Calgary Renewable Energy Meetup
December 18, 2010

The Alberta Electricity Market and Renewables:
An insider view of the Alberta Power Summit, Nov 16-17, 2010

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Agenda

• Alberta Power Summit Overview
• Power Summit Topics
• The Alberta Electricity Market
• Some Issues
• Where do Renewables fit in this Picture?
• Questions and Discussion
Alberta Power Summit Overview

- Metropolitan Center, Calgary, Nov. 16-17, 2010
- Organized by Insight (ALM)
- Co-Host: Terry Tyler and Deborah Emes, from ENMAX
- Alberta Government Invited but did not Participate
- Government “represented” by ATCO Power, EnCana and AltaLink
- Danielle Smith, luncheon speaker
- 28 speakers, 7 topics
Alberta Power Summit Overview

• **Topics:**
  o *The Alberta Electricity Market*
  o *What do consumers want?*
  o Electricity market performance and regulation
  o Grid Reliability
  o Role of government
  o New technologies and natural gas power generation
  o Smart Grid
  o *Renewables*
The Alberta Electricity Market

Industry Structure in Alberta

Minister of Energy
Appoints AESO Board members, MSA & AUC Chair

Electric Utilities Act

Balancing Pool
Independent System Operator
Alberta Utilities Commission (AUC)
Transmission Facility Owner
Distribution Facility Owner
Retailers
Market Surveillance Administrator (MSA)

Source: AESO
The Alberta Electricity Market

The Current Grid

- 22,322 km transmission lines
- Single control area of 660,000 km²
- B.C. & Sask. Interties (785 MW)
- Over 167 generating units
- 9,541 MW summer peak
- 10,236 MW system peak
- Over 200 market participants
- 12,915 MW installed capacity

Source: AESO
The Alberta Electricity Market

Installed capacity (MW) versus Energy Generation (MWh)

12,915 MW Installed Capacity

- 5782 MW Coal
- 5293 MW Natural Gas
- 879 MW Hydro
- 695 MW Wind
- 323 MW Biomass
- 63 MW Waste Heat
- 10 MW Fuel Oil

Actual Generation Mix

Source: AESO and Pembina Institute
The Alberta Electricity Market

Alberta market characteristics

- Energy-only market
- Small market with limited interconnections
- Real time energy-only equilibrium market
- No transmission rights
- High industrial load
- Healthy behind-the-fence generation industry
- Areas of significant transmission congestion
- Supply currently weighted to base load coal
- Existing and potential generation (e.g. coal, gas, wind, hydro) located across the province

Source: AESO
The Alberta Electricity Market

Conditions for energy-only markets

- Fair, efficient and openly competitive
- Price fidelity is key to market success → Market price sends investment signal in new generation
- Minimal barriers to entry
- Broad ownership with no dominant player(s)
- Limited transmission constraints
- Price-responsive demand

Source: AESO
The Alberta Electricity Market

Alberta’s peak electricity demand - MW

Average Annual Growth Over 30 Years = 3.3%
Peak demand growth is forecasted to average 3.0% over the next 20 years

Source: AltaLink and AESO
The Alberta Electricity Market
Electricity Consumption per Sector

Source: Energy Alberta, 2007
The Alberta Electricity Market
Electricity Market Structure

Source: Market Surveillance Administrator
The Alberta Electricity Market
Demand Response: 300 MW Reduction when Price Rises

Load that Responds to Price (MWs)

Total Price Responsive Load
Pool Price

Source: AltaLink
The Alberta Electricity Market
Demand Side Participation

Demand Side Participation

- Loads that respond to price
- Participants in the load shed service who also respond to price
- Participants in supplemental reserves who also respond to price
- Active Supplemental Reserves Providers
- Qualified DOS Providers

Value in Responding to Price for Loads that Exhibit Price Responsive Load Behavior

- Average Pool Price
- Average Price Paid by Price Responsive Load
- % of Load Affected by Responding to Price
- % Savings in Energy Costs

Source: AESO
The Alberta Electricity Market

Price Definition: Electricity Market Merit Order (EMMO)

The EMMO is the primary mechanism by which the relative economic merit of supply offers are evaluated and dispatched to meet load requirements.

- MOMC: power generators submitted to a ‘Must Offer Must Comply’ rule, excepted for wind
- EMMO: Dynamic Scheduling (hourly)

Source: AESO
The Alberta Electricity Market
Price Definition: Electricity Market Merit Order (EMMO)

- Source: Solas Energy Consulting
The Alberta Electricity Market
A Market Price Duration Curve

- Source: William W. Hogan, ON AN “ENERGY ONLY” ELECTRICITY MARKET DESIGN FOR RESOURCE ADEQUACY, 2005
The Alberta Electricity Market
Reserve Margin

Alberta Market Reserve Margin

Supply
Peak Load Less Curtailment
- Reserve Margin (AEO Reserve Margin Forecast - Apr 2006)
- Reserve Margin (AEO LTA Metrics - Feb 2010)

Source: Atco Power
Post 2020, types of generation additions will be dependent on technology development, environmental legislation and economic circumstances.

