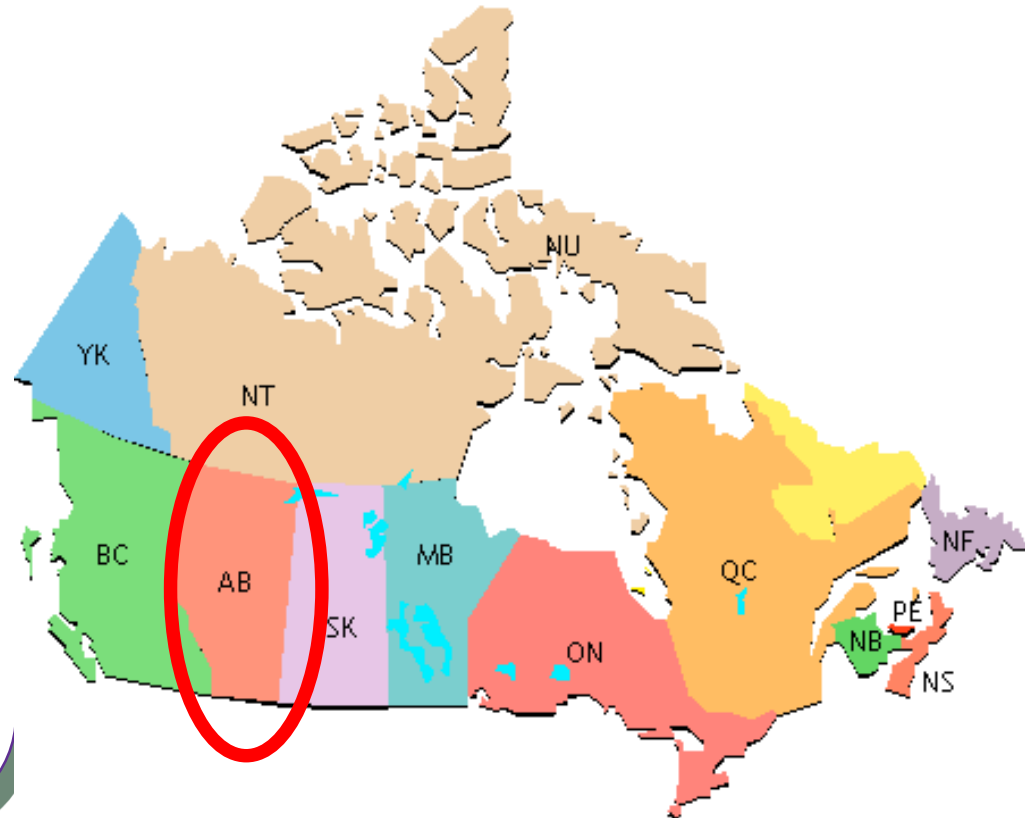


VG Forecasting and Market Operation Experience from Alberta








**Jacques Duchesne P. Eng.
Renewables Advisor
UVIG Atlanta June 2017**

Alberta's Electric Industry

- **Deregulated**
- **11,000 MW winter peak**
- **16,315 MW total generation**
- **Energy only market now but introducing a capacity market**
- **Coal served 64% of system load in 2015 but...**
- **Interties BC, SK and Montana**



Alberta has 16,314 MW of installed generation (as of January 22, 2016)

 Type	Installed Capacity (MW)	Percentage of Installed Capacity (%)	Portion of Energy Production in 2015 (% , Net-to-grid)
 Coal	6,289	39%	64%
 Cogeneration	4,528	28%	17%
 Gas	2,712	17%	9%
 Hydro	894	5%	3%
 Wind	1,463	9%	7%
 Other Renewables	428	3%	1%

Premier Rachel Notley:

