Integration of Renewable Generation  
An Independent Power Producers Perspective

Iberdrola Renewables, Inc.
A collection of exceptional assets...
- #2 developer of wind projects in the U.S. with over 4.8 GWs
- Represents 37% of Iberdrola S.A.’s global wind capacity
- 900 employees at the end of 2011
- 636 MW of CCGT & peaking capacity on the strategic CA-OR border
- Developing utility-scale photovoltaic projects, solar thermal projects, and biomass projects

Wind Energy's Impact to the Power System
- Wind energy has four characteristics that affect how it is integrated into power systems:
  - Output variability
  - Near-zero variable cost
  - Difficulty of forecasting its output precisely
  - Remoteness
- These characteristics can be better accommodated in some markets structures than others
- The diversity of the US markets has made integration a difficult and fragmented effort
**Optimal Wind Integration Conditions**

- Large electric balancing area with access to neighboring markets
- Robust electric grid
- Short-term electricity generation markets
- Access to flexible generation and load
- Effective integration of wind forecasts into utility operations
- Flexible transmission services

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**IRI’s Renewable Integration Goals**

- Increase Reliability & Operational Flexibility
  - Design generator to meet requirements in Interconnection Agreements
  - Voltage Support
  - Frequency Response
  - Comply with current and future regional market and operational rules/requirements
  - Bidding/Scheduling
  - Meter Data Submittals
  - Operational Requirements
  - Dispatchability
  - Real-Time Data Flow
  - Operator training and protocols

- Minimize Costs
  - All resources should be treated equitably
  - Same access to market mechanisms as other generators to mitigate exposure to operational costs
  - Penalties should not be unfairly punitive based on unique operating characteristics
  - Low cost integration solutions implemented prior to higher costs solutions
  - Lead regional initiatives that result in optimal market structures
  - Large BA’s with access to neighboring markets
  - Short-term electricity generation markets
  - Flexible transmission services

- Maximize Capability
  - Create new market opportunities
  - Ability to participate in ancillary services and capacity markets
  - Advocate for rules that improve access to market:
    - Broad allocation of transmission costs for transmission that meets public policy objectives
    - Long-term Certainty
  - Drive toward regulatory and market rules that create cost certainty.

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**Market-Type Comparison**

<table>
<thead>
<tr>
<th>Organized Markets (Inter, PAA, NTRC)</th>
<th>Hybrid Markets (Day)</th>
<th>Bilateral Markets (West, South)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large, single Balancing Area</td>
<td>Coordinate across multiple, smaller Balancing Areas</td>
<td>Small Balancing Areas, with limited coordination across the seams</td>
</tr>
<tr>
<td>Day-Ahead and Real-Time markets, with access to intra-hour flexibility (load and resources)</td>
<td>Bilateral markets, with access to intra-hour flexibility (load and resources)</td>
<td>Bilateral markets, with limited access to loads and owned resources within Balancing Area</td>
</tr>
<tr>
<td>Robust regional interconnections; flexible transmission services</td>
<td>Robust regional interconnections; physical transmission service with one fee for transactions across multiple SPP utilities</td>
<td>Physical transmission service, with “pancaked” rates across utilities</td>
</tr>
<tr>
<td>Regional planning and cost allocation processes</td>
<td>Regional planning done for “information only”, limited regional cost allocation processes</td>
<td></td>
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<tr>
<td>Centralized forecast used to support system reliability; individual generators incented to submit forecasts (e.g. 4-hour, hourly, 5-minute granularity)</td>
<td>Centralized forecast used to support system reliability, no market-based incentives to use/improve generator forecasting.</td>
<td>No centralized forecasting; limited use of market-based incentives to use/improve generator forecasting.</td>
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</tbody>
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**Summary of Wind Integration Issues in BPA’s Balancing Area**

- Wind penetration is rapidly increasing in Balancing Area
  - Iberdrola Renewables is ~34% of the installed capacity in BPA’s Balancing Area
- The hydro system is less flexible then in previous years
- Currently there are thousands of MW’s of merchant flexible generation on BPA’s system which cannot be accessed
Wind Integration Charge Background

