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Striking a Balance Between Energy and the Environment in the Columbia River Basin

Rapid Development of Wind Power Prompts Regional Plan for Its Integration Into Power Supply

In late August, Northwest electricity industry leaders met in Portland to launch a new initiative that will explore how to integrate large amounts of wind power and other renewable resources into the Pacific Northwest electricity system while maintaining high overall reliability of service.

Wind power, a renewable resource, has an important role in the region's future supply of electricity, according to the Northwest Power and Conservation Council's Fifth Northwest Power Plan. The Council completed the Fifth Plan, the latest periodic revision, in 2004. The power plan looks 20 years into the future and provides analysis of the regional energy system and guidance regarding future supplies of electricity, consistent with the Northwest Power Act.

The Fifth Plan calls for meeting growing demand for electricity with a mixture of energy conservation and new power plants, primarily wind power plants. The plan calls for achieving 700 average megawatts of new energy conservation between 2005 and 2009, and up to 5,000 megawatts of new wind power over the 20-year planning period (through 2024). One average megawatt is 1,000 kilowatts of electricity delivered continuously for a period of one year. One average megawatt will power about 585 Northwest homes.

Wind power, a proven source of clean and renewable electricity, currently supplies about 3 percent of the region's electricity. Wind project developers have requested integration services and facilities to add more than 3,000 additional megawatts of wind power in the region over the next several years.

The integration issue is critical because production from wind power facilities can vary widely in a given period due to the intermittent nature of the "fuel," and periods of strong production do not always match up with periods of peak consumption by electricity customers. Adding too much of a variable resource to the baseload power supply coming from hydroelectric facilities and power plants fired by coal and natural gas could reduce the overall reliability of the regional power system.

The current rate of renewable resource development in the Northwest is unprecedented in the nearly 26 years since Congress passed the Northwest Power Act, which emphasizes energy conservation and renewable resources to meet future demand for power. More than 450 megawatts of generation using renewable

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What's Inside

What States Are Doing to Move Toward a Clean Energy Future

Clean energy has been a hot topic recently, due to high fuel costs and concerns about the impact of burning fossil fuels on the environment. In particular, wind power development has been especially well covered in the news. It's now the fastest growing form of electricity generation in the United States, expanding at an average annual rate of more than 20 percent.

While this surge in growth for wind power can be attributed to a number of factors, including technological advances and the federal tax credit, which have helped to lower its cost, the resource has also been helped along to a great degree by incentives that are state-driven.

Many states use a variety of strategies to encourage the development of renewable resources. By including wind, solar, and biomass energy, for example, in a balanced resource portfolio, states can reap environmental and economic benefits. One of the most popular policy tools used by states is the renewable portfolio standard (RPS). An RPS requires utilities and other retail electric providers to supply a minimum percentage or amount of their customer load with eligible sources of renewable energy.

"The renewable portfolio standard started to appear five or six years ago," says Jeff King, senior resource analyst for the Council. "Each state's RPS is designed differently in terms of what qualifies as a renewable, how much is targeted, and which utilities are required to participate." The problem for utilities, however, is that the RPS targets may not always be realistic or achievable.

A penalty of some kind is usually levied on suppliers that fail to meet their renewable energy purchase obligations, and flexibility in how they can meet those targets is considered an important key to reaching compliance. In some jurisdictions, electricity suppliers can use "tradable renewable certificates" (TRCs) to comply with their RPS requirements. A TRC equals one megawatt-hour of renewable energy that can be traded. These credits create revenue for renewable generators while enabling electricity suppliers to comply with the RPS even though they are not directly purchasing renewable electricity.

Although a relatively new policy mechanism, the RPS was first proposed by the wind industry through various restructuring laws a decade ago, and emerged as part of the deregulation of the electricity sector. Consequently, most RPS policies grew out of state legislation, but some developed from regulatory action and one (Colorado) came out of a state ballot initiative. Although initially concentrated in restructured states, about half of the states with an RPS have regulated markets.

One of the central features in RPS laws is that it is "technology-blind," in other words, the least-cost renewable resource

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Notes From the Chair

The stories in this edition of the Council Quarterly reflect the intense interest in renewable energy, both regionally and nationally. In our region, the Council and the Bonneville Power Administration are leading an effort to understand how we can integrate large amounts of wind power and other renewable resources into the Pacific Northwest's energy system while maintaining its reliability. The result will be an action plan to help the region along a clean energy path.

Also in this issue, we look at two of the policy tools currently being used by states to encourage the development of renewable technologies: the renewable portfolio standard and clean energy funds. Both have strengths and weaknesses that the two stories explore. In an interview with Jack Robertson, the former deputy chief executive of Bonneville talks about his vision of the "hydrogen revolution," a technological breakthrough that has the potential to radically change not just the Northwest, but also the world.

And in a story on an area that, like many parts of the Northwest, is under increasing pressure from development, you'll learn how citizens in the Methow Valley are working to preserve its unique natural environment through the use of conservation easements. By moving from conflict to cooperation, they're able to protect the very qualities that attract people to live there.

Making the Change: Energy Trust Programs Help Consumers Save Energy and Invest in Renewable Resources

While renewable portfolio standards are used in several states across the country to encourage the development of new sources of clean energy, the state of Oregon took a different path to reach the same goal.

In 1999, the state legislature passed Senate Bill 1149, the electric industry-restructuring bill. The law required Portland General Electric and Pacific Power to collect a 3 percent public purpose charge from their Oregon customers to support investment in energy efficiency and renewable energy projects. The law also dedicated a separate portion of the funding to energy efficiency efforts for low-income housing and K-12 schools. The law authorized the Oregon Public Utility Commission to direct the majority of the funds to a non-governmental entity for investment, and Energy Trust was organized as a non-profit agency to administer these funds. Today, Energy Trust also provides energy efficiency services to the Oregon customers of NW Natural, Avista, and Cascade Natural Gas.

Since its beginning in 2002, more than 300,000 households and businesses have used Energy Trust's programs to help them invest in energy efficiency and renewable power. Energy Trust has supported the installation of nearly 450 new solar electric systems and has been instrumental in stimulating wind and biomass generation. Its programs include energy-saving recommendations, cash incentives for improvements, referrals to qualified contractors, project management, and technical assistance.