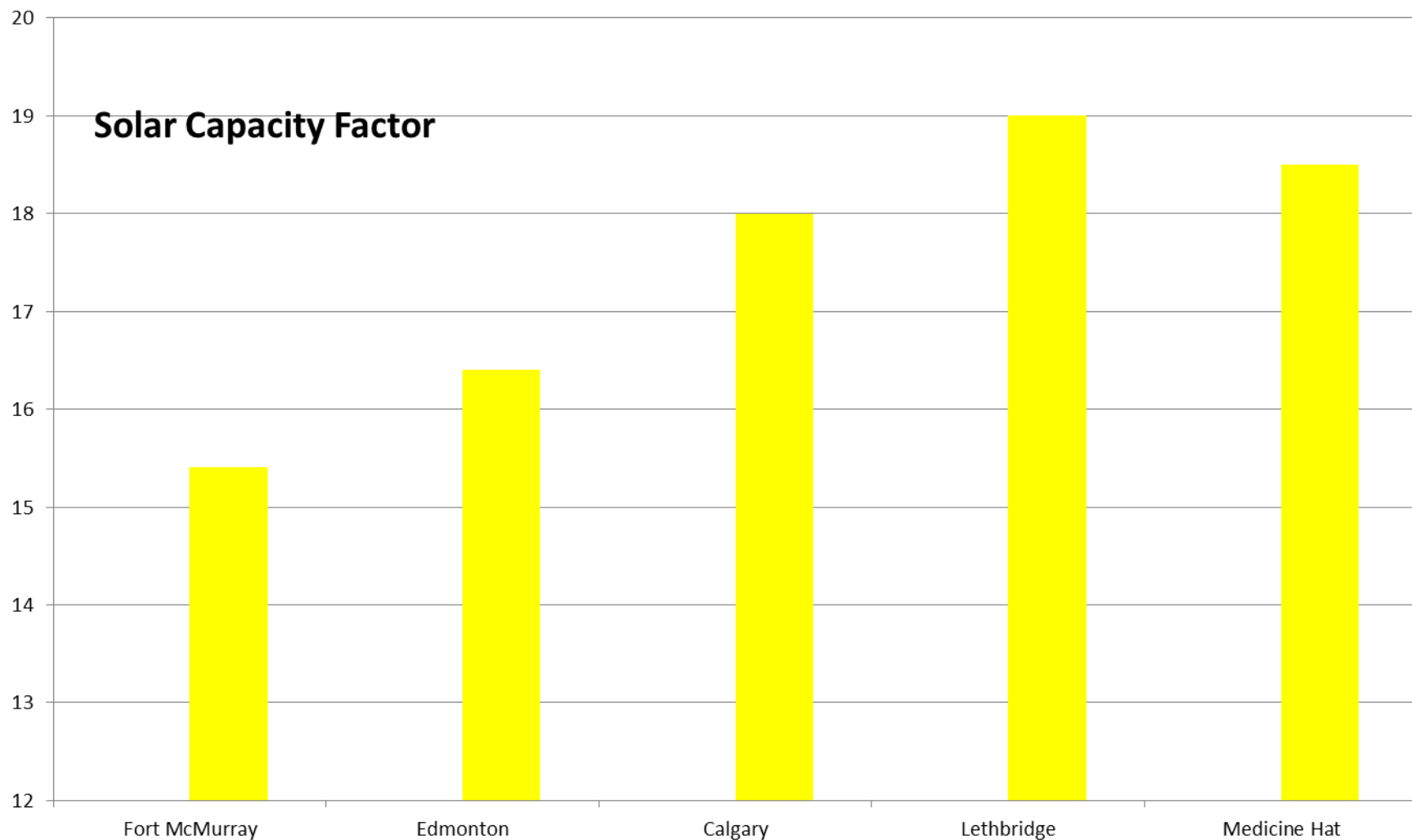
- Phase-out coal emissions by 2030 and encourage clean, renewable electricity
 - 2/3 from renewable sources like wind, solar, biomass
 - By 2030, renewable sources will account for up to 30% of electricity generation
- \$30/tonne carbon tax by 2018

“Provide, via a clean power call, a payment for renewable energy attributes which will achieve desired capacity expansion at the lowest unit cost to Albertans.”

