Response to NW Energy Coalition's "Bright Future"

(Updated May 13, 2009)

This response to the Northwest Energy Coalition's publication, "Bright Future," comes from a group of energy analysts with decades of experience and technical expertise in the electric power industry in the Pacific Northwest. These comments provide corrections and further insight into the NWEC document so that policy makers can realistically evaluate this view of the future.

Overview

The old adage: "If it sounds too good to be true, it probably is," applies to Bright Future. Bright Future is a well-intentioned but overly simplistic approach to regional energy planning that is oblivious to the needs of the region for a reliable power system. A key aspect, the cost of achieving the vision described in this paper, is seriously understated. The paper's premise is also highly unrealistic. To suggest that the region can reduce carbon emissions while meeting over 4,000 aMW of new Northwest load by 2020 through energy efficiency and renewable/wind development, plus replace 4,283 MW of existing resources while retaining power system reliability – all at two-thirds of a cent per kilowatt hour – is a pie-in-the-sky dream. In fact our estimate of the cost of Bright Future is more than double the Bright Future authors' estimates.

The claims made in Bright Future should be cross-checked with those who have real responsibility to plan for, and operate, a power system: the Northwest Power and Conservation Council, the Pacific Northwest Utilities Conference Committee, the Bonneville Power Administration as well as other regional utilities and planners. None of these organizations have identified a realistic path to meeting all load growth with conservation and renewables alone, nor have they found that replacement of existing hydro and coal-fired resources can be done cheaply or without adverse environmental and economic effects. In fact, the Bright Future sponsors' previous attempt to evaluate the region's power system economics with a goal of promoting Lower Snake River dam removal (in a publication called "Revenue Stream") was shown to be in error by the region's Independent Economic Advisory Board, among others.

The Northwest is facing significant challenges. We must meet the region's rising demand for energy, achieve environmental goals and meet even more stringent regulatory requirements. Bright Future does not acknowledge this reality.

Recommendation

Time would be better spent working to refine a vision for the future by developing a thorough plan for the region through the Council's power planning and BPA resource planning processes. These processes are designed to consider the financial and reliability impacts of all resources – existing and planned.

Planning to meet the energy needs of the region requires a thorough approach informed by integrated resource planning (much like the Power Plan now being developed by the Council) which takes into account the energy, capacity and reliability needs of the region. Bright Future is largely an energy-based superficial analysis that fails to take the capacity needs of the region into account. Capacity is the ability of the power system to meet instantaneous and sustained peak loads. Many of the recommendations in Bright Future are based on unrealistic assumptions, and fail to acknowledge what we know about the Northwest's power system. For example – the four lower Snake River dams produce almost as many annual average megawatts as BPA's conservation programs have achieved in 27 years.

Inaccurate Claims Made in Bright Future

"The four Lower Snake River Dams can be removed and their output substituted by conservation and renewables."

- Suggesting that the Snake River dams, which together provide 1,191 average megawatts of energy and up to 3,033 megawatts of capacity[1] could be removed, while simultaneously reducing carbon emissions and bringing more wind resources on line, is downright disingenuous. One thousand megawatts of energy is approximately the amount of power needed to serve a city the size of Seattle.

- Seventy-one percent of Northwest voters agree that removing the Lower Snake River Dams would be an extreme solution according to a recent poll conducted by Tim Hibbitts. 66 percent are unwilling to further reduce the electricity generated by hydro power to help salmon if it means fossil fuels replace the lost hydropower.

- Power from the dams is needed to meet the Northwest's peak energy and reliability needs and currently is necessary to back up the 3,098 megawatts of renewable wind projects already on-line in the region with an additional 473 MW under construction[2].

- The region could not have brought so much wind on-line without the region's existing hydropower dams (including the four Lower Snake River dams). To achieve the region's goal of bringing on 6,000 megawatts of new wind we need the federal hydro system more than ever. However, to maintain a reliable power system and achieve the region's renewable goals will require even more additional back-up resources, most likely natural-gas fired combustion turbines.

- According to the Northwest Power and Conservation Council's analysis of the Region's Carbon Footprint[3] 4.4 million tons (8.8 billion lbs) per year of additional CO2 would be

[1] Northwest Power and Conservation Council, Existing Resource Database, updated April 2009.

