CITY OF BEND

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Technical Memorandum:

SUMMARY OF ANALYSIS USED TO ESTABLISH CLIMATE POLLUTION FEE

May 22, 2026

Introduction

The City plans to implement a Climate Pollution Fee to address fossil fuel emissions resulting from the use of gas appliances in Bend. Gas appliances cause fossil fuel emissions that, on average, exceed the emissions from comparable electric appliances. These additional emissions impose costs on Bend and surrounding communities. The Climate Pollution Fee promotes the general welfare of Bend residents by ensuring that some or all of those costs are reasonably attributed to those choosing to install these appliances in new residential construction within the City of Bend.

The current Bend City Council has been discussing policy options to encourage electrification of buildings in Bend since early 2024 as part of achieving the City's climate action goals, which were established by Council Resolution 3044 in 2016. In early 2025, the City Council adopted the 2025 Bend Community Climate Action Plan Update, which includes a strategy to develop policies to limit fossil fuel use in new construction. Also in early 2025, the City Council directed staff to pursue the development of a Climate Pollution Fee on natural gas appliances in new construction.

The City engaged Brightline Group to assist in establishing a fee design and assigning appropriate costs to appliances based on environmental impact. This memo summarizes the approach and data sources used to establish the fee design and anticipated amount of the fee for each gas appliance.

Definitions

The following are definitions of key terms and inputs used in the development of the Climate Pollution Fee.

1. **Carbon Intensity:** The amount of carbon produced per unit of energy based on the fuel mix of the source energy used. A fuel mix with a higher amount of fossil fuels as source energy will produce more carbon per unit of energy used by the appliance.

2. **Cabon Produced**: The total amount of carbon produced by each appliance over its lifetime of service within a household. The amount of carbon produced per unit of energy varies according to the fuel source of the energy used.
3. **Net Lifetime Carbon Produced:** The total amount of carbon produced by each gas appliance, less the total carbon produced by the electric appliance replacement. Using a net value captures the amount of electric energy produced that may also produce carbon emissions.
4. **Social Cost of Carbon (SCC):** A monetary value of each metric ton of CO2 produced – incorporating both the year(s) when emissions are produced and the value of future year damages (discount rate). The City of Bend uses EPA's Social Cost of Carbon[1] at the 2% discount rate. Specific annual values are provided in the Data Sources Section of this memo.
5. **Life of Equipment**: The estimated total number of years the equipment remains in service and produces carbon emissions.
6. **Tier Factor**: Similar to the approach of the SDC tiering model, the tier factor adjusts the fee amount based on the size of the home. Energy usage estimates for this fee were based on an average size home; this scaling factor is a reasonable proxy for the anticipated increase or decrease in energy usage depending on home size. Scaling factors were based on new homes program data available from the Energy Trust of Oregon.[2]

Fee Formula

The Climate Pollution Fee is developed using the following formula, on a per appliance basis:

Fee Amount = Social Cost of Carbon x Net Lifetime Carbon Produced x Tier Factor

This results in the total monetary value of the net carbon produced over the lifetime of the gas appliance, adjusted for estimates of average home size.

Applicable Gas Appliances

The Climate Pollution Fee applies to the installation of the following gas appliances, regardless of efficiency level:

- Gas furnace
- Dual-fuel heat pump with gas furnace

[1] https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf

[2] Other methodologies may include calculating specific energy usage estimates based on home sizes. The City may consider collecting and/or conducting an evaluation on new construction homes to gain additional information changes in energy usage by home size.

