requiring a higher rate of increased MPG for new vehicles. These forecasts also differ in their treatment of emissions factors (the amount of CO_2e produced per unit of activity) for electricity and efficiency of natural gas.

BASELINE FORECAST RESULTS AND DISCUSSION

The three baseline forecasts yield a wide range of outcomes. Descriptions of the outcomes for each forecast is provided in this section. The Pessimistic forecast predicted an increase in GHG emissions of 14% in 2050 from 2016 levels. Emissions remained fairly flat between 2025-2040 but began increasing at a more rapid pace between 2040-2050 as transportation emissions were no longer offset by decreases in emissions from other sources. Emissions from electricity declined, but those declines were significantly offset by increases in transportation emissions, which rose throughout the forecast period.

The Mid-Range forecast showed a 47% reduction in emissions between 2016 and 2050. Emissions peaked in 2020-2021 before declining until 2045, after which emissions began to increase, primarily due to transportation. Electricity emissions reached near-zero in 2040. Transportation emissions declined until 2045 and then increased slightly.

The Optimistic forecast led to a 64% decline in emissions between 2016 and 2050. Emissions peaked in 2020-2021 before

rapidly declining and then stabilizing around 2045. Electricity emissions declined and then effectively disappeared by 2040 due to very-low electricity emission factors. Transportation emissions declined after 2020 although the rate of decline decreased with time. By 2050, transportation ranked as the largest source of GHG emissions (55%). Wastewater constituted 20% of remaining emissions and natural gas, 16%.

Given the range of 2050 outcomes predicted by the three forecasts (14% increase, 47% decrease, 64% decrease) and given equal likelihood of occurrence, then together the models predict an average decrease of 32% and a median decrease of 47%. Whether the three forecasts are equally likely to occur is subjective. For simplicity, the Mid-range model was used for further projections rather than developing a composite model. The Pessimistic forecast is the closest to a standard BAU model, and therefore most comparable to forecasts from most other CAPs. The assumptions in this forecast are fairly stark and may approach the upper limits of what is likely to occur. For example, the assumption that passenger vehicle MPG efficiency does not improve by 2050 may be too conservative. In all forecasts, PGE achieves carbon neutrality, Salem Electric emissions (which are negligible) remain constant, and NW Natural follows a single scenario to achieve carbon neutrality according to state regulations. If actual utility emissions differ, or if NW Natural seeks a different strategy mix to achieve regulatory requirements, then emissions will differ.