Increased Renewables Interest in Alberta

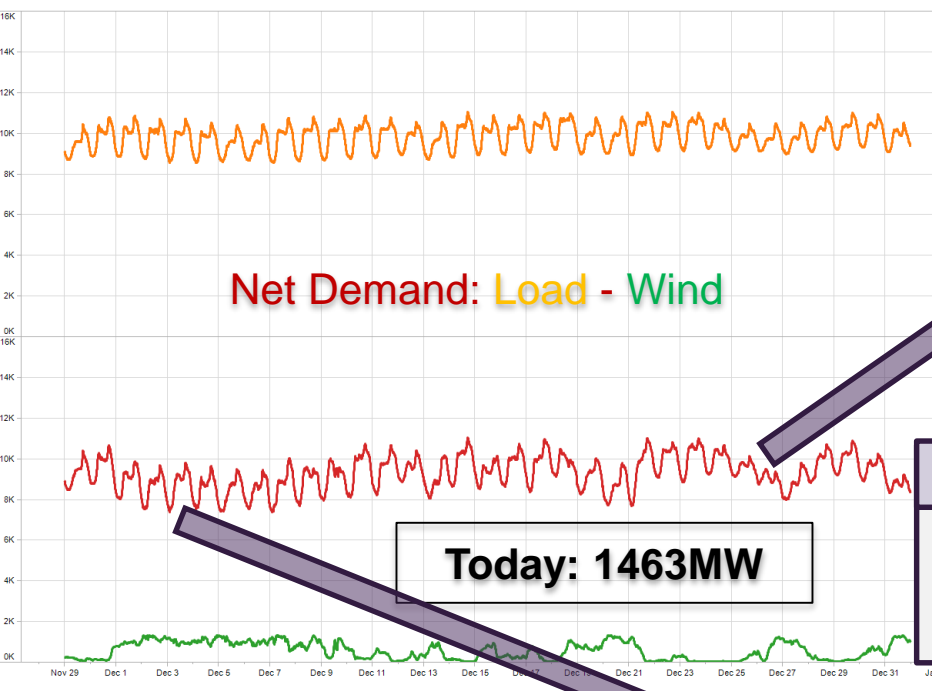
- Received around 90 expressions of interest in the renewables electricity procurement program (REP)
- 53 Wind projects in the connection queue 8000 MW
- 58 Solar projects in the connection queue 2400 MW
 - 30 projects are DER (Distributed Energy Resources) 10 to 20 MW range

Alberta has a good solar resource - NREL



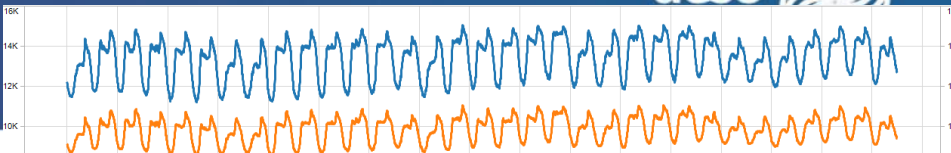
- Increase system operation variability and uncertainty
- Ramping requirement (up and down)
- Increase regulating reserve volume
- Potential curtailment (supply surplus or ramp management)
- Inertia

