



# Washington's CARBON FOOTPRINT



*Hydro-based energy sector boasts low greenhouse gas emissions*

By Ben Tansey

**O**n a per capita basis, Washingtonians contribute less than two-thirds as much to the nation's annual greenhouse gas emissions as the average American.

That's because the state, while constituting 2.1 percent of the nation's populace, accounts for only 1.3 percent of the country's 7 billion metric tons of GHG emissions every year.

The contrast grows sharper as one considers the role of the electric power industry in the production of carbon dioxide, which represents 82 percent of the nation's GHG emissions.

According to the Environmental Protection Agency, the national CO<sub>2</sub> emission rate for electrical generation is 1,363 pounds/megawatt hour. But in Washington, the rate is just 360 lbs/MWh – third lowest in the country. State officials estimate the rate to be even lower – about 322 lbs/MWh.

Notably, public utility districts and other consumer-owned utilities in Washington have some of the lowest carbon footprints of utility groups anywhere in the country.

The significance of this has risen considerably as the challenge posed by climate change has become a central theme in policymaking over the past couple years at all levels of government, businesses, and even in the daily lives of citizens.

Although the state's decades-old commitment to energy efficiency has contributed, its low CO<sub>2</sub> emission rate is due largely to the development of significant amounts of hydroelectric power.

Hydroelectric power relies not on natural gas or coal, but on renewable flows of water that generate no greenhouse gases.

Over 70 percent of the nation's electricity comes from coal, oil or natural gas, but in Washington, it is just the opposite – nearly 70 percent of the power here comes from hydropower.

**Hydroelectric power relies not on natural gas or coal, but on renewable flows of water that generate no greenhouse gases.**

The benefits accrue not just to Washington, but to the region.

Nationwide, electric generation accounts for 39 percent of all CO<sub>2</sub> emissions. In Western states, however, it contributes only 31 percent, and in the Pacific Northwest, only 23 percent – or about 520 lbs/MWh.

According to the Bonneville Power Administration, the Pacific Northwest produces less CO<sub>2</sub> per megawatt-hour than any other region in the country.

More than 70 percent of the 102 billion kilowatt-hours generated in Washington in 2004 came from hydroelectric plants. That's a higher percentage than any other state except Idaho, which produces only a 10th as much power as Washington. Only two states, Idaho and Vermont, which relies primarily on nuclear power, have lower greenhouse gas emissions than Washington.

Washington's public utility districts enjoy a large share of this clean, renewable hydropower for two reasons: One is their statutory, preferential right to output from the 31 dams of the Federal Columbia River Power System. The second is that many of

*continued on page 4*

the state's PUDs own their own hydroelectric resources – nearly a dozen projects with a total capacity approaching 5,000 MW.

The three pillars of preference, hydro project ownership, and a commitment to conservation enable Washington's PUDs to maintain exceptionally low emission rates.

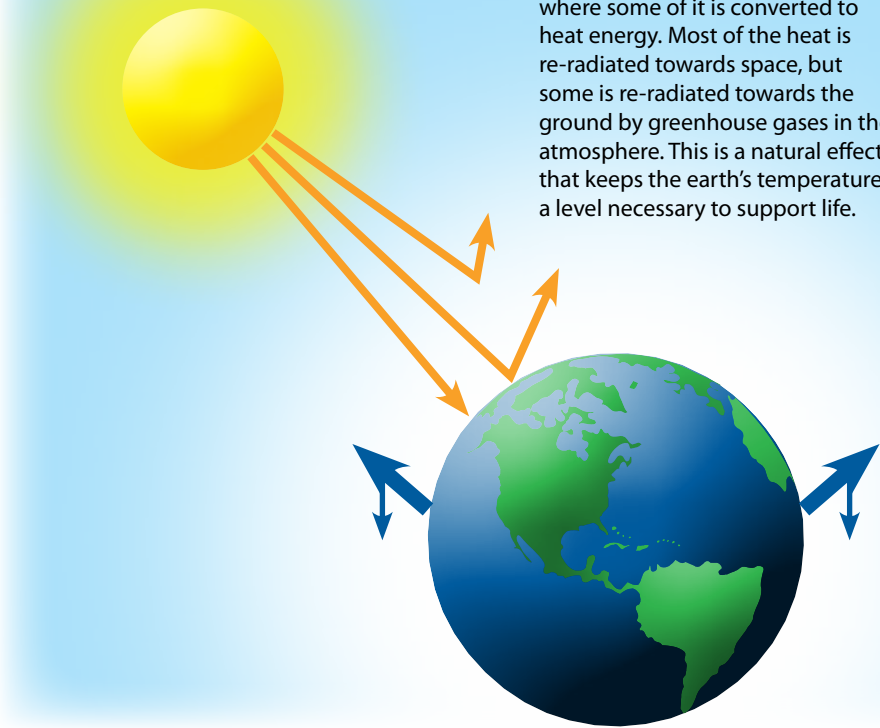
Douglas PUD, for example, which owns and operates the 840-megawatt Wells Hydroelectric Project, produces only 0.01 metric ton of CO<sub>2</sub> per megawatt hour, according to the state Department of Community, Trade and Economic Development (CTED). Only a handful of the state's PUDs even crack the 0.03 metric ton/MWh threshold.

