Northwest Power and Conservation Council

November 6, 2008

MEMORANDUM

TO: Power Committee

FROM: Jeff King, Senior Resource Analyst

SUBJECT: Assessment of wind generating resource potential

At least 3500 MW of wind power capacity is expected to be operating in the four Northwest states by the end of 2009. This development shows little evidence of abating and additional projects are scheduled for construction through 2012. Wind project construction is being driven by state renewable portfolio standards, natural gas price uncertainty, and by risk considerations stemming from emerging greenhouse gas control measures. In spite of significant increases in cost over the past several years, wind power remains the least-cost new renewable resource available in large quantity in the Northwest. As such, the cost and availability of new wind power will influence the cost-effective level of conservation, the costs of achieving state renewable portfolio standards and greenhouse gas reduction targets, and future retail power prices.

Attributes of wind power include low lifecycle emissions of criteria air pollutants and carbon dioxide (no direct emissions but some emissions from equipment fabrication, construction and system integration), short construction lead time, absence of fuel price risk, and favorable public perception. Issues include intermittent energy production with occasional severe ramps, low peaking capacity value, need for transmission expansion to access remote wind resource areas, and high capital cost.

At the September Power Committee meeting, staff gave a presentation on Northwest wind power development, including where the development is occurring, who is doing the developing, who is purchasing the power and who is integrating the projects. The second part of the presentation provided an overview of the staff's approach to the assessment of additional wind resource potential. At the November meeting, staff will describe the more fully developed wind resource assessment. This will include full cost characterization of new wind plants, characterization of the transmission required to access remote wind resources and wind integration costs (the latter topic will be the subject of a separate presentation). A PowerPoint presentation will be provided prior to the meeting.

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Sixth Northwest Conservation & Electric Power Plan

Wind Resource Assessment

Jeff King
Northwest Power and Conservation Council

Portland, OR
November 18, 2008

Issues affecting future role of wind power

- Least-cost renewable resource available in bulk quantity
- No direct production of carbon dioxide or criteria air pollutants (SOx, NOx, etc.)
- Ecological impacts usually avoided with judicious siting
- Public perception:
  - Wind projects - very favorable (scenic areas excepted)
  - Transmission needed to access remote resource areas - possible public resistance
- Little peaking capacity value
  - Supplemental sustained peaking capacity may eventually be needed to maintain resource adequacy
  - Low system reliability risk (low sustained peaking capacity value, small single-shaft risk)

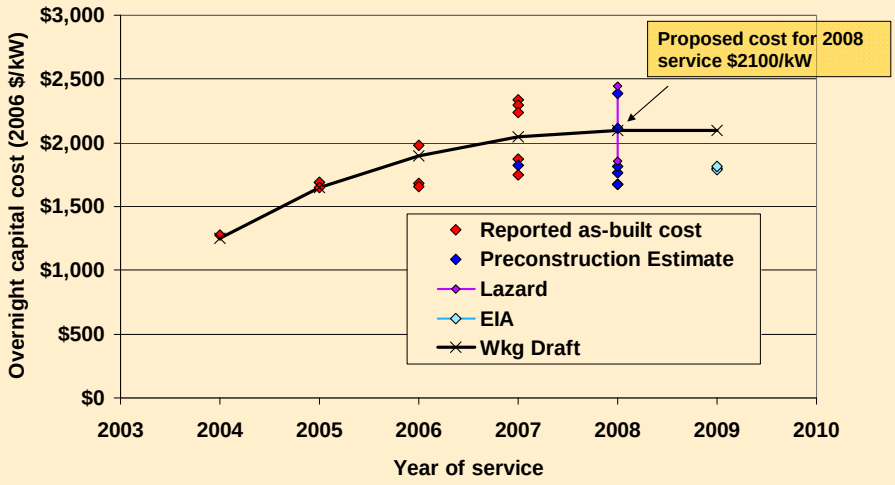
Issues affecting future role of wind power, continued

- Investment risk:
  - High capital cost (currently $2000 - 2200/kW)
  - Short development and construction lead time
  - Transmission in advance of development will be needed to access remote resource areas (MT, WY, AB)
- No fuel price risk
- Intermittent output incurs integration cost
  - Nature of integration costs becoming better understood
  - "Its the ramp, not the ripple"
  - Institutional, procedural, technical measures enabling full use of existing system flexibility + ramp control are available at moderate cost.
  - Higher cost when capacity additions are needed to maintain peak sustained capacity; these may coincidentally provide needed system flexibility.

