BEFORE THE STATE OF WASHINGTON
ENERGY FACILITY SITE EVALUATION COUNCIL

In the Matter of Application No. 2009-01 of WHISTLING RIDGE ENERGY PROJECT LLC for WHISTLING RIDGE ENERGY PROJECT	EXHIBIT NO. 30.00 PREFILED TESTIMONY OF ROBERT J. MICHAELS, PH.D ON BEHALF OF FRIENDS OF THE COLUMBIA GORGE AND SAVE OUR SCENIC AREA

I. QUALIFICATIONS

Q. Please state your name and occupation.

A. My name is Robert J. Michaels. I am Professor of Economics in the Mihaylo College of Business and Economics at California State University, Fullerton and an independent consultant. I am also Adjunct Scholar at the Cato Institute and Senior Fellow at the Institute for Energy Research, both in Washington, D.C. A full biography is attached as Exhibit 30.01.

Q. Dr. Michaels, please describe your educational background.

A. I hold an A.B. from the University of Chicago and a Ph.D from the University of California, Los Angeles, both in economics.

Q. Please describe for the Council your teaching and consulting experience.

A. Upon completion of my Ph.D. I began work as an economist at the Institute for Defense Analyses in Arlington, Virginia, a nonprofit organization performing research for the Secretary of Defense. In 1975 I began my academic career as Associate Professor of Economics at California State University, Fullerton, and was promoted to Professor in 1982. At various times I have also lectured in the University of Southern California's Master in Business Administration program and in the doctoral program in economics at the Claremont Graduate University.

My work in energy economics began in the early 1980s as consultant to Southern California Edison Company (SCE) on antitrust lawsuits and proceedings before the Federal Energy Regulatory Commission (FERC) that lasted through the early 1990s. The lawsuits and proceedings were brought by municipal utility systems claiming that SCE's restrictions on access to the extra-high voltage AC and DC Pacific Intertie lines had harmed their abilities to compete with the company, as had the company's alleged price discrimination in wholesale ratemaking. In the process I became familiar with power markets in the Pacific Northwest and Pacific Southwest.

In the mid and late 1990s I participated in the California Public Utilities Commission's restructuring of the state's electricity markets and investor-owned utilities. I testified before the CPUC and California Energy Commission on behalf of users and marketers. In 1996 I was appointed Senior Advisor to Hagler Bailly, Inc., an international consulting firm. While there I testified before FERC and other state regulatory commissions on electric utility mergers and on the state of New York's takeover of Long Island Lighting Company. After Hagler Bailly's absorption into another firm, I testified before FERC on behalf of Dynegy Corporation regarding competition in California energy markets, and on behalf of competitive retail power sellers before the CPUC. I also provided non-testifying expert services for Duke Energy in refund proceedings before California's market monitoring panels.

In 2001, I became an Affiliated Consultant with Tabors, Caramanis & Associates (TCA) of Cambridge, Masschusetts, performing research on electricity competition for the Japan External Trade Relations Organization and on vertical integration for Tokyo Electric Power Company. I also testified on behalf of the City of Chicago before the Illinois Commerce Commission regarding the prudence of gas distributor Peoples Energy's hedging practices. Since TCA's 2004 acquisition by CRAI I have become an independent consultant, working on assignments that have included the analysis of proposed municipal utility formations, utility mergers, and the effects of retail utility competition and efficiency mandates on power markets in Texas. I also testified before the Mississippi Public Service Commission on the economics of a lignite-fired powerplant proposed by Mississippi Power Company that would include a carbon capture and sequestration (CCS) facility. Regarding wind power, in 2008 I testified before the Vermont Public Service Board on behalf of property owners and businesses on integrated resource planning in the context of a proposed

wind facility, and on the economic value of its contribution to reduced carbon emissions.

I have testified on behalf of clients before FERC, before regulatory commissions in California, Illinois and Mississippi, and before the Regulated Industries Committee of the Texas House of Representatives. I was also invited to provide expert testimony in FERC's 2007 rulemaking on electricity market monitors. I have given invited testimony before committees of the U.S. House of Representatives on three occasions, most recently in June 2010 before the Committee on Science and Technology, where I participated in its hearing on Real-Time Forecasting for Renewable Energy Development.

Q. Can you briefly enumerate some of the areas in which you have performed or edited published research, and any associations or organizations in which you hold membership?

A. Before forming my long-term commitment to research in electricity and gas, I authored peer-reviewed publications on a range of industries including computers, banking, cellular telephony and mental hospitals. My research in power has appeared frequently in peer-reviewed journals, industry publications and law journals. I have been particularly interested in the electricity and gas industries' transitions from regulation to competition and the measurement of competitive conditions in those markets.

My areas of detailed research have included the design of market institutions for short-term energy transactions, standards for determining their competitiveness, and the performance of independent monitors to police competition in them. I have examined franchise competition between public and investor-owned electric utilities, the costs and benefits of vertical integration in the industry, and policies for the recovery of transition costs incurred in electrical restructurings. I have also published work comparing for-profit and non-profit governance of regional transmission operators. My current research centers on proposals for a nationwide renewable portfolio standard for electric utilities and the effects of regulatory efficiency requirements on power markets.

Academically, I have been named outstanding professor among over 200 faculty in the Mihaylo College of Business and Economics. I have also received honoraria after being named Daniel P. Haan Distinguished Fellow in Law and Economics. I am a member of the American Economic Association and have served since 1999 as Co-Editor of *Contemporary Economic Policy*, a peer-reviewed publication of Western Economic Association International. Its

paid circulation and citation ratings are both in the top 10 percent of approximately 200 peer-reviewed economics journals. I am also author the recently published (2010) *Transactions and Strategies: Economics for Management*, a tradition-breaking textbook in managerial economics for MBA students and advanced undergraduates, published by Cengage, the second-largest college text publisher in the U.S.

II. PURPOSES AND CONTENTS OF TESTIMONY

A. Purpose

Q. What is the purpose of your testimony in this proceeding?

A. I have been retained to analyze the value of wind power in the Pacific Northwest (PNW), with particular attention to the proposed Whistling Ridge Energy (WRE) project. I will examine wind's importance in the region's power supply and in the markets where that power is purchased and sold. The Council's approval of WRE's application will have potentially important consequences for those markets and for Washington State.

Counsel has informed me that there have been discussions of the "economic viability" of this project. My testimony does not address whether it will be economically viable in the sense that it will produce a profit for the owner or developer. I simply assume that WRE expects to be profitable, while noting that these expectations depend in part on the details of taxation and regulation, such as tax credits and the evolution of "renewable portfolio standards" (RPS) in Washington, Oregon and California that require utilities to obtain some percentage of their power from renewable sources.

Q. Please describe the WRE project.

A. As currently proposed, WRE will be a 50 turbine "wind farm" located on privately owned property in Skamania County, Washington. According to WRE's application, the turbines will have a total nameplate capacity of 75 megawatts (MW). My understanding is that it will be a "merchant plant" that will sell its power on the open market. I have been asked to provide testimony on the value of this project in the context of Washington and Northwest Power markets.

Q. According to Washington law (RCW 80.50.010), the Energy Facility Site Evaluation Council (EFSEC or "Council") exists in part "to seek courses of action that will balance the increasing demands for energy facility location and operation in conjunction with the broad interests of the public." Among the "broad interests of the public" is a desire that a proposed project will provide

"abundant energy at reasonable cost." Why are these statements relevant in the context of EFSEC's analysis of WRE?

