

# Integrating Renewable Energy into Power Systems Operations

Alberta Electric System Operator Perspective

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Reliable **Power**

Reliable **Markets**

Reliable **People**



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# Outline

- Background & Alberta facts
- Wind Power Characteristics
- System Operations
- Market Operations and System Balancing
- Organization Goals and Priorities



# Role of Alberta Electric System Operator (AESO)

Independent System Operator for the Alberta



- **System Operations:**
  - direct the reliable operation of Alberta's power grid
- **Markets:**
  - develop and operate Alberta's real-time wholesale energy market to facilitate fair, efficient and open competition
- **Transmission System Development:**
  - plan and develop Alberta's 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



# Alberta's Electric Industry



- 9,710 MW peak and 80% LF
- 12,098 MW total generation



COAL-FIRED PLANTS

5,893 MW



GREEN POWER (Wind)

523 MW



NATURAL GAS-FIRED PLANTS

4,635 MW



GREEN POWER (Other renewables)

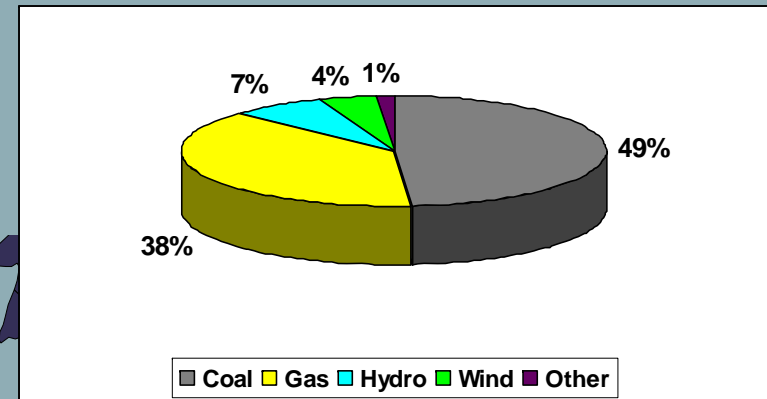
178 MW



HYDRO POWER

869 MW

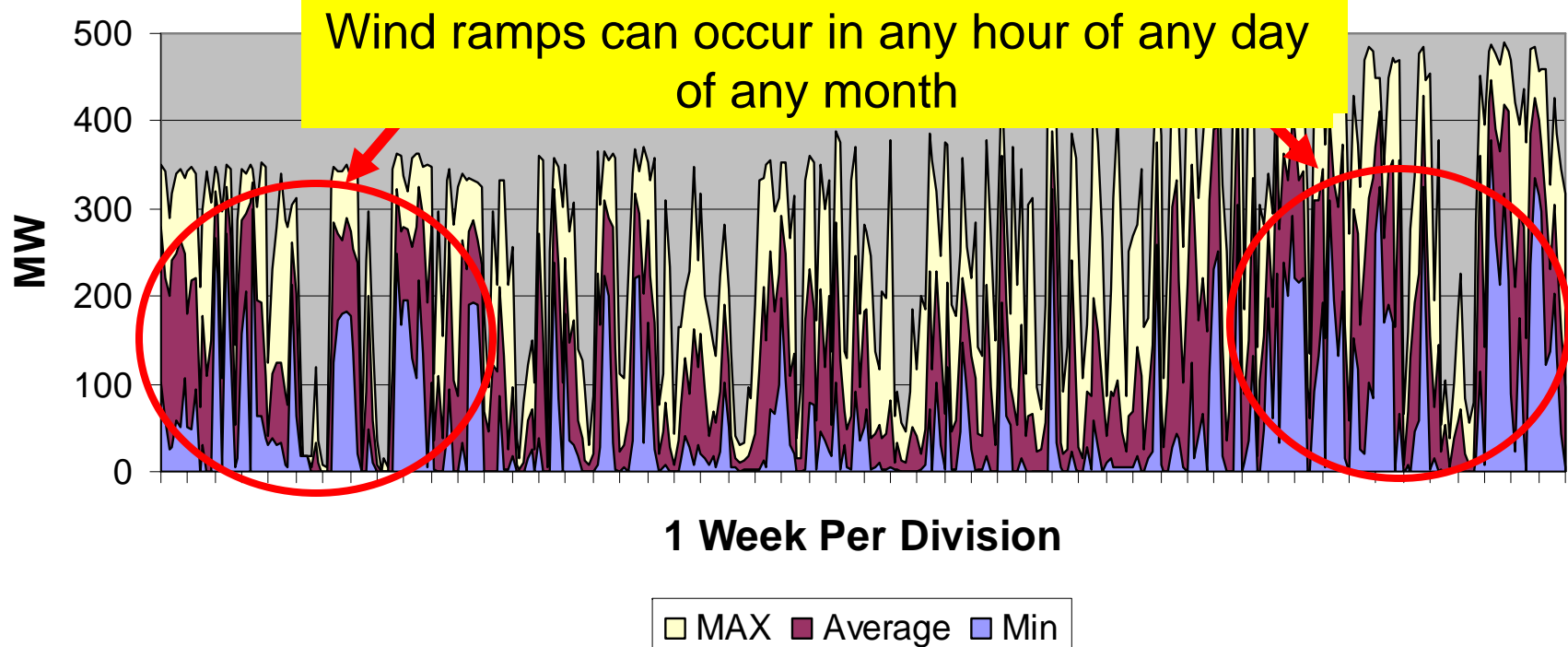
- Over 280 generating units
- Wholesale market with about 200 market participants
- > 21,000 km of transmission
- Interties BC (up to 780 MW) & Sask. (up to 150 MW)