- In 2008 BPA implemented a Wind Integration Charge (WIC) of approximately $3.11/MWh
- In its 2009 rate case, BPA’s initial Wind Integration Charge proposal was in excess of $11/MWh – a 350% increase over the initial charge
- Iberdrola Renewables began preparations to file with the WECC and the NERC to become certified as its own Balancing Authority (BA) and leave BPA’s system entirely
- Through collaboration with industry stakeholders, BPA implemented changes resulting in a final WIC of approximately $5.89/MWh
- BPA allowed customers the option of self-supplying all or a portion of their required balancing reserves

Self-Supply Pilot Introduction

- Iberdrola Renewables elected to self-supply Generation Imbalance Reserves and continues to purchase Regulation Reserves and Following Reserves from BPA
- Iberdrola Renewables worked with BPA over a twelve month period to implement the first Customer Supplied Generation Imbalance (CSGI) pilot that went live September 1, 2010
  - Development and execution of the Participant Agreement
  - Installation of required communications and signaling equipment
  - Completion of comprehensive testing
  - Reconfiguration of settlement systems and processes
  - Execution of Balancing resource contracts
- The initial pilot continued through September 30, 2011 and Iberdrola Renewables elected to extend the pilot through September 30, 2013

Self-Supply Pilot Structure

- BPA has allocated a portion of Regulation and Following reserves to Iberdrola’s generation portfolio and Iberdrola is responsible to self-supply Generation Imbalance reserves to resolve any remaining Station Control Error (SCE) – the difference between the net schedule and net output of Iberdrola Renewables northwest wind portfolio

Self-Supply Balancing Illustration

- Graph showing the self-supply balancing illustration with various components and labels.
Self-Supply SCE Management

- Iberdrola Renewables’ robust forecasting capabilities help to minimize the error of the northwest wind portfolio.
- Iberdrola Renewables’ Klamath Cogeneration facilities, including peaking units, are utilized to provide a portion of the needed generation to keep Iberdrola’s portfolio balanced.
- Iberdrola has also entered into contractual relationships with entities with dispatchable resources to provide additional generation capability.
- All balancing generation is provided over dynamic schedules on an intra-hour basis or through the On Demand transmission product.

Constellation Energy Control & Dispatch

- Iberdrola has engaged Constellation Energy Control & Dispatch (CECD) to provide consulting services and Automatic Generation Control (AGC) infrastructure.
- CECD provides balancing services for ~15 Balancing Authorities across the United States including the nation’s first wind-only Balancing Authority.
- Constellation’s Responsibilities:
  - Respond on a 4-second basis to the Portfolio Error
  - Execute dispatch of resources per resource stack
  - Monitor and respond to applicable compliance parameters
  - Report all aspects of self-supply portfolio

Self-Supply Pilot Assessment & Lessons Learned

- Balancing wind is not for the faint of heart.
- Despite challenges, Iberdrola has successfully balanced its nearly 1400 MW of wind and has exceeded performance requirements.
- Success has been a team effort requiring cooperation and performance by all parties – Iberdrola, BPA, CECD & Versify.
- New balancing agreements are optional with variable price (versus obligation at fixed price).
- Access to dynamic transfer capability is critical to success of CSGI and other initiatives designed to ease burden from BPA.
- DSO 216 remains problematic despite Iberdrola’s strong balancing performance.

What’s Next?

- BPA’s rate case process has already begun for the 2013-2015 rate period and Iberdrola Renewables has developed a proposal for wind balancing services which would replace BPA’s existing Variable Energy Resource Balancing Service (VERBS).
  - Variable rate component designed to provide proper incentives for wind generators
  - Elimination of non-reliability based tag curtailments and other punitive penalties
- Iberdrola Renewables is partnering with other Northwest entities to explore implementation of an energy imbalance program at the Mid-C market hub that can ultimately be expanded to a west-wide footprint.

*Iberdrola Renewables continues to view the CSGI program as an interim solution until a fully functional balancing market evolves.*
Questions?

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