Incentives for many simple efficiency measures (e.g., gas furnaces and high performance fluorescent lighting fixtures) that are known to be cost-effective are available on a predetermined basis. Some are available through retail outlets, and others by working with equipment contractors.

A more design-oriented approach is used for more complex, customized projects. Especially large projects can take as long as three years to complete, from beginning to end, but the typical project is generally a straightforward process, and can be completed in a few months, a timeframe consistent with the normal construction schedule for these projects. For a business looking to improve the energy efficiency of its office, for example, Energy Trust first sends its technicians to walk through the space to look for energy saving opportunities. "It could be changes to the lighting, heating and cooling system, windows, insulation—we assess a menu of items for the customer to consider," says Fred Gordon, director of planning and evaluation. Once the customer has decided on the measures of interest, the project may proceed through the following steps.

With help from Energy Trust of Oregon, this co-op grocery store installed photovoltaic solar panels and can now harness energy from the sun. *(photo courtesy of Energy Trust of Oregon)*

Energy Trust and the customer contract for a study to estimate the cost and savings for those measures. Based on this study, Energy Trust decides whether it is cost-effective to make an offer to co-fund the project. "We ask whether the savings would be a good buy to ratepayers compared to the utility power and power delivery costs it displaces over its life," says Gordon. Energy Trust also considers whether benefits to society exceed the overall cost. Examples of additional benefits to society might include reduced carbon output from power plants, or reduced costs for water and sewage treatment for measures that also reduce water use.

If the measures are found to be cost-effective, the customer is required to pay for at least one of the measures, or pay 50 percent of the cost of the study. A proposal is given to the customer offering a cash incentive based on the savings to be achieved. The customer can select a contractor or use one of Energy Trust's contractor trade allies; often the customer requests competitive bids as the basis for deciding which contractor to use. Once the measure is installed, the Energy Trust conducts a verification inspection and issues an incentive check to the customer.

According to Steve Lacey, director of energy efficiency, Energy Trust has bought more than 100,000 compact fluorescent light bulbs and completed

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will be favored over all other renewables. As a result, the RPS benefits the most cost-competitive forms of renewable energy, which to date has led to the market development of large-scale wind, biomass, and other centrally located facilities.

A recent study by the Clean Energy States Alliance (CESA) noted, "RPS laws favor cheaper, central generation projects over more expensive, smaller scale projects. That is by design."

The renewable that has benefited the most from RPS laws so far, is wind. According to a recent study by the Lawrence Berkeley Laboratory, nearly half of all wind project development from 2001 - 2005 was RPS-related. Some examples of the impact of RPS policies on wind development include: Texas: 700 megawatts installed in 2005; California: 60 megawatts installed in 2005; Wisconsin: 200 megawatts to be built in 2006; and Minnesota: 145 megawatts installed in 2005.

In the Northwest, Montana is the only state with an RPS, enacted in April 2005 as part of the Montana Power Production and Rural Economic Development Act. It requires public utilities to obtain a percentage of their retail electricity sales from eligible renewable resources according to the following schedule: 5 percent in 2008 - 2009; 10 percent in 2010 - 2014; and 15 percent in 2015 and thereafter. Eligible renewable technologies include: solar thermal electric, photovoltaic, landfill gas, wind, biomass, hydroelectric, geothermal electric, anaerobic digestion, and fuel cells using renewable fuels.

Renewable portfolio standard policies are currently under consideration by Oregon and Washington. Oregon, along with a number of other states, uses a public benefit fund system, also called clean energy or renewable energy funds, to promote energy efficiency and renewable energy technologies (see the related story on the Energy Trust, page 3). Like the RPS, there is wide variation in how states have designed the fund depending on their goals and situations. In general, early reviews of clean energy funds suggest they can be an effective incentive for targeted renewable technologies that are proven but relatively expensive compared to fossil fuel generation. Clean energy funds can help bridge the gap between what the market is willing to bear and current costs.

"RPS laws favor cheaper, central generation projects over more expensive, smaller scale projects. That is by design."

A recent study by the Clean Energy States Alliance

The difference between how both policies perform appears to be in the dichotomy between large-scale and small-scale development. "For large-scale renewable energy development, the RPS is generally found to be more effective," says Ryan Wiser, researcher for the Lawrence Berkeley Laboratory. "For smaller-scale solar applications, renewable energy funds are likely to be most effective."

A number of states use both the RPS and the clean energy fund to reach their energy efficiency and renewable energy goals, and as more is understood about how each method performs over time, a better understanding about how to use these mechanisms should emerge. In the CESA study, they observe that the "RPS is an effective policy tool, but is limited in scope…To address the inherent limitations of the RPS policies to spur small-scale projects, many states are developing alternative RPS strategies."

Sometimes states have created "set asides" to target specific resources like solar or distributed generation, but the early indications suggest that RPS policies, including set asides, are successful at encouraging small-scale projects only when combined with significant complementary policies and financial incentives. The CESA study concludes "…it is our view that the most effective method of promoting clean energy benefits within a state is through the combination of mandates (such as an RPS) with strategic and targeted programs and incentives (such as through a state clean energy fund)."

The popularity of the RPS, despite its shortcomings, stems from consumer support for policies that have the potential to deliver economic growth, fuel diversity, and environmental benefits. The important lesson, according to Wiser, is that it is critical to get the legislative and regulatory design details right. While some RPS policies seem to be working well, Texas and Minnesota for example, other policies suffer from weaknesses in their design. Chronic under-compliance is a problem in Arizona, Nevada, Massachusetts, and California, and other policies largely support existing, rather than new, renewable generation. Common design pitfalls include overly broad definitions of eligible resources, inadequate enforcement, transmission bottlenecks, and a too complex design.

