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December 8, 2015

MEMORANDUM

TO: Council members

FROM: Tom Eckman, Power Division Director

SUBJECT: Proposed RPM Data and Input Assumption Updates

BACKGROUND:

Presenter: Tom Eckman

Summary: Staff recommends that the Council update inputs to the Regional Portfolio Model (RPM) to reflect additional staff analysis, the availability of new data and public comments received to date. Additional updates may be recommended once all public comments on the draft 7th Plan have been reviewed.

The following is a high level summary of the proposed recommended updates. Staff will discuss these in more detail at the Power Committee meeting.

Load Forecast Range – Since the draft plan was issued two potential factors affecting future regional electricity loads were identified. The first factor results in lower near-term loads, but uncertain impacts on load growth over the long-term. The second factor could lead to higher mid-term load growth. Staff recommends that the range of future regional loads considered in the RPM be expanded to reflect this increased uncertainty, particularly in the near term.

Natural Gas and Wholesale Electricity Price Range - Since 2014 when the draft plans natural gas price forecast was developed, natural prices have declined and are currently in the two to three dollar per million BTU range. Staff recommends that a revised natural gas price forecast be used as an input to RPM which would lower the medium forecast by around one dollar per million BTU. Staff also recommends that since the prices for natural gas are expected to remain volatile and uncertain that the high and low forecast bounds used in the draft plan for RPM would remain unchanged. Staff recommends that the medium forecast for wholesale market prices for electricity also be adjusted downward to reflect the lower natural gas prices.

Adequacy Reserve Margin (ARM) and Associated System Capacity Contribution (ASCC) Factors – The RPM analysis for the draft plan used ARMs based on satisfying annual energy and winter quarter capacity needs. Further, the draft plan ASCCs for combined cycle combustion turbines and energy efficiency were based solely on the system contribution to winter peak hour capacity needs. Staff recommends that the Council use quarterly ARMs for energy and capacity and quarterly ASCC for combined cycle combustion turbine, energy efficiency and develop quarterly ASCC for wind and solar PV resources. This increased fidelity better reflects the load shape of energy efficiency and energy production profile of wind and solar PV resources. It also better captures the potential need for and resources that can satisfy both winter and summer peaking capacity.

Representation of Existing Renewable Portfolio Standards (RPS) - In the Draft Plan, the RPM logic determines RPS requirements based on a percentage of a utility's load (i.e., retail sales, plus distribution and transmission system losses). One commenter on the draft plan indicated that the existing state RPS requirements established the amount of renewable generation based on a percentage of a utility's retail sales rather than load. Staff verified that this is the case. Therefore, staff recommends that the RPM logic be modified to determine RPS requirement based on retail sales (i.e., exclude anticipated transmission and distribution system losses). Independent of any other changes in RPM input assumptions; this will reduce the amount of renewable resources developed to fulfill the existing RPS.

Additional Renewable Resource Options - Staff recommend that two additional renewable resource options be modeled in the RPM. The first is a 50 MW utility scale solar PV located on the west side of the Cascades. This plant is identical to the solar PV reference plant located in Southern Idaho that was considered in the draft plans development. The second renewable resource option is a conventional geothermal reference plant.

The draft plan's recommended resource strategy calls for development of cost-effective renewable resources that can provide winter capacity and are dispatchable, such as geothermal resources. Staff recommends including conventional geothermal among the resources considered in the RPM to provide further support for this recommendation. For conventional geothermal, the cost and potential estimates will be similar as to those used in the 6th Plan. Full levelized cost estimates for geothermal are highly competitive to wind and solar, but with the additional advantage of being capable of providing dispatchable power. However, potential for new conventional geothermal in the region is limited.

Relevance: Updating data and input assumptions between draft and final plan better assures that the final plan will be based on the best information available.

Workplan: 1. B. Develop Seventh Power Plan and maintain analytical capability

- Complete draft plan resource strategy and draft action plan

Background: **Load Forecast Range** - Near term regional electricity loads are now forecast to be lower as a result of recently announced idling of two aluminum smelter operations. In November 2015 Alcoa announced it would idle its two smelting operations in state of Washington and that these plants would remain idle through 2016. The company has stated that by mid-2017 the smelting operations will resume. However, the long-term operation of these plants depends on world aluminum market conditions. The idling of these two plants reduces near-term regional loads by about 770 aMW. The draft 7th Plan's load forecast assumes these plants continue to operate.

The factor that could significantly increase regional electricity loads is the potential development of three new methanol production plants in Oregon and Washington. In aggregate these plants could potentially increase regional electricity loads by about 800 aMW. These plants are scheduled for a phased-in operation potentially starting in the 2020 to 2022 time period.

Natural Gas and Wholesale Electric Prices - The forecast natural gas prices used by RPM was developed in 2014 when prices at Henry Hub were in the four dollar per million BTU range (2012\$/MMBtu). Staff conducted a poll of the Natural Gas Advisory Committee in November, and the results suggest that the forecast could be lowered slightly, especially in the near term. The price for natural gas affects wholesale electric prices; therefore the electric price will be updated to reflect slightly lower gas prices. Natural gas prices also affect the full levelized cost of energy (LCOE \$/MWh) estimates for new gas fired generating plants such as Combined-Cycle Combustion Turbines and Reciprocating Engines.

Adequacy Reserve Margin (ARM) and Associated System Capacity Contribution (ASCC) Factors – For the draft plan staff developed two factors (ARMs and ASCC) to represent the hourly fidelity of the GENESYS model in the quarterly time-steps used in the RPM. The ARMs are used to represent the regional adequacy standards, i.e., the Council 5% Loss of Load Probability (LOLP). ASCC are used in the RPM to reflect the interaction of new resources with the region’s existing hydro power system. The ARMs are used to translate the Council 5% LOLP adequacy standard in GENESYS to the RPM to ensure that least cost resource strategies maintain system reliability. ASCCs reflect the fact that energy produced by generating resources or saved by energy efficiency resources can be used to store water in the hydrosystem for later use to meet peak demands. This system level impact allows the RPM to reflect the interaction of new resources with the existing hydropower system as modeled in GENESYS. In the draft plan, ASCC were developed for only energy efficiency and combined cycle combustion turbine resources. Staff recommends and public comments support development of ASCC for all resources considered in the RPM. To implement this recommendation for with resources that have a seasonal shape (e.g. solar PV) requires the development of an Adequacy Reserve Margin for energy and capacity for each quarter of the year and associated quarterly Associated System Capacity Contributions for each resource. Staff will report on the status of this development process at the Power Committee meeting.