Imagining the Potential Future Situation

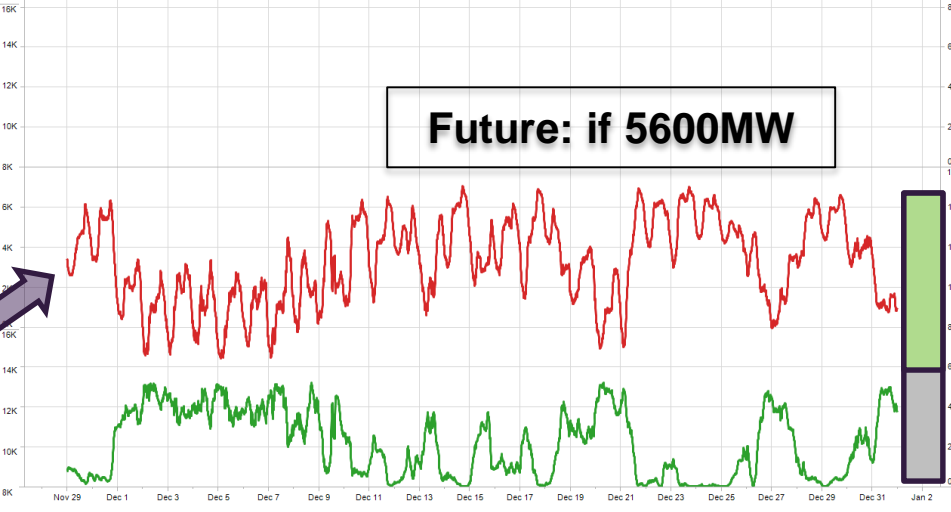


Net Demand: Load - Wind

Today: 1463MW

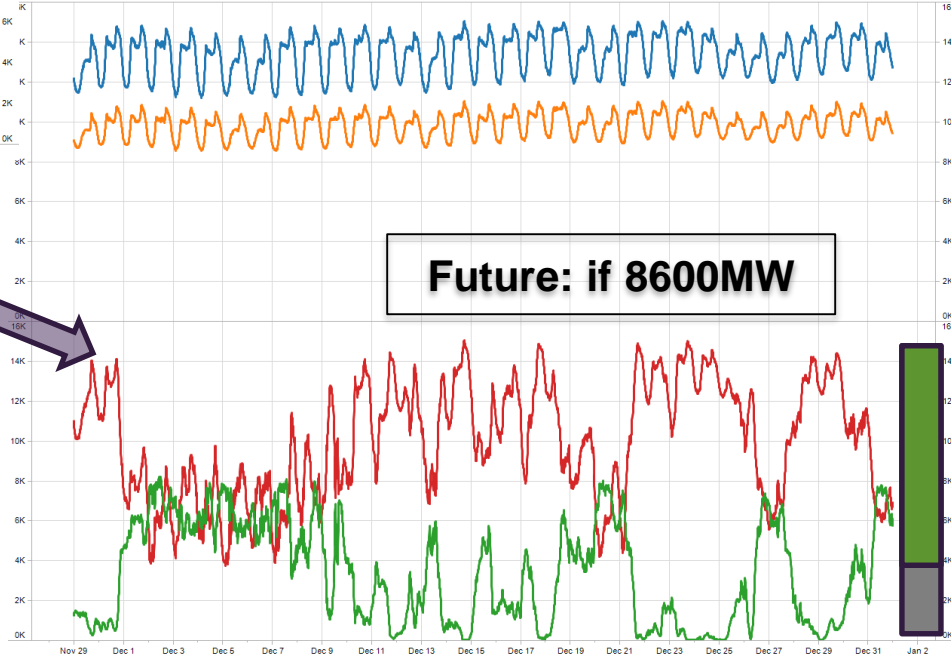