PESSIMISTIC GREENHOUSE GAS (GHG) FORECAST

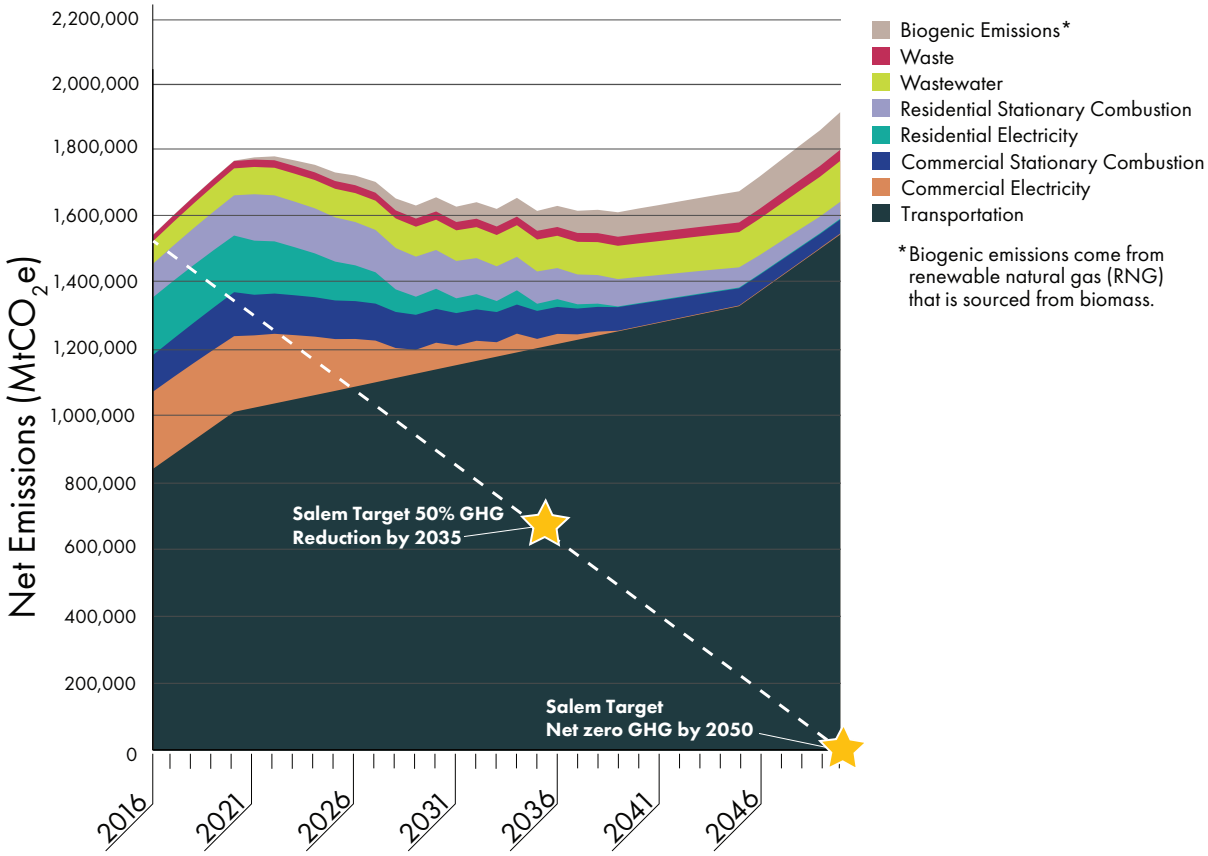

Figure 1. Pessimistic forecast.