As states continue to fine-tune their policies, and as others consider what direction to take toward a clean energy future, recent experience highlights the importance of attending to the details and to implement the chosen methods in a coordinated fashion. It gives these strategies the best chance to be successful. CQ

Energy Trust Programs Help Consumers Save Energy and Invest in Renewable Resources

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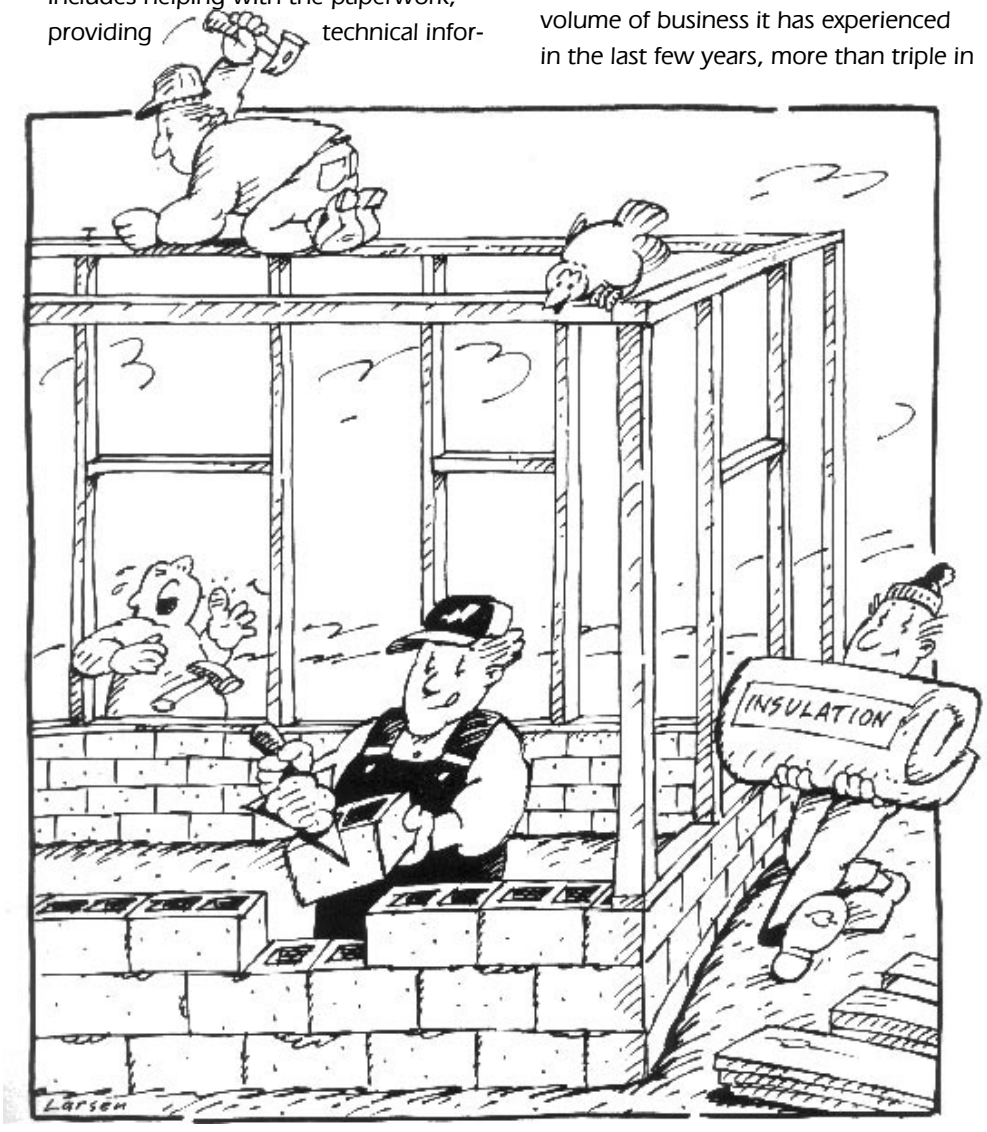
tens of thousands of residential energy efficiency improvements in the form of insulation, duct sealing, high-efficiency heating, and energy-efficient windows. In addition, the organization has helped thousands of industrial and commercial participants to upgrade and improve their operations.

"We strive to make these energy-saving changes as easy and streamlined as possible," says Lacey. Perhaps equally important is Energy Trust's role as facilitator in navigating the various other agencies that are often involved. The Oregon Department of Energy offers a business energy tax credit for 35 percent of eligible project costs, which can be a significant financial component of proposals put together by Energy Trust. "We act as a coordinator for participants, and that includes helping with the paperwork, providing technical information, and information about the other forms of financial assistance that may be available to them through the state's loan program," explains Lacey.

> "We strive to make these energy-saving changes as easy and streamlined as possible."
>
> Steve Lacey, director of energy efficiency, Energy Trust of Oregon

One measure of Energy Trust's growth can be seen in the increased volume of business it has experienced in the last few years, more than triple in 2005 compared to 2004. "We opened for business in 2002, and along with the increased number of projects that have been implemented, we've seen quite a diversity of projects," says Lacey. For consumers and businesses interested in lowering their energy bills and investing in renewable power, you can learn about Energy Trust's programs at www.energytrust.org.

New energy efficient windows, installed by Richart Builders, will improve comfort and lower energy costs for tenants of the Rachel Anne Apartments. *(Photo courtesy of Energy Trust of Oregon)*



Lake Fertilization Appears to Benefit Fish in Idaho and British Columbia

Research in British Columbia and the Stanley Basin of Idaho suggests that nutrients that once were delivered to streams by the carcasses of spawned-out salmon and steelhead, and subsequently lost when the runs declined, can be restored by the addition of artificial nutrients—in essence, fertilizer. Fish populations rebounded after lakes and rivers were treated with a combination of phosphorus and nitrogen. The fertilizer aids the growth of phytoplankton, which feeds zooplankton, which in turn feeds fish.

Dr. John Stockner of the University of British Columbia reported the results of his research at the August meeting of the Northwest Power and Conservation Council. Dr. Stockner said declines in salmon and steelhead abundance, whether through the construction of dams or through overfishing or other causes, robs spawning streams of marine-derived nutrients.

In some rivers and streams in the Northwest and in British Columbia, salmon and steelhead carcasses represented 50-75 percent of the annual infusion of nutrients. The loss of phosphorus and nitrogen from marine-derived nutrients diminished the rearing potential in nursery lakes for sockeye and in streams for Chinook salmon.

"This substantial nutrient loss led to low ecosystem production and biodiversity and to swiftly declining juvenile salmon production," he said.