- Gas water heater
- Gas stove
- Gas dryer
- Gas fireplace

Social Cost of Carbon

The Climate Pollution Fee uses a formula based on the monetary value of climate damage resulting from burning natural gas within a home scaled to the type of equipment installed and the size of home. The monetary value used in this formula is commonly known as the Social Cost of Carbon. The Social Cost of Carbon is derived using assessment models which link climate science with economics. These models estimate how additional CO2 changes global temperature, how that temperature leads to economic damages, and how those damages translate into monetary terms. The Social Cost of Carbon is not a single value, but instead a range of potential values based on the future value of carbon emissions (the discount rate) and the year in which those emissions are being assessed. The City has chosen to follow the EPA methodology, which is the most recently updated model. The City is using the 2% discount rate, which is consistent with the "central value" in the EPA's most recent report on the Social Cost of Greenhouse Gases. Table 1 provides the EPA estimates of the Social Cost of Carbon per Metric Ton in one-year increments from 2026 through 2045 at the 2% discount rate.

Table 1: EPA Social Cost of Carbon

Emissions Year	EPA 2.0%
2026	$215
2027	$219
2028	$223
2029	$226
2030	$230
2031	$234
2032	$237
2033	$241
2034	$245
2035	$248
2036	$252
2037	$256
2038	$259
2039	$263
2040	$267
2041	$271
2042	$275
2043	$279
2044	$283
2045	$287

Net Carbon Produced

In order to determine the monetary value of damages imposed by the carbon impacts of gas appliances, the Social Cost of Carbon must be multiplied by the amount of carbon emitted from the appliance. To account for the fact that electric equipment also emits carbon with current utility system fuel mixes, the City uses a net carbon approach and determines the relative amount of carbon that the gas appliances emit compared to the alternative electric equipment, so that the fee is based only on the additional carbon emitted by the gas appliance over the life cycle of the equipment.

Total Carbon Produced

To determine the net carbon produced for each gas appliance, the total carbon produced must be calculated for each gas appliance and an assumed electric alternative appliance, factoring in the carbon intensity of the fuel sources used. The amount of carbon produced for each appliance is based on the following calculation:

Total Carbon Emissions = energy use of appliance X carbon intensity of energy used

Energy Use of Appliance

The total carbon produced for each appliance requires an estimate of the energy usage per year by each applicable appliance. Energy usage estimates within a home can vary due to several factors including: code requirements, home size, occupancy, appliance efficiency levels, and climate zone. Estimates of energy usage are based on annual energy consumption of each appliance within an average size new construction single family home in a Bend climate zone (where applicable). Energy usage by appliance is based on efficiency levels as required by code, current practice efficiency levels based on the Residential Building Stock Assessment[3] (RBSA), and appliance workbooks produced by the Regional Technical Forum.[4] The RBSA provides the Northwest with information on energy use and characteristics of residential buildings and their installed equipment. The study includes a representative sample of over 2,000 homes across the region and includes homes within the Bend area. The RTF develops and maintains a list eligible energy efficiency resources in the Northwest, created through peer-reviewed unbiased analysis in a public forum. Data used from the RTF includes energy usage, energy savings, appliance cost data, and the service life of the equipment. Table 2 below provides a summary of the assumed efficiency levels and average annual energy usage for each appliance considered in the analysis. Additional data is still needed to determine an average efficiency level and an average annual energy usage for dual-fuel heat pumps with gas furnaces, since

[3] Residential Building Stock Assessment - Northwest Energy Efficiency Alliance (NEEA)
[4] Regional Technical Forum

those systems do not currently have RTF published energy usage and savings values. This data will be gathered before the initial fee goes into effect in April 2027 and will be included in the fee resolution adopted in earlier 2027 to set the fee schedule.

Table 2: Equipment Efficiency and Energy Usage

Equipment	Assumed Efficiency Level	Average Annual Energy Usage (MMBtu)
Gas Forced Air Furnace	97.5% AFUE	55.76
Dual-Fuel Heat Pump + Gas Furnace	TBD	TBD
Gas Water Heater	Energy Star	12.68
Gas Stove	DOE Standard	6.90
Gas Dryer	3.5 CEF	4.20
Gas Fireplace	70% or greater	3.66
Heat Pump	3.92 COP	16.08
Electric Resistance Heat	NA	60.26
Electric Air Conditioner	14 SEER	2.64
Electric Water Heater	Energy Star 4.0	10.09
Electric Stove	195 kWh	.67
Electric Dryer	50% Energy Star/ 50% Non-Energy Star	2.56