MID-RANGE GREENHOUSE GAS (GHG) FORECAST

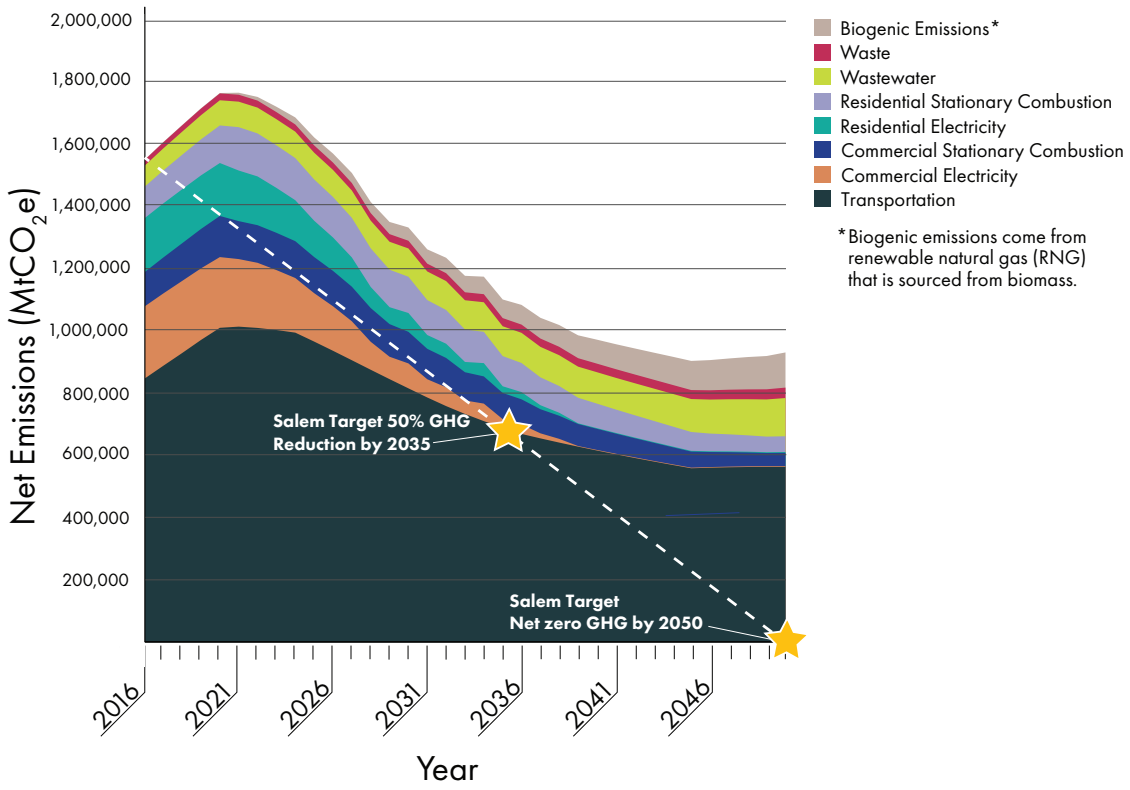

Figure 2. Mid-Range forecast.

OPTIMISTIC GREENHOUSE GAS (GHG) FORECAST

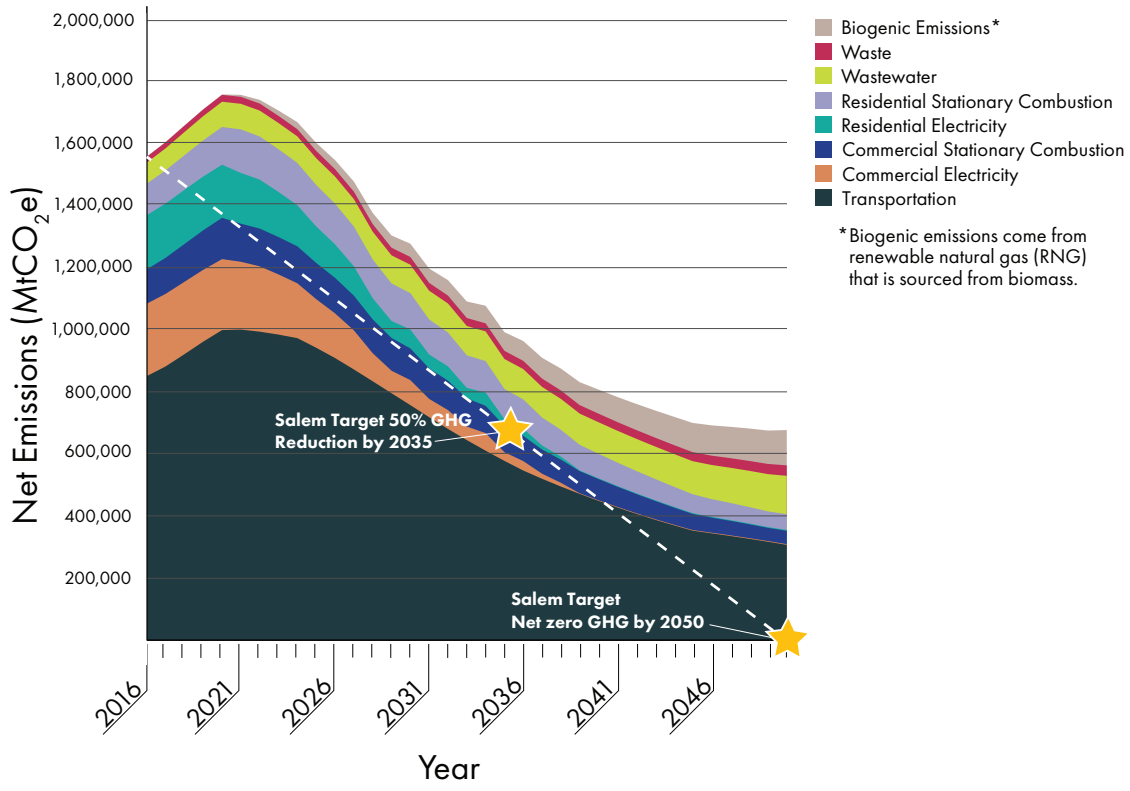

Figure 3. Optimistic forecast.