Treatment with nitrogen and phosphorus enhanced the growth of food organisms and led to improved fish production. "Treated ecosystems show immediate responses with higher forage production levels attained within months of application," said Stockner.

That has been the result, generally, of lake fertilization in Idaho, a project funded by the Bonneville Power Administration through the Council's Columbia River Basin Fish and Wildlife Program. The Shoshone-Bannock Tribes have been fertilizing three lakes in the upper Salmon River Basin for about 10 years, said Doug Taki, sockeye program manager for the tribes.

> "We've seen increased densities of phytoplankton and zooplankton, and overall the result has been good survival and growth of sockeye."
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> Doug Taki, sockeye program manager for the Shoshone-Bannock Tribes

"We've seen increased densities of phytoplankton and zooplankton, and overall the result has been good survival and growth of sockeye," Taki said. He said the tribes spray phosphorus and nitrogen into the lakes—Petit, Alturas, and Redfish—periodically between midsummer and the fall, depending on where hatchery-raised sockeye fry have been released and where the growth of food organisms would provide the most benefit for the fish. The tribes don't fertilize each lake each year, he said.

Fertilization of lakes and streams is being studied elsewhere in the U.S. portion of the Columbia River Basin, including in the Kootenai River in Idaho, Lake Wenatchee in Washington, and Dworshak Reservoir in Idaho. Fertilization also has been suggested as part of a steelhead restoration program in Washington, where Lake Quinault on the Pacific Coast already is being fertilized.

Meanwhile, Kootenay Lake in British Columbia has been fertilized to enhance kokanee production since 1992, and in the Upper Arrow Lake, which is part of the mainstem Columbia River, since 1999. In both areas, BC Hydro, the provincial electric utility, pays for the fertilization as part of its Columbia Basin Fish and Wildlife Compensation Program. The Compensation Program, which mitigates the impacts of BC Hydro's dams on fish and wildlife, is a joint initiative of BC Hydro, the provincial Ministry of Environment, and the federal Fisheries and Oceans Canada.

In Kootenay Lake and the Upper Arrow Reservoir, as in the three Stanley Basin lakes in Idaho, nutrients are sprayed from boats or small barges towed by boats. In the Upper Arrow Reservoir, the fertilizer tanks are mounted on the provincial ferries that cross the lake between Galena Bay and Shelter Bay.

According to the Compensation Program, as a result of the fertilization, fisheries in both Kootenay Lake and the upper Arrow Lakes Reservoir are healthier than they were before the programs began. The Compensation Program also funds the maintenance of artificial spawning channels in Kootenay Lake and in the Upper Arrow Reservoir. Since fertilization began, the number of kokanee using the spawning channels, while variable from year to year, is trending upward.

This tank truck is dispensing fertilizer into the Upper Arrow Lake from the Shelter Bay ferry. *(Photo: Brian Sperling)*

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fuel sources have been placed in service since December 2004 when the Council completed the latest version of its Northwest Power Plan, and at least that much more wind power is under construction.

Wind power is the fastest-growing source of new renewable energy. Factors contributing to the rapid rate of development include sustained high natural gas prices, which encourage development of alternative power supplies; climate change concerns, which discourage investments in power plants that create carbon-based emissions; continuation of the federal production tax credit, which lowers the cost of new wind power facilities; and state renewable resource portfolio standards, which require utilities to include a certain amount of renewable energy in the power they sell.

> "Wind power is being developed much faster than the Council anticipated in our regional power plan, and we want to be sure that the power system absorbs this resource efficiently and economically."
>
> Tom Karier, chair
> Northwest Power and
> Conservation Council

The August policy discussion, the first of a series, was convened by the Council and the Bonneville Power Administration at the Council's Portland headquarters. Participants included power experts from the four Northwest states and British Columbia. Council Chair Tom Karier of Spokane, and Bonneville Administrator Steve Wright co-chaired the policy discussion.

Technical workshops are scheduled throughout the fall, and an action plan for Northwest wind integration will be developed and issued for public review in early 2007. The action plan will address three key questions:

• How much wind power and other intermittent resources can the regional power system currently absorb?

• What additional integration capability might be secured through revised or new policy, operational, and market mechanisms?

• What generating, transmission, and other equipment upgrades are available to further extend renewable resource integration capability in a cost-effective manner?

"We feel lucky to be facing this issue in the Northwest because most areas of the world don't have the wonderful combination of both a robust hydroelectric system and a quickly growing wind power component," Wright said. "Our job is to find strategies to accommodate the growing renewable technologies into the system we already have so that the efficiency of both can be maximized while preserving our system's high level of reliability."

Karier noted that the popularity of wind power in the region today was not predicted just a few years ago.

"Wind power is being developed much faster than the Council anticipated in our regional power plan, and we want to be sure that the power system absorbs this resource efficiently and economically," Karier said.

Summer High Temperatures Translate Into a Wake-up Call for Energy Planners

On July 24, when the West was experiencing extremely high temperatures over an extended period of time, several Northwest utilities received a rude awakening on how quickly a favorable resource adequacy outlook can turn precarious. On that day, Puget Sound Energy, Portland General Electric, and PacifCorp declared that all their available resources were in use; spot market prices spiked to $400 per megawatt-hour; and the Bonneville Power Administration had to alert the federal hydropower operators that it may have to violate spill requirements in order to meet power needs.

"While we weren't on the verge of blackouts—it was more of an economic situation than a reliability issue—it was a wake-up call for the region," says Wally Gibson, the Council's system analysis and generation manager.