[2] Northwest Power and Conservation Council, Power Plant Development Activity in the Pacific Northwest, updated April 2009.

added to the atmosphere if the dams were removed, due to the need for fossil fuel-based replacement generation. This figure does not include higher emissions that would result from shifting to truck/rail transport of goods downriver versus barging that is now made possible by the dams. One barge is equivalent to 134 trucks on the road[4]. For comparison purposes the Council estimates that 4.4 million tons of CO2 per year is equal to the CO2 released by 587 MW of coal-fired electric power, or to 1,467 MW of electricity produced by gas-fired combined cycle power plants.

"Energy efficiency can be used to meet 340 aMW of energy needs a year."

- Based on a recent Council presentation, since 2001 the region has added 1600 aMW of energy efficiency savings for both utility and building and appliance efficiency code programs.

- Utilities recognize that energy efficiency will also be the resource of choice in the future. Under its most aggressive conservation plan, the Council is suggesting that energy efficiency be increased from just over 300 aMW of energy efficiency achieved in 2007 to 366 aMW of energy efficiency savings per year by 2019[5]. This aggressive path is not much different from the Bright Future recommendation. When the Council's Draft Sixth Power Plan is released later this year, the region will have the opportunity to consider the feasibility of this level of planned conservation.

- Energy efficiency targets are achieved through such means as BPA programs, utility programs, state and federal building and appliance codes and individual consumer purchases and lifestyle choices. Energy efficiency targets are comprised of a large array of measures. Attaining energy efficiency can be done by the end-use consumer, with or without incentives from their utility; by the utility; by collaborative efforts of utilities, regional entities, etc. Other measures come from changes made upstream by the manufacturer or by state or national codes and standards. It is important to take into consideration the variety of ways energy efficiency measures can be implemented when forecasting the amount of potential energy efficiency savings. Measure implementation can be hard to predict and influence and hinges on a number of variables, such as economic impact and lifestyle impact. Individual utilities, energy policy makers and planners have limited control over many of the ways in which energy efficiency can be achieved, particularly when actions are required far upstream (at the manufacturing or national level) or far downstream (at the end-use consumer level).

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[3] "Carbon Dioxide Footprint of the Northwest Power System", November 2007, Northwest Power and Conservation Council, 2007-15.

[4] www.pnwa.net, Columbia Snake River System Facts

[5] Draft Sixth Power Plan presentation to the Northwest Power and Conservation Council, April 2009. http://www.nwcouncil.org/news/2009/04/p5.pdf

"Renewables can be used to meet all of the region's energy needs after the four Lower Snake dams are removed and all of the coal plants are phased out."

- Bright Future assumes that there is a one-for-one equivalence of hydro and wind energy. This is not the way power systems operate.

- Bright Future assumes that by 2020 we can obtain an additional 2,500 aMW of new renewables (mostly wind) at 10 cents per kWh compared to "business as usual." Because the wind doesn't blow all the time, about 8,000 MW of new wind capacity will be needed to generate that 2,500 aMW. Assuming ten-cents per kilowatt-hour power for such a massive build-out of the region's wind resource ignores the fact that as more and more wind power plants are sited in the region the cost will increase, power output will decline and transmission costs will increase. Using the current estimate for the cost of wind power today is an extreme underestimation of what it would actually cost if the region chose to follow the path recommended by Bright Future.

- Bright Future neglects to adequately consider the transmission costs to get the power to consumers. Typically these costs add 30 to 40 percent more to the cost of wind resources[6]. The transmission lines that bring power from Montana and other areas with wind resources are already fully committed to existing uses. Thus, more wind will require new transmission capacity. The first transmission additions are generally the least expensive because existing facilities can be upgraded, but as greater quantities of generation are built, the additional new transmission facilities become more expensive. The extent of new transmission facilities required for Bright Future is unknown but cannot be assumed equivalent in cost to today's transmission. Bright Future also neglects to address the problem of siting new transmission. Until it is certain that sufficient transmission will be built, it would be risky to assume that power needs will be met with remote generation.

- Also Bright Future fails to consider the cost of integrating an intermittent resource with the existing power system to meet load. The shape of the overall loads doesn't match the shape of how wind resources produce power. These costs are under study in the region at this time but initial estimates are that integration of wind resources can add another 20 percent or more to the cost of wind.