Conversely, the Optimistic forecast may not be the lower bounds of what is possible without Salem's intervention. The Optimistic forecast is grounded in what is known today and does not include technological interventions that are not currently expected to become feasible. For example, direct carbon capture and sequestration are already possible but are not yet economically feasible or deployable on a large scale. These types of technologies might be deployed en masse before 2050, but without concrete plans, they could not be included in the forecast.

FUNDAMENTAL MODELING ASSUMPTIONS BY BASELINE FORECAST

CATEGORY	VARIABLE	PESSIMISTIC	MID-RANGE	OPTIMISTIC
Population	Growth Rate	Annualized estimates from 5-year Portland State University Projections	Annualized estimates from 5-year Portland State University Projections	Annualized estimates from 5-year Portland State University Projections
Transportation	Passenger MPG	No change from 2016	Annualized 5% improvement	Annualized 5% improvement
	EV Adoption Rate	No change from 2016	Low adoption rate	High adoption rate
	Heavy vehicle MPG	No change from 2016	Annualized improvement rate	Annualized improvement rate
	Air travel emissions	Grows with population, baseline 2016	Grows with population, baseline 2016	Grows with population, baseline 2016
Electricity	Salem Electric Emissions Factor	No change from 2016	No change from 2016	No change from 2016
	PGE Emissions Factor	Achieves 2040 net-zero	Achieves 2040 net-zero	Achieves 2040 net-zero
Stationary combustion	NW Natural	Scenario provided by NW Natural	Scenario provided by NW Natural	Scenario provided by NW Natural
	Other fuels (ex: diesel, propane)	No change from 2016	No change from 2016	No change from 2016
Waste	Waste	No change in per capita use	No change in per capita use	No change in per capita use
Wastewater	Wastewater	No change in per capita use	No change in per capita use	No change in per capita use

Table 1. Fundamental modeling assumptions by baseline forecast.

DATA SOURCES

ENERGY EMISSIONS FACTOR PROJECTIONS

The PGE 2019 Integrated Resource Plan (IRP) goal, NW Natural efficiency, and NW Natural high efficiency goal were obtained verbally. NW Natural Efficiency has a goal to improve efficiency 47% from 2002 values by 2037. Given the challenge in achieving that goal, two columns were created to represent different assumptions for baselining. In one scenario, NW Natural achieves a 11% efficiency gain while in the other scenario, NW Natural achieves its goal. Salem Electric's projected emissions factor was obtained from Salem's 2016 sector-based GHG inventory[3] and held constant. The PGE 2040 was linearly modeled from actual 2016 to goal 2040.

TRANSPORTATION-RELATED ASSUMPTIONS			
YEAR	VEHICLE FUEL EFFICIENCY IMPROVEMENTS (MPG)[4]	EV ADOPTION RATE[5]	HEAVY TRUCK EFFICIENCY IMPROVEMENTS (MPG)[6]
2016	25	1%	0%
2020	26	3%	0%
2025	40	8%	8%
2030	49	24%	17%
2035	57	43%	27%
2040	66	54%	36%
2045	74	65%	46%
2050	83	76%	55%

Table 2. Fundamental model assumptions for transportation.

ENERGY EMISSIONS FACTOR PROJECTIONS			
YEAR	PGE 2040 IRP GOAL ($MTCO_2E$/ MWH)	SALEM ELECTRIC ($MTCO_2E$/ MWH)	NW NATURAL ($MTCO_2E$ EXCLUDING BIOGENIC EMISSIONS AND OFFSETS)
2016	0.37	0.01	205,809
2020	0.30	0.01	247,250
2025	0.20	0.01	243,329
2030	0.09	0.01	212,783
2035	0.03	0.01	176,254
2040	0	0.01	142,217
2045	0	0.01	108,193
2050	0	0.01	89,417

Table 3. Projected emissions factors for Salem Electric and PGE. Projected emissions (excluding biogenic and offsets) from NW Natural.

