Environmental Matters

This appendix contains a wide range of information that relates to the environmental concerns PSE faces and seeks to address.

1. PSE Greenhouse Gas Policy D-2

A summary of PSE policy and goals with regard to greenhouse gas emissions.

2. Regulatory and Policy Activity D-10

Current legislative and regulatory activity that may affect PSE's future operations.

3. Challenges/Issues of Climate Change Policy D-15

A review and explanation of issues that will be impacted by Climate Change Policy.

1. PSE Greenhouse Gas Policy

Many scientists and policymakers believe climate change may prove to be the most important business issue of the 21st century. Business leaders once asked if the climate is changing. And if so, if humans are causing the change. But many now ask how profound the impacts will be, and if solutions to those impacts will be feasible and economically viable.

In just a few years, the possibility of climate change regulation has gone from almost “unthinkable” to a “strong possibility”. As the issue has gained momentum, federal efforts to address climate change have increased significantly, and a growing number of U.S. companies have abandoned their earlier view that it required more research before warranting emissions reduction.

In late 2006, the utility commissioners of California, Oregon, Washington, and New Mexico agreed to collaborate on strategies to fight climate change. Specifically, they said their "regulatory oversight ensures that the utilities operate in a manner that protects the environment and human health and safety, and protects ratepayers from economic risks of failure to plan for future regulation of emissions that cause climate change.”

PSE understands the importance of assuming leadership in devising new strategies to address climate change, even before such measures are mandated. As a first step, the company developed a climate change policy statement (see next page). The policy provides a guiding sense of the challenges PSE faces, its obligation as a utility, and the solutions we see are feasible. A discussion of the local implications of global climate change can be found in the 2007 IRP.

Greenhouse Gas Policy Statement

Puget Sound Energy (PSE) concurs with the growing concern that increased atmospheric concentrations of greenhouse gases will adversely impact the climate in a way that will do adverse economic and social harm. Presently, most of the world still relies heavily on fossil fuels for its electric power and heating needs. Therefore, climate change policies must balance a number of competing short-term and long-term interests to moderate the growth in greenhouse gas emissions while encouraging responsible growth of the economy.

Climate change is a very important issue which requires effective, efficient and equitable collective responses from policy makers. To that end, PSE advocates a national strategy that achieves both short-term measures designed to lessen the growth of greenhouse gas emissions and long-term strategies that will ultimately manage greenhouse gas emissions to appropriate levels in a scientifically sound, and responsible fashion. In furtherance of the strategy that reduces near-term growth of greenhouse gases, PSE's policy is to take cost-effective measures to reduce greenhouse gas emissions from our energy activities while maintaining a dependable and diverse energy portfolio mix that will sustain our customers' needs now and into the future.

The specific near-term strategies PSE will continue to explore and implement include the following:

1. Ongoing development and investment in our customer energy efficiency program;
2. Pursuit of a diverse energy portfolio mix of resources including renewable generation that will result in lowering of our greenhouse gas emissions consistent with least cost planning principles;
3. Customer based generation of renewable energy;
4. Opportunities to reduce greenhouse gas emissions with our partners in the utility industry, our local communities, and state and national government;
5. Ongoing development and investment in our green fleet and low emission vehicle programs;
6. Transparency with our greenhouse gas emissions footprint reporting; and

7. Coordination with our customers to help them minimize their greenhouse gas emissions footprint.

Furthermore, PSE believes the U.S. government must take a strong leadership role on this global issue by regulating the sectors that consume fossil fuels and setting corresponding policies, including the following:

1. Institute a tax policy that provides clear, long-term price signals so that affected firms can invest intelligently.
2. If a cap-and-trade system is established, a cost containment mechanism which establishes a price ceiling should be created so all firms can reliably estimate and manage compliance costs.
3. Formulate active strategies to promote the development and demonstration of new large-scale, low-emissions technologies and energy systems. Additionally, any tax and/or trading system should be leveraged to accelerate the adoption of new no and low-emission technologies through R&D incentives and appropriate price signaling.
4. Remove barriers, and disincentives for the advancement of renewable resources and smart grid technologies.
5. Sustainable energy is an essential component of sustainable development, and PSE will continue to take steps to meet the goal of providing reliable energy while decreasing the resulting impact on climate change.