A. In the existing situation, there are important unanalyzed questions on whether construction and operation of WRE will in fact advance these aspects of the public interest. Those questions are about both the likely abundance of its energy and the reasonableness of its cost.

B. Contents

Q. What do you intend to demonstrate in this testimony?

A. I will analyze available information to show that WRE is unlikely to produce abundant energy at reasonable cost, both in the context of northwest power markets and relative to alternative sources of energy or energy services. In light of the PNW's existing resource mix the benefits to Washington residents and businesses of such an incremental expansion in the region's wind capacity will be minimal. This will be the case whether our criterion is the abundance of energy or the reasonableness of its cost. I take "abundance" and "cost" as referring to both price and reliability.

Q. Please outline your testimony.

A. Section III of the testimony begins by discussing some basic considerations of electrical system planning and reliability that apply to any utility or region. They stem from the physical characteristics of electricity and apply to any transmission grid that moves power from sources (generators) to loads (consumers). If a grid operator is to maintain reliable service it must exactly match supply and demand every second, and do so with a commodity that cannot be stored and moves at the speed of light. In what follows I refer to a centrally operated grid as a "utility," whether it is an investor-owned system, a municipal or cooperative venture, or a regional transmission and generation operator such as Bonneville Power Administration (BPA), whose customers are other utilities rather than final users.

I go on to discuss in broad terms how a utility might construct a generation mix that will reliably meet demand at minimum cost. Here "generation" is taken to include customer-side conservation and load management. Generation resources include both "dispatchable" ones whose outputs can be directly controlled, such as nuclear, fossil fuel and hydroelectric facilities, and "intermittent" sources such as wind turbines that can only produce when the wind blows. I next discuss the implications of randomly varying production of wind energy for reliability and system planning, and the need to use dispatchable

resources to "integrate" into a reliable power supply package. Although wind units burn no fuel, they can be costly to build and costly for the system operator to integrate reliably. Maintaining a steady output requires "balancing" wind power's fluctuations by adjusting generators whose output can be varied. Hydroelectric power can do that job, but fossil-fuel generators can also be used for balancing. In the latter event, wind power may have environmental consequences even though it does not directly burn any fuels.

The factors discussed in Section III of this testimony set the stage for the analysis in Section IV of WRE's economic value in its regional electrical environment. I begin with a discussion of the current loads and resources in the PNW, with particular emphasis on BPA's situation. Currently, BPA is able to meet nearly all of its customers' power demands from available resources, including improved efficiency of use, and the growth of wind power on its grid will not be of help in meeting expected future shortfalls in peaking capacity. I emphasize BPA because as of now it bears near-total responsibility for integrating units such as WRE into a reliable power supply, and because ever-growing amounts of wind capacity now challenge its abilities to continue operating the regional system reliably and at low cost. The robust recent growth of wind generation, particularly in the Columbia Gorge area, is probably seen by the wind industry as only the first stage of a far greater increase in the region's wind capacity. To see the consequences of such growth I discuss some examples from the recent past in which BPA's system was severely stressed by weather events that appear to be quite common in the area. Data show that the presence of wind power on the system aggravates rather than eases BPA's difficulties in accommodating weather changes, particularly when we consider its other responsibilities such as managing river flows to facilitate the migration of endangered fish species.

Having described the regional balance of supply and demand, Section V describes in more detail the markets in which WRE will operate and its costs and benefits to the region. The PNW is a congenial environment for wind generation, and its construction is further encouraged by federal and other subsidies. Moreover there is a "captive audience" of utilities in Washington, Oregon, and particularly California, all of which face RPS requirements and (particularly in California) difficulties in locally siting renewables that result from environmental regulation. In the emerging situation, BPA may lose its abilities to balance ever-larger wind exports, and transmission capacity between the PNW and

California is becoming scarce. Whether it is exported or kept in the PNW, wind power in excess of current amounts is of little value to Washington State. Little wind generation equipment is produced in Washington, tax collections are relatively small, construction produces only short-lived employment opportunities, and operation produces few long-lived ones. Section VI summarizes the testimony and sets forth my conclusions.

III. SYSTEM PLANNING AND OPERATIONS WITH INTERMITTENT GENERATION RESOURCES

A. Basic Characteristics of Electricity and Its Production

Q. Please provide a summary description of how power is produced and distributed.

A. Electricity is generated when spinning electromagnets induce high-voltage alternating currents into a transmission network, which ultimately delivers that power at usable voltages to individual homes and businesses. Most generators burn fossil fuels or depend on nuclear reactions to boil water that produces high pressure steam to turn the magnets. Others, such as solar and hydroelectric power, obtain their primary energy from such sources as photovoltaic conversion or falling water. Power enters a grid at high voltages to minimize delivery losses and the grid operator transforms it to lower voltages as necessary.

To ensure reliability the system operator must ensure that power going into the grid exactly equal the amount that consumers want to use. Supply and demand must match exactly at every instant, power travels at the speed of light, and a mismatch for less than a second can trigger a regionwide blackout. Two other technological facts compound the operator's problems: [1] with the exception of hydroelectric power, electricity is uneconomic to store and must be used at the moment it is generated, and [2] a grid must operate as a unit because power flows like water and cannot be directed to some particular destination. The operator must always have reserve generators in operation that can instantly replace the output of a generator or transmission line that has suddenly gone out of service.

Q. How does a system operator attempt to minimize the cost of delivered power to end-users?

A. The time profile of power demand and the costs of adjusting its supply pose both challenges and opportunities. Over a typical day power consumption rises with the sun and grows to a peak in late afternoon or early evening to meet

air conditioning (in the PNW, heating) and lighting demands. Meeting the daily power use profile at minimum cost requires three types of resources. First are baseload generators, often large units that burn coal or use nuclear fuel. They can take days to start and bring up to full power, but once in operation they can produce at the lowest incremental ("marginal") costs per megawatt-hour (MWh). They thus operate at all times (save for maintenance), but their output cannot quickly be varied to meet short-term load changes. Second are intermediate units whose output is ramped up during hours when demand is rising and ramped down as it falls with the coming of night. In most parts of the country these units burn natural gas, but in the northwest they are often hydroelectric. Intermediate units have higher operating costs than baseload units, but have the advantage of relatively quick startups and adjustments in output to meet demand changes. Third are peaking units, usually gas turbines with high operating costs, that only operate to serve the last increments of demand during the few hours of the year when all baseload and intermediate generators are in use or acting as reserves. In normal operation, almost all dispatch is controlled by computers programmed to minimize operating costs rather than by humans.

Q. Are there alternatives to generators such as those described in the previous question?

A. Yes. Depending on the configuration and capacity of its interconnections, a utility often has the option of purchasing power from other generators. It can come from independent (non-utility) power producers ("IPPs"), or from generators owned by other utilities. Purchased power may substitute for the output of higher-cost generators that the utility owns, and regulatory agencies often require the passthrough of such savings to end-users.

Power users offer the utility another set of options. They can participate in demand management programs that reward them for reducing loads at peak times when the utility would otherwise operate high cost generation, or give bargain rates for consumption that is shifted to off-peak hours. Variants of demand management include interruptible service that offers a customer a discounted rate if it will promise to go off-line when requested by the utility. (Such rate schedules exist in California.) There are also utility programs that subsidize customer purchases of energy-efficient equipment, as occurs in some states for both industrial motors and household goods like refrigerators.