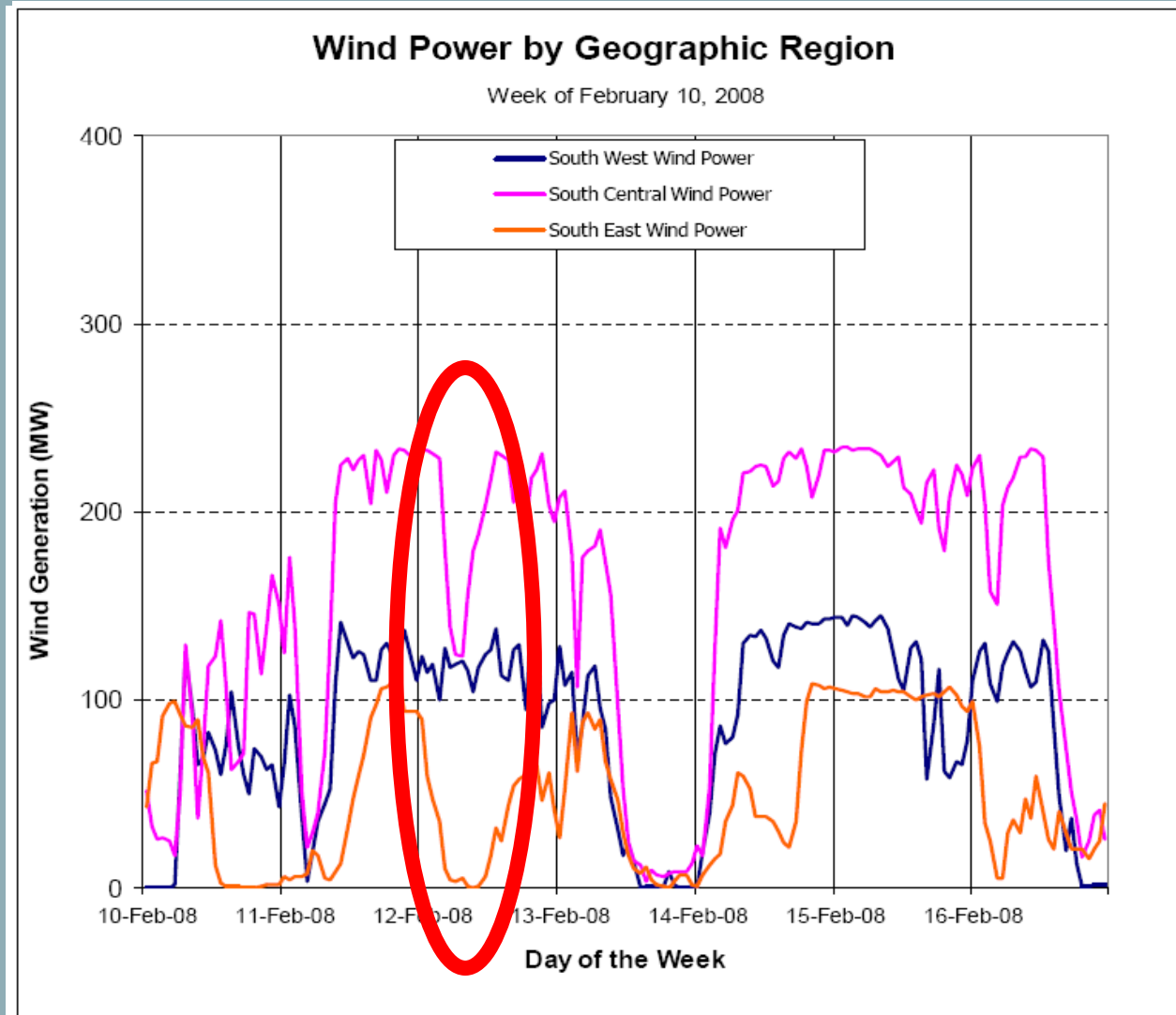
Over 9,000 MW of Wind Power Interest

# Wind Characteristics

**2007 Actual Wind Power Data**  
(Daily minimum, Daily Average, Daily maximum)



# Wind Characteristics Diversity



# System Operations

## Dispatch of Wind Power Facilities



### Supply Surplus

#### TODAY

Wind power is exempt from dispatch

#### FUTURE

Wind power will participate in dispatch

### Transmission Constraints

#### TODAY

Wind power does participate in curtailment procedures  
WPFs may use power limiting feature to curtail