Revisions & refinements to wind assessment

- Revised capital cost
- Revised operation and maintenance costs
- Revised operational integration costs
- Revised future capital cost assumptions
- Added bounding scenarios for future capital costs
- Expanded supply curve (added resource areas)
- Representative hourly project output by resource area (later)
- Optimize transmission, integration, energy production (later)
- Assessment of offshore wind (later)

Derivation of proposed wind plant capital cost



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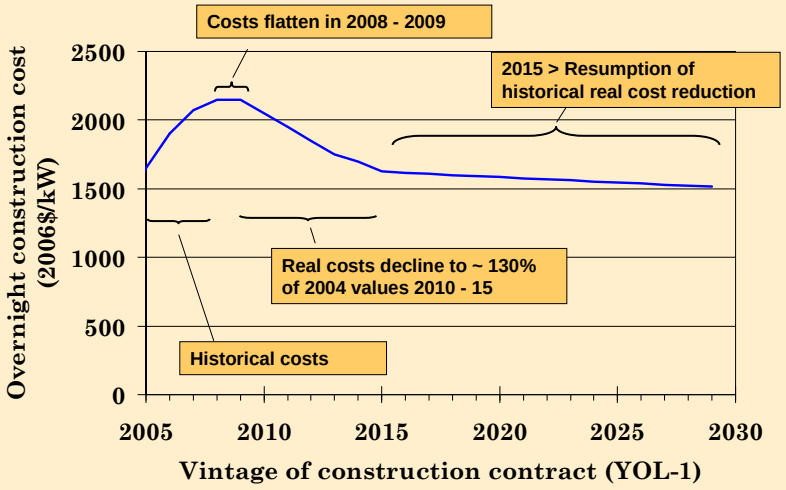
Thinking on future construction costs (Slightly evolved, but still provisional)



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Wind power operating and maintenance costs

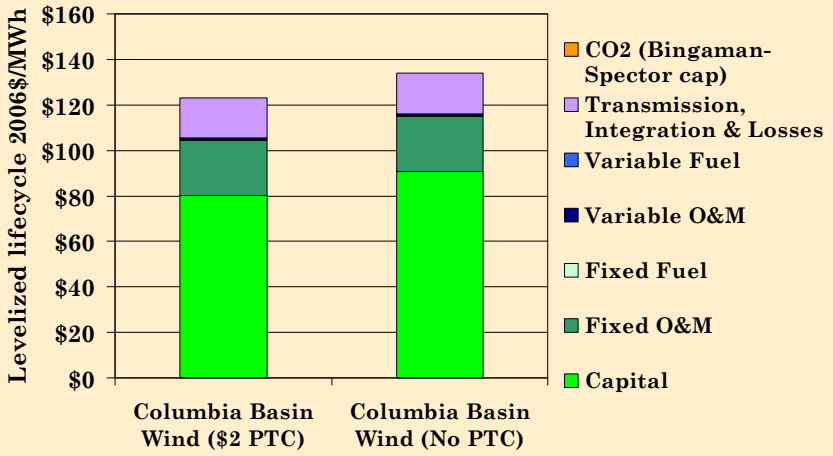
	5th Plan	Proposed 6th Plan	
Routine O&M + capital replacement	$23/kW/yr	$43/kW/yr	Fixed - Cap Rep treated as an expense
Land & ROW rent/royalties	$1.16/MWh	$2.00/MWh	Variable
Property Taxes	1.4%/yr of depreciated investment	Unchanged	"Regional average" Common to all resources
Insurance	0.25%/yr of depreciated investment	Unchanged	Common to all resources
Integration	$5 - 10/MWh	$8.70 - 11/MWh	

Planning assumptions - Basic wind project

- 150 MW project
- $2100/kW overnight development and construction cost (2008 base)
- Plant capital cost stable through 2009, declining to 130% (real dollar terms) of 2004 costs by 2015, then resuming historical (pre-2004) learning curve through 2025 (provisional assumption)
- Operating costs:
  - Fixed O&M - $43.00/kW/yr
  - Variable O&M - $1.00/MWh
  - Integration - $8.70 (near-term) - $10.90 (long-term) per MWh
- 36 mo from conceptualization to service (minimum)
  - 18 mo Development phase (site identification through completion of permitting) - 2% of TPC
  - 9 mo Preparation phase (turbine order through turbine shipment) - 12% of TPC
  - 9 mo Construction phase (turbine shipment to commercial operation) - 86% of TPC
- Earliest service for new Northwest project ~ 2011
  - Construction initiated at permitted site 2010