- **Coal-Fired**
  - Ultra Supercritical Pulverized Coal
  - Integrated Gasification Combined Cycle
  - Oxy-fuel Combustion

- **Gas-Fired**
  - Cogeneration
  - Combined Cycle (CC)
  - Simple Cycle (SC)

- **Oilsands By-product Fuel**
  - Integrated Gasification Cogeneration

- **Nuclear**

- **Large Hydro**

- **Distributed generation**

*Source: AESO*
The Alberta Electricity Market

Issues not addressed
• Energy Efficiency
• Decentralized Generation
  • Small-scale renewable energy projects
• Overpriced Transmission Lines

Source: AltaLink
Transmission and Efficiency: AESO’s Role in the Alberta Electricity Market

AESCO Core Business:

- **Markets:** develop and operate Alberta’s real-time wholesale energy market to facilitate fair, efficient and open competition
- **Transmission System Development:** plan and develop the transmission system to ensure continued reliability and facilitate the competitive market and investment in new supply
- **Transmission System Access:** provide system access for both generation and load customers
- **System Operations:** direct the reliable operation of Alberta’s power grid

*Source: Atco Power*
The Alberta Electricity Market

ALBERTA LONG TERM TRANSMISSION PLAN 2009
($16.5B)

- GROWTH/RELIABILITY PROJECTS: 43%
- INTERTIE PROJECTS: 13%
- COGENERATION/OILSANDS: 13%
- HYDRO INTEGRATION: 9%
- RENEWABLE INTEGRATION: 16%
- NUCLEAR INTEGRATION: 3%
- FOSSIL FUEL INTEGRATION: 3%

Source: AltaLink
What do consumers want?

- **Residential Customers:**
  - Low rates + education or service simple to use
  - 69% of Albertans are unable to correctly identify the main source of electricity in the province
    - 31% identify coal
    - 28% other sources
    - 41% do not know

- **Industrial Customers**
  - Low rates
  - Reliability
Where do Renewables fit in this Picture?
Renewables Integration

Source: Pembina Institute
Where do Renewables fit in this Picture?

- **Alberta Average Wind Speeds**
- October to December, 1971-2000, based on Environment Canada data at 10 m
- Source: [http://www.albertaacts.ca/GreenEnergyTour](http://www.albertaacts.ca/GreenEnergyTour)
Renewables Integration
Transmission Congestion

• 695 MW of wind connected to the grid today (5% of installed capacity)
• 1100 MW expected by end of 2011

Wind Connection Queue (based on forecast ISD) & Amount of Wind Accomodated by Proposed Transmission Upgrades (existing and new additions) as of October 31, 2010

Congestion management will be applied where more wind is connected than can be accommodated by the system. Operating constraints are project-specific, and depend on local and regional development.

Source: AESO
Renewables Integration
Balancing Supply/Demand: Grid Reliability

Wind Ramp Event
July 30th, 2009

MW vs Time

Source: AESO
Renewables Integration
AESO: “Impact of Subsidies (FITs) on Price Fidelity”

- AESO:
  - “Not presently an issue in Alberta, where we have no RPSs, PPAs or FITs, but seen in numerous other jurisdictions”
  - “Increasing pressure / lobbying creates risk in an energy-only market that depends on the fidelity of the price signal to incent investment”

- Source: AESO
Renewables Integration
The current market design is Both helping AND hurting the growth of Renewable Energy

Helping
• Power pool design provides effective firming (shaping) services to renewable energy (varied sources & peak gas)

Hurting
• No long term PPA/FIT
• Merit Order
• Short term wind integration – Curtailment
• Low ramp up rate capability
• Small Balancing Area
• Hourly dispatch

Source: Solas Energy Consulting
Renewables Integration

Criteria for an attractive market

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<th>Alberta</th>
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<tr>
<td>✔</td>
<td>• Strong Resource (e.g. Wind)</td>
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<td>• Strong Power Pricing</td>
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<td>• Long Term Offtake Agreements</td>
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<td>• Government Commitment to Renewable Energy – mandate/incentive/target</td>
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<td>• Climate Change Policy (ends 2014)</td>
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Source: Solas Energy Consulting
Renewables Integration
Other Factors

- Natural Gas Supply & Price
- Storage Technologies
- Smart Grid
Questions and Discussion