Additional Renewable Resource Options – The proposed solar PV resource located west of the Cascades has a lower capacity factor than the Idaho resource; however it could be located near available transmission. As such, full levelized cost of energy (LCOE \$/MWh) are higher than the solar resource in Idaho, but this resource option could offer a viable alternative to having to build new transmission to bring solar power west. Enhanced Geothermal (EGS) was analyzed as an emerging technology and was not input to RPM. Staff continues to recommend that this resource option be considered as emerging since it has yet to be demonstrated.

More Info: N/A

Proposed RPM Data and Input Assumption Updates

December 2015

Load Forecast Updates

draft to final

uncertainty remains

December 2015

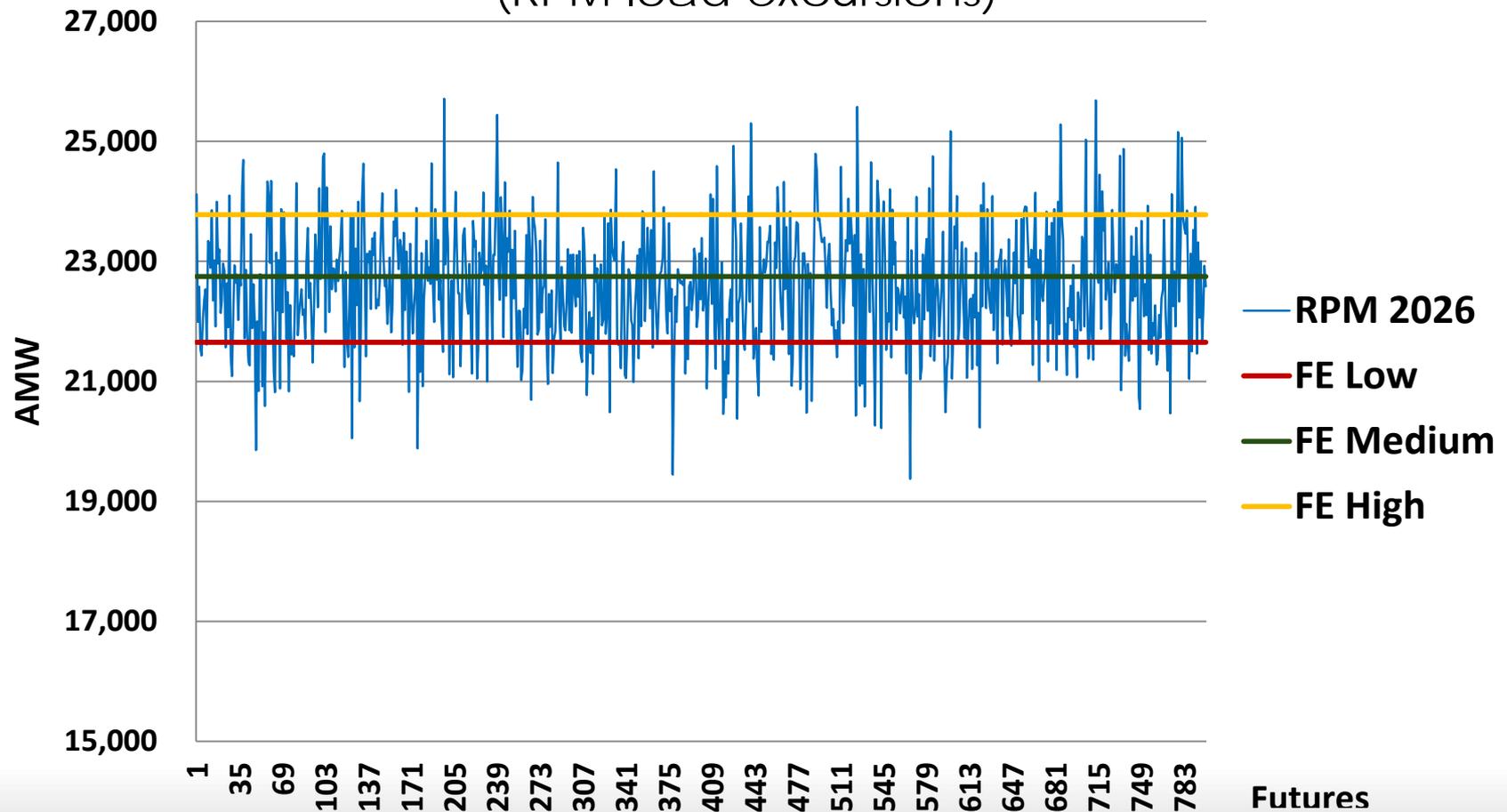
Load Uncertainty Remains

- Council's resource planning process is built on recognizing and incorporating inherent uncertainty in its major planning inputs, such as future loads & fuel prices.
- Across the 800 futures tested in the RPM annual loads vary over a range of 2600 aMW during the Action Plan period
 - Over the 20 year planning period this range increases to ~4000 aMW.

RPM Comparison of 800 future load paths and range of loads from Frozen Efficiency Load Forecast for 2026