Elements of wind energy cost

IOU financing
2010 service
Point-to-point transmission
32 % CF



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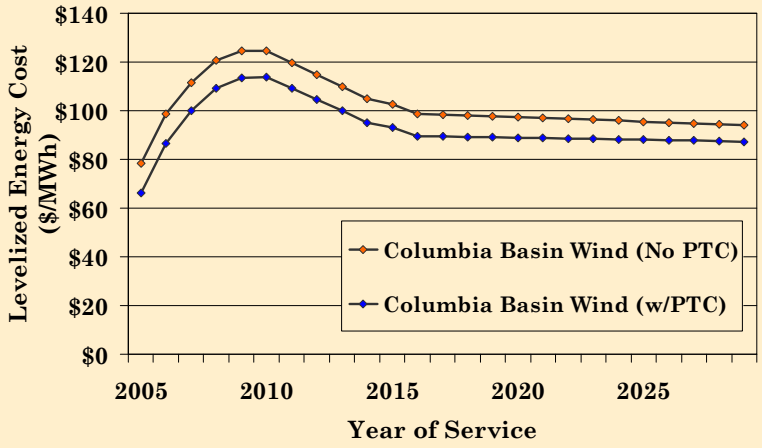
Effect of historical and forecast cost trends



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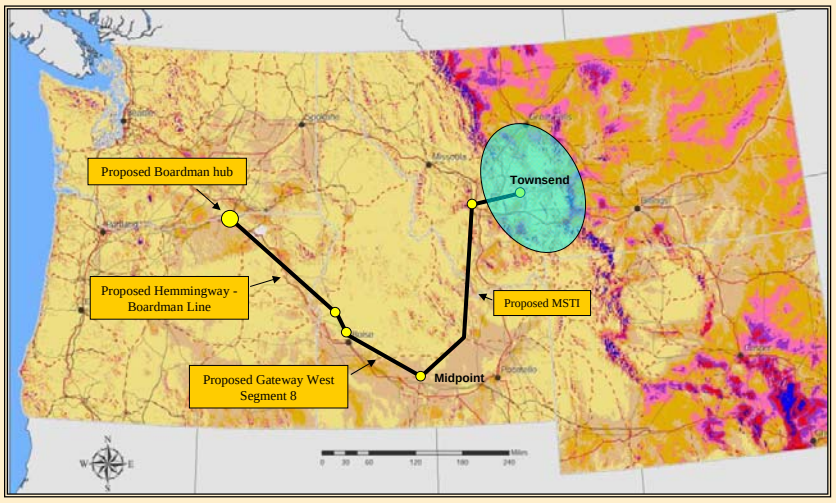
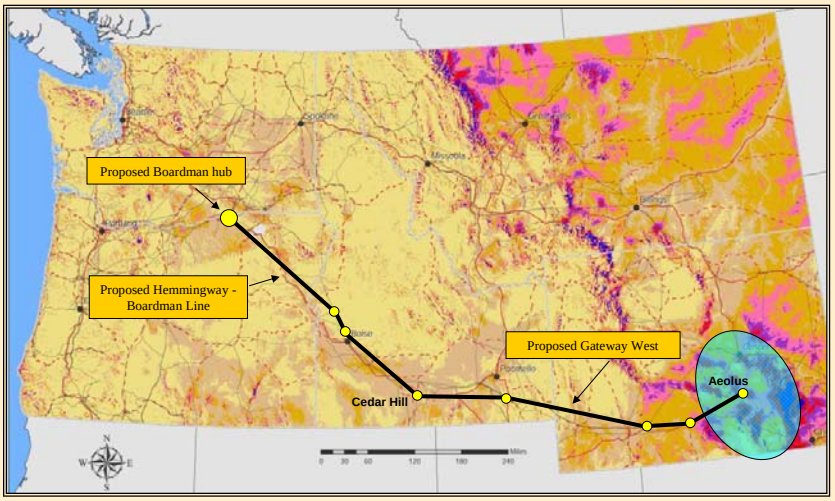
Assumptions for transmission cost estimates

- Incremental transmission system cost fully allocated to wind energy transfer (no network reliability credit).
- Transfer capacity provided for 100% of wind project output.
- Line miles and number of substations are as proposed for Gateway, B2H, MSTI segments. Northern Lights configuration is older C-N-C.
- All new lines assumed to be single-circuit 500kV AC.
- Transmission line and substation unit costs are from Idaho Power Co. July 2008.
- ROW, communication, EPC & owner's cost percentages are from MSTI proposal.
- O&M percentage is from MSTI proposal.
- Unit losses are from 2006 NTAC Canada-Northwest-California study

