

CARBON FOOTPRINT REPORT

for Calendar Year 2007



Introduction

This report describes the results of the Portland Water Bureau's 2007 carbon footprint calculation. This initial calculation estimates the greenhouse gas (GHG) emissions during the 2007 calendar year.

Carbon Footprint Goals

The goals for this 2007 carbon footprint calculation are the following:

- Identify the bureau functions with the highest carbon impact
- Create a carbon emissions baseline against which future carbon footprint reporting can be measured
- Assess the bureau's contribution to meeting existing city, county, and state greenhouse gas reduction goals

The **city, county,** and **state** have all set goals to reduce greenhouse gas emissions to 10 percent below 1990 levels. County-wide, greenhouse gas emissions for 2007 are at the same levels as 1990, despite a population growth of 18 percent. This means per capita emissions have decreased by 17 percent since 1990 (Portland Office of Sustainable Development 2008).

Data for the baseline year of 1990 were aggregated at the whole county level. Equivalent subset data for the Water Bureau are not readily available. The Water Bureau plans to use the 2007 data described in this report as a baseline for comparison against future-year carbon calculations.

How do Greenhouse Gases Affect the Earth?

Carbon dioxide and other greenhouse gases warm the surface of the planet by trapping solar heat in the atmosphere, keeping our planet habitable. However, by burning fossil fuels and clearing forests, humans have dramatically increased the amount of carbon dioxide in the Earth's atmosphere (Climatecrisis.net 2008). In 2002, researchers at the University of Washington's Department of Civil and Environmental Engineering analyzed the impacts of climate change on water supply and demand for the Portland Water Bureau (Palmer and Hahn, 2002). The study indicated that, during dry years, a warmer climate is likely to reduce future water availability and significantly increase future water demand.

Methodology

The Water Bureau's carbon footprint was calculated using the 2007 methodologies of the [Greenhouse Gas Protocol](#). This protocol is the most widely used international accounting tool for understanding, quantifying, and managing GHG emissions. The methodology translates units of natural gas, electricity, and fuel used into estimates of carbon emissions. The results are reported in carbon dioxide equivalency (CO₂e) units.

The Water Bureau's carbon footprint calculation consists of emissions from the following sources:

- Electricity use for groundwater and distribution pump stations, lighting, and other facility uses
- Fleet fuel — combustion of biodiesel, diesel, and gasoline fuels for transportation, heavy machinery, and power tools
- Natural gas use for heating
- Fuel used for employee air travel

The calculation excluded emissions sources for which data are not readily available. Excluded emissions sources include the following:

- Fuel used during employee commutes to and from work at Water Bureau locations
- Emissions produced by services provided to the bureau such as solid waste collection and disposal
- Emissions produced during the manufacturing, delivery, and disposal of purchased material (such as steel pipe, concrete, chlorine gas, and other materials)
- Fuel used during construction work performed by contractors

As more data become available and methodologies are improved, more of these emissions sources will be included in future calculations.

The complete set of Greenhouse Gas Protocol calculation tools is available here: www.ghgprotocol.org/calculation-tools/all-tools.

More detail about the methodology and conversions used is available upon request.

Portland's Water Sources

The mission of the Portland Water Bureau is to provide reliable water service to more than 860,000 Portland-area customers. The majority of the city's drinking water is from the [Bull Run watershed](#), a 147-square-mile watershed 25 miles east of the Portland metropolitan area. The Bull Run watershed provides approximately 36 billion gallons of unfiltered water to customers annually.

Surface water from the Bull Run watershed is supplemented with groundwater from the city's [Columbia South Shore Well Field \(CSSWF\)](#). The CSSWF can provide almost 100 million gallons of groundwater per day. In the winter, when heavy rains in the Bull Run watershed create turbidity, the bureau can serve 100% of water demand from the well field. During the dry summer season (the peak water season), the city uses the well field to augment and extend supplies in the Bull Run reservoirs. On average, the Water Bureau uses groundwater to supplement peak season supply every other year (Portland Water Bureau 2008).

Renewable Energy Production

[The City owns three hydropower facilities](#). Powerhouses at each of the two Bull Run dams generate a total of 86 million kWh of electricity per year. The powerhouses, operated by Portland General Electric, produce over three times more electricity than the bureau used in 2007. An additional microhydropower facility at Mt. Tabor generates 690,000 kWh per year, enough electricity to power 80 homes in the Pacific Northwest for a year (Energy Information Administration 2005). These facilities add to the region's renewable energy portfolio. They are not, however, included as a carbon emissions offset in the 2007 carbon footprint calculation.

2007 Results

The Water Bureau's total CO₂e emissions for calendar year 2007 was 13,998 metric tons. This is equivalent to the annual carbon footprint of approximately 700 average people in the United States. An average U.S. citizen generates approximately 20 metric tons of CO₂e emissions (The Climate Trust 2008, Massachusetts Institute of Technology 2008).