Forecast for 2026

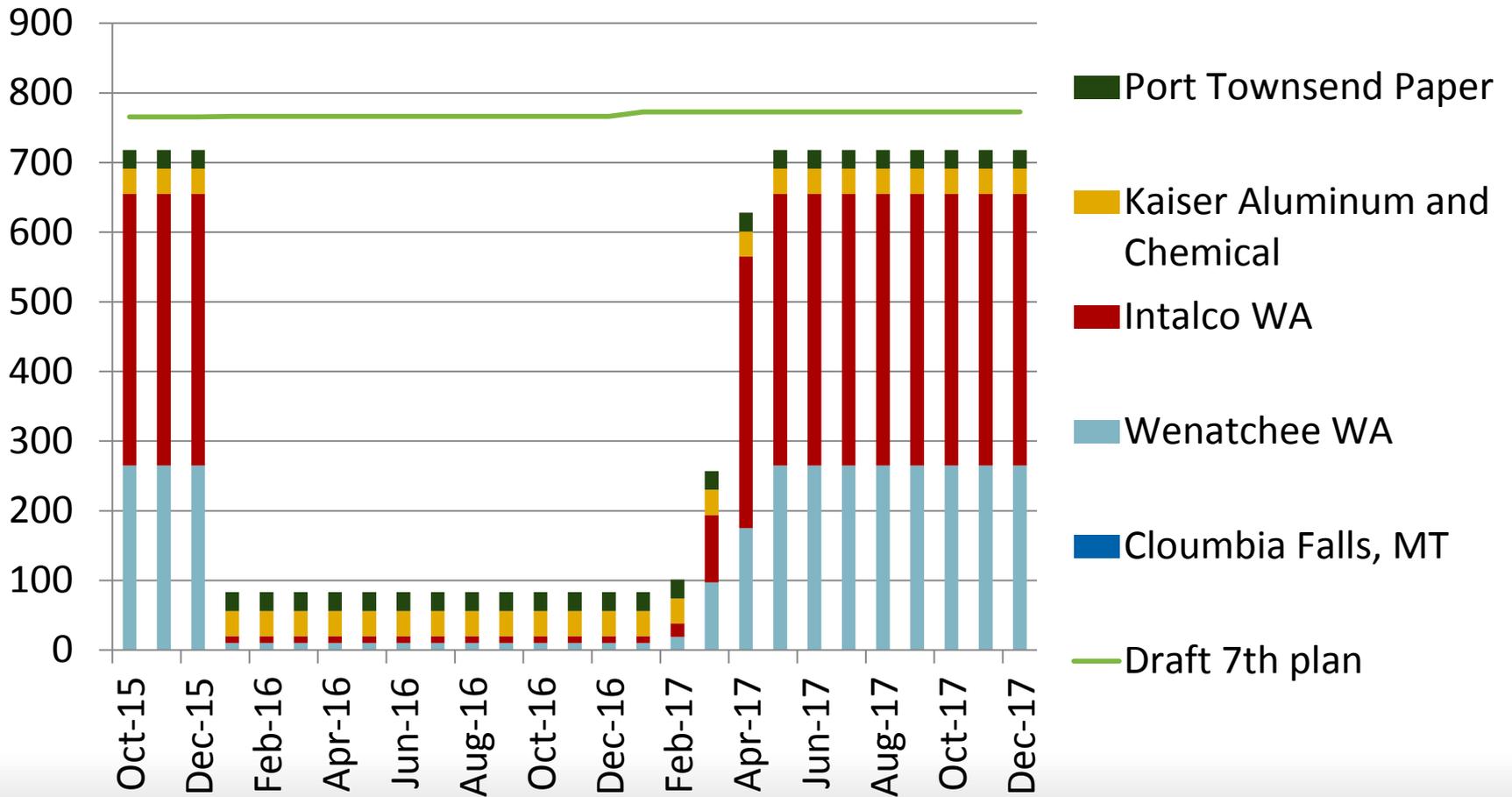
(RPM load excursions)



Changes in Loads and Forecast Loads Since Draft Plan

- **Existing Aluminum Smelter Loads**
 - In Montana, Columbia Falls plant- *closed*
 - In Washington, Intalco and Wenatchee smelters idled in 2016 scheduled to return mid 2017
- **Potential New Methanol Refinery Loads**
 - One plant in Oregon
 - Two plants in Washington
 - Schedule online 2020-2022

Revised DSI Load Forecast



DSI Smelter Summary

- Currently there is a worldwide glut of Aluminum
- Demand for aluminum products is on the increase.
- Worldwide supply and capacity is increasing faster than demand.
- Market share of US production of Aluminum has been declining rapidly and most likely continue to do so.
- Increasingly regional smelter's electricity cost is market based.
- It is likely that long-term smelter loads will be zero.

Possible Large Load Additions

- **Three Methanol production facilities:**
 - One in Oregon (city of St. Helens) – 200 aMW
 - Two in Washington (port of Tacoma, and port of Kalama) -600 MW
- Sites *scheduled* for completion by 2020-2022.
- Total potential 800 aMW of flat load.
- Plants could increase regional natural gas consumption by 50%.
- New plants will require additional natural gas infrastructure investments.

Port of Tacoma Methanol Site located in the closed Kaiser Aluminum site



Project Schedule provided by Northwest Innovation Works

Summary of Change in Load

(aMW)	2016	2017	2018	2019	2020	2021	2022-2035
<i>DSI load in the Draft Plan</i>	766	773	772	770	770	770	770
DSI – Low Final	83	83	83	83	83	83	83
DSI - Medium Final	83	275	338	338	338	338	338
DSI - High Final	83	568	718	718	718	718	718
Methanol – Low Final	-	-	-	-	200	200	200
Methanol – Medium Final	-	-	-	-	200	400	400
Methanol – High Final	-	-	-	-	200	400	800

DSI loads shown here includes 63 aMW of Non-smelter DSI loads at Kaiser aluminum and chemical plant as well as Port Townsend paper.

Summary and Options

- DSI smelter loads are declining in the short-term and can go to zero in the long-term
- There is potential for new large industrial loads in the region
- Load reductions and additions are uncertain
- Council planning process incorporates uncertainty

Options

1. Only adjust smelter load to reflect Low, medium and high range.
2. Include both smelter and methanol load forecast range, shown below.
3. Take either option and expand the range of load uncertainty in RPM.

(aMW)	2016	2017	2018	2019	2020	2021	2022-2035
Low	83	83	83	83	283	283	283
Medium	83	275	338	338	538	938	938
High	83	568	718	718	918	1,118	1,518

Natural Gas and Wholesale Electricity Price Forecast Updates

draft to final

uncertainty remains

December 2015

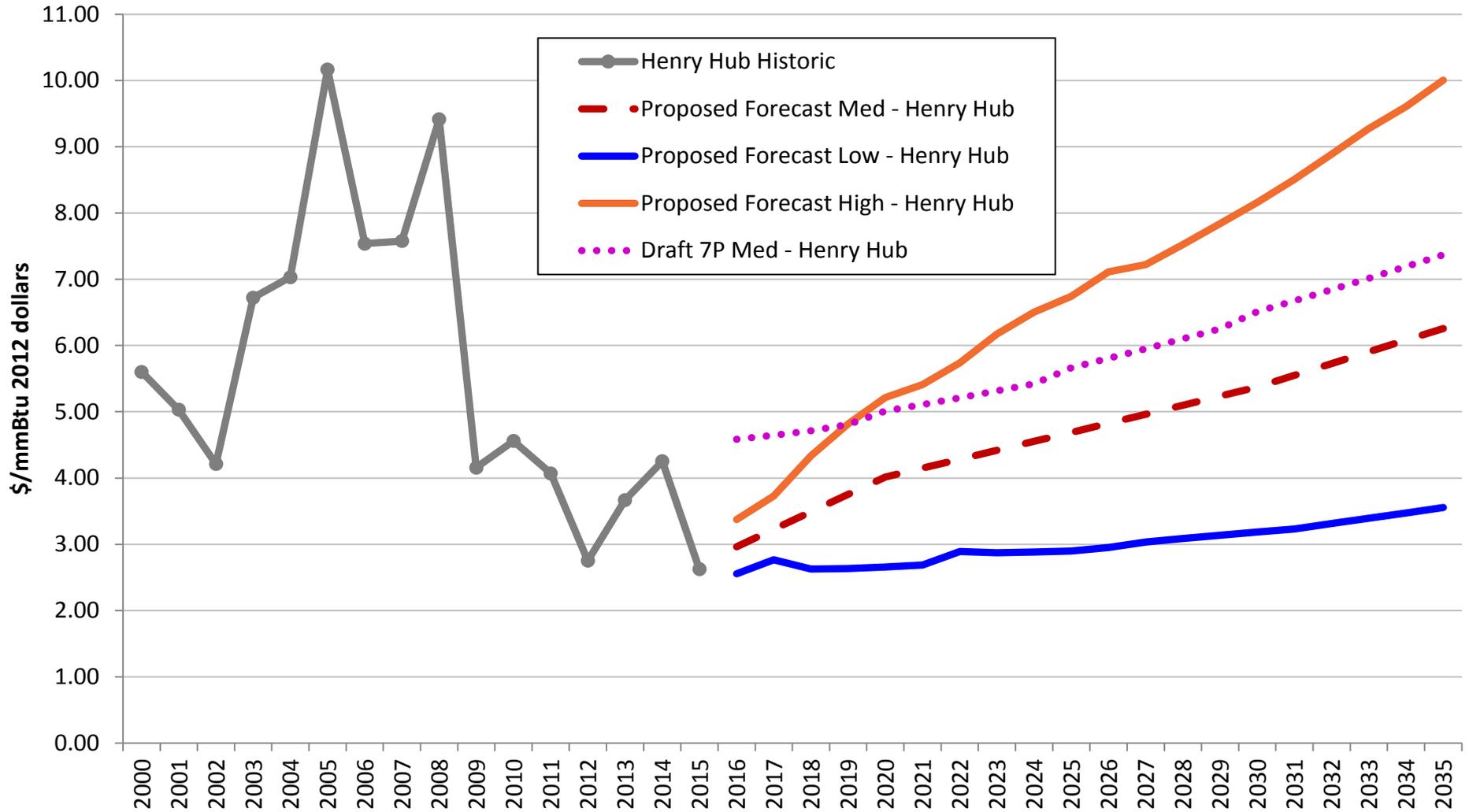
Natural Gas & Wholesale Electricity Prices