Future: if 5600MW

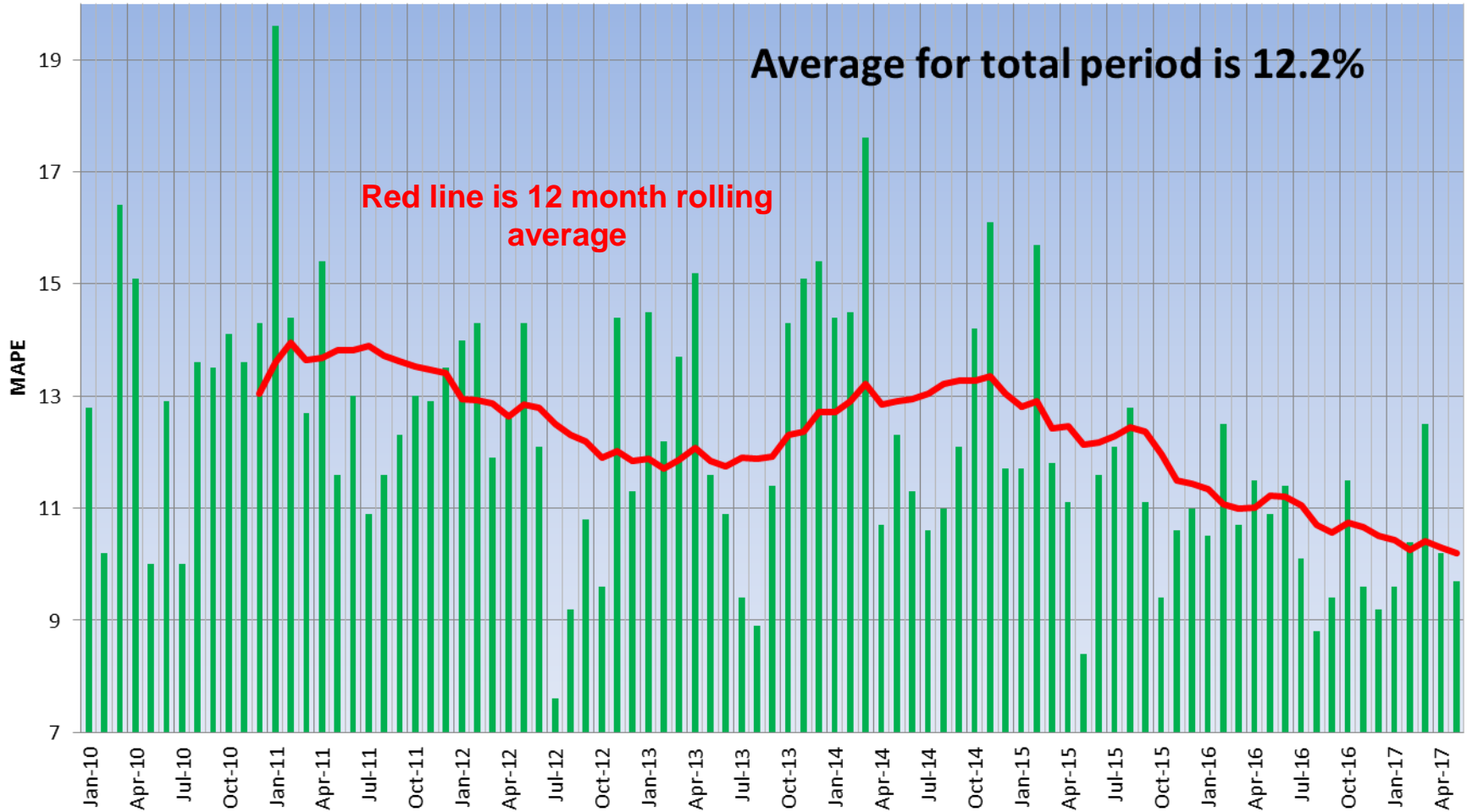


Future: if 8600MW

The **net demand** will have bigger variance range, and without "Typical Daily Pattern" (uncertainty)