A. PSE's Emissions

During 2007, PSE's total electric retail load of 23,195,000 MWhs was served from a supply portfolio of owned and purchased resources. Since 2002, the company has undertaken a voluntary inventory of the greenhouse gas (GHG) emissions associated with PSE's portfolio. This inventory follows the protocol established by the World Resource Institute GHG Protocol (GHG Protocol). The most recent data indicate that PSE's total 2007 GHG emissions -- both direct and indirect -- from its electric supply portfolio were 12,744,899 tons (CO_2e). Figure D-1 shows PSE's historic emissions from 2002 to 2007.

Figure D-1
Historic PSE Emissions

Year	Emissions (Total = Direct & Indirect)
2002	13,688,501 tons
2003	14,742,960 tons
2004	12,613,681 tons
2005	12,999,051 tons
2006	13,527,794 tons
2007	13,099,834 tons

B. Comparison of Life Cycle Greenhouse Gasses Emissions from Conventional and Alternative Generation Sources

The transition to a "low carbon" economy is underway, with wind, solar, and nuclear as some of the most promising options for "carbon-free" generation technologies. But are these technologies truly "carbon free," as many claim? Though these generation sources don't *directly* emit GHG's, emissions do result from the manufacturing processes behind these technologies. PSE has been and will continue to aggressively develop wind power. Each typical turbine in PSE's existing fleet is composed of three 7-ton composite blades, a hub, generator, and nacelle weighing over 90 tons that sits upon a 100-ton steel tower. The whole turbine rests on a 25' to 35' deep concrete footer reinforced with steel rebar.

The shipping and assembly also require consumption of fossil fuels and other resources. Of course, building a new natural gas or nuclear power plant would also require a vast amount of materials, but the central question is: How do the total emissions compare for conventional and alternative generation technologies when viewed from this perspective?

Life Cycle Assessment

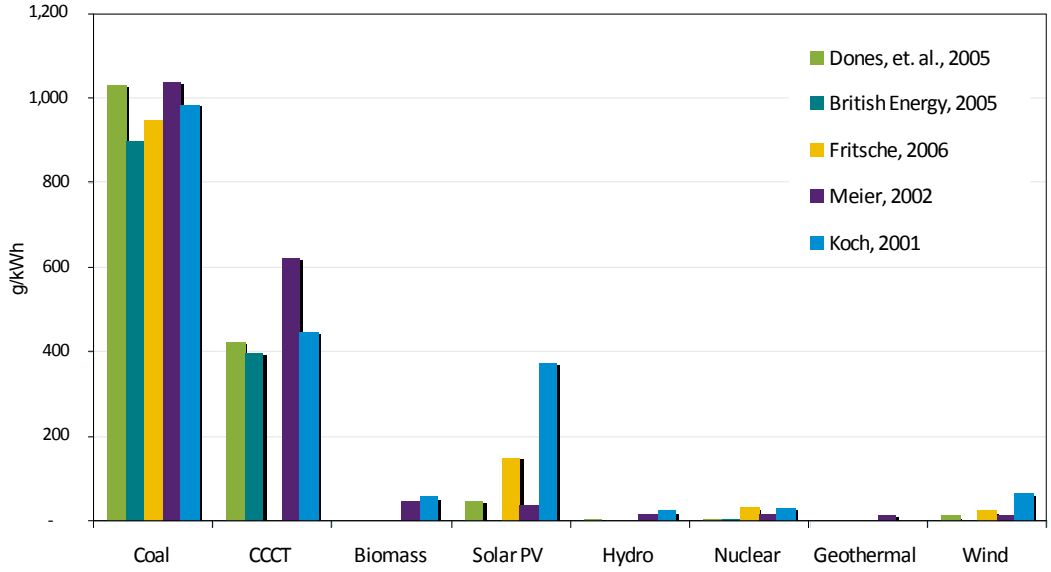
This question forms the basis for a field of study called Life Cycle Assessment (LCA). A similar form of analysis is “energy input-output”, but this approach only measures the total energy required to produce and operate the system versus its life-cycle output. Such analysis is useful, but it does not analyze the relative emissions and the resulting impacts from the energy and materials inputs. LCA analyzes all components of a system or service, beginning with the gathering of raw materials to create the product and ending at the point when all materials are either recycled or returned to the earth. For example, an LCA for a nuclear plant would assess the emissions from plant construction and all embodied materials, uranium mining and processing, plant operation, and also end of life considerations such as plant decommissioning and spent fuel disposal and/or reprocessing. Many such analyses go beyond simply estimating emissions and attempt to quantify the type and magnitude of multiple environmental and social impacts. This next step is considerably more complicated and rests on many assumptions. The ultimate goal, however, is to avoid decisions that solve one environmental/social problem but end up creating another.