- Natural gas prices have dropped since the draft price forecast was developed
 - Current spot prices for gas at Northwest hubs are very low: AECO is around \$1.85, and Sumas \$2.25 per mmBtu
 - Continued strong gas production, high storage inventory levels, and an expected mild winter ahead
- Current prices for wholesale electricity at the Mid-C are also low, currently around \$23/MWh
 - Annual average for 2014 was around \$31/MWh

Action and Implications

- Conducted a poll of the Natural Gas Advisory Committee in late November regarding future gas prices
- A new price forecast (medium, high and low) was developed to be input to RPM in order to reflect current sentiment – prices in the medium case would drop by around \$1 from the draft forecast
- The new gas prices were also used to update the Wholesale Electric Price Forecast input – which lowers medium forecast by \$3 to \$4 /MWh
- Full Levelized Cost of Energy calculations for Natural Gas Plants (used for resource comparison purposes) – will be slightly lower

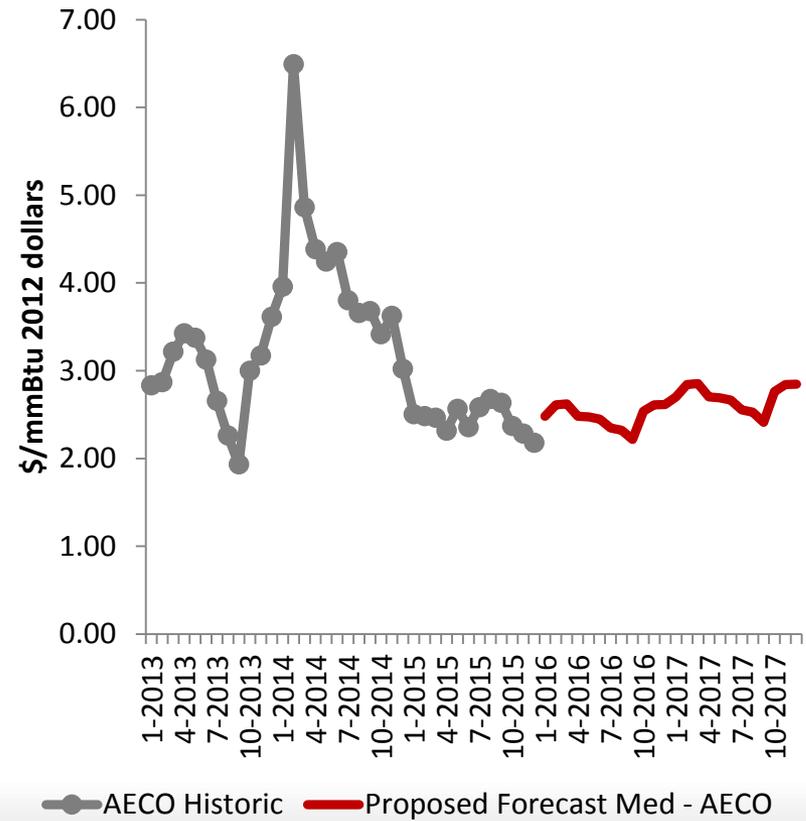
Natural Gas Price - Henry Hub (\$/mmBtu)



