Northwest Power and Conservation Council

August 4, 2010

MEMORANDUM

TO: Power Committee

FROM: Jeff King

SUBJECT: Briefing - Northwest Wind Integration Forum Technical Work Group meeting of July 29/30

A meeting of the Technical Work Group of the Northwest Wind Integration Forum was held on July 29 and 30 in Portland. The purpose was to achieve a better understanding of the practices used to integrate wind and solar power in Denmark, Germany, and Spain - power systems with large and increasing amounts of variable renewables capacity. Five experts with substantial knowledge of Danish, German and Spanish system operations discussed the role of wind in these power systems, institutions and operating practices employed to integrate wind power, and emerging issues as the penetration of variable renewables continues to increase.

Unlike the Northwest, these systems are fully restructured, and operated by large, independent, for-profit transmission system operators (TSOs, roughly equivalent to ISOs). However, some of the techniques and operating practices employed could help resolve the challenges of integrating increasing amounts of wind power in the Pacific Northwest.

Factors enabling successful integration of intermittent wind and solar capacity in these systems include:

- Deep, smoothly-functioning, liquid and transparent capacity and energy markets
- A high degree of geographic diversity of wind and solar installations, substantially dampening generation volatility.
- Extensive transmission networks with limited congestion and generally strong interties to adjacent TSOs
- Shared reserves and common business practices among TSOs

The workshop agenda and presentations are available on the Council's website at http://www.nwcouncil.org/energy/Wind/meetings/2010/07/Default.htm.

Staff is preparing a summary of the meeting and key observations of relevance to the Northwest. The summary will be supplied to the Committee prior to the webinar. In the webinar, staff will review the summary with a focus on issues of relevance to the Northwest.

851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1348
www.nwcouncil.org

Steve Crow
Executive Director

503-222-5161
800-452-5161
Fax: 503-820-2370

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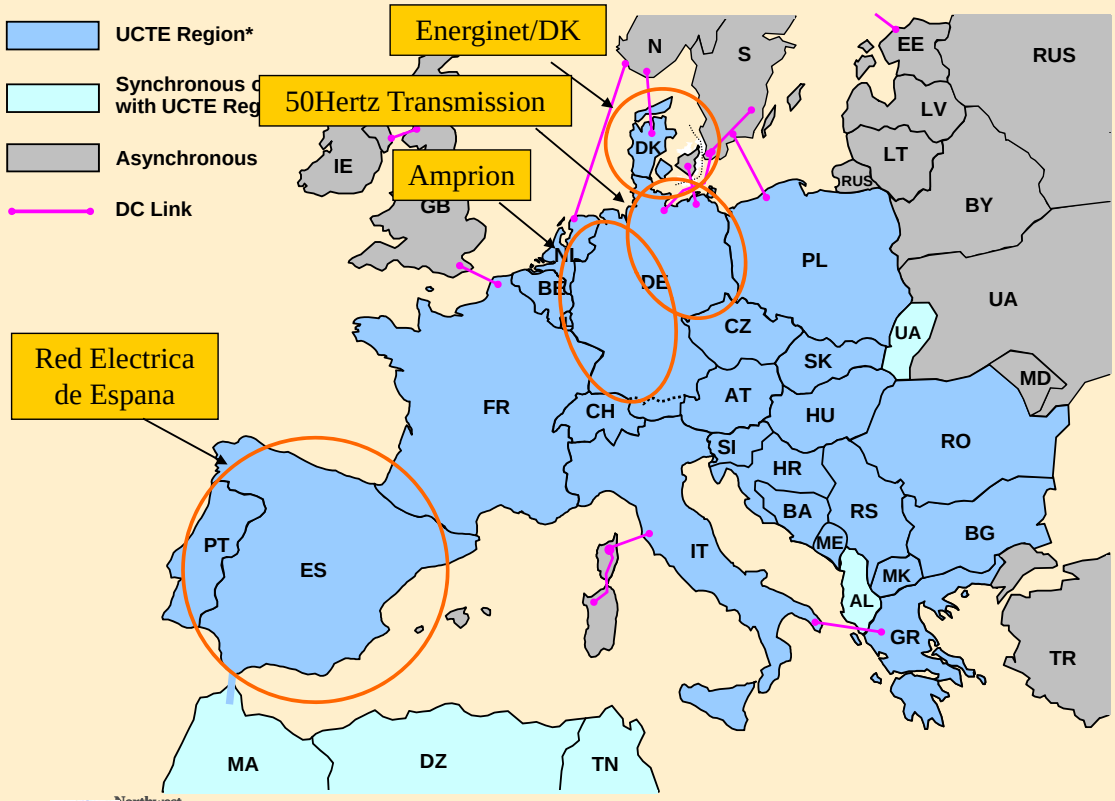
Summary: Wind Integration Forum Technical Work Group Meeting