The LCA approach is becoming increasingly common and even standardized under the International Organization for Standardization (ISO 14040:2006 and ISO 14044:2006). Several databases provide the backbone for this type of analysis and are continuously refined and updated. The down side to this analytical approach is the massive amount of data that must be collected and analyzed, and the substantial number of assumptions and estimations that must frequently be made. Despite these limitations, the results can reveal important trends. The electric power industry would be wise to avoid the debacle of the ethanol industry, where the net environmental benefits of that fuel remain controversial. Relating this issue to PSE, we ask how the life-cycle emissions from wind power compare to existing and alternative generation technologies.

Results

While a comprehensive LCA was not performed on PSE's wind fleet, the company did conduct a preliminary literature review on the topic. Five studies were reviewed, and the results compared side-by-side. Not all studies analyzed all generation sources, but the results between studies for coal, natural gas combined-cycle combustion turbines (CCCT), hydropower, nuclear, and wind are largely consistent with one another (see figure D-2). The results also suggest that solar, hydropower, nuclear, and wind offer significantly lower life-cycle GHG emissions than natural gas and coal. More research is needed on biomass and geothermal, but the results from these studies look promising for these technologies as well.

Figure D-2
Life Cycle Greenhouse Gas Emissions (CO_2e) by Generation Source



Discussion

Discrepancies in methodology do exist between the studies, which partially explain the variability. For example, the British Energy study analyzed CO_2 emissions only (not CO_2-e) and thus likely understates the total GHG emissions. Other studies, such as Fritsche and Dones et. al., divided wind generation into land-based and offshore, which were

averaged for the purposes of this review. Other assumptions such as the average wind capacity factor used will significantly affect the results.

The greatest variability exists in the results for solar photovoltaics (PV), mostly likely due to the nascent stage of the industry at the time of the Koch study (2001), and substantial discrepancies in assumptions for the type and size of the solar system analyzed and the energy mix assumed to be used to manufacture the cells and modules. For example, a solar cell composed of silicon manufactured in Moses Lake, WA, would have very low embodied GHG emissions because the electricity mix consists primarily of hydropower. A similar cell made of silicon manufactured in China would with coal-based electricity would have substantially greater life-cycle emissions.

One particularly interesting result, considering PSE's substantial and growing reliance on natural gas fired generation, is that life-cycle GHG emissions can be substantially higher than direct emissions. According to the Meier study, a 48% efficient CCCT will directly emit 382 grams of CO_2-equivalent per kWh from operations, but when the emissions related to natural gas production are included, CO_2-e emissions increase by 23% to 469 g/kWh, mainly due to methane releases during gas extraction and transport. Methane is over 20 times more powerful as a heat trapping gas than CO_2, and thus increases the GHG emission rate sharply. If future legislation imposes caps or taxes on this type of emission, this generation source would find itself at a competitive disadvantage.