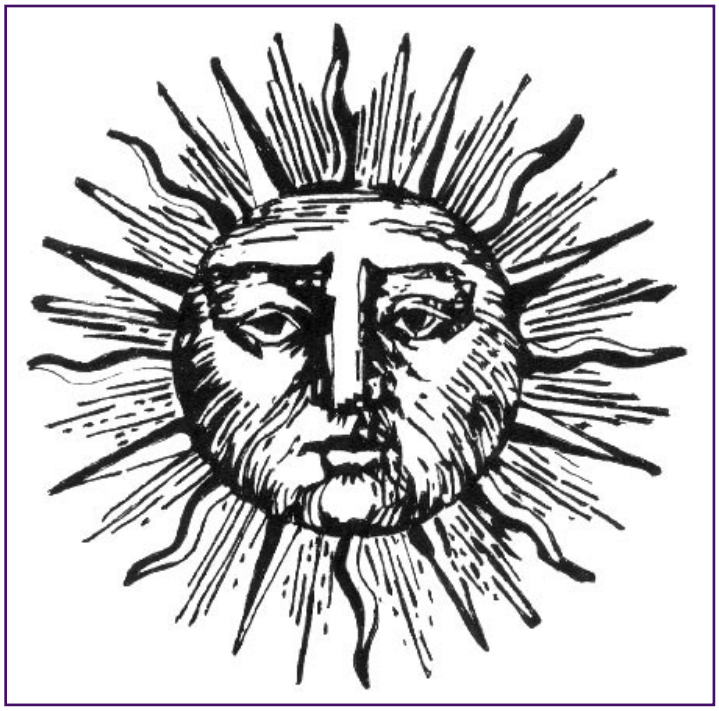
Energy planners had believed that the region enjoyed a substantial reserve of energy from which to draw upon, thanks to the number of independent power producers and their generation. But during the last weeks of July, when temperatures soared beyond planning levels and above the daily forecasts for both the Northwest and California, the entire West Coast was struggling to serve loads.

July 23 was the hottest day on record in Portland, and the 24th was only a degree or two lower—a one in 70-year event. "It was an extremely rare temperature event," says Gibson. "Planning standards are set for one in 10 or one in 20-year events, but not for record-breaking temperatures."

Most of the generation produced by Northwest independent power producers thought to be available to the region—about 3,500 megawatts—was sold to California, which was also experiencing its own heat wave.

Contributing to the situation was an under forecasting of loads prior to the weekend of extreme temperatures and significant advance sales to California. A couple of generation outages at the time of peak demand, a limited ability to call on customers to voluntarily reduce loads, and wind power running at low capacity—the wind doesn't blow in a heat wave—all added to the strain on energy resources.

The Resource Adequacy Forum, a group initiated by the Council and the Bonneville Power Administration to develop a regional resource adequacy standard, is currently reviewing an analysis of the summer's events to determine a summer capacity adequacy standard. "We've always been concerned about the Northwest's resource adequacy in the winter," says Gibson. "Now we may also have to think about our summer adequacy."



Success Stories — Methow Valley

Conservation easement protects critical habitat in the Methow Valley of Washington

In the Methow River Valley of north-central Washington, where demand for vacation home sites is strong and property prices are doubling annually, the Council, in collaboration with the Methow Conservancy, Bonneville Power Administration, the National Fish and Wildlife Foundation, and other partners, is working to limit future development and protect fish and wildlife habitat by purchasing conservation easements.

The latest parcel to be protected, known as the Heath property for its owners, Harold and Tina Heath, comprises 140.5 acres approximately four miles upstream from Winthrop, Washington. The Methow River flows through the property, which has the only known heron rookery in the Methow watershed. The river and its numerous side channels and wetlands within the conservation easement provide important spawning and rearing habitat for Upper Columbia spring Chinook salmon, an endangered species.

"The easement property is incredibly rich and diverse biologically," said John Sunderland, Methow Conservancy Land Project Manager, in a news release issued by the Conservancy. "During the course of creating the easement, I saw spawning salmon, eagle, osprey, great blue herons, and black bear."

The easement for the privately owned property cost $1.9 million. In exchange for the payment, the owners agreed not to develop the property, which was appraised at $3.57 million for development purposes. The easement prohibits all land development. Without the easement, current zoning could allow approximately 20 home sites on the property.

Bonneville paid $1 million of the easement cost. The Tributary Fund, a habitat-conservation program run by the Douglas County Public Utility District, contributed $812,000, and Washington's Salmon Recovery Funding Board contributed $137,000.

The easement contains two zones, a 114-acre riparian habitat conservation zone, which spans the river and is between 300 and 3,000 feet wide, and a 28-acre forest conservation zone. The easement helps meet NOAA Fisheries' goal to protect habitat for the listed salmon in the Methow, Entiat, and Wenatchee river basins. The Council's Methow River Subbasin Plan identifies problems including low flows and high water temperatures in the Methow, and the easement will help address those problems.

The nonprofit Methow Conservancy accepts voluntary conservation easements, provides conservation education opportunities for visitors and residents, and assists with community-based conservation projects. To date, the Conservancy has worked with more than 75 families to protect more than 5,000 acres of critical habitat and more than 15 miles of shoreline in the Methow Valley.

Left, the conservation easement will protect the Methow River as it cuts through the property.

Above, one of many spring-fed streams that connect riparian areas within the protected easement.

Northwest Q&A: Jack Robertson on the Hydrogen Revolution

Jack Robertson was born and raised in Portland, Oregon. He graduated from Stanford University. For nearly a decade he was a legislative advisor and director of communications in Washington, D.C. for Senator Mark Hatfield (R-Oregon). In 1983, Robertson moved back to Oregon and began working for the Bonneville Power Administration, the largest federal power-marketing agency in the nation. The agency provides about half of the electricity used in the Pacific Northwest. For 15 years, Robertson was the deputy chief executive officer and acting chief executive officer of Bonneville.

Robertson served on two presidential commissions studying water policy, and on the national boards of the Electric Power Research Institute and the North American Electric Reliability Council. In 1997, he helped found the Bonneville Environmental Foundation. In 2003, Robertson co-founded the Northwest Hydrogen Alliance, a non-profit organization devoted to expanding the hydrogen economy in the Pacific Northwest and Alaska. He currently serves as chairman of the Alliance.

What is hydrogen energy? How does it work?

Hydrogen is the most plentiful element in the universe. Hydrogen is a virtually endless energy source that burns beautifully. Its only by-product is water vapor. The key challenge to a hydrogen-powered world is to cost-effectively separate hydrogen from its chemical bonds. With water, for example, hydrogen is bonded to oxygen. Separate the hydrogen in water from oxygen by an electric current and store the hydrogen gas or liquid in a tank. Then use the hydrogen to power a modified combustion turbine, fuel cell, or internal combustion engine, and you can generate on-demand power with zero pollution.