Large-scale Wind & Solar Integration Germany, Denmark, Spain

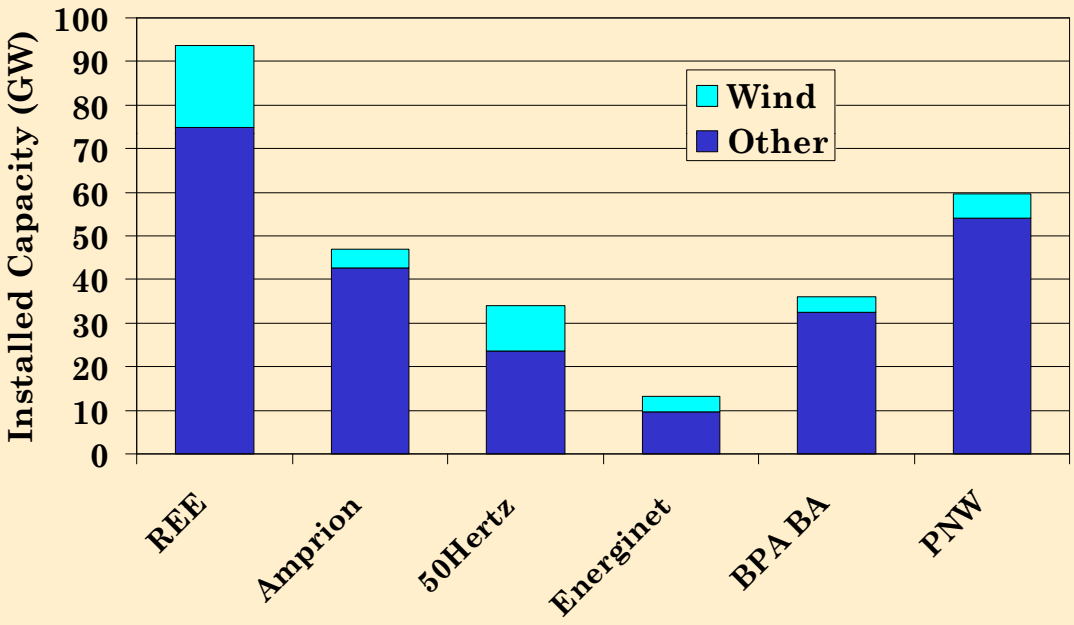
Jeff King

August 12, 2010

European Interconnected System



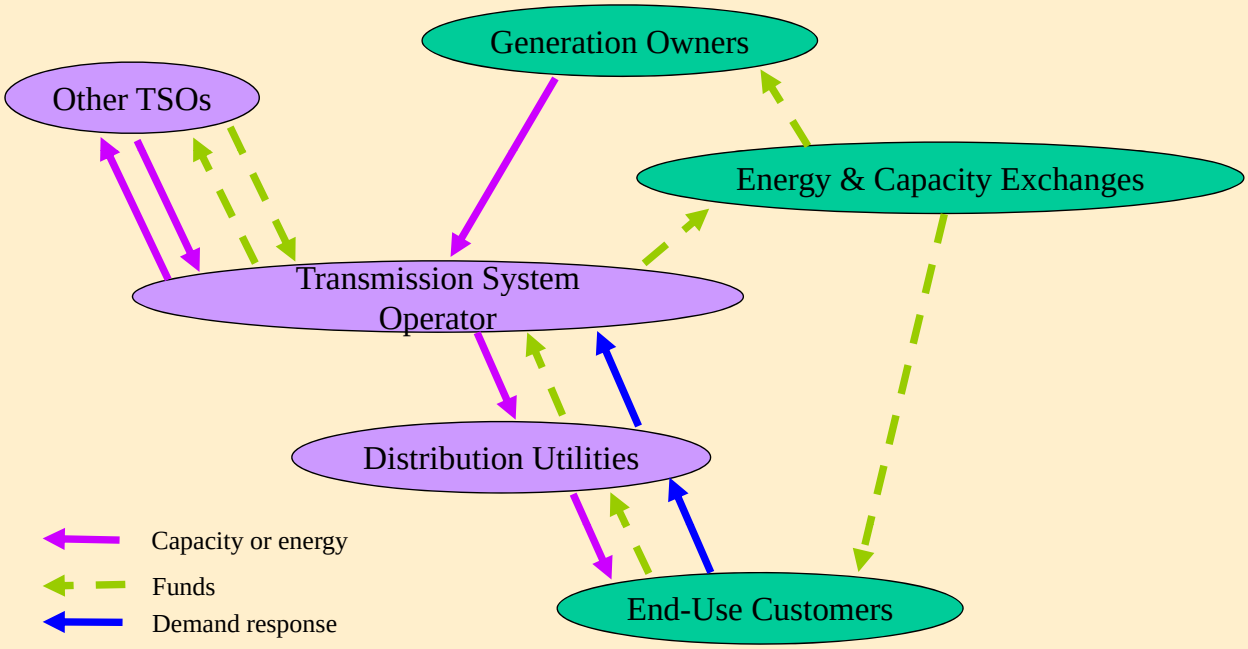
Each TSO has high % of wind power



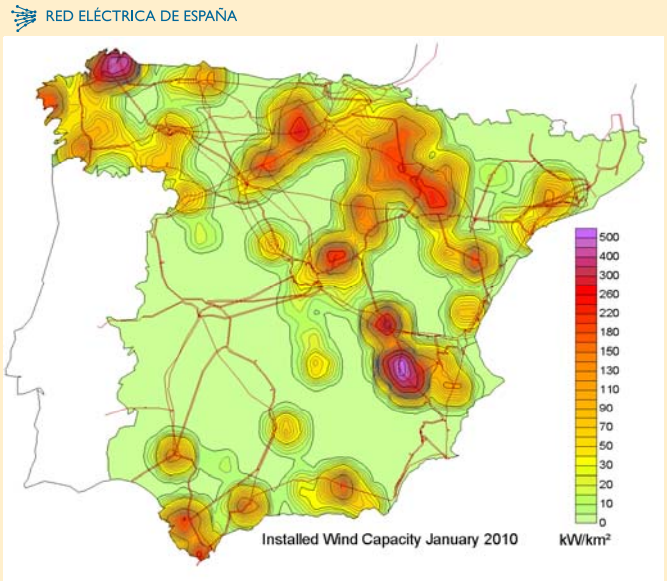
Features facilitating integration of variable resources