Carbon Intensity of Energy Used

For gas appliances, the City uses the EPA AP-42 and the EPA Greenhouse Gas Inventory list as the standard factor for CO_2 emissions.[5]

For electric appliances, the amount of carbon produced depends on the fuel source of electricity. Electric fuel sources and the mix of resources are provided by Central Electric Cooperative[6] and Pacific Power.[7] Carbon emissions are reported in pounds of CO_2 per MMBtu of energy produced. These values are based on utility reported fuel mixes as of May 2026.

[5] Emission Factors for Greenhouse Gas Inventories
[6] https://www.cec.coop/about-cec/who-we-are/
[7] https://www.pacificpower.net/content/dam/pcorp/documents/en/pacificpower/my-account/bill-inserts/PP_OR_Fuel_Mix_2023-Year_Bill-Insert_RESIDENTIAL.pdf

These values are expected to change and will be updated by the City as new information is made available.

Under Oregon HB 2021, Pacific Power is required to reduce baseline emissions by 80% in 2030, 90% by 2035 and 100% by 2040. Carbon emission estimates for Pacific Power incorporate assumed reductions in fossil fuel mix into the estimate of carbon produced for each electric appliance, consistent with the utility's most recent Integrated Resource Plan[8] (IRP). The assumed reductions may also change as the utility provides updates on their compliance pathway for HB 2021 and will be updated by the City as new information becomes available.

Table 3 provides the estimate of carbon produced by MMBtu for each utility, consistent with the changes in fuel mix reported in the IRP. When calculating net carbon emissions for each appliance, the City uses a weighted average carbon intensity based on the share of residents for each utility with the City; 85% Pacific Power and 15% Central Electric Cooperative.

Table 3: Carbon Intensity by Utility

Utility	2028-2030 Lbs CO2/ MMBtu	2030-2034 Lbs CO2/ MMBtu	2035-2039 Lbs CO2/ MMBtu	2040+ Lbs CO2/ MMBtu
Cascade Natural Gas	117	117	117	117
Pacific Power and Central Electric Coop (Weighted Average)	300	61	31	.81

Total Carbon Emission Calculations

Carbon emissions produced by each appliance are based on the annual estimated energy use of that appliance multiplied by the carbon produced per unit of the fuel type. Table 4 summarizes the annual and total carbon emissions of applicable gas appliances (in metric tons of CO_2). The total emissions is calculated by multiplying the annual emissions by the service life of the appliance.

Table 4: Annual and Lifetime Carbon Emissions of Gas Appliances

Equipment	Annual Carbon Produced (MTCO2)	Service Life	Lifetime Carbon Produced (MTCO2)
Gas Forced Air Furnace	2.95	15	44.29

[8] 2025_IRP_Update.pdf

Dual-Fuel Heat Pump + Gas Furnace	TBD	15	TBD
Gas Water Heater	0.67	15	9.73
Gas Stove	0.37	10	3.65
Gas Dryer	0.22	10	2.22
Gas Fireplace	0.19	16	3.10

To determine the total carbon emissions to use in the net carbon component of the fee formula, the City made assumptions about what electric equipment would be installed in a home avoiding the fee. The City assumed the following electric equipment would have been installed in replacement of the gas appliance:

- Air-source heat pump
- Electric Water Heater
- Electric Stove
- Electric Dryer

Table 5 provides the lifetime carbon emissions of the electric appliances the City assumes would have been installed in replacement of the gas appliances. The lifetime number reflects the expected change in carbon emissions as Pacific Power meets its clean energy goals as established in HB2021. Because of the evolving utility system fuel mix and potential changes in carbon reduction plans, these values will change over time and will be reviewed and updated by the City.