#### FUTURE

Wind power will continue to participate in curtailment procedures

### Voltage Control

#### TODAY

Wind power does participate in voltage dispatch  
and voltage regulation

#### FUTURE

Wind power will continue to participate in voltage  
Dispatch and voltage regulation

### System Restoration

Wind power does not participate and will need to examine if it can participate in the future

# System Operations Forecasting and Forecast Information



## Ancillary Services

### TODAY

Wind power is not considered day-ahead, system operator discretion in real-time for additional AS

### FUTURE

Wind power forecasting and related information used in advance of real time

## Short Term Adequacy

### TODAY

Wind power is considered up to a maximum of 80 MW

### FUTURE

Wind power forecasting and related information used

## Available Transfer Capability

### TODAY

Wind power is not considered day-ahead, wind power is considered using statistical methods  
Within the t-2 period

### FUTURE

Wind power forecasting will be  
Considered day-ahead and near real-time

# System Operations Performance



- CPS1 and CPS2 are good (CPS2 ~98%)
  - In 2003, the master AGC was modified from “unit control allocation” to a form of “broadcast (multiple unit) control allocation”.
    - Modification was for market fairness and not variability.
    - Performance increase from about 93% to 98% with the change
  - Energy Market has compliance requirements to offers and dispatch (must offer-must comply).
- Our regulation range varies from about 135 to 225 MW
  - This has been reasonable sufficient to accommodate today’s level of wind power.
  - AESO’s 2004 System Impact studies assessed additional mitigating measures are likely to occur beyond 600 MW and escalate beyond 900 MW.

# Market Operations/System Balancing



- Quick Review on Alberta's market structure
  - AESO plans transmission; market participants develop generation.
  - All generators (existing or new) have equal access to transmission capacity.
  - The AESO may limit the output of any generating unit for the reliability or security of the Alberta system.
  - Alberta has an Energy Only Market and Ancillary Services Market for operating reserves.
    - Energy market has a price floor of \$0 and a price cap of \$999.99
  - AESO provides short and long term forecasts and metrics to market participants.
  - Market forces determine the generation mix and location of generation in Alberta – no RFPs.

# Market Operations/System Balancing

## Today's Balancing Resources



- Resources that are providing most of the balancing services in Alberta
  - The energy market merit order provide most of the balancing and some is providing by the regulating reserve services.
  - Balancing resources from the energy market or regulating reserve market will vary amongst the coal fired, gas fired and hydro generators.
- System ramping capabilities
  - Ramps rates requirements are increasing but still within the current capability of the market.

# Market Operations/System Balancing

## Addressing the Issue



- Steps to address dealing with wind power variability
  - The AESO does not do generation planning.
  - We have indicated in the Market and Operation Framework for Wind Integration that we will use;
    - the energy market merit order as first priority, this is the flexible dispatchable generation
    - Regulating reserves (supply/load following) as second priority