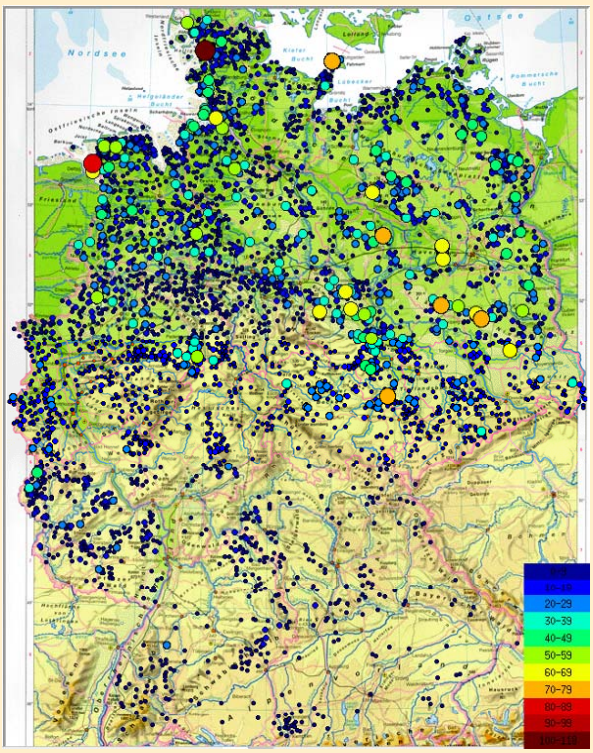
- Robust day-ahead and intraday power exchange markets for energy and capacity
- Strong interconnections and common business practices among TSOs
- Extensive transmission networks + development policy = geographic distribution of wind and solar
- Sophisticated wind forecasting capability

