UWIG Workshop 2007

AESO Wind Power Forecasting Pilot Project

July 24, 2007

Anchorage, Alaska

Reliable **Power**

Reliable **Markets**

Reliable **People**

John H. Kehler

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Operations and Reliability

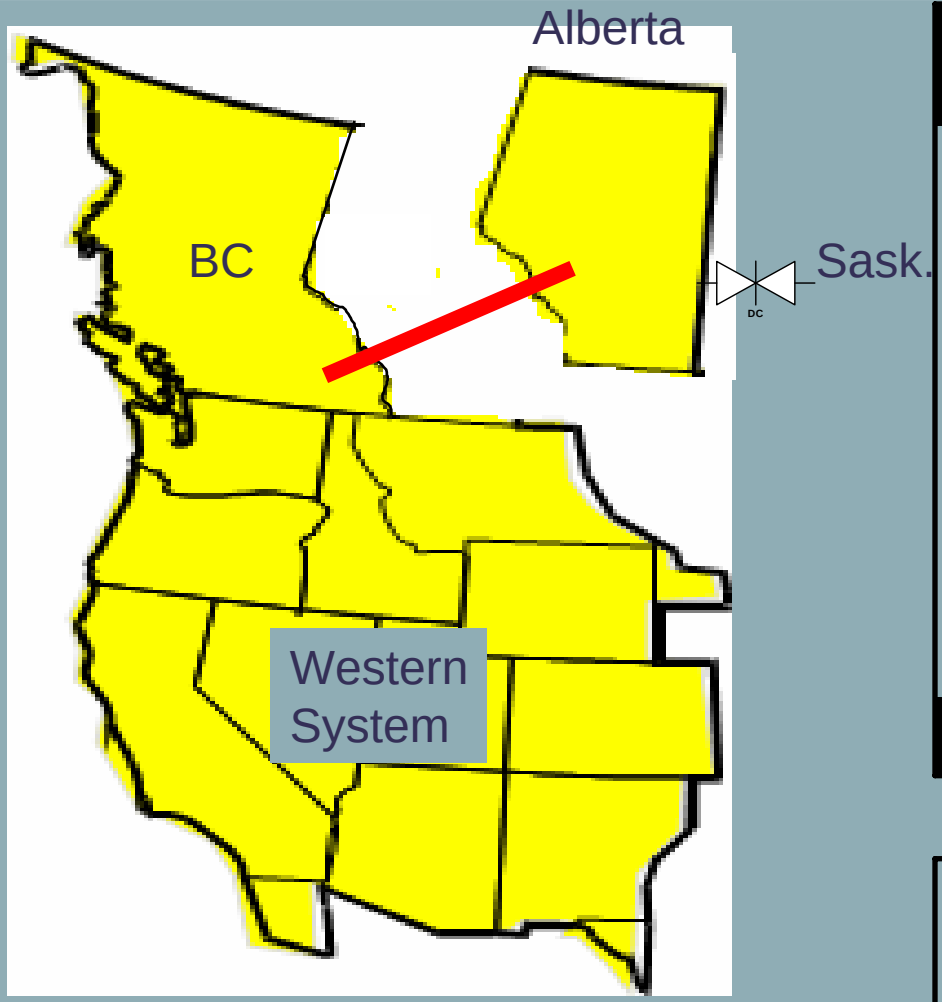
aeso
ALBERTA ELECTRIC SYSTEM OPERATOR

Topics

- Wind Power Forecasting in Alberta
- Purpose of Pilot Project
- Design of the Pilot Project
- Deliverables
- Analysis
- Schedule

Quick Facts

Alberta Power Supply



Fuel Type	Supply Capacity (MW)
Coal fired	6182
Gas fired	4606
Hydro	899
Wind	443
Biomass	133
Other	30
BC Intertie	780
Sask Intertie	150
TOTAL	13223