Montana wind to S. Idaho, Oregon & Washington



Wyoming wind to S. Idaho, Oregon & Washington



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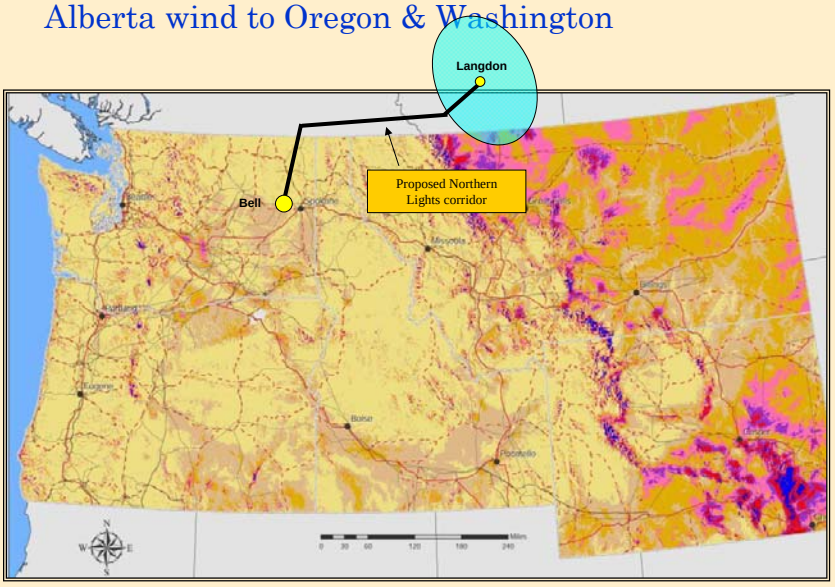
November 18, 2008

Alberta wind to Oregon & Washington



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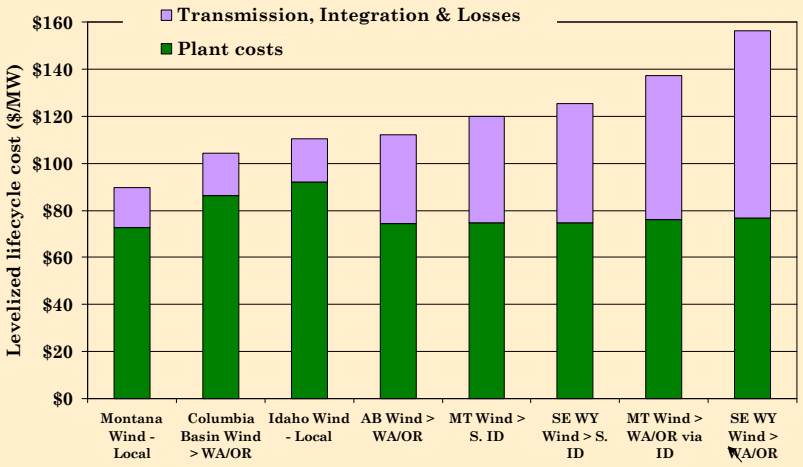
Wind supply options 2020 Service

Point-to-point transmission included
No federal production tax credit
Assumes Boardman or Bell > OR/WA @ embedded cost
All other segments at full incremental cost



Estimating quantities for 2020 supply curve

Montana Local: 300 MW - 30% of est. 2020 NWE hourly peak less current wind capacity

Columbia Basin: 3500 MW - Preliminary estimate of remaining BPA BA integration capability

Idaho Local: 1200 MW - 30% of est. 2020 S. ID hourly peak less current wind capacity