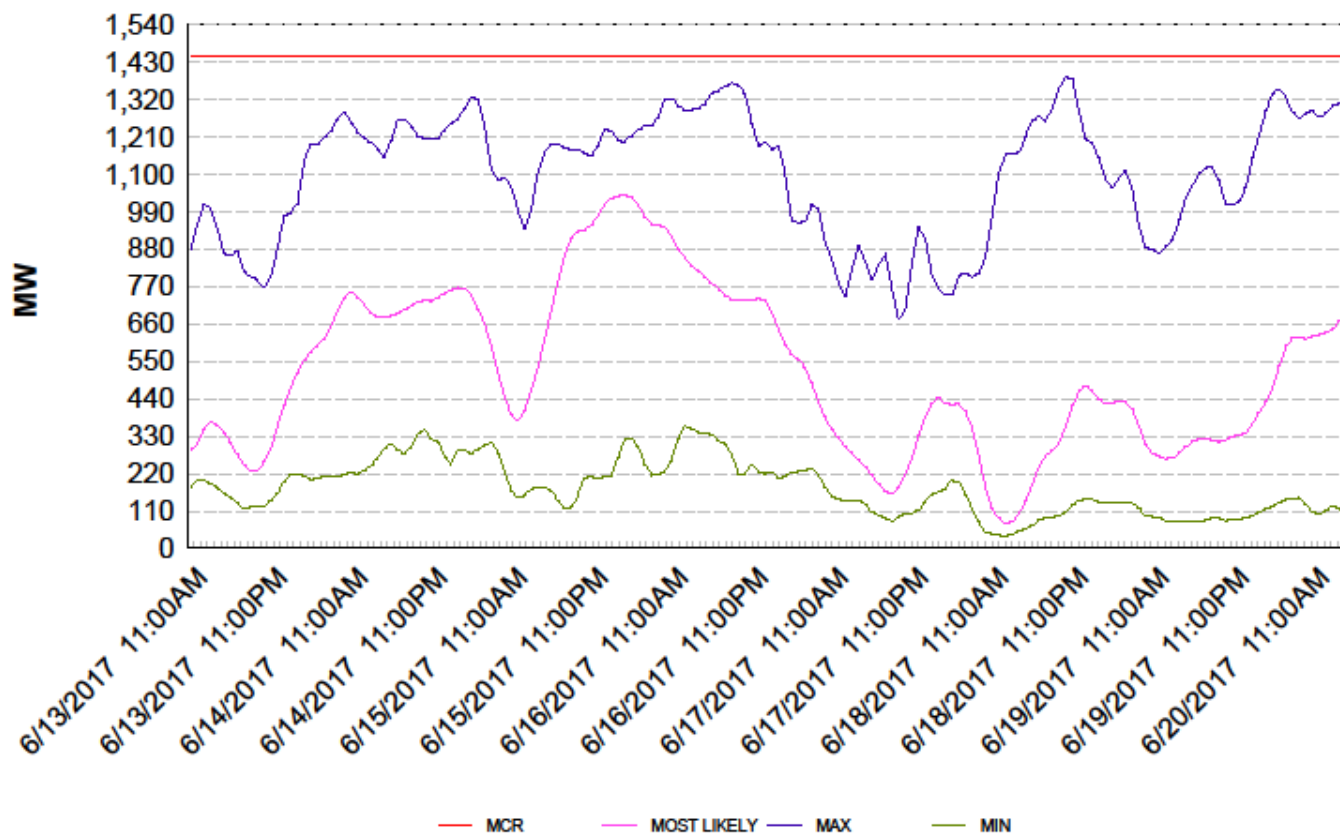
Day Ahead Wind Forecast Accuracy



7 Day Forecast



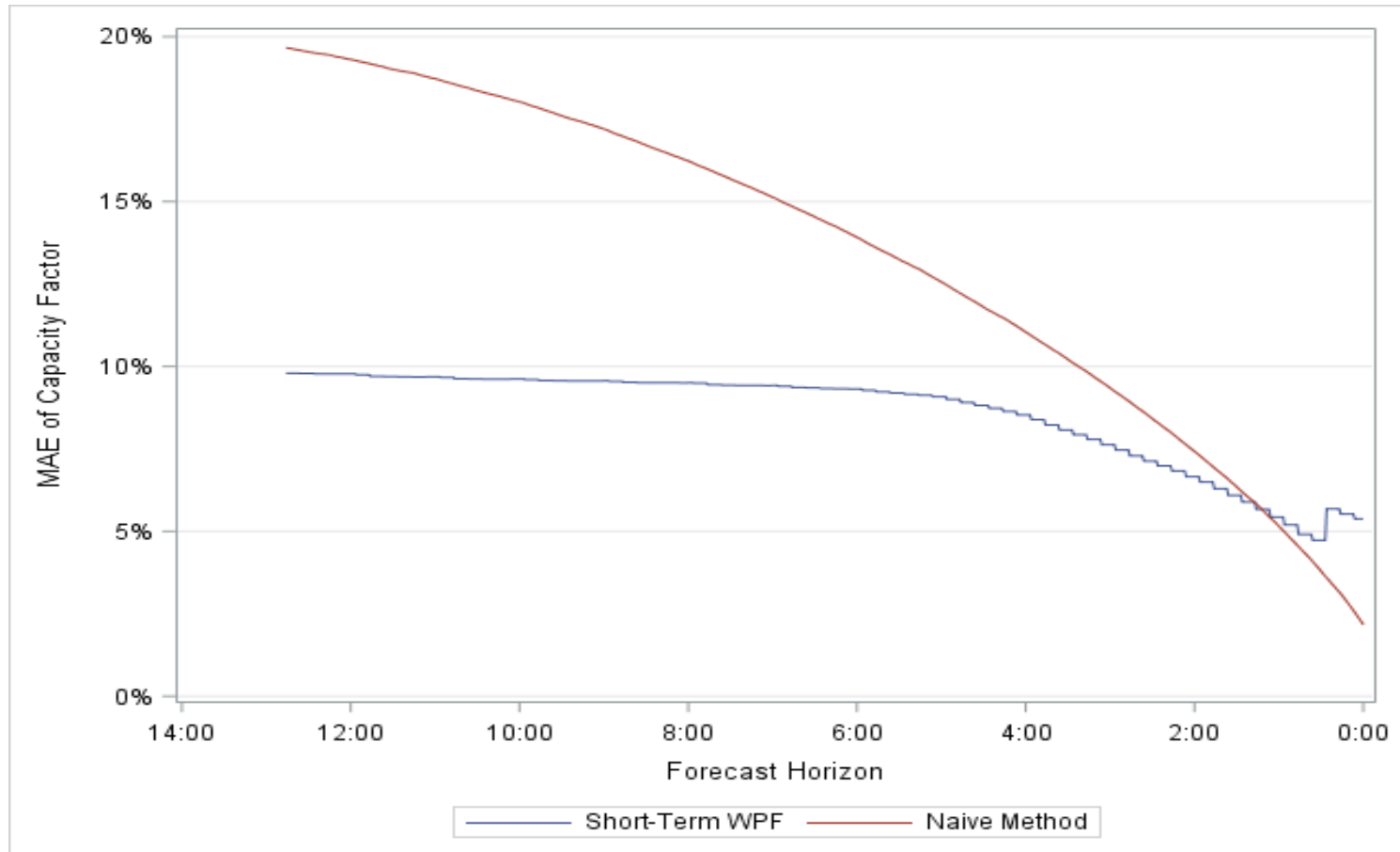
Alberta 7 day Wind Power forecast updated as of
6/13/2017 11:04:00AM MT



Forecasting Time Frame

- 12 hrs ahead and updated every 10 minutes
- 7 day ahead and updated every 6 hours
- All wind farms are providing 10 minute average data

Short Term Forecast - 2016



Naïve vs Short Term Forecast

- How long does it take for the forecast to beat a naïve or persistent forecast?
- 2016: 1hr and 18 minutes
- 2015: 1hr and 21 minutes
- 2014: 2 hr and 1 minute

- Consulting on new wind and solar forecasting rule
- Propose to:
 - Apply to all wind or solar 5 MW or greater
 - Apply to distribution or transmission connected
 - Exchange one minute average data from every VG site to improve short term and ramp forecast
- Built a simulation tool to investigate future (Ming Hu)
 - Ramp
 - Supply surplus
 - Rule modification impact

Thank you !

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