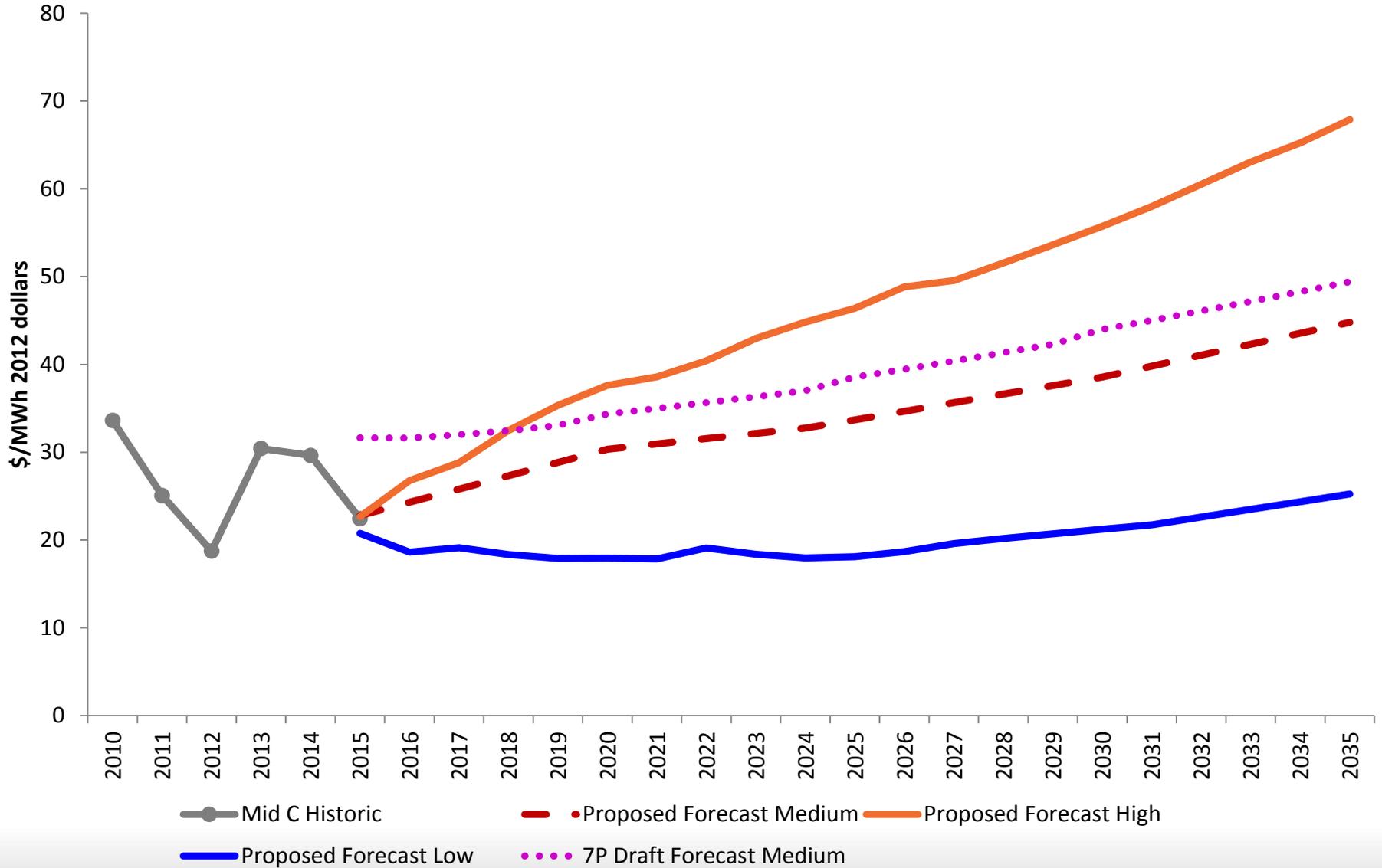
Uncertainty

RPM will continue to impose uncertainty around the medium forecast to reflect price spikes due to weather, shortages due to supply issues or pipeline/storage constrictions.....

Natural Gas Prices - AECO Hub



Wholesale Electricity Price (\$/MWh) - Mid C



Recommendations

- Lower medium natural gas price forecast, by approximately \$1/MMBtu
- Very similar forecast future gas price range (i.e. high to low)
- Lower medium wholesale electricity market price forecast by approximately \$3 to \$4/MWH
- Very similar forecast future electricity price range (i.e. high to low) unchanged

Renewable Resource Generation Updates

December 2015

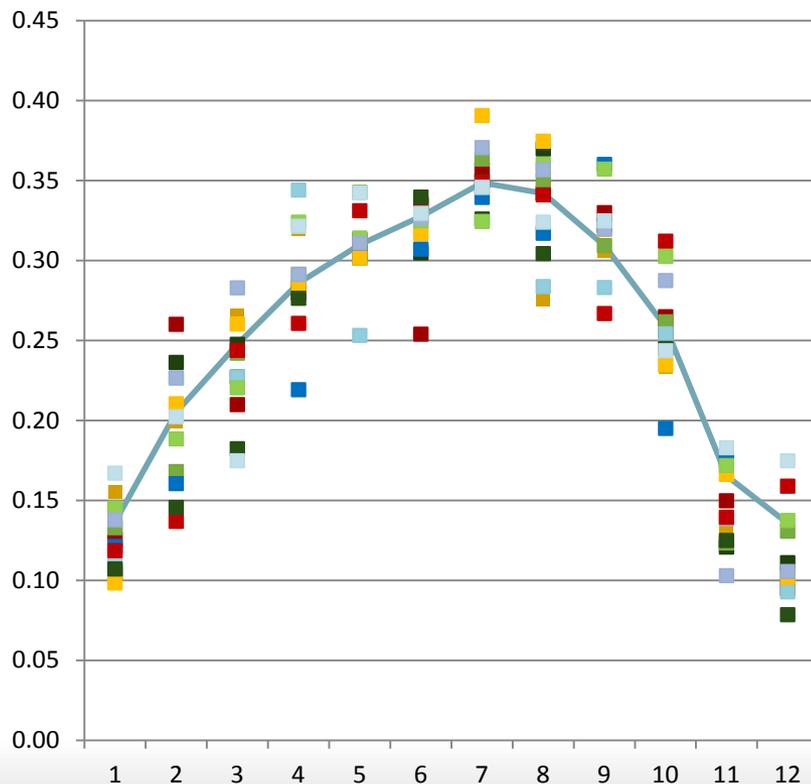
Renewable Resources

Proposed New Options

- **Utility scale solar PV plant on the West side of Cascades**
 - Levelized cost of this resource is higher than Southern Idaho solar but offers additional potential to build solar near available transmission
- **Conventional Geothermal generation based on 6th Plan analysis**
 - Levelized cost may make resource economic
 - Provides winter capacity
 - Enhanced Geothermal (EGS) has strong potential and was analyzed as an emerging technology but was not modeled in RPM

Utility Scale Solar & Geothermal

Solar Capacity Factor by month for multiple years – S. Idaho Location



- Westside Utility Scale Solar Reference Plant added to RPM
 - 50 MWac plant, c-Si with single axis tracking
 - Levelized Cost of Energy falls between S ID plant and S ID plant with new transmission
- Conventional Geothermal
 - Levelized Cost on par with solar or less
 - Offers dispatchable power
 - Limited developable potential

Modeling of Resource Adequacy (ARMs) and System Capacity Impacts of Resource Additions (ASCCs)

- **Recommend increasing resolution of adequacy assessment from single quarter (winter) to all quarters**
 - Requires translating annual LOLP adequacy standard to “quarterly” criteria
 - RPM must meet adequacy standard in both summer and winter
- **Recommend increasing resolution of system capacity contribution of resources (i.e., ability to store hydro for peaking use) from annual to quarterly**
 - Improves representation of capacity for resources that have seasonal variation in output (e.g., solar, wind and energy efficiency)