# Market Operations/System Balancing

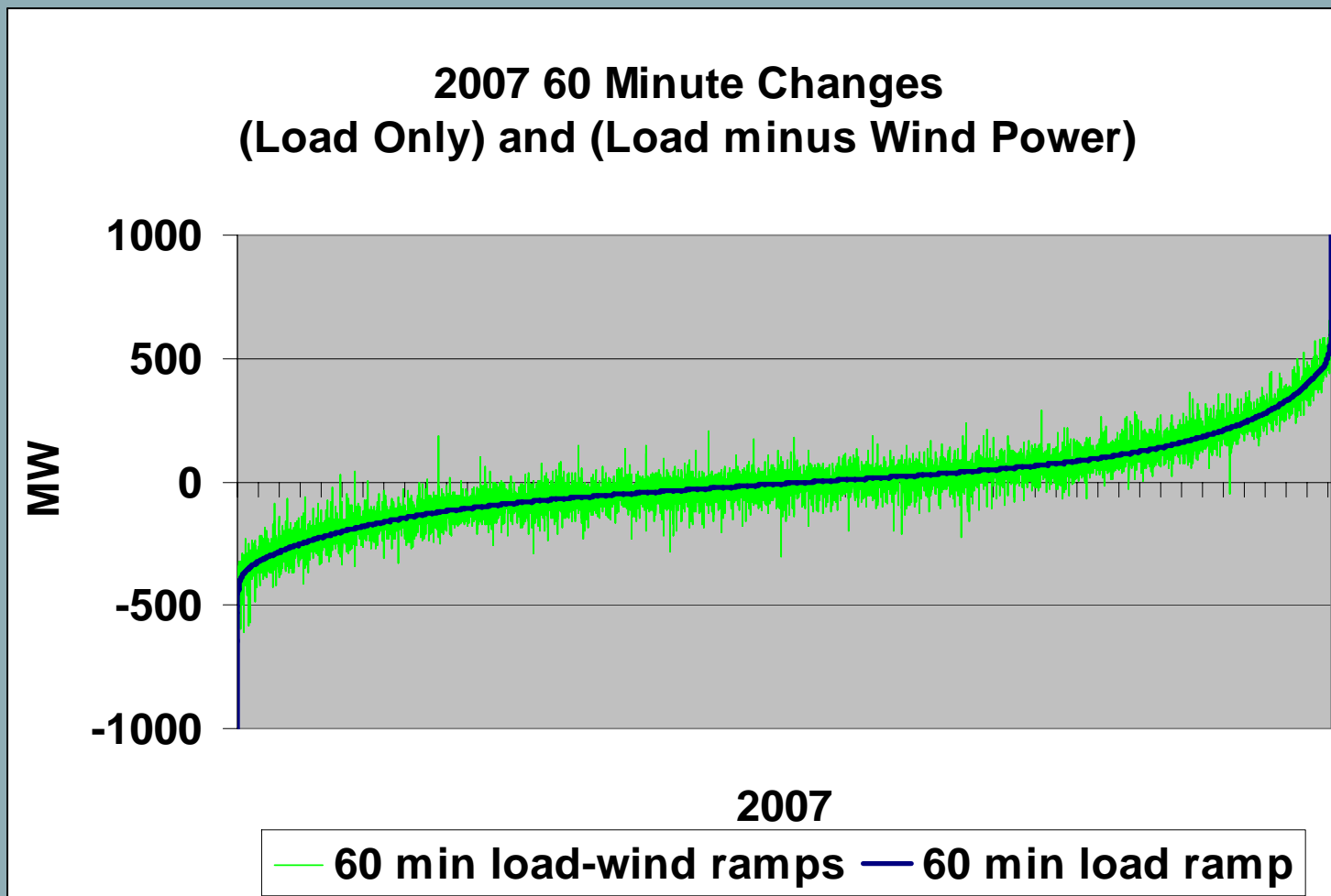
## Future Balancing Resources



- Future resources
  - The AESO does not do generation planning.
  - Based on current input from generation developers;
    - Generation resources (other than wind power) proposed are primarily super critical coal and gas fired technology.
    - Generation resources contemplated (other than wind power) are nuclear, clean coal.

# System Ramping Requirement

Load and Load-Wind Power



# Organizational Goals/Priorities

## Operational Requirements



- Alberta wind power development is expected to ramp up to 600 MW by June 2009, then ramp up to 900 MW by Jan 2010.
- Our plan is to have all the necessary tools, rules, procedures and standards in place and operational by June 2009.
- Key projects operational by June 2009
  - Supply surplus rules, procedures and operator tools
  - Wind power management standards, rules, procedures and operator tools
  - Wind power forecasting standards, rules, procedures and operator tools
  - Dispatch Decision Support Tool for the system operators
  - Ancillary Service forecasting procedures
  - Short term adequacy procedures
  - Market information

# Organizational Goals/Priorities

## Demand Side Management Concepts



- For the past several years, load has been eligible to participate in the Supplemental Reserve market
- Price sensitive load.
  - This is load customer that does not offer into the energy market merit order, but when the pool price hits a specific value the customer will reduce their energy consumption
- To be explored in 2008
  - To determine their significance with respect to the fundamental relationships that form the basis of the AESO's *Future Demand and Energy Outlook*.
    - New demand side management initiatives, including demand response programs - dispatchable load can be extremely value to the system operator
    - New technology, with different electricity intensities
    - New environmental regulations around greenhouse gases
    - New exploration, particularly coal-bed methane extraction

# Organizational Goals/Priorities

## Market Solution Concepts



- Load Supply Following would be a new service
  - This less stringent ramping requirement should widen the potential for suppliers along with available resources such as;
    - storage facilities,
    - inter-control area dynamic schedules,
    - load shedding services and
    - others.
- Operating Reserves Market Re-Design
  - The operating reserve market is currently day-ahead forecasting and procurement
  - The intent of the re-design is to examine efficiencies and move closer to a 2 hour ahead
  - Although the intent is not specifically for wind power, there are some natural synergies as uncertainties associated with wind power forecasts reduce within a short time frame

# Questions/Comments



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