Finally, utilities can take advantage of power that comes from "intermittent" or "variable energy" generators whose operation cannot be

guaranteed and cannot be reliably dispatched. Some "renewable" sources such as biomass conversion and geothermal power are dispatchable and easily incorporated into a utility's normal operating plans. Wind and solar generators, however, can only produce in the presence of wind or sunlight and their output can quickly fall to zero if the wind stops blowing or the skies become cloudy.[1] Intermittent sources can lower the utility's fuel costs, but intermittency also means that the utility must take some special actions to ensure maintenance of reliability.

B. Intermittent Generation Resources and Reliability

1. Capacity and Energy

Q. All generators are potentially subject to interruptions and outages in the normal course of operations, so why single out intermittent generators for special consideration?

A. If wind power is a minor part of a utility's generation, a sudden reduction in wind requires the same adjustments of dispatchable generators as a random rise in load. More important integration problems arise as the percentage of intermittent resources grows, particularly if the utility is compelled by law, regulation or contract to accept an intermittent provider's power and to pay for it.

Q. Please explain the significance of the fact that wind turbines in the U.S. are available (i.e. not out of service for maintenance or repairs) 98 percent of the time, a higher percentage than applies to other generators.[2]

A. The statement tells us nothing about the economic desirability of wind power or its possible effects on the costs of a power system. A generator whose "availability factor" is 98 percent may only be actually operable during the much smaller percentage of the time when strong winds are blowing.

Q. Are there alternative measures that better characterize the contribution that a wind turbine might make to a utility's energy production?

A. Yes. A generator's "capacity factor" is the ratio of its actual output over, e.g., a year to the maximum hypothetical output it would have produced if operating without interruptions. I have not been able to obtain meteorological

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[1]Solar generation is so small a part of national and regional totals that the remainder of this testimony treats wind as the only relevant intermittent resource.

[2]American Wind Energy Association, "Wind Energy Basics," http://www.awea.org/faq/wwt_basics.html#What%20is%20availability%20or%20availability%20factor This document is attached as Exhibit 30.02.

records or other data with which to calculate WRE's likely capacity factor, but we do know that BPA has calculated an average "Columbia Basin" capacity factor of 32 percent for wind units.[3]

Q. According to the U.S. Department of Energy's Energy Information Administration, in 2008 the average capacity factor of natural gas-fired combined cycle powerplants was 40.7 percent, and for other gas-fired plants (mostly combustion turbines) it was 10.6 percent.[4] Since the capacity factor for wind units in WRE's area is 32 percent do they make roughly the same contribution to reliability as gas-fired ones?

A. No. Few gas-fired generators operate during every hour when they are available. As noted above, they are more typically used as intermediate (combined cycle) and peaking (combustion turbine) resources. The gas-fired units are dispatchable and can be operated when they are of the most value, which happens in 40.7 percent of the hours for combined cycle units. They are also available to operate during most other hours but during those hours they are not economic choices. The wind turbines are not dispatchable, and the fact that they produce power in 32 percent of all hours is no indication of the value of that power for reducing costs or maintaining reliability. Unlike a wind unit, a gas-burning generator will often qualify as a "capacity" resource, capable of production whenever it is available. If demand for power exceeds production at some moment a unit can fill the gap with near-certainty. A wind unit can only do so if it happens to be producing, which randomly occurs 32 percent of the time in our case.[5]

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[3]BPA, 2010 Resource Program, Sept. 2010, 58, http://www.bpa.gov/power/P/ResourceProgram/documents/Resource-Program.pdf

[4]Energy Information Administration, Electric Power Annual 2008, 54, http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html.

[5]Exhibit 30.03 provides an example of the value of continuous generator operations, a recent request for proposals by Seattle City Light stated its intent to purchase 200,000 MWh of renewable energy. The utility expressed its preference "to acquire new renewable energy resources that will meet the baseload needs of our commercial, industrial and residential customers. This solicitation will be by competitive bid, not least cost, which means the shape, capacity, seasonality and other factors associated with the energy resources will be considered." Seattle City Light "Power Lines," Sept. 21, 2010.

2. Balancing

Q. Let's next consider some possible ways to improve wind's reliability and usefulness. Is it possible that if turbines are dispersed over a large area random changes in wind will "cancel out" and make wind reliable enough to qualify as capacity?

A. Wind power is dispersed throughout the U.S., but probably its greatest concentration relative to loads is in the territory dispatched by the Electricity Reliability Council of Texas (ERCOT), which covers the bulk of the state's geography. As of June 30, 2010, ERCOT controlled 9,317 MW of wind capacity, over three times that currently in the PNW, located in areas ranging from the Gulf of Mexico to the high desert.[6] This is nearly the capacity that BPA views as "likely" to be operating by 2016, as shown by Exhibit 30.06. As of 2005 ERCOT had tentatively assigned wind power a capacity factor of 2 percent, although wind's average capacity factor in its territory was 16.8 percent.[7] A nominal megawatt of wind capacity (i.e. the "nameplate" rating of a plant) is thus the equivalent for planning purposes of 2 percent of a readily and constantly available megawatt of conventional capacity. The implication is clear: a system dependent on wind must also invest in dispatchable generation equal to a significant fraction of that capacity.

Q. Are the problems of wind's intermittency alleviated if power is storable (e.g. by batteries, flywheels, compressed air or hydroelectric dams)?

A. Yes, but the first three of these are still the subject of much research and are not yet commercially viable. Hydroelectric dams can indeed compensate for wind's intermittency, but even in the PNW their capabilities are limited. If wind generation is significant, as will be seen in Section IV below, they may not be

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http://powerlines.seattle.gov/2010/09/21/seattle-city-light-seeks-new-renewable-energy/

[6]ERCOT, "Texas Renewables Implementation Plan, Quarterly Update for the Period Ending June 30, 2010, 1, found at http://www.ercot.org/content/meetings/board/keydocs/2010/0817/Item_09c_-_Second_Quarter_2010_TRIP_Report_to_the_PUCT.pdf.

[7]ERCOT, "Transmission Factors Associated with Renewable Electricity in Texas," March 28, 2005, 8, found at website http://www.epa.gov/statelocalclimate/documents/pdf/TX_20renewables_transmission_white_paper_final.pdf

able to release or accumulate water sufficient to balance wind's generated output. Any hydroelectric power generation carries an opportunity cost, because generation now means that the system foregoes the possibility of production in the future when power may be more valuable.

Q. Even if a wind turbine cannot dependably generate on demand, isn't the output that it does produce still potentially valuable?

A. Yes. Wind could then make up for high-cost production by fossil-fuel generators and thus lower system costs.

Q. Power is likely to be most valuable at certain times of the day and the year. What is the general relationship between hourly loads and the volume of wind-generated power?

A. In part, the value of a wind-generated MWH depends on the incremental cost of the generator that it displaces. On average, however, in most of the U.S. wind velocity is lower during daytime hours of peak demand.

If so, a utility must still run significant volumes of high-cost generation to meet its daytime peaks. Away from the peak, wind generation is less valuable because it displaces generation at lower incremental costs. If the grid operator must also accept wind power late at night, it can aggravate the difficulties associated with "minimum load" conditions. Some baseload generators that take time to start and ramp up must operate continuously to meet the next day's expected demand, and they cannot simply be disconnected while operating. If the utility must accept all the wind power offered, its costs may rise and its reliability may be affected.

Q. Is there any general relationship between wind velocity and temperature?

A. Wind velocities depend in complex ways on gradients (differences) in atmospheric pressure. A very broad summary statement is that calmness is associated with very high and very low temperatures. In Section IV I consider in more detail the consequences of extreme temperatures and diurnal weather cycles for wind power in the PNW.