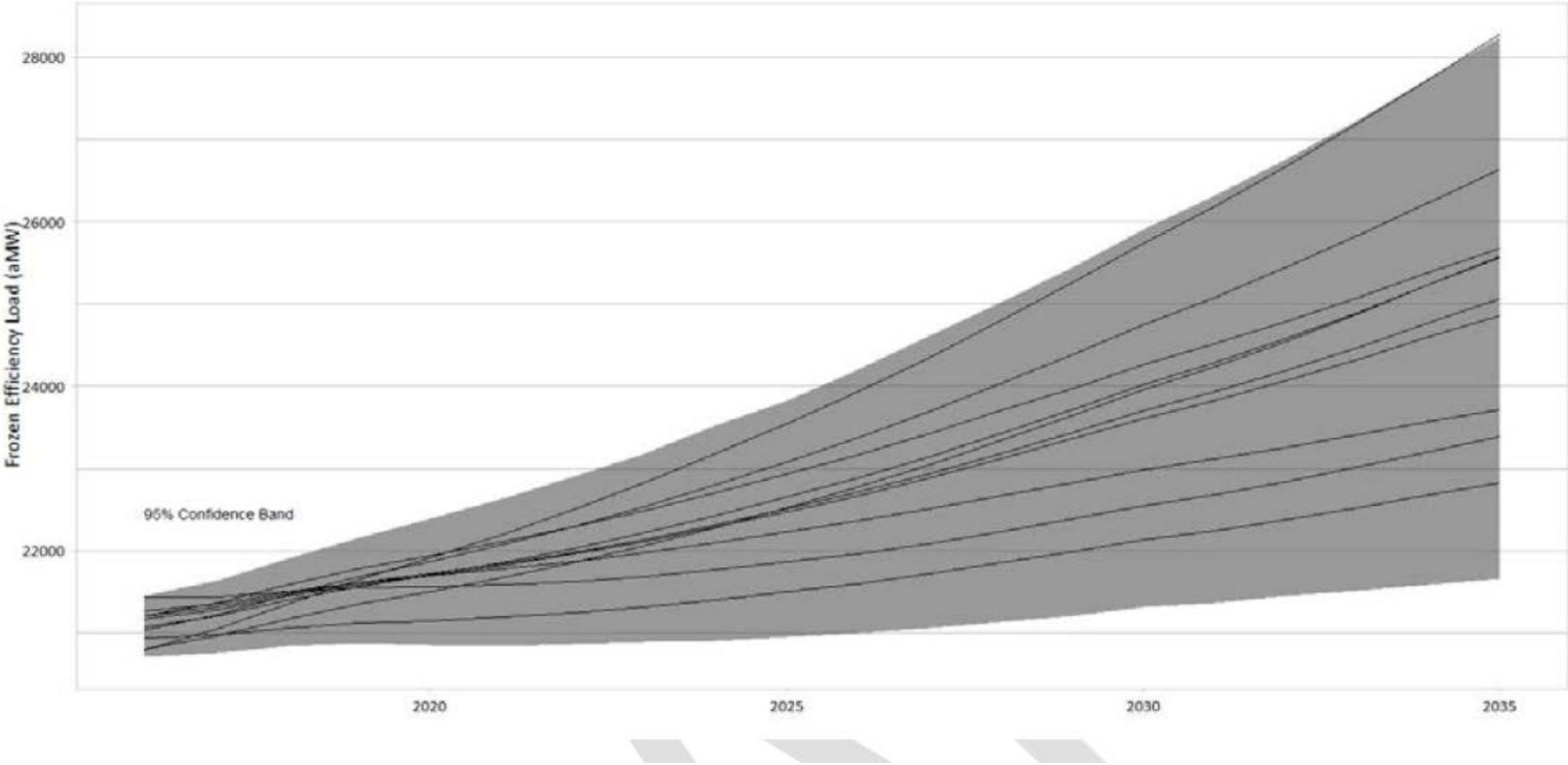
Modeling Existing RPS

- Draft Plan assumed Existing RPS requirements are calculated based on percent of “load” (i.e., retail sales, plus distribution and transmission system losses)
- Review of statutes/rules revealed that requirements are calculated based on percent of retail sales (exclude losses)
- Net result is that existing RPS requirements are lower than shown in draft