Conclusions

Despite the discrepancies and uncertainties, the results of this literature review reveal that solar, nuclear, hydropower, biomass, and wind all have substantially lower life-cycle emissions of greenhouse gasses than that of natural gas or coal fired generation. Our conclusion from this is that PSE's focus on wind power is a sound choice to reduce GHG emissions. As efforts intensify to reduce such emissions, life cycle assessment will likely be an important tool to ensure that wise long-term decisions are made.

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2. Regulatory and Policy Activity

Limits on emissions of GHG in the United States have gained significant political momentum in just the past few months. The federal government hasn't successfully addressed the issue yet, but states, local governments and corporations are taking action, resulting in a patchwork of GHG policies and regulations that are adding significant challenges to long-term resource planning. This section outlines regulations and policies that may impact PSE's operations.

I. Federal Policies

Obama Administration

The election of President Obama and stronger Democrat majorities in Congress have greatly increased the likelihood that the federal government will adopt climate change legislation within the next two or three years. In stark contrast to President Bush, President Obama has indicated that he supports the creation of a federal cap and trade program to reduce the emission of GHG. Like a growing number of political leaders, he supports the setting of a cap to reach an 80% reduction of GHG emissions by 2050.

He further demonstrated his priority on energy and environmental matters by appointing former Clinton Environmental Protection Agency (EPA) Administrator Carol Browner as his new Special Assistant for Energy and Climate Change. In this role, Browner is expected to work closely with the Council on Environmental Quality, as well as the Department of Energy and the EPA to develop aggressive renewable energy and climate change policies.

U.S. House of Representatives

Newly elected House Energy and Commerce Committee Chairman Henry Waxman (D-Calif.) has moved rapidly in this new Congress to tackle energy and climate change matters. In appointing his new Energy and Environment Subcommittee chairman, Waxman asked his long-time colleague Rep. Ed Markey (D-Maine) to lead the committee's work to develop new climate and energy legislation. Markey is also the Chair of the House Select Committee on Global Warming, which he led during the last Congress as well. Markey has been a vocal advocate for developing strong national climate legislation.

Waxman has already set an aggressive timeline for developing new energy and climate legislation this year. In June, 2009 the U. S. House of Representatives passed the American Clean Energy and Security Act (ACES), which supports a cap and trade system for CO2 emissions.

U.S. Senate

This year, the U.S. Senate will be reviewing the ACES 2009 bill that passed the House of Representatives in June 2009.

II. State and Local Polices

A. In Washington State

Washington state is taking an aggressive approach to GHG emissions, making reduction a priority issue for state government. During 2008, the Legislature passed House Bill 2815, which 1) established GHG emission reduction levels to an ultimate goal of returning to 1990 levels by 2020, 2) created a mandatory reporting program for greenhouse gases to begin in 2010, and 3) established a "green jobs" program. The measure also directed the Department of Ecology (DOE) to negotiate on behalf of the state in the Western Climate Initiative (WCI) process to develop a regional cap-and-trade program. Additionally, Governor Christine Gregoire reconvened a citizen's group, the Climate Action Team, to explore and present possible complimentary measures for the reduction of GHG emission through areas such as energy efficiency codes, land use permitting, waste reduction, and transportation planning.

DOE will implement the Washington GHG mandatory reporting requirement for GHG emitters in 2010. All stationary sources that emit at least 10,000 metric tones per year of CO2 equivalent, or on road motor vehicle fleets that emit at least 2,500 metric tones of CO2 per year will be subject to reporting requirements. PSE will comply with all reporting requirements.

In 2008, the DOE, the Washington Utilities and Transportation Commission (WUTC), and the Washington Energy Facility Site Evaluation Council adopted rules to implement an emissions performance standard for utilities. The rules outline the emission profile of resources utilities must meet on resource acquisitions, currently equal to or less than 1,100 pounds of GHG emissions per megawatt hour. PSE is aggressively seeking out

renewable resources to meet customer load while at the same time being a good environmental steward.

State efforts to reduce GHG emissions in 2009 shifted to energy use applications rather than generation sources. The Legislature passed measures to cut GHG emissions through increased energy efficiency application, building code upgrades, and the development of electric vehicle infrastructure. PSE will be required to assist government, companies, and individuals in the work to minimize greenhouse gases.