Bright Future will keep the lights on

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[6] Northwest Power and Conservation Council, Review of Generating Resource Options for the Sixth Power Plan. http://www.nwcouncil.org/news/2009/01/4.pdf

- The most important function of the power grid is reliability. The power system needs to provide electricity on a continuous basis and meet peak power use when consumers demand it. When a consumer turns on a light or a factory turns on a motor, electricity must be there, reliably. The consequences of not having a reliable electric power system would have severe health and safety implications and would be disastrous for the economy. Even momentary reliability lapses can lead to substantial national reliability standard violations with significant monetary consequences.

- Bright Future relies on wind generation to fulfill the energy needs of the system. While renewables are a very important part of meeting load growth in this region they do not bring reliable power that can meet consumer demands. Wind resources are not available at the push of a button. The region's experience is that when power is needed most, the wind is not blowing. For example, we have observed that when it very hot or very cold wind generation is simply not there. During the cold days of January 5 to 28, 2009 wind generation in the region was almost non-existent[7].

- Capacity has to be provided by backup hydro and thermal (typically fossil fuel) resources. These are the very resources that Bright Future is asking to be removed. It is unrealistic to assume that we can continue to bring on new wind resources without making major investments in new reliability resources to shape the wind output to meet load based on consumer demand.

- Energy efficiency met 50 percent of the Northwest's electricity load growth between 1980 and 2006 (based on BPA numbers). However, maintaining a reliable power supply requires control; conservation measures cannot be turned on when consumers demand more energy. As a result, energy efficiency cannot provide backup for intermittent generation such as wind nor can it be used to maintain system reliability. For example, wind energy is generated when the wind blows – this rarely occurs when the system faces peak demand for electric energy. Plus, on average, wind only produces approximately 30 percent of maximum power the turbines can technically produce. To maintain system reliability, electric generation must instantaneously match customer demand for electric energy. This physical requirement leaves electric utilities no choice but to acquire additional generating resources that can be used to increase power output when wind generation is less than what customers demand for electric energy – or decrease output when wind generation exceeds customer demand for electric energy.

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[7] http://www.transmission.bpa.gov/business/operations/wind/WindGen_VeryLow_Jan08Jan09x.xls

- Failure to consider the impact of removing the Snake River dams and coal plants on peaking, load following, and reliability is a serious shortcoming of Bright Future. Reliability is essential to consumers, so any power plan pursued by the region must be far more than just a plan for meeting the average energy needs as was done in Bright Future.

Bottom line

Bright Future is only an additional 0.67 cents/kWh over business as usual.

- The costs of Bright Future are extremely underestimated. To use a few glaring examples, the report assumes that 2000 MW of capacity will be lost if the dams are removed (the full capacity of the lower four Snake River dams is 3033 MW) and that this loss of capacity can be replaced at a very low cost estimate of $83 million per year. In addition, there are no assumed costs of replacing the assumed loss of 1000 MWa of coal-fired capacity in 2020.

- The Public Power Council (PPC) estimates that the real cost of Bright Future are more than twice as expensive as the cost estimated by the Bright Future authors[8].

- Key problem areas with Bright Future:
  - Capacity replacement costs for coal and Lower Snake resources are seriously underestimated.
  - The cost of dam removal is not considered.
  - Wind integration costs are ignored.
  - The capital needed to finance the conservation, wind and coal replacement resources included in Bright Future in 2020 will be more than $100 billion. The up-front costs of conservation will cause a significant rate impact. Use of lifecycle cost of conservation understates that impact. For example it will require almost $7,000 per installed kW of energy efficiency to finance conservation that has a lifecycle cost of 4 cents/kWh.
  - The Council's regional power plan already relies on achieving all cost effective conservation and renewables. One can't just assume more conservation and renewables to replace dams and coal plants will appear out of thin air.
  - Overstatement of availability of wind resources.
  - Transmission availability and cost are not adequately considered.
  - The Bright Future vision fails to provide for a reliable power system.