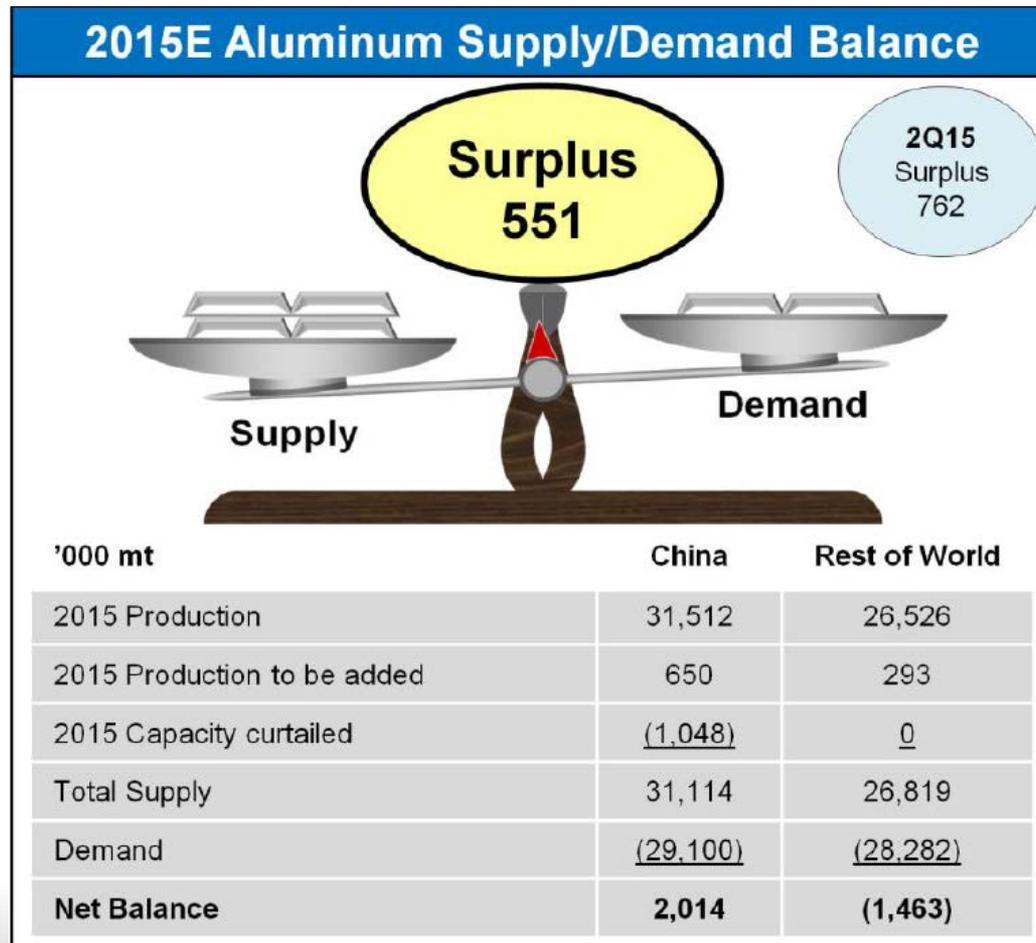
Backup Slides

Current Range of Load Forecast in RPM

Figure 15 - 1: Example of forecast potential future load for electricity



Background on Aluminum Market



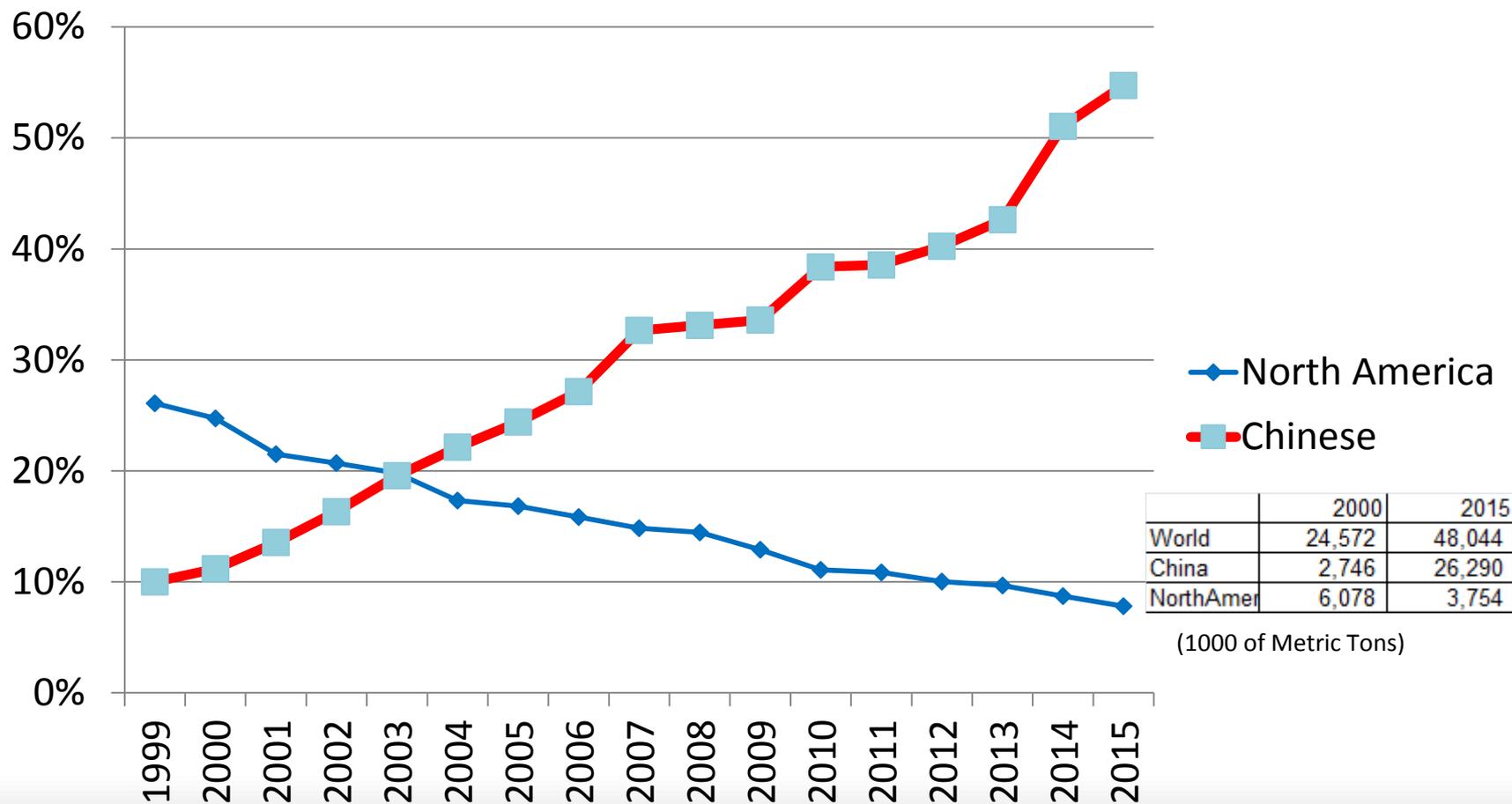
Source: Alcoa Q3 2015 Report

Factors impacting the forecast for Alcoa Smelter operations

- **Price of aluminum**
 - World production by other producers
 - Demand for aluminum
 - Regional price premium
 - Exchange rate
- **Regional Cost of production**
 - Electricity
 - Feedstock (carbon and Alumina)
 - Labor
- **Alcoa's corporate direction**
 - Upstream production
 - Downstream value added

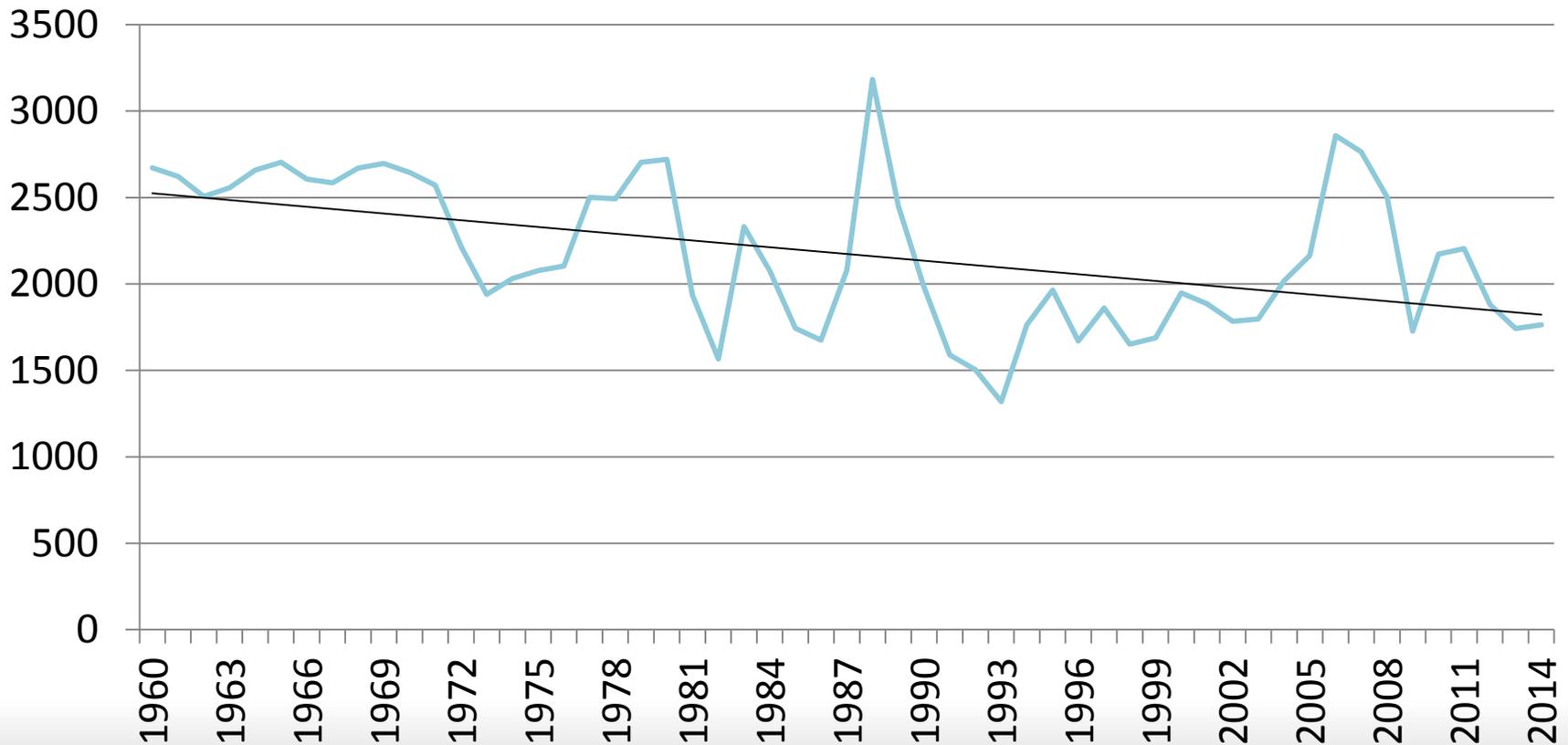
US production capacity has been on a steady decline