Power system structure centers on the transmission system operator

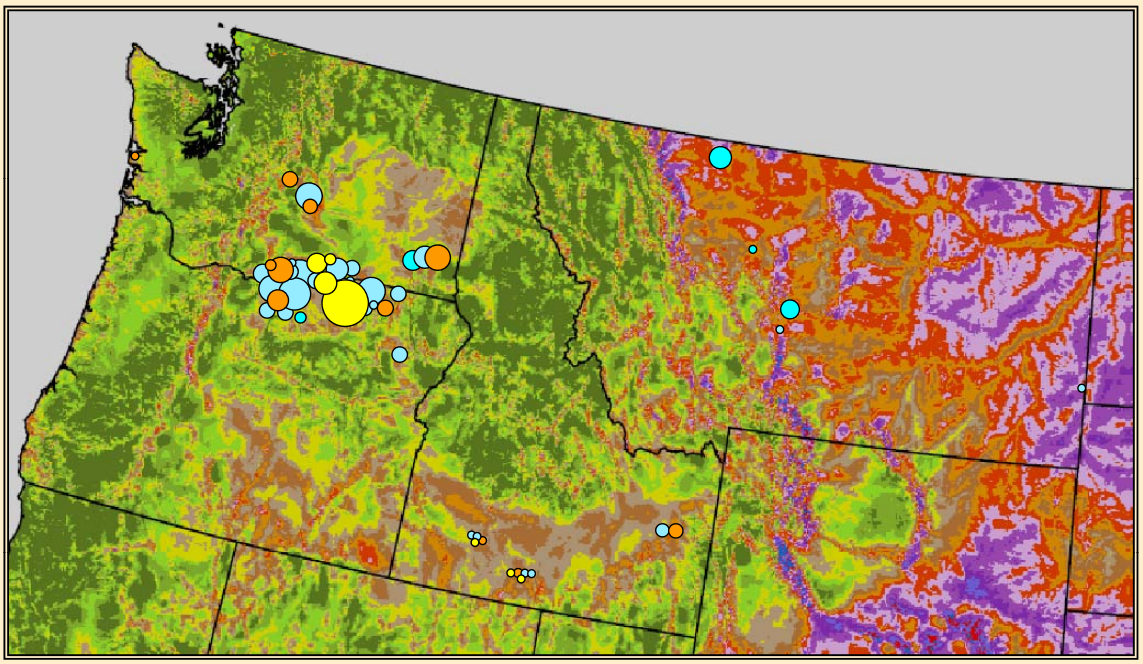


European wind capacity is highly distributed ...





… compared to the Northwest



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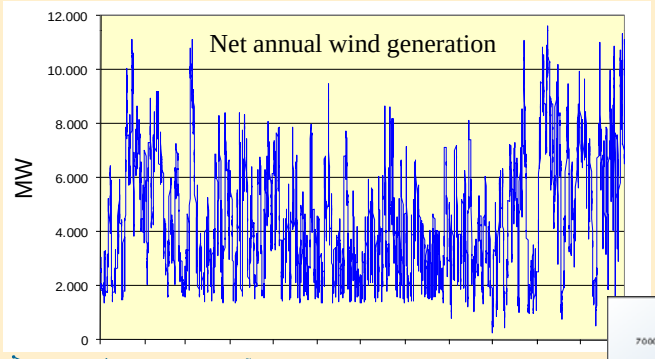
Geographic diversity > Moderate ramping events, infrequent production extremes



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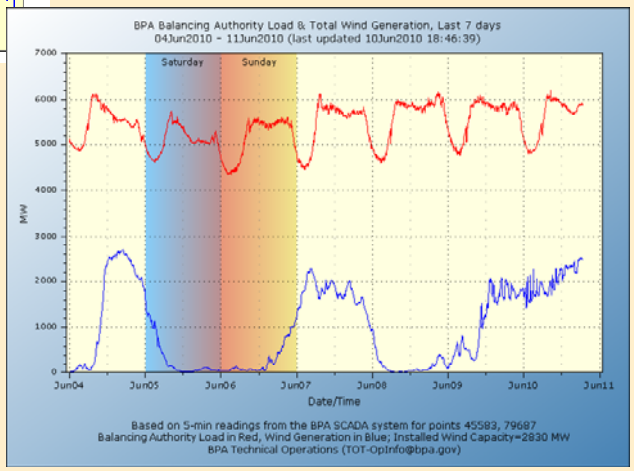