POPULATION GROWTH PROJECTIONS[7]	
YEAR	POPULATION SALEM
2016	162,060
2020	194,692
2025	206,712
2030	219,061
2035	231,260
2040	243,302
2045	255,373
2050	296,470

Table 4. Salem population projections, based on Portland State University projections, used for modeling.

REDUCTION VALUES USED TO DRIVE OUTCOMES IN SCENARIO 2								
YEAR	**Emissions from non-resident internal combustion traffic are zero**	**Emissions from air traffic are zero**	**Electricity grid is 100% renewable**	**Fossil fuel-derived natural gas in the built environment has been replaced**	**All other fossil fuels in the built environment (e.g., diesel, propane) have been replaced**	**Net-zero waste achieved**	**All waste-water emissions captured**	**All septic emissions captured**
2030	100%	100%	100%			100%	100%	100%
2031	90%	90%	95%			95%	95%	95%
2032	80%	80%	90%			90%	90%	90%
2033	70%	70%	85%			85%	85%	85%
2034	60%	60%	80%			80%	80%	80%
2035	50%	50%	75%			75%	75%	75%
2036	40%	40%	70%			70%	70%	70%
2037	30%	30%	65%			65%	65%	65%
2038	20%	20%	60%			60%	60%	60%
2039	10%	10%	55%			55%	55%	55%
2040	5%	5%	50%	100%	100%	50%	50%	50%
2041	0%	0%	45%	90%	90%	45%	45%	45%
2042	0%	0%	40%	80%	80%	40%	40%	40%
2043	0%	0%	35%	70%	70%	35%	35%	35%
2044	0%	0%	30%	60%	60%	30%	30%	30%
2045	0%	0%	25%	50%	50%	25%	25%	25%
2046	0%	0%	20%	40%	40%	20%	20%	20%
2047	0%	0%	15%	30%	30%	15%	15%	15%
2048	0%	0%	10%	20%	20%	10%	10%	10%
2049	0%	0%	5%	10%	10%	5%	5%	5%
2050	0%	0%	0%	0%	0%	0%	0%	0%

Table 5: Percentage of 2016 emissions projected to decrease by year in order to achieve Scenario 2.

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1 Bureau of Transportation Statistics. "Average Fuel Efficiency of U.S. Light Duty Vehicles." National Transportation Statistics. Accessed April 6, 2021. https://www.bts.gov/content/average-fuel-efficiency-us-light-duty-vehicles

2 Voelk, Tom. "Rise of S.U.V.s: Leaving Cars in Their Dust, With No Signs of Slowing." The New York Times, May 21, 2020. https://www.nytimes.com/2020/05/21/business/suv-sales-best-sellers.html.

3 City of Salem and Cascadia Partners. "Salem, Oregon: Community Greenhouse Gas Inventory." May 24, 2019. https://www.cityofsalem.net/citydocuments/final-community-greenhouse-gas-inventory.pdf.

4 Clifford Atiyeh, "U.S. Sets Final Fuel Economy, Emissions Standards for 2021–2026 Vehicles," Car and Driver, March 31, 2020, https://www.caranddriver.com/news/a31993900/us-final-fuel-economy-emissions-standards-2021-2026/.

5 *Electric Vehicle Outlook 2017*, Bloomberg New Energy Finance, July 2017, https://data.bloomberglp.com/bnef/sites/14/2017/07/BNEF_EVO_2017_ExecutiveSummary.pdf.

6 *Oregon Statewide Transportation Strategy: A 2050 Vision for Greenhouse Gas Emissions Reduction*, Volume 2, Technical Appendices, Oregon Sustainable Transportation Initiative, Oregon Department of Transportation, December 2012, https://www.oregon.gov/odot/Planning/Documents/STS-Technical-Appendices.pdf.

7 These figures were provided by the City of Salem and are taken from Portland State University Population Estimate Reports. See https://www.pdx.edu/population-research/population-estimate-reports.