Q. Please summarize the costs and benefits that should be considered when performing an economic analysis of a wind turbine project.

A. <u>The time dimension</u>. At the outset, I note that both costs and benefits depend on the characteristics of both the wind project and the network in which it will be embedded. A 75 MW increment of wind power on a system that has no pre-existing wind resources will impose different types and amounts of costs than the same increment in a region like the PNW where wind capacity

(operating, permitted and under construction) will soon exceed 6,000 MW (*see* Exhibit 30.08). Hence the analysis should be on two different levels. The first is at the "margin." Here the added costs (e.g. extra balancing reserves for integration) are likely to be higher when pre-existing wind capacity is larger. The added benefits at the margin will be smaller, since a later addition to the wind fleet will displace fossil generation with lower incremental costs than an early addition. The second level of analysis should be long-term. Any new generation must be viewed as part of a continuing flow of small increments whose total effect cannot be accurately estimated by simple extrapolation from figures for a single project.

Looking forward. The costs and benefits of a project to (e.g.) Washington residents and businesses must be calculated by looking forward, not backward as is usually done in utility regulation. The forthcoming costs and benefits need not bear any particular relation to the historical costs of capital and fuel, or to today's assumed values for future carbon emission allowances if a cap-and-trade system comes into being. Regulatory statutes allow a utility (but not a market-based project such as WRE) to recover the full costs of "prudent" investments in generation, but these costs will only coincidentally equal the economic value of the powerplant.

Alternative sources. The economic value of a MWH of wind power depends not on the cost of a turbine, but rather on the cost of power that it displaces. As a general principle, avoidable costs are minimized by dispatching generation in "merit order," starting with baseloaded generators that have the lowest incremental costs and ending with the highest-cost generators needed to meet load. The latter will typically be gas-fired units whose output can quickly change when a MWH of wind power enters the grid. The value of that MWH is the incremental cost, mostly fuel expense, of the gas-generated power that it displaces. Fuel expense, however, can vary greatly with conditions in the gas market.

Reserves and balancing. More wind turbines on a system mean larger fluctuations in power output due to intermittency, and thus the need to hold additional conventional generation as "spinning reserves" that can instantly smooth them. More wind capacity will probably require holding more conventional generation as "non-spinning reserves" that can begin operating if spinning reserves become depleted. Either hydro or fossil-fuel facilities can take on the reserve role, but the details of the underlying economics are complex.

Gas that is not burned has a readily visible market value, but estimating the benefits of an ungenerated MWH of hydropower is conceptually quite difficult. Such an estimate must account for the value of saved water in the present relative to the future (which also means accounting for non-electric constraints like fish), and the value of readily available water as a hedge against high fuel prices.

The costs of fossil-fuel balancing. The use of gas-fired generation to mitigate fluctuations in wind power output carries costs beyond those of fuel: generators used for balancing produce emissions of their own, and in the process lower the net environmental benefits of wind turbines. In some documented cases these benefits become net costs. A system operator that must accept wind power for contractual or other reasons may find itself short of both hydro and gas-fired generation for balancing. If so it will have little choice but to adjust coal-burning generators that are normally baseloaded for steady output. Adjusting coal-fired units is more problematic than gas-fired ones because such changes substantially increase their fuel costs, and also their emissions of carbon dioxide and EPA "criteria pollutants" such as ozone and oxides of nitrogen and sulfur.[8]

The longer term. The presence of substantial intermittent resources will also affect future investments, in particular the mix of conventional powerplants that can best meet future demands in such an environment. Those resources will include both utility-owned facilities and power transactions with other utilities and independent power producers. More wind generation will probably also raise the values of demand response and load management, whose functioning can at times be similar to that of utility-provided balancing. In several parts of the country, growing wind resources require new and upgraded transmission, since windy areas are often far from consuming areas. Intermittency also affects the characteristics of individual lines. The best economic choice for a transmission

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[8]One study of Colorado's and ERCOT's systems concluded that the cycling penalty for coal-fired units so increased their pollutant and carbon dioxide emissions that the areas would have less pollution if they contained no wind units at all. Bentek Energy LLC, How Less Became More: Wind Power and Unintended Consequences in the Colorado Energy Market, Executive Summary. http://www.bentekenergy.com/files/userfiles/file/BENTEK%20-%20Executive%20Summary%20-%20How%20Less%20Became%20More_100416.pdf

link to an isolated wind-producing area may be a line with capacity insufficient to carry that area's full output. This is so if the cost of added capacity exceeds the benefits of seldom-produced incremental power that cannot use the line.

IV. THE ECONOMICS OF THE WRE PROPOSAL

A. Introduction

Q. According to Washington law (RCW 80.50.010), the state's Energy Facility Site Evaluation Council (EFSEC or "Council") exists in part "to seek courses of action that will balance the increasing demands for energy facility location and operation in conjunction with the broad interests of the public." Among the "broad interests of the public" to guide the Council's decisions are that a proposed project is to provide "abundant energy at reasonable cost." In addition, WAC 463-47-110, EFSEC's "Policies and procedures for conditioning or denying permits or other approvals," provides that "(d) [EFSEC] shall ensure that presently unquantified environmental amenities and values will be given appropriate consideration in decision making along with economic and technical considerations." Why are these statements relevant in this docket?

A. There are important unanswered questions of whether and how the construction of WRE and its operation will advance the public interest. The questions address both the likely abundance of its energy and the reasonableness of its cost.

Q. What do you intend to demonstrate in this portion of your testimony?

A. I intend to show that WRE is unlikely to produce abundant energy at reasonable cost, both in the context of northwest power markets and relative to alternative sources of energy or conservation services. Given the area's existing resource mix the benefits of such an incremental expansion of its wind capacity will be minimal. This will be the case whether our criterion is the abundance of energy or the reasonableness of its cost. I take "abundance" and "cost" as incorporating both price and reliability. I am aware that WRE may have important environmental impacts on biological, natural and scenic resources, but these issues are beyond my professional expertise.

Q. How will you proceed?

A. Earlier in this testimony I described a utility's dual needs for low costs and reliability, and how the physical characteristics of electricity affect its decisions on how to meet them. I then discussed the benefits and costs of adding wind turbines and reliably integrating them with existing generation and transmission.

Here I will provide data on existing and future wind power in the PNW, with particular attention to subregions served by BPA. In the process I describe the construction and content of load and resource forecasts by BPA and the Northwest Power and Conservation Council (NPCC). These reports agree that the region has few major resource needs for the near future, and that cost-effective investments to meet those that exist do not include wind power. Increased efficiency and load management can substitute in important ways for new generation and transmission. I then show that however wind is treated for purposes of RPS and taxation, additional wind power will impose its own costs on the region. Hydroelectric power is in some ways ideal for balancing wind's intermittency, but BPA now states that further use of hydro capacity for balancing will affect efficiency and reliability, as well as its abilities to meet non-electrical obligations such as fish migrations. At the same time, hydro operations to accommodate wind power do not provide the same ratepayer benefits that would accrue if wind displaced thermal capacity. Further, BPA's balancing services are applied to a wind resource whose capacity it values at zero. Wind is also of little value as on-peak energy. Changing load patterns have left little correlation between the availability of wind and strains on the system due to extreme weather or abnormal water flows.