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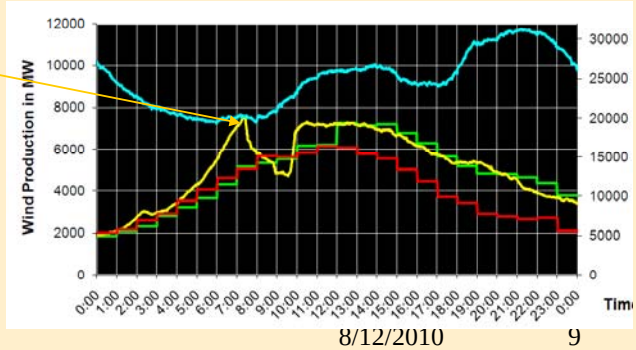
These systems are not without problems

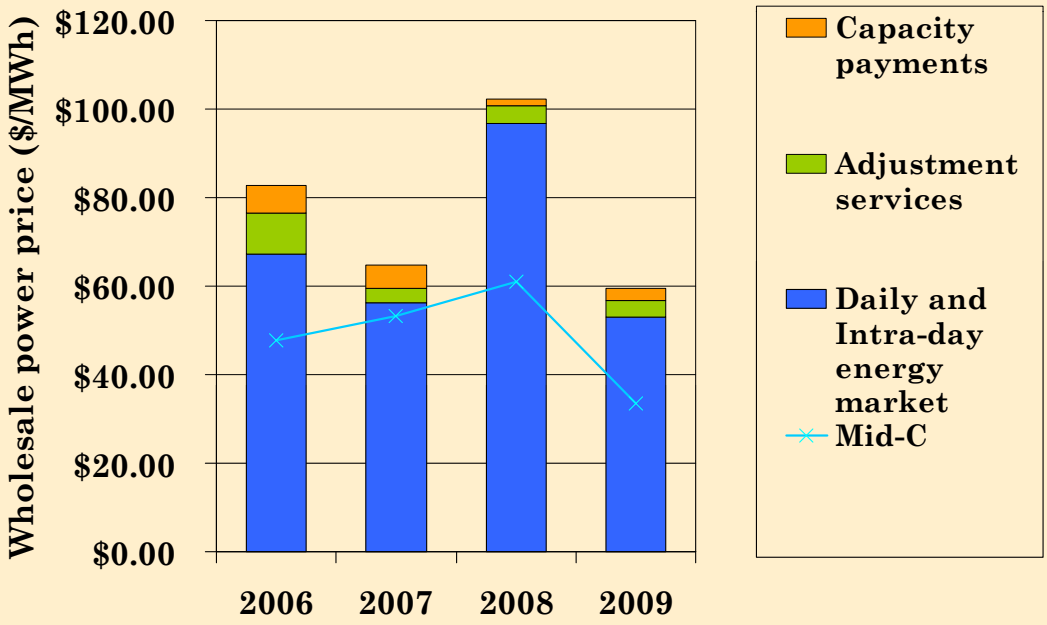
- Increasing episodes of over-generation
- Increasing frequency of negative wholesale prices
- Increasing volatility of wind and solar output
- Transmission congestion
- Increasing penetration of uncontrolled generation
- High wholesale power prices

RED ELÉCTRICA DE ESPAÑA

Wind curtailment



RED Electrica wholesale prices



Existing European system characteristics facilitating variable resource integration

- Geographic diversity of windpower development
- Well-established day-ahead, intraday and real-time capacity and energy markets
- Large and/or strongly-interconnected transmission system operators with compatible business practices

The Northwest can work toward mimicking the attributes of these characteristics that facilitate variable resource integration

European initiatives to cope with continued variable resource development

- Improved wind and solar forecasting
- Transmission reinforcements
- Strengthened interties
- Increased geographic diversity
- Expanded sources of balancing reserves
  - Flexible generation
  - Storage
  - Demand-response measures
- Smart grid
  - Monitor and control distributed wind and solar generation
  - Facilitate demand-response measures

Not dissimilar from Northwest initiatives!