A hydrogen-powered economy in the Northwest would start with rain: Collect the water, separate hydrogen from oxygen, and burn the hydrogen—creating electricity. Water vapor formed by burning hydrogen would return to the atmosphere and produce more rain. The rain would fall again, forming a perfect environmental closed loop. Hydrogen from water produces effective, controllable power output with zero pollutants. If we can figure out how to produce

and burn hydrogen cost effectively, and that's our goal at the Northwest Hydrogen Alliance, I believe it is one of the few breakthroughs that could revolutionize the world.

We need a technological revolution in hydrogen equaling or surpassing the computing revolution of the last 30 years. Thirty years ago the most powerful super computer cost tens of millions of dollars and could barely fit in a very large room. Today, much more powerful computers cost a couple thousand dollars and rest on your lap. We need an energy breakthrough as powerful as the computing revolution. But this revolution will do more than create hundreds of thousands of new jobs. It can radically reduce our dependence on foreign oil, strengthen the power grid, and help solve pollution on a global scale.

Given the condition of world events, I believe our national security now depends on it. In my view, the only form of energy with the potential for igniting this technological revolution within this decade is hydrogen.

What are the applications for hydrogen energy? What will hydrogen energy be used for?

The potential for hydrogen production here in the Pacific Northwest is enormous. I've said the Northwest can be the Saudi Arabia of hydrogen energy. Let me explain that.

Saudi Arabia has by far the largest oil reserves remaining in the world—estimated now at some 260 billion barrels of oil. With these reserves, Saudi Arabia dominates the price and flow of oil worldwide. The remaining 260 billion barrels of oil—at 20 gallons of gasoline per barrel—equal about 5.2 trillion gallons of gasoline. Some experts believe this supply of oil has now peaked and will begin to disappear by the end of the century. It is highly vulnerable to disruption and attack.

Contrast this with our own potential source of power. In a normal year, the Columbia River can produce some 250,000 cubic feet of water per second. The hydrogen content locked in each cubic foot of this water is equal to 3.6 gallons of gasoline. In three and a half minutes, the Columbia River car-

ries enough hydrogen in its water flow to power every one of the 127 million passenger cars in America for an entire day. In 67 days, the Columbia River carries enough hydrogen in water to equal the 5.2 trillion gallons of gasoline contained in all the remaining oil reserves of Saudi Arabia. And the Columbia does this every 67 days—forever. Moreover, low-cost, off-peak hydropower from the Northwest can convert water to hydrogen cheaper, faster, and cleaner than anywhere else in the world.

How will hydrogen be used? In simple terms, the world is powered by two remarkable, trillion-dollar energy infrastructures. The first $1 trillion infrastructure is regional and national power grids around the world providing the fundamental building block of modern society—electricity. The second $1 trillion infrastructure is the food and transportation infrastructure powered virtually entirely by oil. Civilization itself rests on these highly complex, increasingly vulnerable systems.

With the right technical breakthroughs—some of which the Northwest Hydrogen Alliance wants to demonstrate soon—hydrogen can run any engine that now operates on gasoline, diesel fuel, or natural gas. I think new hydrogen-powered systems can be competitive in price, help decentralize the power generation for the grid, and allow us to site renewable, highly controllable power generation inside urban growth areas. And as I've said, a significant source of hydrogen can come from natural regional resources, not foreign governments fueling terrorism. The key to the hydrogen revolution is safely and cost effectively creating, storing, and burning hydrogen in new systems that can retool the world's carbon-based energy infrastructures.

> "In three and a half minutes, the Columbia River carries enough hydrogen in its water flow to power every one of the 127 million passenger cars in America for an entire day."
>
> Jack Robertson, chairman
> Northwest Hydrogen Alliance

You've laid out the challenges to using hydrogen energy, do you have ideas about how we can get to this energy revolution?

The Northwest Hydrogen Alliance sponsored quite an exciting conference, entitled the "Hydrogen Economy 2006," this past August at the Oregon Convention Center. One purpose of the Alliance is to bring new ideas together around how to build a real-world hydrogen economy. We want to prove it can be practical, easy for consumers to use, and effective for industry investment. People attended the conference from all over the world. Two particularly important technological breakthroughs were presented.

The first breakthrough was a new, highly efficient internal combustion engine that can run directly on hydrogen-rich fuels and produce electric power with no pollution. The Alliance sees these and other engines as the center of "hydrogen hubs" that can be placed at strategic locations in areas of load growth for the power grid. Now, because of strict air quality standards in cities, we typically build carbon-based power generators hundreds of miles away from the source of electric load. We then have to invest hundreds of millions of dollars in transmission, distribution, and substation costs to get that power to the cities that need it—if environmental restrictions and the public allow us to build these wires at all. This adds significant costs to the price of electricity. Even wind power development is now facing challenges because of its distance from load and lack of predictable power generation. Hydrogen hubs can be built inside urban areas, close to substations, generate non-polluting power on demand, and help integrate wind power into the grid.

The Alliance is interested in testing this engine, along with other hydrogen-burning fuel combustion turbines and fuels cells, as we demonstrate the potential of hydrogen hubs for the power grid.

The second breakthrough was an idea to solve one of hydrogen's most vexing problems—storage. Hydrogen gas can be safely stored. But because it is a very light gas, it's expensive to store a lot of hydrogen in quantities sufficient to run power generators. The breakthrough idea came from a former scientist at the national labs, Dr. John Holbrook. His idea was to store hydrogen in a liquid, hydrogen-rich fuel—ammonia.

He pointed out that the largest amount of hydrogen produced in the world today is not for use as hydrogen fuel, but is intended for the manufacture of anhydrous ammonia, used as fertilizer for farming. Over 23 million tons of hydrogen is produced worldwide every year for fertilizer. That amount of hydrogen is equivalent in energy content to 23 billion gallons of gasoline. All other production of hydrogen for the "hydrogen economy" is dwarfed by that production rate. Hydrogen-rich ammonia has a much higher energy content than hydrogen gas. It is safely stored and transported as a liquid in tanks throughout the country. Most importantly, I also learned hydrogen-rich ammonia can be produced from renewable wind and hydropower. Finally, ammonia can be burned directly in the new internal combustion engine discussed at the

conference, generating electricity highly efficiently with no pollution.

