ERIC HIRST

Consulting in Electric-Industry Restructuring

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Dear Dick:

Thanks for inviting me to participate in last week's Council Workshop on "Wind Energy and Electric Power Systems." The combination of excellent presentations and active audience participation produced a very informative and interesting day.

You asked me to summarize the key points from the workshop, including suggestions for future work to increase the viability of wind energy within the Pacific Northwest. The key themes I heard at the workshop include:[*]

- Substantial progress has been made during the past several years. The region has moved a long way toward making wind a mature technology through data collection, development of analytical techniques, improvement in processes related to transmission access, construction of wind farms, and production of wind-driven electricity. Although much more work remains to be done in each of these areas, the region should be proud of all it has accomplished in a few years.

- Transmission access and costs are likely the most important issue facing wind today. A key issue concerns the possibility of buying some firm transmission and some nonfirm transmission to move the wind output from source to load centers. The development and application of new analytical techniques are needed to assess the appropriate mix of firm and nonfirm transmission (where the mix might vary with time or with the capacity factor of the wind farm). These analytical tools will likely examine the interactions between the probabilistic output of the wind farm in question, the probabilistic loadings on the transmission elements between the wind farm and the load centers, and the probabilistic values of spot energy prices. A related issue concerns the lengthy process associated with interconnection of wind to the

[*] I received helpful comments on a draft of these key points from several of the workshop speakers, including Ken Dragoon, Stephen Enyeart, David Kobus, Michael Milligan, and John Wade.

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transmission grid and determination of any capital costs for upgrading the transmission system to accommodate wind output.

- Many of the modeling tools needed to analyze integration of wind energy with the grid in the short term (from day-ahead unit commitment through real-time regulation) have been developed and subjected to initial tests. Future efforts should focus on site- and project-specific applications and the development of widely applicable rules of thumb on the cost of this short-term integration (e.g., these costs amount to $2 to $5/MWh of wind output for control areas with a wind-farm capacity of less than 20%). Some work remains to validate and improve these models. In particular, the inner workings of utility unit-commitment and economic-dispatch models, most of which are proprietary, need to be opened for inspection and review.

- The relationship between wind and capacity (reserves) is largely unaddressed. This issue has two components:
  - Planning (long-term) reserves: Can wind (given its intermittent, unpredictable, and uncontrollable output) qualify as installed capability? If so, under what conditions? How would improvements in wind-output forecasts affect the amount of wind capacity that could qualify as installed reserves?
  - Contingency (operating) reserves: Should wind farms be responsible for (i.e., be required to pay for) spinning and supplemental reserves? How much contingency reserves should be assigned to wind (e.g., 5% of wind capacity, as for hydro resources)? More important, what determines the appropriate assignment of contingency reserves to wind?[#]

- How accurate are today's wind-forecasting models, both the persistence models and the meteorological models? How can the accuracy of these models be improved and at what cost? What additional data should be collected at or near each wind farm to improve forecast accuracy? What are the benefits of more accurate forecasts? As examples, how would improved accuracy affect the costs of day-ahead unit commitment (relative to real-time hourly dispatch), the assignment of contingency reserves to wind, the capacity credit given to wind for installed reserves, and the ability to purchase nonfirm transmission? What are the benefits of supplementing wind forecasts with decision-analysis tools that assess the accuracy of individual hourly forecasts? The region needs a careful benefit/cost analysis of improving wind-forecasting models.

[#]The Northwest Power Pool, in October 2003, decided to require wind resources to carry 5% of their load responsibility as contingency reserves.

- What are the benefits of increased geographical dispersion of wind farms throughout the Pacific Northwest? Additional data and analytical tools are needed to assess the benefits (based on the lack of statistical correlation among the outputs of individual wind farms) related to lower temporal variation in energy output, improved forecasting of wind output, and perhaps other characteristics. The associated economic benefits of lower production costs and higher reliability then need to be compared with the costs of developing and applying improved forecasting methods.

There are surely other issues the region and the Council could be addressing (e.g., the need for additional data on wind potential, such as taller meteorological towers; the need for more testing of new turbine designs, especially under moderate-wind conditions; and careful assessments of different ways to increase demand for wind energy, including green-power programs, renewable portfolio standards, and system benefit funds). But the issues highlighted here are the ones that came through most strongly (at least to me) at last week's workshop.

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