In contrast, investor-owned utilities serving Washington own or purchase most of the electricity from the region's relatively few coal and natural gas plants, with their higher greenhouse emissions.

Puget Sound Energy, for example, is responsible for 0.447 tons of CO<sub>2</sub> per megawatt hour – a total of 10 million metric tons in 2005 alone – which represents a 10th of the state's total greenhouse gases.

According to CTED, consumer-owned

## Greenhouse Effect



The earth is covered by a blanket of gasses which allows energy from the sun to reach the earth's surface, where some of it is converted to heat energy. Most of the heat is re-radiated towards space, but some is re-radiated towards the ground by greenhouse gases in the atmosphere. This is a natural effect that keeps the earth's temperature at a level necessary to support life.

## Measuring CO<sub>2</sub>

Joseph Black, a Scottish chemist and physician, first identified carbon dioxide in the 1750s.

At room temperature, carbon dioxide is an odorless, colorless gas that is faintly acidic and non-flammable. Although we most often think of CO<sub>2</sub> as a gas, in its solid form, it is better known as dry ice.

Carbon dioxide, while representing less than one percent of the atmosphere, plays an important role in vital plant and animal process, such as photosynthesis and respiration.

Large amounts of CO<sub>2</sub> emissions are measured in tons or metric tons. A metric ton (mt) is 2,204.6 pounds, or 1.1 regular or "short" tons. A ton of dry ice takes up 22.6 square feet, but CO<sub>2</sub> in its gaseous form takes up 17,096 square feet.

In addition to releasing heat, the chemical components of fossil fuels combine with oxygen during combustion, which is why more CO<sub>2</sub> is emitted than fuel burned. Since CO<sub>2</sub> is about 3.5 times heavier than carbon alone, burning 1,000 square feet of natural gas, or methane, at standard temperatures and pressure produces about 122 pounds of CO<sub>2</sub>, or about three times its weight.

Different greenhouse gases have individual "radiative" capacities, or the ability to absorb heat. They also stay in the atmosphere differing amounts of time. For example, CO<sub>2</sub>

stays in the atmosphere for 50 to 100 years. More potent GHGs can stay for thousands of years. Consequently, each greenhouse gas has a different "global warming potential" or GWP.

Carbon dioxide is the least potent of the greenhouse gases, but it is also the most abundant. Scientists have assigned CO<sub>2</sub> a GWP of 1. Other greenhouse gases are measured in terms of their "equivalent emissions" of CO<sub>2</sub> or CO<sub>2</sub>e.

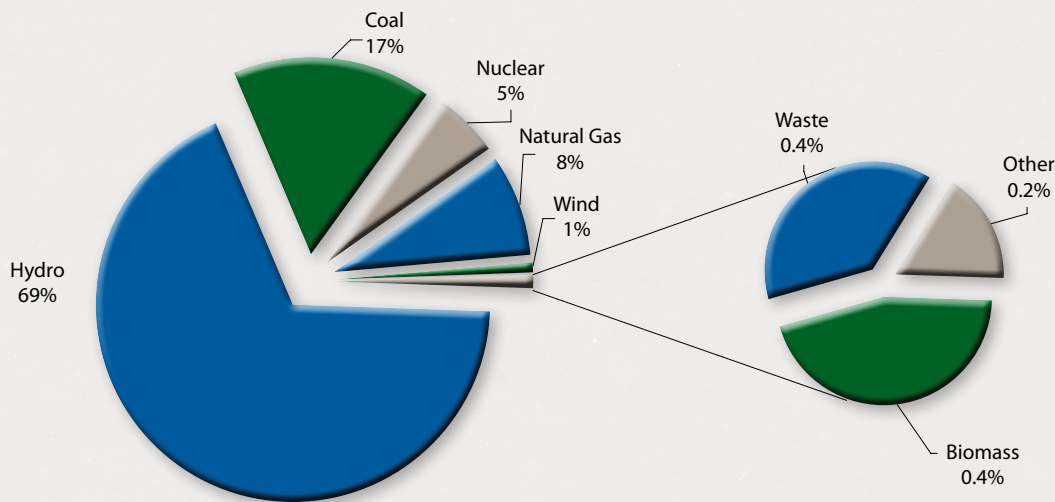
Methane has a GWP of 23 CO<sub>2</sub>e, meaning its capacity to cause global warming is 23 times that of CO<sub>2</sub>. Nitrous oxide has a GWP of 296 CO<sub>2</sub>e.