MT > S. ID - Preempted by ID Local

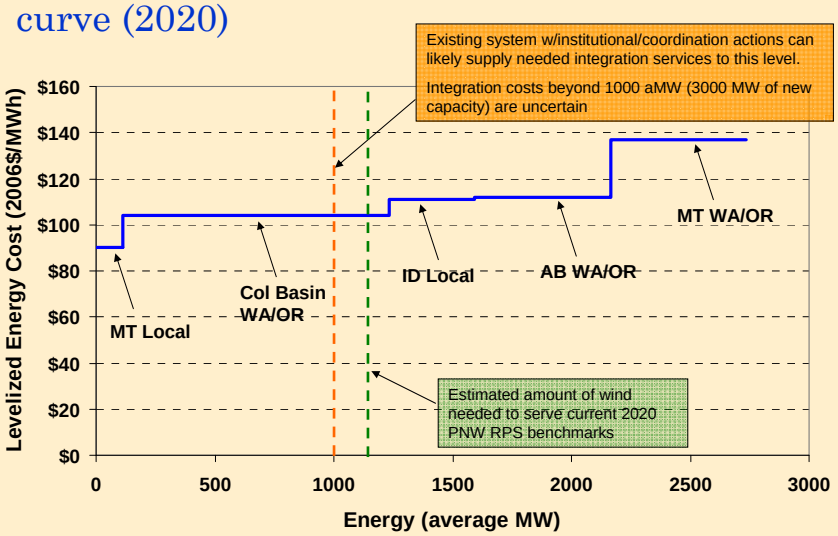
WY > S. ID - Preempted by ID Local

AB > WA/OR: 1500 MW - Capacity of single-circuit 500kV AC line

MT > WA/OR: 1500 MW - Capacity of single-circuit 500kV AC line

WY > WA/OR - Preempted by MT > WA/OR

Preliminary post-2008 wind power supply curve (2020)



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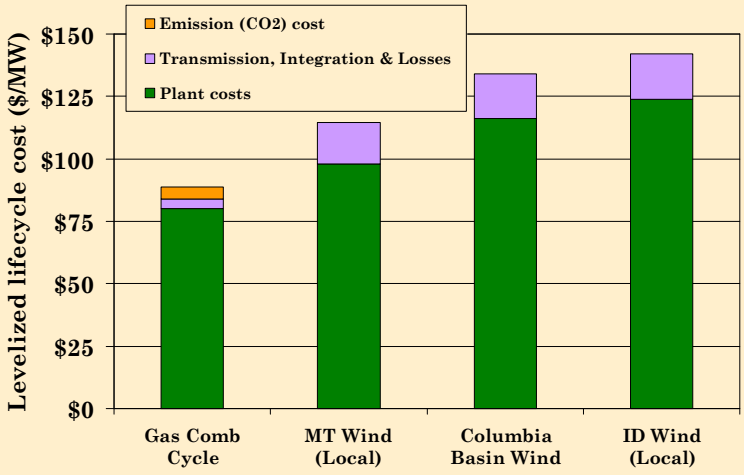
Resource options 2010 Service

Transmission cost & losses to point of LSE wholesale delivery
No federal production tax credit for wind
Baseload operation (CC - 85%CF, Nuc 87.5% CF)
Medium NG price forecast (Proposed 6th Plan)
Bingaman/Specter safety valve CO2 cost



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Resource options
2020 Service*

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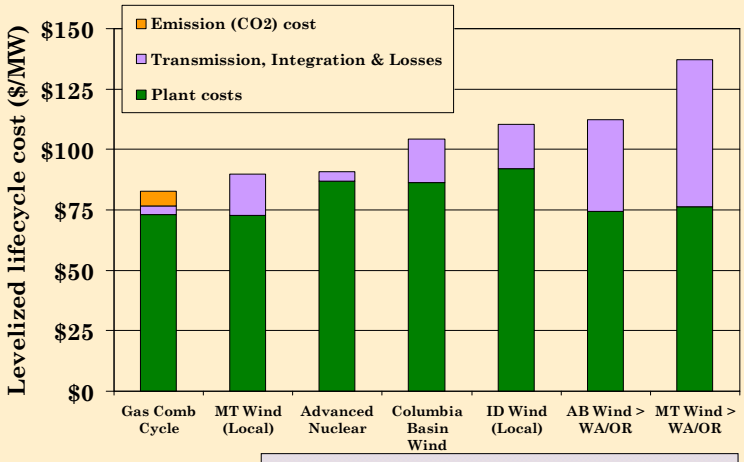

* Earliest plausible operation of advanced nuclear in PNW is assumed to be ~ 2022

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Additional analysis

1. Improved production estimates and understanding of seasonal value (Dec)
2. Sustained peaking capacity needs (Dec)
3. Tradeoff: Incremental transfer capacity cost vs. incremental energy value (Jan - Feb)
4. Value of locating generation or storage at wind resource area (Jan - Feb)
5. Impact of geographic diversity on short-term volatility of wind power production, including ramping events (Jan - Feb)

3 - 5 are Wind Integration Action Plan Action 15 - Framework for long-term regional wind development

Further analysis, e.g. subhourly, likely needed to achieve full understanding of 3 -5

6th Plan Action item may be needed for further refinement

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