B. Loads and Resources in the PNW

Q. On the demand side, please summarize current load and recent load growth in the region.

A. According to the NPCC's most recent conservation and power plan (Feb. 2010), average power consumption in the region in 2007 was 19,000 average MW, or 166 million MWH.[9] Since 2002, regional demand has grown at an average 2.5 percent annual rate.[10]

Q. Please summarize recent forecasts of load growth in the region.

A. All growth scenarios are assumption-dependent and error-prone due to intervening events. The NPCC's midrange scenario expects average

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[9] The PNW region is defined by the Northwest Power Act, section 3(14) of P.L. 96-501, and is identical for forecasts by both the NPCC and BPA.

[10] NPCC, 6th Conservation and Power Plan (Feb. 2010), 3-1 and 3-2. http://www.nwcouncil.org/energy/powerplan/6/ (http://www.nwcouncil.org/energy/powerplan/6/final/SixthPowerPlan_Ch3.pdf). Certain chapters are included at Exhibit 30.04.

consumption to rise to 25,000 by 2030, growing annually at 1.2 percent. Its low-growth forecast is 0.8 percent per year, and high growth is 1.8 percent. The region's winter peak will grow to 43,000 MW in 2030, a rate of 1 percent per year, and the summer peak will rise to 40,000 MW, at 1.6 percent per year.[11]

NPCC's forecasts are a major input into BPA's annual PNW Loads and Resources Studies. Exhibit 30.05 shows its 2010 forecast growth (bottom line of graph) of average firm (non-interruptible) load in the region, from 22,512 MW in 2011 to 25,161 MW in 2020, an average increase of 1.1 percent per year.[12] That exhibit also shows that BPA has adjusted its forecast downward in recent years. Its 2007 regional forecast for 2011 is approximately 1,000 MW higher than its 2010 forecast for that year. The most important reasons for the decline appear to be increases in the efficiency of power use, coupled with the effects of the 2008-2010 recession.

Q. Please summarize the PNW's mix of power generation and reserve positions in the near future.

A. Exhibit 30.06 summarizes BPA's estimates of the region's expected loads and the resources that will serve them in 2011 and 2020. Hydroelectric estimates are for worst-case ("1937-critical") water conditions. BPA expects that in 2011 the region will hold 26,418 MW of resources to serve an average 22,512 MW of firm load. There will be 11,730 MW of firm hydro capacity (44.4 percent of the total), combustion turbines (11.9 percent), renewables (4.7 percent), cogeneration (9.8 percent), imports (4.3 percent), large thermal generation (22.6 percent, including coal, nuclear, and larger gas-fired plants), and non-utility generation (2.3 percent). BPA estimates a similar mix of sources for 2020, but its figures include only sources known to be operating or under construction today.

Q. BPA supplies no more than one-third of all wholesale power in the Pacific Northwest, with the rest coming from numerous publicly- and investor-owned utilities and independent producers. Why is BPA of particular interest for your

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[11] NPCC, 6th Conservation and Power Plan (Feb. 2010), 3-3 -- 3-8.

[12] BPA, 2010 Pacific Northwest Loads and Resources Study, 52 and 129. These are also the sources of the data on Figure 1 and Table 1 below. BPA does not present high and low growth scenarios. http://www.bpa.gov/power/pgp/whitebook/2010/WhiteBook2010_SummaryDocument_Final.pdf

testimony?

A. There are several reasons. BPA is a dominating presence in the PNW because it operates approximately 70 percent of the region's transmission capacity. It has service obligations to meet any load requirements that qualified regional utilities (mostly public and cooperative systems) cannot meet with their own resources. BPA dispatches a major portion of the generation in its area, most importantly the hydroelectric facilities of the Federal Columbia River Power System. It also has legal obligations to accept power from qualifying wind turbines in the area and integrate it into the region's electricity supply if sufficient transmission capacity is available.[13] Doing so requires that it operate generation that can quickly compensate for unpredictable fluctuations in wind. BPA's resource plans must be consistent with those of the NPCC.

Q. How does BPA construct its forecast of load growth?

A. BPA operates under a ten-year planning horizon. It uses "scenario" techniques to determine its best resource choices in response to three economic situations (boom, recovery, and prolonged recession). Having settled upon the scenarios it then examines the various components of loads and resources (e.g. firm service obligations, expected growth in wind capacity) in more detail to produce a "needs" assessment.[14]

Q. How does BPA choose the resources it will use to meet its obligations to service the forecast load?

A. It examines the levelized lifecycle costs of various options, taking due account of their differing functionalities (e.g. increased demand response vs. firm fossil-fuel resources) and the value of maintaining flexibility to mitigate the effects of unforeseen events. The process is one of "integrated resource planning," in which the utility considers the costs (including environmental factors) and the benefits of both power production and reductions in power consumption, for example by subsidizing end-user investments in efficiency or designing rates to encourage "demand response" at peak hours that reduce the need for new investments in generation.

Q. What are the most important "needs" that BPA's plans must address?

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[13] "Columbia River High-Water Operations [June 1-14, 2010], Exhibit 30.12, 1.

[14] BPA, 2010 Resource Program, Sept. 2010, 83-85, Chapter 8, Conclusions, http://www.bpa.gov/power/P/ResourceProgram/documents/Resource-Program.pdf

A. The assessment assumes that non-power obligations (e.g. fish movements) are met first, after which remaining resources are available to meet the identified needs. Those needs include various dimensions of energy (annual, seasonal, and heavy load hour demands), "120-hour 'superpeak' loads, 18-hour peak capacity loads," and "balancing reserve needs, including wind integration needs….the resource of second choice under the act is renewables."[15]

Q. What other factors constrain BPA's choices?

A. Under the Northwest Power Act, BPA's resource choices must "with certain narrow exceptions… act consistently with the [NPCC Plan] in its resource acquisition activities."

In particular, the law specifies that in acquiring resources necessary to serve its loads, BPA is "to make cost-effective conservation the resource of first choice. To carry out that function, Bonneville also manages programs that help utilities acquire conservation."[16]

Q. How does the NPCC plan envision BPA's choices for resources to meet future loads?

A. The NPCC plan gives both quantitative and qualitative primacy to conservation and efficiency. In particular, it "finds enough conservation to be available and cost-effective to meet 85 percent of the region's load growth for the next 20 years. If developed aggressively, this conservation, combined with the region's past successful development of energy efficiency could constitute a resource comparable in size to the Northwest federal hydroelectric system."[17]

C. The Growth of Wind Power

1. Data

Q. Please summarize the growth of wind generation in the region.

A. Exhibit 30.18 is a chart from BPA that shows the growth of wind capacity in its balancing area, current as of October 2010. As recently as June 2005 only 250 MW had been installed. Five years later that figure had grown by over 1,100 percent, to 3,011 MW.

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[15] BPA, 2010 Resource Program, 25.

[16] NPCC, 6th Conservation and Power Plan , 13-2 and 13-3.

[17] NPCC, 6th Conservation and Power Plan, 1.

Q. Please summarize BPA's forecasts for future wind interconnections to its grid.

A. Exhibit 30.06 is a graphic of BPA's latest forecast of wind capacity on its system, made in May 2010. It presents low, likely and high forecasts for each (fiscal) year, beginning in 2010 (BPA's fiscal year begins on July 1 of the prior year). Starting from approximately 3,000 MW in 2010, the "likely" figure rises to slightly below 10,000 MW in 2016, while the "low" and "high" ones are approximately 6,000 and 11,500 MW. BPA thus expects that the current amount of wind on its system could increase by a factor of 100 and 300 percent within six years.