B. Local

Local governments and non-governmental organizations (NGO) in the Pacific Northwest continue to develop their own climate change and sustainability ordinances and policies, many of which require PSE compliance. Following the creation of the U.S. Mayors Climate Protection Agreement in 2005 (launched by Seattle Mayor Greg Nickels), more than 500 mayors nationwide, including 28 mayors representing communities within PSE's service territory, agreed to commit to the following actions:

1. Strive to meet or beat the Kyoto Protocol targets in their own communities, through actions ranging from anti-sprawl land-use policies, to urban forest restoration projects, to public information campaigns;

2. Urge their state governments and the federal government to enact policies and programs to meet or beat the greenhouse gas emission reduction target suggested for the United States in the Kyoto Protocol;

3. Achieve a 7% emissions reduction from 1990 levels by 2012; and

4. Urge the U.S. Congress to pass the bipartisan greenhouse gas reduction legislation, which would establish a national emission trading system.

In addition to these activities, five local communities have established "Green Ribbon Commissions on Climate Protection" through a stakeholder group developed to create additional local emissions reduction policies. PSE developed a handbook for climate change, which provides municipal and business customers with a guide of PSE resources to help evaluate how their energy use is related to their impact on the climate.

The City of Seattle formed a Mayor's Green Building Task Force to focus on improving efficiencies in new and existing buildings, and PSE assisted with efforts to develop a plan to achieve the mayor's request of a 20% increase in the energy efficiency of Seattle's buildings.

PSE is actively working to foster more efficient direct use of natural gas through local programs to reduce overall carbon emissions in our region. We are doing so by 1) reducing electric demand by converting electrically heated homes to gas, where appropriate; 2) encouraging the conversion of oil heated homes to natural gas, resulting in 41% less carbon emissions; and 3) offering incentives to install high efficient gas equipment.

Lastly, NGOs and other quasi-judicial organizations continue to seek PSE's input on a variety of local climate change projects including the provision of emission inventory tools for local governments, green fleet initiatives, data repositories, local reports and guidance. PSE's local government and community relations departments work with municipal customers to explain how the company calculates our carbon footprint, as well as to connect customers with PSE services to help them manage their own energy use and emissions.

III. Regional Polices

Renewable Portfolio Standards (RPS) are important in the effort to reduce GHGs across the West Coast, with Washington, Oregon and California among 32 states with RPS laws in effect. The standards require electric utilities and retail providers to supply a specified minimum amount of customer load with electricity from eligible renewable energy sources. California's efforts to increase its RPS standard to 33%, along with potential federal renewable standards, will affect energy markets across the country.

In a coordinated effort through the Western Climate Initiative (WCI), seven western states and four Canadian provinces are designing a cap and trade system, targeting implementation in 2012. The goal is to reduce each state's GHG emissions levels by 15% below the levels of 2005, by the year 2020.

The group released a draft design in late 2008 outlining principles and general framework for a system to allocate and allow buying, trading and selling of GHG emission

allowances. Each WCI member must evaluate the design and choose to implement the program in its jurisdiction. So far, only California has provided the necessary legal requirements to implement the WCI plan.

Other options to affect GHG emissions releases are being explored by government entities in the West, including the carbon tax on fossil fuels in British Columbia. The British Columbia carbon tax, which began in 2008 and will ramp up the rate until 2012, applies to gasoline, diesel, natural gas, coal, propane, and home heating fuel. To offset the carbon tax cost to consumers, corporate and personal income tax rates will drop, and lower-income residents of British Columbia will receive an annual climate action credit of $100 per adult and $30 per child.

Whatever policy governments make, it is clear PSE and other utilities will face an ever increasing move toward greater GHG reductions. The company's resource plans must include these possible factors.

3. Challenges/Issues of Climate Change Policy

With ongoing development of state and federal initiatives intended to address climate change, the challenge to develop strategic solutions is more complicated than ever. However, PSE believes that now is the time to act. Consequently, the company will work with lawmakers to achieve the objectives of the Greenhouse Gas Policy Statement, and address what we feel are some of the major challenges and obstacles associated with climate change policy.