Hydrofluorocarbons have GWPs that range from 120 CO<sub>2</sub>e to 12,000 CO<sub>2</sub>e. Sulfur hexafluoride (SF<sub>6</sub>), which historically has been used in the electric utility industry as an insulator in substations and transformers, has a GWP of 22,200 CO<sub>2</sub>e.

Although SF<sub>6</sub> is extremely potent, its concentration in the atmosphere is extremely low – it contributes 0.1 percent of the total effect of anthropogenic greenhouse gases, compared to about 60 percent for CO<sub>2</sub>.

Utilities have made efforts to reduce SF<sub>6</sub>. SF<sub>6</sub> emissions attributed to power marketed by the Bonneville Power Administrations have decreased by about two thirds over the past 10 years.

## Washington State Electric Utility Fuel Mix



### MWh Totals

Hydro:	59,609,529
Coal:	14,245,188
Natural Gas:	7,319,961
Nuclear:	4,513,216
Wind:	867,392
Biomass:	392,712
Waste:	331,963
Other:	145,352
<b>Total:</b>	<b>87,425,313</b>

Source: Department of Community, Trade and Economic Development, based on 2006 data.

utilities – public utility districts, municipal utilities and cooperatives – serve 55 percent of the load in Washington, but generate only 13 percent of the state electric industry’s CO<sub>2</sub> emissions.

The state’s IOUs – which serve 38 percent of the state’s load – are responsible for 86 percent of the industry’s emissions. And on average, they charge a penny more per kilowatt than consumer-owned utilities to boot!

To more fully understand the significance of Washington’s small carbon footprint, it’s important to understand the relationship between greenhouse gases and the threat of global warming.

About two-thirds of the sun’s ultraviolet radiation that reaches the Earth is absorbed, mostly by the surface of the planet and a little by the atmosphere. The rest is reflected back into space.

The energy absorbed by the planet’s surface is converted into heat energy, which is radiated back into the atmosphere. Because of their “radiative” quality, greenhouse gases can “trap” this heat energy, preventing it from escaping, and redirecting

it back towards earth. This is known as the “greenhouse” effect.

Greenhouse gases are a natural part of the environment; by trapping the sun’s warmth they maintain the earth’s surface temperature at levels necessary to support life.

The problem is that the concentration of greenhouse gases in the atmosphere has increased dramatically over the past 150 years – most likely the result of human activities, particularly the burning of fossil fuels (coal, oil and natural gas) and the clearing of forest lands. In particular, the atmospheric concentration of CO<sub>2</sub> has increased from 315 parts

per million in 1958 to 378 ppm by the end of 2004 – which creates the prospect of global climate change.

Not all atmospheric gases possess this radiative capacity. Oxygen and nitrogen, which together make up 99 percent of the atmosphere, are not greenhouse gases. The three principal greenhouse gases are carbon dioxide, methane, and nitrous oxide.

CO<sub>2</sub> represents 82 percent of all U.S. anthropogenic (caused by human activity) greenhouse gases, while methane and

nitrous oxide account for 9 percent and 5 percent, respectively. Two percent is composed of an array of perfluorocarbons, hydrofluorocarbons and sulfur hexafluoride, some of which also deplete ozone. The Intergovernmental Panel on Climate Change also considers water vapor and ozone to be greenhouse gases.

As a class, U.S. greenhouse gas emissions have increased 16 percent since 1990, but not all are trending up. Methane emissions are down 10 percent from 1990 and nitrous oxide emissions are down 2 percent. Emissions of HFCs, PFCs and SF<sub>6</sub>, however, have grown a troubling 58 percent, according to the Environmental Protection Agency.