Q. Are there more detailed data on current and emerging amounts of wind turbine capacity in the area?

A. Yes. Exhibit 30.08 is a table compiled under my supervision. It shows all known wind capacity in Washington and Oregon that is currently in operation, under construction, in the permitting process, or proposed. Currently, Oregon contains 2,301 MW of operating wind capacity and Washington has 2,224.2, for a total of 4,525.2 MW. A total of 2,657 MW is under construction in the two states, and 1,728 MW have been approved but not yet begun construction. Finally, 8,092 MW are either proposed or in the process of obtaining construction permits. Even if we disregard all of the last group, the two states contain 9,069.9 MW of capacity that is either operational, under construction, or approved for construction. Adding the active and proposed capacities yields a total of 17161.9 MW.

Any inferences made from these figures must be uncertain, most importantly for plants that are proposed or in the permitting process. Very conservatively, assume that none of those plants ever comes into existence. Compare the 9,069.9 MW operating, under construction, or fully permitted units with BPA's estimates in Figure 3. If they all go into operation, this is an amount of capacity that BPA's "high" scenario predicts would not exist until around 2015. BPA's "low" projections end in 2016, but even in that year those projections fall 2,000 MW (25 percent) short of the volume of capacity that as of today we can confidently expect will be on line. These figures suggest that BPA is underestimating future capacity. If we add in the proposed and unpermitted generators, the total is about 5,000 MW short of BPA's highest expectation for 2016. No matter which source we use, large amounts of wind capacity will go on line soon, both in absolute terms and relative to today's. In addition, note that I

am not counting plants that have yet to be proposed and might go into operation within this time horizon.

2. Problems in Integration

Q. Does BPA expect that it will be able to provide balancing for such high amounts of wind capacity as mentioned in the previous questions?

A. According to many statements by BPA, it is already pushing the limits of wind capacity that it can integrate. Exhibit 30.09 states that it currently carries nearly 2,000 MW of balancing capacity, an amount which must increase as its wind obligations rise.[18] Its 2010 resource plan expects that by the end of fiscal year 2013 it will have 6,122 MW of wind within its balancing authority, which will require 1,390 MW of incremental reserves and 1,827 MW of decremental reserves.[19] In the Columbia Gorge, BPA has seen increases and decreases in wind power output at rates of 1,400 MW per hour.[20] Since at some hours its total load is only 4,000 MW, the integration of additional wind may come at a high price in reliability and operational flexibility. Based on the growth in nominal wind capacity described in Exhibit 30.18, these problems will become serious even earlier than stated in the resource plan.

Q. Are BPA's difficulties in managing its balancing capacity in the face of increasing wind capacity analogous to those of a non-hydro system with growing wind capacity?

A. Yes. Although small additions in wind power carry risks of the same types as minor outages on a fossil-fuel-based system, those risks grow disproportionately with increasing reliance on wind increases, as does the necessity for greater increases in fossil-fuel operating and ready reserves.

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[18]Exhibit 30.09, Post-Workshop Reply Comments of the Bonneville Power Administration, California Public Utilities Commission Rulemakings 06-02-12 and 08-08-09 (May 12, 2010), 5.

[19]Exhibit 30.10, BPA 2010 Resource Program (September, 2010), 28. This "imbalance reserve capacity" is to compensate for differences between scheduled and actual output for the hour. BPA must also provide capacity resources for regulation (moment to moment balancing) and load following (0 to 10 minute balancing). See Comments of the Bonneville Power Administration, FERC Docket No. RM10-11-000 (April 21, 2010), 11.

[20]Exhibit 30.09, Post-Workshop Reply Comments of the Bonneville Power Administration, California Public Utilities Commission Rulemakings 06-02-12 and 08-08-09 (May 12, 2010), 4.

These problems are more acute for a system which must accommodate an undiversified mix of intermittent renewables, i.e. one like BPA that has only wind rather than a mix that also includes solar and tidal power (to the extent either is cost-effective).[21]

Q. Has BPA yet encountered any actual operating problems that threatened its reliability or its abilities to fulfill its non-electrical obligations?

A. Yes. BPA has described and analyzed two extreme events that occurred earlier in 2010. Low flows in April and high flows in June demonstrated to BPA that events "can stress the hydro system to the brink with the current wind fleet."[22] In June BPA had to simultaneously accommodate fish migration, a task that includes limiting the gas content of the water, while maintaining balance in the face of unexpectedly high streamflows. As an alternative to spilling, BPA was forced to operate its generators, which produced so much power that it could only sell to others at prices of zero or below. Even the Columbia Generating Station nuclear plant had to be stepped down to 20 percent of full output, the lowest level possible without a costly restart. Over the same interval, BPA reached the limits of abilities to balance wind output that it was bound to accept when feasible, and had to order wind generators to stop producing or curtail their access to transmission.[23]

Q. The integration of wind power has thus on occasion aggravated BPA's operational problems. But isn't it true that wind generators can supplement and replace high-cost energy when loads are high?

A. This is of course possible, but in general there is no systematic relationship between wind and load on BPA's system. Exhibit 30.13 exemplifies the lack of a relationship between hourly loads and wind generation during a

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[21]The increases in costs that accompany undiversified intermittent resources are estimated for BPA in more detail in Exhibit 30.11, Douglas Halamay et al, "Reserve Requirement Impacts of Large-Scale Integration of Wind, Solar, and Ocean Wave Power Generation, Oregon State University, 2010. http://nnmrec.oregonstate.edu/sites/default/files/PES_GM_2010_HalamayVariability_y09m11d30h13m26_DAH.pdf

[22]2010 BPA Resource Program, 35.

[23]These events, which affected generation and transmission throughout the PNW, are described in more detail by BPA in Exhibit 30.12, "Columbia River High-Water Operations, June 1 - 14, 2010."

"typical" week.[24]

Q. The Sixth NPCC Conservation and Power Plan has noted a relationship of interest between wind generation and temperatures in the Columbia Gorge. Please describe it and explain its significance.

A. The Plan says that "[a]nalysis done by Bonneville and the Resource Adequacy Forum suggests that, for the wind area at the east end of the Columbia River Gorge, where much of the region's current wind generation is located, there is an inverse relationship between wind generation and extreme temperatures, both in winter and summer."[25] It then provides an example of such a situation, in which for two cold weeks in January 2009 the area was virtually devoid of wind, shown in Exhibit 30.14. It is important to note that the graphic describes a single event, and does not necessarily verify the research findings that claim to show a general tendency.

Q. Wind generation may vary greatly over a short period of time, but isn't its average volume roughly constant from year to year?

A. Exhibit 30.14 shows that there is considerable variation here too. The rightmost part of its bar chart shows average generation from December 2008 through February 2009 (the blue bar) and for the corresponding months in 2009 - 2010 (the red bar).[26] The exhibit notes that between the two winters, wind generation connected to BPA rose by 58.8 percent, from 1,695 to 2,692 MW. Nevertheless, average daily wind-generated power fell by 29.0 percent, from 403 to 286 MW. Per megawatt of installed capacity, wind power production in winter 2009 - 2010 fell to only 45 percent of its 2008 - 2009 value, i.e. by more than half.

Q. Will the growing amount of wind power interconnected with BPA be of use in meeting the needs described in its Resource Plan?

A. In general, no. The generating capacity and energy that BPA requires to satisfy those needs must generally be "firm," i.e. reliably backed up so that BPA can depend on its delivery, and dispatchable, i.e. capable of being run at various

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[24]The graphic is copied from NPCC, 6th Conservation and Power Plan, 12-7.