[8] See Examining Bright Future, PPC, May 13, 2009

Examining The Cost Comparisons In *Bright Future*

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Public Power Council

May 13, 2009

On page 36 of *Bright Future*, there are two tables which purport to do a cost-comparison between the resource development advocated in *Bright Future*, and a "Business-As-Usual" option, one through 2020, and one through 2050. Although the tables are designed to look like spreadsheets, they are not – the average megawatt numbers and the costs in the columns do not add to the totals at the bottom of the table. Because of this, it is necessary to make some inferences about what the *Bright Future* analysis did.

For the 2020 table, *Bright Future* proposes buying 2,760 aMW of lower-cost conservation, 1,320 aMW of higher-cost conservation, 2,500 aMW of new renewables, and 580 aMW of "extra gas variable costs", with reductions of 1000 aMW of coal-fired generation, and 1,000 aMW of Snake River dam output, leading to an increase of 5,160 aMW. (*Bright Future* cites 6,580 aMW of additional aMW added – the discrepancy is not explained in the table, but most of that may reflect the loss of energy from the Snake River dams.)

The "business as usual" case proposes buying 2,760 aMW of lower-cost conservation, and 2,000 aMW of new renewables, while maintaining the Snake River dams and full coal output, leading to 4,700 aMW of additional generation. (The table cites 4,180 aMW of additional resources in the "business as usual" case – the discrepancy is not explained.)

So, the *Bright Future* alternative adds 5,160 aMW of additional generation and "business as usual" adds 4,700 aMW – there is no explanation for the 460 aMW discrepancy between the two cases, but a start on adding the 1,500 aMW of new electric vehicle load *Bright Future* posits by 2050 is perhaps a plausible explanation.

Looking at the costs that *Bright Future* posits for its resources leads to a total cost estimate of $3.822 billion (vs. the reported figure of $3.517 billion – again, the discrepancy is not explained), and a cost for the "business as usual" case of $2.477 billion (vs. a reported cost of $2.172 billion for business as usual), leading to a cost difference between the two cases of $1.344 billion (which actually agrees with the number reported in *Bright Future*). However, there are some errors in *Bright Future's* analysis. Given that the Regional Council recently prepared a graph indicating that the cost of providing new capacity from a single-cycle CT was about $125/kW/yr, then the cost of replacing the 2000 MW of Snake River dams' capacity is $250 million, not $83 million. *Bright Future* assumes that the Snake River dams provide 2000 MW of capacity, but BPA in its fact sheet *Power benefits of the lower Snake River dams* (Jan,

2009) notes that the sustained peaking capability of the dams is 2,650 MW. Using the correct sustained peaking number yields a capacity value of the Snake River dams of $331 million. Also, given the *Response to NW Energy Coalition's Bright Future Document* study's estimate that one conservatively has to add 20% to the cost of wind to reflect the cost of backing it up and 30% to reflect transmission costs would raise the cost of renewables from 100 mills (a mill is a tenth of a cent) to 150 mills. Putting these updated numbers into the analysis yields a cost of additional generation of $5.165 billion vs. $3.353 billion – a differential of $1.811 billion, which is 135% of the cost differential reported in *Bright Future*. Instead of the cost differential of 6.7 mills reported in *Bright Future*, the actual differential is 9.0 mills.

Bright Future additionally makes a curious assumption: the "business as usual case" assumes that the 2,760 aMW of lower-cost conservation is acquired and 2,000 aMW of renewables, but <u>no</u> higher-cost conservation. This is odd, since the cost of higher-cost conservation is assumed to be 60 mills, and *Bright Future* assumes that the cost of renewables is 100 mills. It is left unexplained why reactionary, business-as-usual utilities would have a such a preference for renewables development over higher-cost conservation, even when the higher-cost conservation was available at 60% of the cost of renewables (or 40% of the cost of renewables with backup and transmission costs included). You could assume a "modified business as usual case", where the much cheaper "higher-cost" conservation is acquired instead of renewables. This would lead to the acquisition of 1,320 aMW of higher-cost conservation and just 680 aMW of renewables (instead of 2,000 aMW). Even using *Bright Future's* renewables cost of 100 mills, and a Snake River dam capacity cost of $83 million, the cost of added resources in the "modified business as usual case" would be $2.015 billion, and the differential between *Bright Future* and the "modified business as usual" case would be $1.807 billion, or 9.0 mills. If you use the corrected numbers of $331 million for the capacity value of the Snake River dams, and 150 mills for the full cost of renewables, the cost differential between *Bright Future* and the "modified business as usual" case is $2.852 billion, or 14.2 mills – over twice the cost differential claimed in *Bright Future*.

