April 30, 2013

MEMORANDUM

TO: Council Members

FROM: Gillian Charles, Power Planning Division

SUBJECT: Update on the Region’s Wind Development

The Pacific Northwest has seen a large influx of wind power development over the past ten years, significantly altering the region’s portfolio of generating resources and reshaping how the region thinks about and operates its power system.

Today, wind projects account for almost 13% of the region’s existing installed generating capacity. Driven both by tax incentives and state renewable portfolio standards, rapid development of wind power has pushed topics such as resource integration, power system flexibility, and marketing and scheduling practices to the forefront of conversations in the region by system operators, utilities, independent power producers, power traders, and government agencies.

An update on wind power in the Pacific Northwest will be presented at the Council meeting on May 8, 2013. Gillian Charles will begin the discussion by providing an update on the status of wind generating projects in the region and the outlook for future development. Then Tina Ko, Manager of Long Term Power Planning at the Bonneville Power Administration (BPA), will introduce the concept of annual firm wind energy and describe initial studies indicating that the annual variability of generation from the wind fleet is comparable to the variation in the hydro generation system. Finally, Ben Kujala will discuss the challenges of integrating wind generation into the power system.
Update on the Region’s Wind Development

Council Meeting
May 8, 2013
Boardman, OR

Overview

1. Current status of wind development in the PNW
2. Variability of wind
3. Wind integration challenges
Current Status of Wind Development in the Pacific Northwest

Current Picture of Wind in PNW

- Almost 8,500 MW wind operating in the PNW
  - 5% of the region’s average annual generation
  - 13% of region’s total installed generating capacity
  - 50% of total installed wind capacity is in BPA balancing authority
- ~1,700 MW new wind installed in 2012
Recent Wind Projects in Operation

<table>
<thead>
<tr>
<th>Name</th>
<th>State</th>
<th>Capacity (MW)</th>
<th>Load</th>
<th>Online Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountain Air Wind Park (6)</td>
<td>ID</td>
<td>138 MW</td>
<td>IPC (20 yr PPA)</td>
<td>Dec 2012</td>
</tr>
<tr>
<td>Musselshell 1 &amp; 2</td>
<td>MT</td>
<td>20 MW</td>
<td>NorthWestern (20 PPA)</td>
<td>Dec 2012</td>
</tr>
<tr>
<td>Palouse</td>
<td>WA</td>
<td>104 MW</td>
<td>Avista (30 yr PPA)</td>
<td>Dec 2012</td>
</tr>
<tr>
<td>Shepherds Flat (3)</td>
<td>OR</td>
<td>845 MW</td>
<td>SCE (20 yr PPA)</td>
<td>Aug 2012</td>
</tr>
<tr>
<td>Spion Kop</td>
<td>MT</td>
<td>40 MW</td>
<td>NorthWestern</td>
<td>Nov 2012</td>
</tr>
<tr>
<td>Swauk Valley Ranch Wind</td>
<td>WA</td>
<td>4.3 MW</td>
<td>Local (RECs likely sold elsewhere)</td>
<td>Mar 2013</td>
</tr>
</tbody>
</table>
Wind Additions 2003 - 2012

Wind currently makes up 70-90% of eligible resources for WA, OR, and MT

Federal Production Tax Credit (PTC)
- Extension - Projects are eligible if under construction by end of 2013 (2.3 cents/kWh over first 10 years of operation)
- Emission-free resource with no fuel costs
Where is the Generation Going?

Wind Capacity by Load

*Located in Pacific Northwest, including PacifiCorp WY projects and NorthWestern MT projects

Wind In BPA’s Balancing Authority

Wind Generation Capacity in the BPA Balancing Authority Area

Last update: 6/13/13. Chart displays sequential changes in wind generation capacity in the BPA BAL, based on data when wind generation first exceeded 50% of nameplate. Note that movements in wind generation facilities out of the BPA BAL are shown as negative increments to capacity.
Future Status of Wind Development

- Surge in development of wind projects in 2012, followed by lull in early 2013
  - Industry uncertainty over future of production tax credit
- ~12,000+ MW wind projects “proposed”
  - What does “proposed” really mean?
- No new wind projects currently under construction in PNW

Proposed New Wind Projects

* Not currently operating or under construction; in various stages of permitting process
Variability of Wind

Variation in Wind vs. Flows

Comparing Wind, Regulated and Unregulated Hydro Variability
(Coefficient of Variation = Standard Deviation / Average)

- Ave 80 yr UnReg Hydro Coeff Var = .30
- Ave 68 yr (post 1941) Reg Hydro Coeff Var = .28
- Ave 12 yr Wind Coeff Var = .31
Monthly Wind Energy Variability

BPA BA Wind Fleet Capacity Factor by Month
(point represents sum of hourly data over one month of one year, Jan 2002 - Dec 2011)

Capacity Factor (%)

Period of Very Low Generation

Highly Variable Season Runoff

January - July Runoff at The Dalles
1929-2012

80-yr Avg (1929-2008) = 102 maf
Annual Firm Wind Variability

BPA BA Wind Fleet Capacity Factor by Operating Year

Historical Average: 29.2%

Wind Integration Challenges
Wind Integration

- Integrating wind generation continues to be a challenge in the Northwest
- Significant factors in wind integration
  - Forecast Error
  - Scheduling Granularity
  - Market Design
- Regional Efforts in Wind Integration
  - Sub-hourly Scheduling
  - Energy Imbalance Market
  - Wind Integration Forum

Actual vs. Scheduled Wind Generation