Hydrogen hubs can use wind and water generated hydrogen, or renewable ammonia, as fuels to generate clean power at key locations throughout Northwest cities, and near wind farm locations in our region's rural areas. These hydrogen hubs can become a key way for utilities to generate hydrogen and electric power precisely where it is needed, exactly when it is need, with no pollution. Successful hydrogen hubs can also form the centers of hydrogen production and storage for the transportation system once hydrogen-powered fuel cell cars become technically practical. In the meantime, there will likely be an increase in electricity demand from new "plug in" hybrid cars and pure electric vehicles powered by new, breakthrough batteries. This will intensify the need for utilities to come up with a practical, non-polluting source of energy to meet the expected, growing demand from these new, partially electric power cars in addition to regular load growth.

Do you see hydrogen potentially as the foundation for the Northwest's power system?

Yes. The hydrogen potential here is staggering. But we, of course, still face technological challenges. The Northwest Hydrogen Alliance is putting together a business plan now for a year-long experiment. We hope to form a group from selected Northwest governments, utilities, universities, and others to create the first hydrogen hub. Our purpose will be to prove, with these new technologies, that hydrogen can rapidly become a practical, cost-effective, renewable breakthrough to generate power for the grid.

There is a process that will allow us to take electricity produced by wind and hydropower and use it to create and store ammonia from these and other renewable resources. The idea would be to create this hydrogen-rich fuel during periods of time when the price of electricity drops; during the night and the spring runoff months, for example. You could also store hydrogen from wind energy to firm up the resource when the wind doesn't blow. So when energy prices drop, we would create lower-cost hydrogen, store it in the form of ammonia, and generate power again precisely when and where the grid demands it, particularly during peak periods when the demand for, and the price of, electricity is high. The Alliance believes this effort may qualify for extensive, renewable tax credits in Oregon, for example.

> "The Northwest can't become the Saudi Arabia of hydrogen energy overnight. But it can certainly take the first important steps toward achieving that goal."
>
> Jack Robertson, chairman
> Northwest Hydrogen Alliance

Again, since renewable-sourced hydrogen is pollution free, this high value electricity can be generated at or near the center of the region's load growth—its cities. This can save the region hundreds of millions of dollars in the long term in transmission, distribution, and substation costs. It also stabilizes the grid with instantly available power and distributes generation resources in smaller sized units throughout the region. This, in turn, increases system reliability and decreases the threat that the grid might be disabled by terrorist attacks on large-scale generation resources. Finally, we hope the price of this power will be competitive, all costs rolled in, with other proposed energy resources.

Hydrogen hubs can begin to tap the enormous amount of hydrogen energy that's stored in the Columbia River. Hydrogen hubs can also help integrate the region's wind energy into the power grid and serve as back-up power when the wind's not blowing. The Northwest can't become the Saudi Arabia of hydrogen energy overnight. But it can certainly take the first important steps toward achieving that goal. I think the potential for hydrogen hubs is very exciting.

Will this happen through your organization?

The Northwest Hydrogen Alliance is a 501 (C)(3) non-profit organization. It will pool resources from federal, state, local governments, businesses, utilities investors, and others to rapidly bring the latest technology to power the first hydrogen hub. The hub may prove the first role for the hydrogen revolution might not be in powering cars, but instead in energizing the power grid. If it works, we can put the Northwest at the center of a new energy hydrogen economy creating new jobs and growth industries in the region. Instead of sending billions in oil payments to the Middle East, we would be investing instead in a unique Northwest system powered by the Columbia River and wind energy stored in hydrogen-rich fuels. New Northwest hydrogen industries can begin to sell the technologies worldwide, expanding the hydrogen revolution in the decades to come.

Once you have these hydrogen hubs in place to generate power for the grid, you have built a hydrogen infrastructure that can also serve the transportation industry. The hottest debate in the hydrogen car arena is, which should come first, the fuel cell car or the hydrogen gas station? Hydrogen hubs help crack this riddle. In our model, hydrogen hubs will first serve the power grid. Once islands of hydrogen are established throughout urban areas for power generation, the hydrogen fuel will be readily available for hydrogen-powered cars. Fuel cell cars may still be a decade off. In the meantime, increased electric-

ity demand to power hybrid cars seems quite likely within five years. In the long run, successful hydrogen hubs will share costs between the power grid and transportation infrastructures, significantly reducing the cost of the emerging hydrogen economy for both systems. I believe the sharing of costs between these two $1 trillion dollar energy infrastructures is crucial to a practical, cost-effective, large-scale hydrogen future.

You really see this as the next revolution?

I do. I think practical hydrogen development is the most important challenge civilization faces in the 21st century. It doesn't take a genius to understand the stress the world is under because of our dependency on distant, unstable sources of oil. Al Qaeda calls the global oil-based energy system "the umbilical cord and lifeline of the crusader community."

The average piece of food is said to travel 1,500 miles before it's consumed. Two-thirds of global oil reserves are in the Middle East. Two-thirds of Saudi Arabia's crude oil, a tenth of the world's oil supply, is processed in a single, enormous facility and sent out through two primary oil export terminals. These key chokepoints are highly vulnerable to an attack that would devastate Western economies.

These are not comforting statistics. They frankly make my blood run cold. But they create strong motivation to create a new energy revolution based on hydrogen—an indigenous source of energy that is clean, abundant, and practically powerful.

Ultimately, hydrogen from wind, solar, and water may well be the key to distributing power to the over one billion people in the world with no light, and little hope.

Are there other parts of the world that are looking at this energy source?

Everybody is looking at it. The Bush administration has highlighted the hydrogen economy and put billions of dollars into research development. Most of it is going to research into transportation-related infrastructure concepts and fuel cell cars. Similar efforts are underway in Europe and Asia. But until we crack the question of what comes first, the hydrogen car or the hydrogen fueling station, the hydrogen revolution in the transportation sector will be delayed. One of my deepest frustrations is that every five years or so we are told that a hydrogen infrastructure is another five years into the future.