Worldwide, CO<sub>2</sub> emissions from the burning of fossil fuels totaled 28,200 million metric tons in 2005, according to the Energy Information Agency. North America accounted for 7,000 million metric tons, or about a quarter of the worldwide total.

According to CTED, Washington’s greenhouse gas emissions from all sources in 2005 were the equivalent of 94.8 million metric tons of CO<sub>2</sub>.

Using a U.S. Forest Service formula, CTED also found that as much as a third of that was offset by sequestration in the state’s forests and agricultural soils, which act as “carbon sinks” through photosynthesis, the process by which

*continued on page 6*

**Puget Sound Energy, for example, is responsible for 0.447 tons of CO<sub>2</sub> per megawatt hour – a total of 10 million metric tons in 2005 alone – which represents a 10th of the state’s total greenhouse gases.**

plants convert CO<sub>2</sub> into oxygen.

Breaking down the state's emissions by sector, the EIA attributes 52 percent to transportation, primarily cars and trucks, 21 percent to industry, and a relatively modest 17.2 percent to electric power. Nationwide, the EIA reports that transportation is responsible for 39 percent of all CO<sub>2</sub> emissions, compared to 33 percent for electric power production.

In 2006, according to CTED, 69 percent of the power generated in Washington came from hydroelectric projects. Coal made up another 17 percent, while natural gas supplied 8 percent and nuclear power, 5 percent. Wind came in at 1 percent, with solar and biomass both contributing less than a half percentage point.

Also according to CTED, 80 percent of the state's greenhouse gas emissions attributed to electric generation – the equivalent of 15.2 million metric tons of CO<sub>2</sub> – came from burning coal. Since most of the coal plants that serve Washington are outside the state, that figure is based on consumption.

In reality, there is only one commercial coal plant in Washington, TransAlta's 1,782-MW plant in Centralia, which produced 5.9 million metric tons of CO<sub>2</sub> in 2006, according to the Western Electricity Coordinating Council – by far the most of any power plant in the state. Most of that power is sold outside the state.

**Still, the state should continue to enjoy a relatively small carbon footprint – at least from its electricity sector – for years to come because of its public and private investment in hydropower and continued efforts to increase efficiency at the region's hydroelectric dams.**

Most of the GHG emissions attributed to burning coal to serve Washington electric loads are produced by power plants outside the state, including Boardman (Oregon), Colstrip (Montana) and Jim Bridger (Utah). Those plants are all owned by investor-owned utilities – Portland General,

PPL Montana and PSE, and PaciCorp and Idaho Power respectively.

The only other greenhouse gas emissions attributed to electricity consumption in the state were from natural gas.

There are 21 natural gas power plants in Washington, which collectively contribute about 3.6 million metric tons of CO<sub>2</sub> emissions. About half of those are owned by investor-owned utilities, three by PUDs, and

the rest by independent power producers.

Natural gas emissions can vary considerably depending on power market conditions, age, usage and technology. The two natural gas power plants in the state with the most emissions in 2006 were Puget Sound Energy's 167 MW March Point facility in Whatcom County at 663,000 metric tons of CO<sub>2</sub> and Suez Energy Resource's 520-MW Chehalis Generating Facility at 516,000 Mt.

With growing demand for electricity, CTED projects that the state's consumption-based CO<sub>2</sub> equivalent emissions will reach 25 million metric tons by 2020 – despite legislative efforts to encourage development of renewable resources and to block long-term contracts with out-of-state coal plants.

Still, the state should continue to enjoy a relatively small carbon footprint – at least from its electricity sector – for years to come because of its public and private investment in hydropower and continued efforts to increase efficiency at the region's hydroelectric dams. ■

*Ben Tansey is principal of the energy editing and research firm Wynoochee Resources and senior contributing editor for Energy NewsData in Seattle. He also wrote about the policy of "preference" – giving consumer-owned utilities first-rights to power from federal hydro electric dams – and the Bonneville Power Administration's "residential exchange" program in the Fall 2007 issue of Connections.*

# Is your Choice by Chance?

**Choose TEA® and you won't second guess your wholesale market decisions**

- Reduced wholesale energy risks
- Greater rewards and savings
- Portfolio-wide perspective

With The Energy Authority's® market expertise, real-time credit monitoring, and nationwide energy trading capabilities, you can concentrate on what's important to you — "Keeping the lights on!"

800.423.4800 ext. 11191

[www.teainc.org](http://www.teainc.org)

Jacksonville • Seattle • Portland