2006 Peak Load	9661
Annual Load Factor	80%

Wind Power Operation

Current use of Predicted Wind Power

- Where we use wind power forecasts today
  - Energy Market dispatch – System controller best judgment
  - Short term adequacy – Wind power is set at 80 MW or system controller best judgment
  - Alberta – BC export Available Transfer Capability (ATC)
    - Minimum wind power based on 99% certainty for the next 2 hours

Wind Power Operation

Current use of Predicted Wind Power

- Where we don’t use wind power forecasts today
  - Wind power is assumed at 0 MW for market or operational activity outside of 24 hours
    - Day ahead pool price forecast
    - Day ahead interconnections ATC
    - Procurement of ancillary services
    - 14 day / 3 month supply adequacy

Alberta Studies

- AESO's Wind Integration Study concluded that accurate real-time and longer term WPF forecasting would:
  - Reduce real-time operational uncertainty
  - Reduce the amount of additional RR needed to mitigate the variability issue; and/or
  - Reduce the amount of WPF constraints needed to mitigate the variability issue
  - Effect Unit commitment and scheduling
    - Reduce market uncertainty in the T-2 to T-12 timeframe
    - Reduce uncertainty in the T-1 to T-6 real time forecast of pool price

Market and Operational Framework

Issued March 7, 2007 for stakeholder consultation

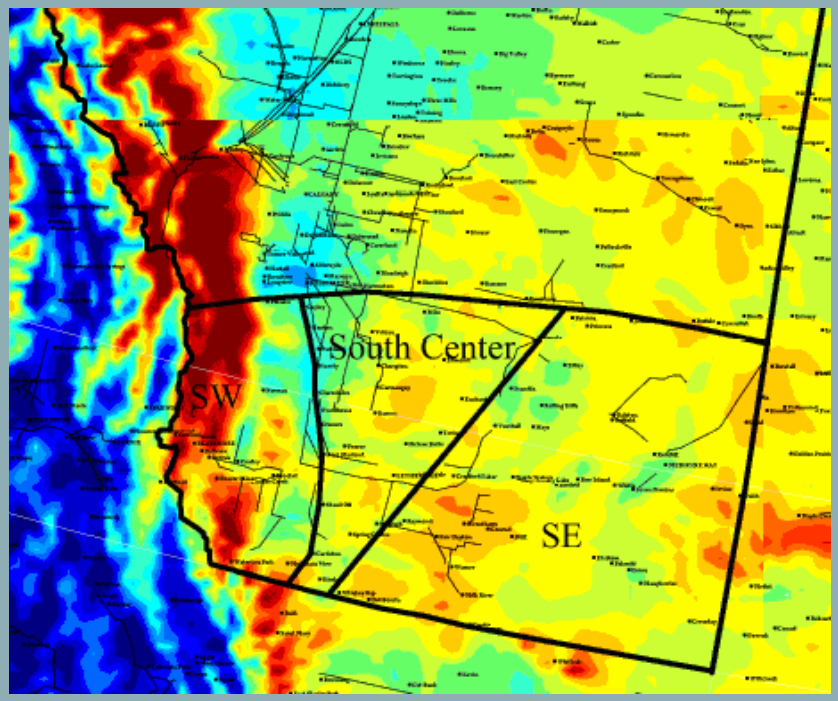
If the System Operator receives a reasonable forecast of wind power generation, ***then*** the System Operator can establish an operating plan to accommodate the forecast wind energy by using the following tools:

- The Energy Market Merit Order
- Regulating Reserves
- Load / Supply Following Services
- Wind Generation Power Management

Purpose of the Pilot Project

- To evaluate different forecasting methods in order to find the most effective means to forecast wind power in Alberta.
  - Increased opportunity for success as:
    - CanWEA study concluded:
      - "a model that performs well in one geographic region may not necessarily perform well elsewhere"
      - "a period of forecast service experimentation may be helpful, in order to gain an understanding of achievable accuracy in the Albertan context"
    - California ISO trialed different methods/providers to aid them in negotiating requirements with stakeholders in the future.
- To leverage the experience of other jurisdictions globally
- To determine what level of forecast accuracy can be achieved in Alberta
- To recommend wind power forecasting methods to be implemented in Alberta for use in:
  - today's environment
  - with enough flexibility to address future growth in wind power.