I'm tired of waiting. My personal view is it that the first practically hydrogen infrastructure will be built by utilities, by the power grid. Because we have the Columbia River and abundant wind energy, we should be the first region in the world to create practical hydrogen hubs. If we're right, we might just play a significant role in finally igniting the hydrogen revolution.

Where are the utilities with regard to hydrogen? Is there interest in this energy source?

From personal conversations, I can tell you that many utility leaders have a great deal of curiosity about hydrogen. They are interested in breakthroughs insuring that hydrogen generation makes practical sense. No utility manager, or energy leader, wants to take chances with the power grid. The power grid is the world's largest machine, running at the speed of light. Modern civilization literally depends on it. So you don't want to take chances with the power grid. We have an absolute obligation to insure that hydrogen engines generating power are completely safe and dependable. We want to make sure they are dispatchable, non-polluting, and efficient compared to other sources of energy. If we are able to bring all these qualities together—and we now think we can—I believe we are on the verge of an important breakthrough. But the Northwest Hydrogen Alliance has to prove this. So our hydrogen hub pilot project becomes very important.

So you see a pilot project established in the next couple of years?

No. We want to establish a pilot project to be finished in a year. We know the highly efficient hydrogen-fueled internal combustion engines are going through initial testing right now by the manufacturer. We want to work with the state, utility partners, universities, and many others to find the best location for the first hydrogen hub. We want expert, independent corroboration of the results. We want to verify safety, efficiency ratings, a zero pollution standard, hydrogen fuel densities, and reliability of hydrogen generation. If that works, we're going to want to build hydrogen hubs in other areas of the region as soon as possible.

I have to say, I have a sense of urgency about this. I'm not interested in something that's another 10 years down the line. Too much is at stake. We hope to find out, relatively quickly, whether hydrogen hubs can work in the real world. If they can't, then we'll go back to the drawing board and try again.

Are there ramifications for fish and wildlife by developing hydrogen energy?

That's a good question. My personal view is hydrogen development in the Northwest will be very good for fish and wildlife.

First, since our goal is to create hydrogen from off-peak renewable sources of power, there will be no net pollution from our efforts. Obviously, reducing pollution that can end up in forests and rivers, and add to global warming concerns, should be a clear benefit to fish and wildlife.

Second, we plan on using wind and hydropower as sources for hydrogen. We will put demands on the power system at night when the price and use of power drops off. Without a night load, the river fluctuates from day to

night in order to meet changing power demands. This can cause turbidity in the water that can affect fish habitat and spawning. We hope to increase demand at night that will help stabilize the river and lessen turbidity. We will also generate hydrogen storage during the spring runoff. This is a way of renewably "storing" Columbia River hydropower in the form of hydrogen-rich fuels during a time when generation far exceeds regional power needs. The power will be saved for later periods when the system is stressed by peak power demands.

Third, generation from hydrogen hubs can be placed close to load. This reduces the amount of forests and habitat that need to be removed to build transmission and distribution lines to meet expanding electric demand from the region's population centers. Portland alone, for example, is estimated to add one million people in the coming decades.

Lastly, the hydrogen economy should benefit revenues of utilities and Bonneville. Demand for hydrogen should increase. Power lines will be better used at night, increasing transmission and distribution revenues. We will be buying our energy from naturally sourced, locally produced resources, not sending billions in oil payments to unpredictable foreign governments. With the advent of hybrid "plug in" cars, the electric grid will increasingly be seen as a cost-effective competitor to gasoline and the oil companies. This should lower our overall energy bills and provide strong, stable funding for fish and wildlife costs in the Northwest.

If hydrogen hubs work, the region's utilities can become the pivot point for this new energy revolution that will help shape our nation's future. If we can prove hydrogen works in the real world, it promises a future that has the potential to bring a much-needed national cohesion. Rich and poor will benefit. So will the economy and the environment. So will Republicans, Democrats, and Independents. National security will be strengthened, and so will our ability to attack global poverty. Like the computing revolution, the hydrogen economy can create millions of new jobs here at home and around the world. With the Northwest's powerful resources of water and wind, we can become the center of a new hydrogen-based economy. With our enormous natural advantages, why shouldn't the hydrogen revolution start right here?

Year of Celebration ~ 25th Anniversary
NORTHWEST POWER ACT of 1980

A distinguished group of guest speakers and panelists will share their thoughts on the past and future significance of the Northwest Power Act.

Celebration Event
December 14, 2006, 10 a.m. - 2 p.m.
Hilton Portland Hotel
Pavilion Room

To register online, please go to www.nwcouncil.org/act
For more registration information, please call 800-452-5161

Council Decisions

Biological Objectives

August

The Council issued for public comment a paper describing a process to develop biological objectives for ecological provinces under the Council's Columbia River Basin Fish and Wildlife Program. The paper describes the current state of affairs influencing the timing and approach for developing the objectives, reviews the need and use for provincial objectives, and invites public comments on the planned course, schedule, and general approach. The paper is posted on the Council's Web site.

Resource Adequacy

September

The Council approved the release of a draft Regional Resource Adequacy Implementation Plan for public comment. The Council plans to make a decision on the plan at its November meeting in Coeur d'Alene, Idaho. Adoption of the plan will mark another important step toward ensuring that the region has adequate energy resources.

Regional Dialogue

September

The Council discussed and approved its comments to the Bonneville Power Administration on Bonneville's draft Regional Dialogue policy, which is a proposal for the future role of Bonneville in regional power supply. The Council addresses a number of aspects of the draft policy and notes that, overall, the proposal is consistent with the Council's goals for the Regional Dialogue as presented in the Council's Fifth Northwest Power Plan. The comment letter is posted on the Council's Web site.

Fish and Wildlife Project Recommendations

October

The Council recommended to the Bonneville Power Administration more than 460 projects totaling about $450 million in funding to implement its Columbia River Basin Fish and Wildlife Program over the next three years, fiscal years 2007-2009. The Council's program is funded by Bonneville with a portion of its revenues from electricity sales.

Comment Sought on Capacity Standard

October

The Council approved the release of an issue paper (Document Number 2006-18) for public comment describing a proposed electricity supply capacity standard for the Northwest. The paper, with comment directions, is posted on the Council's Web site, www.nwcouncil.org.

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