[25]The graphic is copied from NPCC, 6th Conservation and Power Plan, 12-4.

[26]This is a copy of the diagram at http://transmission.bpa.gov/business/operations/wind/Winter0809_vs_Winter0910x.xls

output levels (including possibly zero) as the system operator deems necessary.

Q. Has BPA's assumption about the capacity value of wind units changed in recent years?

A. Yes. BPA's 2009 forecasts (and the NPCC forecast) assumed that despite intermittency, wind could dependably provide 5 percent of its rated capacity. For the 2010 forecast BPA reduced that value to zero.

Q. Wind units are not dispatchable, and will only provide useful added power at peak times by chance. Nevertheless, aren't they also valuable because every megawatt-hour produced by a wind turbine, regardless of the time of day, saves the incremental fuel expense for a conventional generator?

A. In many other power systems the answer would be in the affirmative because the wind power displaces fossil-fueled power. In the PNW, however, the wind-generated megawatt-hour will most often displace hydro energy, which does not have a direct fuel cost. There are also important uncertainties to be dealt with. As noted above, however, depending on the details of the situation a unit of hydropower produced today may mean that one less unit can potentially be produced at a later date.

Q. Will the growth of wind generation capacity affect the choice of generation and other utility investments in power production and reliability?

A. Yes, and in ways that cannot be fully predicted today. The PNW must learn to live with a diminishing percentage of hydropower in its total supply, and make investments that maximize the value of wind's contribution to resources. The NPCC Sixth Plan has noted that

> "planners must now consider potential resources in terms of their energy, capacity, and flexibility contributions. The rapid growth of wind generation… means that meeting growing peak load and flexibility reserves will require adding these capabilities to the power system. Changes can be made to the operation of the power and transmission system that will reduce flexibility reserve needs. These operational changes are expected to cost less than adding peaking generation, demand response, or flexibility storage, and they can be implemented more quickly. [27]

It is, of course, possible that optimism about the ease of such a transition is unwarranted, or that that transition will be even easier. At this point, uncertainty prevails.

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[27] NPCC, 6th Conservation and Power Plan, 9.

V. WRE AND WESTERN POWER MARKETS

A. Markets for PNW Wind Power

Q. As noted in the previous section, wind turbine installations are growing at very rapid rates in the PNW and particularly in the Columbia Gorge. Please summarize the factors that have led to this growth.

A. Geography, technology, financial, and regulatory forces have all contributed to the attractiveness of the area as a prime location for wind generation.

Q. How does the region's geography affect investment in wind power?

A. Wind in the Columbia Gorge is intermittent, just as it is everywhere else. Typically, however, its volume and velocity are high enough that the capacity factors of generators there are similar to those in other areas that have seen heavy wind investment. For comparison purposes, Exhibit 30.17 summarizes capacity factors for wind installations from different dates in different regions, and those for the PNW are similar to BPA's stated average "Columbia Basin" capacity factor of 32 percent.[28] The area contains substantial open acreage well-suited for wind installations, and recent growth in them may indicate a relatively receptive local population.

Q. How does technology in the region affect investment in wind power?

A. The PNW's transmission grid, largely owned and operated by BPA, covers the region quite thoroughly and can accommodate substantial volumes of wind energy alongside other power flows. The PNW's non-wind resources are largely adequate for the near future. Recently enacted Renewable Portfolio Standards (RPS) in Washington, Oregon and California require that their utilities obtain increasing percentages of their power from renewable sources (excluding large hydro). Even if wind power is not an overall least-cost choice, it is often the cheapest way to achieve compliance with an RPS. BPA's grid is interconnected with other transmission whose capacity (if available) allows southward flows to California, Nevada, and the desert southwest.

Q. What financial factors have incentivized the growth of wind generation capacity?

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[28] BPA 2010 Resource Plan, 58. The exact definition of "Columbia Basin" is not given. U.S. Department of Energy, 2008 Wind Technologies Report, DOE GO-102009 (July, 2009), 39. http://eetd.lbl.gov/ea/ems/reports/2008-wind-technologies.pdf

A. Exhibit 30.16 is a summary chart of subsidies to various forms of power generation estimated in 2007 by the U.S. Department of Energy's Energy Information Administration. Wind's disproportionate subsidies stem in part from federal tax provisions that advantage it relative to other energy sources, including some renewables. The American Reinvestment and Recovery Act of 2009 extended previously enacted production tax credits and investment tax credits for wind through 2012. The PTC provides a 2.1 cent per kilowatt-hour benefit for the first ten years of a renewable facility's operation, including wind, solar and geothermal installations (other renewables such as incremental hydropower and solid waste processing receive only 1.0 cents per kwh). The Act also added the option of direct Treasury grants in lieu of tax credits. IRS rules also allow wind power producers the option of a five-year accelerated depreciation schedule. Roughly speaking, the provision allows deduction of half the project costs during the first two years and full recovery in six. To my knowledge, none of California, Oregon or Washington have special property or corporate tax provisions that apply only to wind or renewable energy projects. Wind producers must pay market prices for their plants and workers, but BPA has stated that its "existing rates for wind integration service are well below the prices others charge for comparable service."[29]

Q. What regulatory factors are driving investment in wind power?

A. As elsewhere in the country, support for renewable power has grown in the PNW. Washington, Oregon and California have all enacted legislation mandating renewable portfolio standards (RPS) which require some or all utilities to obtain certain percentages of their electric energy from "renewable" sources as time passes.[30] There are differences in provisions regarding the use of renewable energy credits for compliance. Washington requires each "qualifying" public or investor-owned utility (a total of 84 percent of state load) to obtain at least 3 percent of their 2012 loads from renewables, 9 percent by 2016, and 15 percent by 2020. Oregon's compliance schedule differs for utilities of different sizes, but the most important are "large" ones, defined as those that serve 3 percent or more of the state's load. They must obtain 5 percent of their retail

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[29]Post-Workshop Reply Comments of BPA, May 12, 2010, 3.

[30]Data were taken from state entries in DSIRE, the "Database of State Incentives for Renewable Energy," at http://www.dsireusa.org/summarytables/rrpre.cfm

sales from "eligible" sources (basically, those that began operating post-1995, including hydropower) by 2011, 15 percent by 2015, 20 percent by 2020 and 25 percent by 2025. California until recently had a legislated 20 percent requirement that was to have been met by 2010 but was not. The state's Air Resources Board recently ordered a 33 percent requirement for 2020 as part of its climate policy rulemaking. This action will surely face legal challenges prior to finalization of any new RPS standard.

Q. What is known about exports of wind power from the PNW?

A. Most wind power contracts are not publicly available, so neither their pricing terms nor the identities of their purchasers are known. BPA, which does have some such knowledge, has estimated that by the end of 2010, 47 percent of the wind generation connected to its system will be under contract to California utilities.[31]

Q. Why are California utilities active in the market for PNW wind power?

A. As noted earlier, California's utilities are currently not in compliance with their original 2010 RPS goal of 20 percent, and they now face a 2020 requirement of 33 percent that they are unlikely to meet unless they become more active as purchasers. California's environmental and electric regulatory regimes have made it very difficult to site new powerplants, even renewables locally, and there have been long delays in the permitting and construction of transmission to wind-rich parts of the state.

Q. What is currently known about the availability of capacity on the Intertie and other lines between the PNW and California?