Wind Power Forecasting Pilot Project - Design



Funded by

AESO

Alberta Energy Research Institute

Alberta Department Of Energy

- Trial three very different forecasting methods over a one year period:
  - AWS Truewind (US)
  - WEProg (Denmark)
  - energy and meteo (Germany)
- 4 different geographic terrains / wind regimes in Alberta
- 7 existing and 5 future facilities to represent geographic diversity and future expansion
- Independent analytical analysis from ORTECH (Canada)
- Data Collection by Phoenix Eng. (Calgary) – 1 met tower/site

Deliverables

- Forecasters
  - Provide hourly forecasts for 1 year:
    - T-1 to T-48 hrs
    - met data (wind speed, wind direction, temperature, pressure)
    - Avg power and uncertainty (min, max)
    - Future sites are forecasted using a linear interpolation to a provided power curve
  - Provide recommendations on how forecasting should be done in Alberta (rules and technical requirements)
- Independent Quantitative Analysis Consultant
  - Quarterly reports on the accuracy of the forecasts (no priority yet on accuracy metric/time frame)
  - Final report on the accuracy of the forecast method and on the vendors
  - Recommendations on how to improve forecasting in Alberta and how Alberta should forecast (rules and technical requirements)

ORTECH Analysis

ORTECH will perform a detailed analysis of the following for each forecasting model:

- The general accuracy of the Forecasts,
- The accuracy of the Forecasts at the different forecast horizons studied (T=1 hour to T=48 hours),
- The accuracy of the Forecasts at different hours of the day and seasons of the year,
- The accuracy of the Forecasted Metrological Data before running through the Power Conversion models,
- The accuracy of the Power Conversion,
- Potential co-variance from given data samples,
- The accuracy of the Forecast at different wind speeds or different points of a Wind Power Facility's power curve,
- The relative comparison between Forecasts from two or more providers, and
- The validity of the Forecast methodologies used and their strengths and weaknesses.
- The trend of the Forecast performance through time.
- Forecast accuracy for individual wind farms in the study, aggregate forecast accuracy of all wind farms considered in the study which are in the same region and aggregate forecast accuracy of all wind farms considered in the study.
- How well the Forecast predicts fast ramp up and ramp down times,
- Comparing all the above between Alberta Wind Regions.

Accuracy Metrics

The following accuracy metrics will be used/considered:

- Root Mean Square Error (RSME)
- Mean Absolute Error (MAE)
- Normalized prediction error expressed per unit of capacity or energy (in RSME or MAE)
- Improvement over persistence in the short term (in RSME or MAE)
- Reliability diagrams to illustrate the relationship between probability forecasts and observations
- Linear Error in Probability Space Score
- Ensemble of regions (examining the smoothing effects of more wind power facilities spread out on forecast error)
- Principle component analysis
- Cluster analysis
- Probability of Detection and False alarm ratios to analyze extreme event or non-systematic errors

AESO Analysis

- Receiving aggregate wind power forecast for 7 existing facilities
- System Impact Model simulations with forecast information inputted
- Dispatch Decision Support Tool with forecasts inputted
- Will help the AESO in prioritizing accuracy metrics

Wind Power Forecasting Pilot Project - Schedule

- July - Oct 2006
  - Industry Work Group Stood up, Develop Project Design, Write Terms of Reference, and RFP development
- Oct 2006
  - Issue RFP (x 2)
- Nov 2006
  - Evaluation of Submitted Proposals
- Dec 2006 - Feb 2007
  - Contract Negotiations
  - Develop Data Collection

Wind Power Forecasting Pilot Project - Schedule

- Feb 2007 - April 2007
  - Data Collection, model training
- April 16, 2007
  - Forecast Delivery Begins
- Quarterly Reports
  - Aug 07, Nov 07, Feb 08
- Final Report
  - Draft End May 08
  - Final End Jul 08

Questions

- Thank you
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