***Bright Future* – 2050**

Looking at the *Bright Future* 2050 table, a number of things stand out. In the *Bright Future* case, it is assumed that of the 7,310 aMW of coal generation, 710 aMW is repowered, and the rest shut down. It should be noted that the *Bright Future* case contradicts recommendation #5 in *Bright Future*: **Prohibition of new coal plant construction or extending the lives of existing ones.** Although the *Bright Future* case assumes most coal generation is shut down by 2050, it does not assume that <u>all</u> coal generation is shut down. It assumes that both the lower-cost and higher-cost conservation is acquired, assumes massive development of new renewables, and continued use of the 580 aMW of new gas-fired generation that the *Bright Future* case had acquired by 2020.

In the "Business-as-usual" case, existing coal capacity is repowered, higher-cost conservation is ignored, and a modest amount of new renewables is acquired between 2020 and 2050, and a substantial amount of natural gas-fired generation is constructed between 2020 and 2050. The analysis appears to use constant dollars (not dollars escalated for inflation), since generation costs are largely unchanged between 2020 and 2050. The conclusion of *Bright Future* is that the *Bright Future* case would be 6.8 mills more expensive than the "business-as-usual" case.

Looking at the *Bright Future* case, a number of problems become evident. As noted before in the 2020 analysis, the 100 mill cost estimate for renewables ignores transmission and integration costs, and arguably integration costs as a proportion of overall renewables costs will go up, if the region acquires 11,000 aMW of renewables (which would be well over 30,000 MW of installed capacity, if the renewables were wind). Gas does not share the same problems – it is not intermittent, and is not location-specific like renewables. The *Bright Future* 2050 analysis suffers from the same problem as the 2020 analysis, inasmuch as it assumes that reactionary, business-as-usual utilities prefer renewables to much cheaper "higher-cost" conservation, for some reason.

A smaller issue is that *Bright Future* assumes that new gas-fired plants will cost 100 mills, yet the *Bright Future* case assumes the 580 aMW of 2020 gas-fired plants will stay at 60 mills in 2050. The plausible reason why gas would be more expensive in real terms in 2050 than 2020 would be because gas prices have gone up, since it is a reasonable assumption that the efficiency of combustion turbines will continue to increase. If new gas-fired generation costs 100 mills in 2050, then the old gas-fired generation will cost 100 mills as well.

Another curious assumption is *Bright Future's* claim that the cost of coal-fired generation in 2050 will increase by 60 mills, due to the need to repower old coal plants. By itself, this assumption isn't a bad one, since old coal plants will need refurbishment – the curious thing is that *Bright Future* fails to apply equivalent refurbishment costs to any other resource. *Bright Future* assumes that the 4,080 aMW of conservation and the 2,500 aMW of renewables acquired by 2020 in the *Bright Future* case continue to be available in 2050, without any acknowledgement of equivalent refurbishment costs: conservation and renewable resources apparently come with infinite lives.

In comparing the real costs of the 2050 *Bright Future* case with the 2050 "business as usual" case, in order to have the *Bright Future* case comport with the actual policy recommendations in *Bright Future,* I am making the assumption that the 710 aMW of coal is <u>not</u> repowered in the *Bright Future* case, but instead is replaced by an additional 710 aMW of renewables.

Using the modified *Bright Future* case (revised to have no coal generation), and including the 150 mill cost of renewables, 100 mill cost of all gas-fired generation, and $331 million in capacity value for the Snake River dams, the modified *Bright Future* case has an incremental cost of $20.333 billion, and the "business as usual" case has $13.380 billion – a difference of $6.953 billion, or 22.3 mills, more than triple the claimed cost of the *Bright Future* case. You can modify the "business as usual" case as in the 2020 example to acquire more conservation, less renewables, and slightly more gas-fired generation; but the overall impact isn't that great – it only pushes the difference between the *Bright Future* case and the "business as usual" case to 26.0 mills.

The differential in cost would be even greater, of course, if real natural gas prices do not go up by two-thirds by 2050. As we have recently been reminded, forecasting fossil fuel prices is a difficult task, whether over the short-term or long.