Table 5: Lifetime Carbon Emissions of Electric Appliances

Equipment	Service Life	Lifetime Carbon Produced (MTCO2)
Heat Pump	18	10.14
Electric Water Heater	10	5.78
Electric Dryer	10	1.47
Electric Stove	10	.38

Net Carbon Calculations

Using the energy estimates and carbon intensity values shown above, Table 6 below provides the net carbon emissions for each gas appliance. These values assume the installation of equipment in 2028 and that Pacific Power will meet its HB 2021 emission reductions goals beginning in 2030. They also use the weighted average carbon intensity values shown in Table

2 which depend on the current utility fuel mix. These values are therefore subject to change. The values below are multiplied by the Social Cost of Carbon to calculate the fee amount.

Table 6: Net Carbon Emissions for Gas Appliances

Equipment	Net Lifetime Carbon Produced (MTCO2)
Gas Forced Air Furnace	34.15
Dual-Fuel Heat Pump + Gas Furnace	TBD
Gas Water Heater	3.95
Gas Stove	3.27
Gas Dryer	1.76
Gas Fireplace	3.10

Service Life of Equipment

The values for the Service Life of each appliance come from the appliance workbooks developed by the Regional Technical Forum. The service life is estimated based on best available regional and national cost data collected through actual program data and secondary research. Each workbook develops and estimates service life slightly differently. Workbooks are available on the **RTF website** with information on methodology generally found within the summary tab.

Tier Factor

Similar to the approach of the SDC tiering model, the tier factor adjusts the fee amount based on the size of the home. Energy usage estimates for this fee were based on an average size home; this scaling factor is a reasonable proxy for the anticipated increase or decrease in energy usage depending on home size. Scaling factors were based on new homes program data available from the Energy Trust of Oregon. This data includes nearly 500 homes within the Bend area where annual gas usage of home was estimated through the program. The City categorized these homes based on their square footage shown in Table 7. The average difference in energy usage between Tier 1 and Tier 2, and Tier 2 and Tier 3 was calculated and is the basis for the Scaling Factor shown below.

Table 7: Tiers by Home Size and Scaling Factor

Tier	Square Footage	Number of Homes in dataset	Average Energy Usage (Therms)	Scaling Factor
Tier 1	1600 or less	33	315	65%
Tier 2	1601-3000	347	468	100%
Tier 3	Greater than 3000	51	710	150%

Fee Adjustment

The total fee amount represents the maximum monetary value of net carbon emissions based on the formula set forth above. The Council, in its discretion, may choose to reduce the fee by resolution. To reduce the fee, an adjustment factor may be applied to the total fee amount.

Fee Amount x Fee Adjustment = Adjusted Fee Level

Fee Table

Table 8 below provides each appliance fee amount by tier size, at the 20% fee adjustment level, which is the initial fee adjustment level directed by the Bend City Council. These fee amounts will be reviewed annually and may be updated to reflect changes in, among other things, the Social Cost of Carbon, carbon intensity, and any applicable adjustment level.

Table 8: Climate Pollution Fee Table

Equipment	Tier 1 Fee Amount	Tier 2 Fee Amount	Tier 3 Fee Amount
Gas Forced Air Furnace	$972	$1,496	$2,244
Gas Water Heater	$112	$173	$260
Gas Stove	$93	$143	$215
Gas Dryer	$22	$33	$50
Gas Fireplace	$88	$136	$204
Total	$1,288	$1,981	$2,972

Data Sources

The City of Bend referred to the following data for inputs and assumptions in establishing the Climate Pollution Fee.

Table 9: Data Sources

Data Source	Data Used
City of Bend	Annual housing production, average home prices, new construction fuel types
Regional Technical Forum	Energy usage estimate and cost data for electric and gas equipment, life of appliances
NEEA Residential Building Stock Assessment	Efficiency levels of appliances in new construction homes
Environmental Protection Agency	Social Cost of Carbon
Pacific Power	Residential energy rates, utility fuel mix
Central Electric Cooperative	Residential energy rates, utility fuel mix
Cascade Natural Gas	Residential energy rates
Energy Trust of Oregon EPS Program	Average estimated annual gas energy usage for new construction homes participating in program

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