(North American and Chinese Market Share in world Aluminum Production)



World Aluminum Prices has been on a long-term decline trajectory

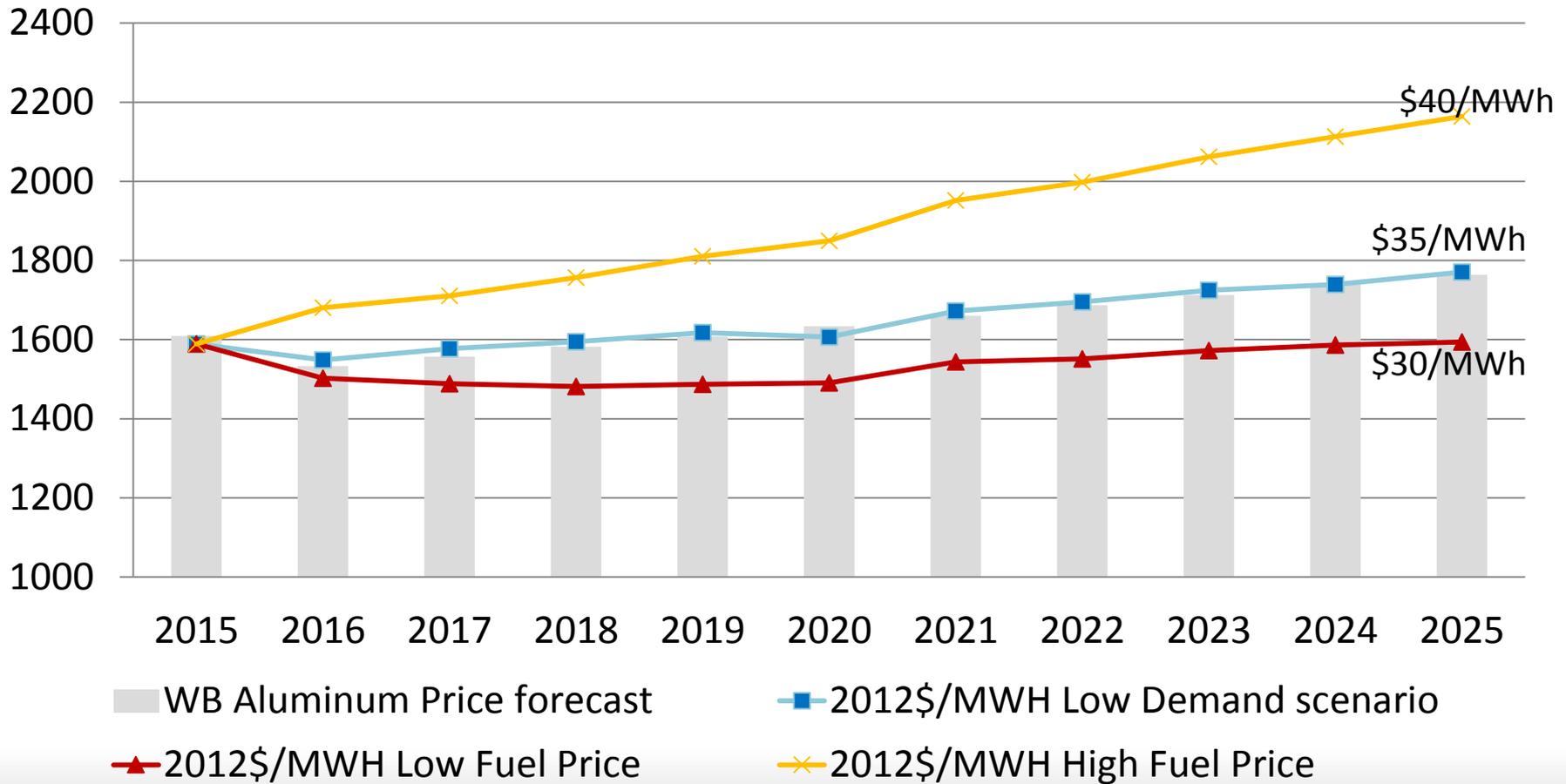
(2010 \$/Metric tons)



Estimated Breakeven Cost of Aluminum Production (2012\$/metric tons)

at different wholesale electricity price forecasts

(30-40 dollars /MWh @Mid C)



Alcoa net income sensitivity

Annual Sensitivity Summary

LME Aluminum Annual Net Income Sensitivity

+/- \$100/MT = +/- \$190 million

API/Spot Alumina Annual Net Income Sensitivity

+/- \$10/MT = +/- \$20 million

Currency Annual Net Income Sensitivity

Australian \$	+/- \$11 million	per 0.01 change in USD / AUD
Brazilian \$	+/- \$ 1 million	per 0.01 change in BRL / USD
Euro €	+/- \$ 2 million	per 0.01 change in USD / EUR
Canadian \$	+/- \$ 4 million	per 0.01 change in CAD / USD
Norwegian Kroner	+/- \$ 4 million	per 0.10 change in NOK / USD