Electricity use was approximately 81 percent of the Water Bureau's 2007 carbon footprint. The other 19 percent of the footprint were emissions related to the fuel used by the bureau's vehicles and equipment, natural gas use and employee air travel (see Table 1).

Table 1. Portland Water Bureau CO₂e Emissions for Calendar Year 2007

Fuel Type	CO ₂ e in Metric Tons	Percentage
Electricity	11,420	81%
Fleet Fuel	2,117	15%
Natural Gas	350	3%
Employee Air Travel	111	1%
Total Annual CO ₂ e Emissions	13,998	100%

Table 2 shows the Water Bureau's energy and fuel use for three calendar years, including the 2007 baseline. Data for 2005 and 2006 are provided for context and comparison.

Table 2. Portland Water Bureau Energy and Fuel Use, Calendar Years 2005 – 2007

Energy and Fuel Use Category	CALENDAR YEARS		
	2005	2006	2007
Electricity (kWh) ^a	20,099,286	36,430,956 ^b	27,335,981
Fleet Fuel (gallons) ^c	229,968	247,447	286,407
Natural Gas (therms) ^d	53,462	56,312	65,914
Employee Air Travel - Passenger Air Miles	646,653	558,573	577,237

^a kWh is kilowatt hours.

^b The spike in electricity use is due to a weather-related increase in groundwater use (see Table 4).

^c Fleet fuel includes diesel, biodiesel, and gasoline.

^d Natural gas is used solely for building heating.

Table 3 shows the carbon emissions, expressed as carbon dioxide equivalency (CO₂e) units, resulting from energy and fuel use shown in Table 2.

Table 3. Portland Water Bureau CO₂e Emissions, Calendar Years 2005 – 2007

Category Contribution to CO ₂ e in Metric Tons	CALENDAR YEARS		
	2005	2006	2007
Electricity	8,397	15,220	11,420
Fleet Fuel Consumption ^a	2,216	2,189	2,117
Natural Gas	284	299	350
Employee Air Travel - Passenger Air Miles	125	108	111
Total CO ₂ e Emissions	11,021	17,816	13,998

^a Fleet fuel emissions were calculated based on the fuel type and percentage of biodiesel.

Results by Emissions Source

Electricity Use

In 2007, the Water Bureau's electricity use was 27,335,981 kilowatt hours (kWh) and accounted for the majority (81 percent) of the bureau's CO₂e emissions. This is equivalent to the average electricity used by over 3,200 Pacific Northwest homes (Energy Information Administration 2005). Depending on the year, most of the bureau's electricity usage comes from facility uses, including lighting and pumping water from reservoirs to storage tanks to provide service to customers at higher elevations. The rest of the electricity usage is a result of pumping groundwater.

ROLE OF GROUNDWATER

Groundwater at CSSWF is pumped from three underground aquifers and is the bureau's single-largest use of electricity, generating the most CO₂e of any Portland Water Bureau operation. In 2007, about 21 percent of the Water Bureau's electricity use was from pumping groundwater. In 2006, when more groundwater was used, about 37 percent of the bureau's total electricity use resulted from groundwater pumping (see Table 4).

Table 4. Comparison of Energy Used for Groundwater Pumping, Calendar Years 2005 – 2007

Category	CALENDAR YEARS		
	2005	2006	2007
Amount of GW Pumped for Water Supply (MG) ^{a,b}	0	4,680	1,870
Electricity Used for Pumping GW (kWh) ^{b,c}	971,946	15,726,549	6,953,454
CO ₂ e Emissions (MT) ^d	406	6,570	2,905
Percentage of Total Carbon Emissions	4%	37%	21%

^a MG is millions of gallons.

^b GW is groundwater.

^c In 2005, the groundwater facility used some electricity for testing and equipment maintenance but no groundwater was pumped for water supply.

^d MT is metric tons.

Fleet Fuel Use

The Water Bureau's 630 employees use vehicles and equipment for a variety of daily tasks. Fuel combustion of the bureau's fleet vehicles, heavy machinery, and power tools account for 15 percent of the Water Bureau's 2007 carbon emissions. The bureau operates 347 vehicles that run on biodiesel (primarily B99 during the summer season and B50 during the winter) or gasoline, as shown in Table 5.

Table 5. Water Bureau Fleet Inventory and Fuel Type

Vehicle Type	FUEL TYPE	
	Biodiesel	Gasoline
Passenger Vehicles ^a	18	26
Light-Duty Trucks	34	132
Heavy-Duty Trucks	91	3
Heavy Construction Equipment	43	0
Total	186	161

^a Includes five gasoline/electric hybrid vehicles.

In 2007, fleet fuel consumption equaled 2,117 metric tons of CO₂e (see Table 6). The 161 gasoline-burning vehicles contributed the largest percentage of CO₂e emissions.