A. Energy Efficiency

Chapter 5 and Appendix L of the IRP discuss PSE's ongoing energy efficiency efforts. PSE is committed to continuing its leadership in energy efficiency. However, some challenges need to be addressed. Appendix L shows the historic potential of demand-side resources (DSR), but does not identify infrastructure constraints that go beyond the modeling. Moving beyond the 30 aMW achieved in 2007, and toward the levels identified in the appendix will require infrastructure investments to develop greater DSR.

B. Transportation Efficiency

PSE recognizes that approximately 50% of the GHG emissions in the Puget Sound region, and almost 28%[1] nationally are caused by transportation. PSE believes that any efforts to address climate change must improve transportation use and efficiency. To that end, the company has implemented several internal programs to improve efficiency in its own operations.

The company's Green Fleet Program has expanded the use of hybrid vehicles within its fleet in order to reduce fuel use. Currently, PSE has 45 hybrid cars and light truck vehicles in fleet service, and has added a hybrid line truck to its fleet for testing.
PSE also has an active commuter trip reduction program to help employees reduce the emissions associated with their daily travels. To help minimize work related travel, PSE has a network of teleconference facilities across our operations, as well as a fully networked system that allows for mobile employees.

[1] U.S. transportation sector GHG emission data is for 2007. Source: U.S. Energy Information Administration, *Emissions of Greenhouse Gases Report (DOE/EIA-0573 [2007])*, released December 3, 2008

PSE's fleet is also piloting the use of two electric plug-in vehicles, and the utility is an active participant in regional discussions about the use of alternative fueled vehicles, including electric and natural gas vehicles.

C. Renewable Energy

One of the biggest challenges facing renewable energy is how to integrate renewable resources. Appendix H discusses wind integration. Currently, the most readily available renewable source of energy is wind generation. While PSE plans to meet the RPS requirements, it is important for the utility, and the region, to begin exploring the adequacy of the hydroelectricity, transmission, and gas systems to integrate intermittent renewable resources such as wind.

D. Carbon Sequestration

PSE is tracking and using technologies such as integrated gasification combined cycle plants, which use coal and other fuels, yet are capable of capturing and sequestering carbon. PSE participates in the Big Sky Carbon Sequestration Partnership based in Bozeman, Mont., which is investigating numerous sequestration technologies for effectiveness and cost.

Carbon sequestration can be terrestrial or geologic. Terrestrial carbon sequestration uses natural methods for returning carbon to the soil and plants at the surface level. Soil contains CO2 sequestered by plants, but overgrazing reduces the ability of plants to perform this function; improved pasture management can increase soil CO2. Crops also sequester carbon in the soil, but the tilling process releases it back into the atmosphere. Agricultural practices that reduce tilling have led to an increased level of carbon in the soil. Afforestation projects—growing trees to capture and hold carbon until the wood decomposes or is combusted—require long-term management to ensure that the carbon stays sequestered. Overall, while agriculture is responsible for a small portion of America’s contribution to climate change, it can also be part of the solution.

Geologic sequestration involves pumping CO2 deep into the ground, where it reacts with rocks to form an inert compound. There are numerous opportunities for carbon capture and sequestration (CCS). For example, oil companies have practiced “enhanced oil recovery” for 30 years—pumping CO2 produced by the refining process into their wells to improve oil recovery. Companies in the Northwest are currently testing wells drilled deep

into the saline aquifer. Pumped CO2, in an aqueous state, reacts with basalt to form inert calcite. Costs for this type of geologic sequestration have not yet been determined; however, large-scale CCS will require significant infrastructure investments.

The Big Sky CO2 Partnership is currently operating several test injections of CO2. The basalt injection site in eastern Washington involves the test injection of CO2 into a basalt formation that was extensively characterized by the Department of Energy. The Labarge Platform site in Wyoming involves injecting up to one million tons of CO2 per year into a sandstone formation that is present in significant portions of the West.