A. BPA has stated that "the major transmission lines linking the Northwest to California are fully subscribed on a long-term firm basis."[32] I am unfamiliar with the possible availability of interruptible service on these lines, or about whether interruptible service and/or unbundled RECs will allow California utilities to claim RPS compliance.

Q. Is there any publicly available information about WRE's arrangements for marketing the power from its project or the identity of its counterparty?

A. No.

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[31] *See* Exhibit 30.09, Post-Workshop Reply Comments of BPA, May 12, 2010, page 3.

[32] *Id.,* 9-10.

B. Effects of wind power sales to other areas on the PNW

Q. What are the benefits and costs to the PNW that result from such purchases of wind energy by California utilities?

A. Relative to the delivered value of the power, the benefits to the PNW are small. As noted below, the workforce at an operating wind installation typically consists of only a handful of people. Payments to BPA for balancing and other services will also be small relative to the value of the power, and their prime effect is to reduce the contribution to fixed costs that would otherwise have had to be made by PNW persons and entities. WRE will also pay certain taxes to state and local governments, but their exact amounts cannot be determined from available information.[33] The bulk of a wind project's costs are for hardware and for payments to creditors and shareholders, who will generally be scattered over the nation or world.

Q. Applicants have claimed that WRE's local benefits will be substantial thanks to the employment opportunities it will open up in construction and operation, and the "second-round" effects of these workers spending their incomes in the region. Please evaluate these claims.

A. According to its EFSEC application, WRE expects that construction will require approximately 12 months, during which an average of 143 workers will be employed, and 71 local "indirect" or "induced" jobs will exist for that period.[34] Total cost will be $150 million, of which $13.2 million will be sourced locally, primarily for labor. After construction, WRE will be associated with a total (direct, indirect and induced) of 12 permanent jobs.[35]

Q. Please comment on the significance of these calculations.

A. Any justification for the project must be based on its effects on the cost and availability of power in the PNW and on its environmental consequences. The long-term employment effects are so small relative to its cost that the project cannot possibly be justified that way - the $150 million project provides 12 such direct and induced jobs, so each comes at a cost of $12.5 million. This far

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[33] WRE EFSEC Application, Sec. 4.4, 4.4-14. http://www.efsec.wa.gov/Whistling%20Ridge/Application/Amended%20App/Amend%20Part%204.pdf

[34] WRE EFSEC Application, Sec. 4.4, 4.4-22.

[35] WRE EFSEC Application, Sec. 4.4, 4.4-29.

exceeds the typical investment required per long-term job in the economy. Numerous other short-lived jobs will be associated with the manufacture of the components, but they will vanish as those components are completed.

The increase in local employment that comes with construction benefits those who take the jobs. According to WRE's application, only 25 to 30 percent of construction workers would come from the three-county area, and most of the remainder would commute from the Portland area.[36] In no sense, however, can we say that the project "created" jobs on a net basis. Funds that were invested in the construction of WRE could have been expended on any project anywhere in the world that the capital markets deemed worthy of funding. Workers who might have built those other projects will be doing something else. WRE's project application provides no evidence that those employed in building it would have languished in long-term unemployment absent its construction. Today's unemployment rates are symptomatic of macroeconomic (economy-wide) problems, and not the result of insufficient spending on alternative energy or any other good or service.

VI. SUMMARY AND CONCLUSIONS

Q. Having given the above testimony, please summarize your conclusions.

A. They are six in number:

1 A wind turbine is a "variable energy" or "intermittent" source of electric energy that produces power only when the wind is blowing. Winds will not necessarily be strongest when wind they could make the greatest contribution to a reliable and inexpensive power supply. In the PNW peak loads are more likely during times of extreme temperatures, but it is at those times that wind turbines are less likely to be delivering substantial quantities of power.

2 Wind's inherent variability requires that a system operator "balance" it by adjusting the output of generators that can be controlled. Major problems have arisen in the recent past and may also materialize in the future as a consequence of committing large amounts of generation capacity to perform this function. BPA has acknowledged that its reliability has at times been endangered by the high quantities of generation capacity that must be allocated to the balancing function.

3 There are slightly over 3,000 MW of nameplate wind generation in

[36] WRE EFSEC Application, Sec. 4.4, 4.4-21.

the northwest today, and the record of projects in progress (under construction and permitted) shows it quite likely that more than 9,000 MW will be operating within six years. WRE's 75 MW are a final increment to this mass of capacity. The fact that BPA is encountering difficulties as it attempts to integrate today's volume of wind power suggests that the future will bring more severe problems, absent technological progress and changes in electricity regulation.

4 Early in 2010 the Pacific Northwest Power & Conservation Council released its Sixth regional power plan. That plan anticipates that existing hydro and other resources will be sufficient to meet expected loads through 2030, with the exception of a need for summer peaking resources after 2024. Wind's intermittency will not allow it to function as either a baseload or peaking source.

5 BPA has stated that nearly 50 percent of wind power generated in the PNW is being purchased by California utilities to meet their state's high renewable portfolio standard. Wind projects intended to sell power outside of Washington State provide its residents and businesses with few economic or environmental benefits. If the balancing resources include gas-fired generation, Washingtonians may bear environmental costs while non-Washingtonians import cleaner electricity.

6 Wind's variability renders wind generation of little or no value to utilities seeking to efficiently serve their peak loads, and it is also unsuitable as a baseload resource. Regional energy plans are in agreement that as much as 85 percent of load growth can be served by more efficient use of electricity, which will greatly reduce the utility industry's investment requirements for the next 20 years. Taken together, these facts lead to a conclusion that Whistling Ridge is not necessary to meet future PNW power demands.

//END OF TESTIMONY//

EXHIBIT LIST

30.01 Curriculum Vitae

30.02 American Wind Energy Association, "Wind Energy Basics," http://www.awea.org/faq/wwt_basics.html#What%20is%20availability%20or%20availability%20factor

30.03 Seattle City Light "Power Lines"

30.04 NPCC, 6th Conservation and Power Plan (Feb. 2010), excerpts (Chapters 1,2,3,6,12 and 14)

30.05 BPA 2010 PacNW Loads and Resources graph, p.54, "Annual Regional Firm Energy Load Projections Including Exports for OY 2011 through 2020"

30.06 Forecast of Reenewable projects on BPA Grid

30.07 BPA 2010 PacNW Loads and Resources graph, p.129 excerpt, "Pacific Northwest Regional Loads and Resources, 2011 and 2020"

30.08 Oregon and Washington Wind Capacity spreadsheet

30.09 Post-Workshop Reply Comments of the Bonneville Power Administration, California Public Utilities Commission Rulemakings 06-02-12 and 08-08-09 (May 12, 2010)

30.10 Comments of the Bonneville Power Administration, FERC Docket No. RM10-11 -000 (April 21, 2010) (pp1-31 provided)

30.11 "Reserve Requirement Impacts of Large-Scale Integration of Wind, Solar, and Ocean Wave Power Generation" from http://nnmrec.oregonstate.edu/sites/default/files/PES_GM_2010_Halamay Variability_y09m11d30h13m26_DAH.pdf

30.12 BPA, "Columbia River High-Water Operations, June 1 - 14, 2010"

30.13 Graph Load and Wind Pattern; Sixth Power Plan, Ch12, p7

30.14 BPA Wind Generation, Winter v Winter

30.15 Wind Generation, January 2009; Sixth Power Plan, Ch12, p4

30.16 Subsidies per MWH to Various Types of Electricity Generation (Chart)

30.17 Wind Capacity Factors for Regions

30.18 Wind Generation Capacity in the BPA Balancing Authority Area