Table 6. Fuel Consumption and CO₂e for Calendar Year 2007

Fuel Type	CONSUMPTION		
	Gallons Used	CO ₂ e Emissions (metric tons)	Percentage of Total Emissions
Ultra-low sulfur diesel ^a	69,315	720	5.1%
Biodiesel	62,946	7	0.1%
Gasoline	154,146	1,390	9.9%
Total	286,407	2,117	15.1%

^a Ultra-low sulfur diesel (ULSD) is the fuel used to complement biodiesel in a biodiesel mix. For example, B99 is 99% biodiesel and 1% ULSD; B20 is 20% biodiesel and 80% ULSD.

Natural Gas Use

The Water Bureau owns or leases 10 facilities heated with natural gas. Natural gas use creates about 3 percent of the bureau's carbon emissions (see Tables 1-3).

Air Travel

Water Bureau employees periodically travel by air to attend meetings and conferences. Aircraft release gases such as nitrogen oxides that have potent climate-changing effects because of the elevation at which they are released (Sightline Institute 2004). In 2007, bureau employees traveled approximately 577,200 miles by air resulting in 111 metric tons of CO₂e emissions. These emissions account for about 1 percent of the total annual CO₂e units generated by the bureau.

Carbon Footprint per Unit of Potable Water

One way to describe the bureau’s carbon footprint is by the quantity of carbon emissions associated with each unit of water produced for customers. This calculation will differ from year to year because of the annual variation of total water served and total carbon emissions generated by the bureau. Table 7 compares the number of metric tons of CO₂e emissions per million gallons of water produced in each of the last two years. Compared to other water utilities, the Portland Water Bureau uses relatively little electricity. This is because water flows to Portland predominantly by gravity, which requires little pumping. The result is a very small carbon footprint per unit of potable water produced by the bureau.

Table 7. CO₂e Emissions per Million Gallons of Water, Calendar Years 2006 and 2007

Category	CALENDAR YEAR	
	2006	2007
CO ₂ e (metric tons)	17,815	13,998
Total Water Production (million gallons)	37,928	37,068
Bull Run water	33,248	35,198
Groundwater	4,680	1,870
Metric tons of CO ₂ e per million gallons	0.47	0.38

Water Bureau’s Initial Carbon Mitigation Strategy

The Water Bureau’s Management Team reviewed the carbon footprint results and adopted a set of initial mitigation strategies in August 2008:

- 1) Plan for and address increased energy use and carbon emissions implications of facilities required to comply with the federal Long Term 2 Enhanced Surface Water Treatment Rule.
- 2) Improve efficiency of the bureau’s fleet through the following measures:
 - Adopting vehicle purchasing criteria for passenger cars and light trucks
 - Instituting greater use of shared vehicle pools and vehicle scheduling
 - Adopting a bureau policy to discourage unnecessary engine idling, particularly large trucks
 - Empowering the fleet manager and sustainability staff to implement fleet recommendations and update the fleet emissions goal in the 2007 Sustainability Action Plan
- 3) Reduce the impact of emissions from employee air travel through the following measures:
 - Limiting employee air travel as feasible (e.g., promoting alternatives)
 - Purchasing green tags to offset travel (green tags help fund energy efficiency upgrades and renewable energy projects)

The City of Portland has also set a goal to purchase all electricity from renewable sources by 2010. Since electricity use generates the largest component of the Water Bureau’s carbon emissions, using renewable energy will make a substantial contribution toward reducing the bureau’s carbon footprint.

Progress to date

In addition to the mitigation strategies described above, the Water Bureau's ongoing sustainability efforts are resulting in a variety of carbon-related improvements including the following measures.

ELECTRICITY

Bureau staff recently evaluated pumping efficiency for a service area that requires two pump stations to deliver water to the pressure zone. By optimizing the gallons of water pumped per kWh of electricity, the bureau achieved a 17 percent improvement in efficiency.

The bureau is planning to construct a photovoltaic facility at the CSSWF pump station. The solar facility will have the capacity to produce 270 megawatt hours of electricity per year (equivalent to 300,000 kilowatt hours). Design is complete, and construction is anticipated during 2009.

FLEET FUEL

The Water Bureau began converting its diesel fleet to fuels containing higher percentages of biodiesel in 2004. Biodiesel combustion produces approximately 78 percent fewer CO₂e emissions than conventional diesel fuel (Sheehan et al. 1998). Tables 2 and 3 show that, even though the bureau purchased more gallons of fuel in 2007, the CO₂e emissions have decreased due to the increased use of biodiesel.

The bureau also offers employees a wide range of alternative transportation options for local work-related travel including free transit passes for the bus, light rail, and streetcar. City-owned bicycles are available to borrow for short trips. Alternative transportation options are supported by an employee education effort.

Conclusions

The Portland Water Bureau is actively working to reduce its carbon footprint with a focus on electricity and fuel use. The bureau's [Sustainability Action Plan](#) includes a variety of measures to reduce its CO₂e emissions.

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For more information on the Portland Water Bureau's Sustainability Program,
see the webpage:

www.portlandonline.com/water/sustainability.

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