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October 28, 2014

MEMORANDUM

TO: Council members

FROM: Steven Simmons

SUBJECT: Draft Plan Wholesale Power Price Forecast Range

BACKGROUND:

Presenter: Steven Simmons

Summary: A 20-year forecast range of wholesale power prices has been completed for use in the Draft Plan. Council staff uses the electric market model AURORAxmp by EPIS to generate a forecast for power prices across the Western Electricity Coordination Council (WECC) region, with special emphasis on regional prices. A few key points to take away from this forecast cycle include:

1. There is little change in prices from the previous forecast completed in 2013. Prices remain relatively low and reflect continued low variable cost hydro and wind generation, low demand growth, and low natural gas prices.
2. The power price values at the Mid C are strongly influenced by the price of natural gas. Accordingly, the power price forecast range is defined by the span of forecasted high and low prices for natural gas.

Relevance: The forecast provides the Regional Portfolio Model (RPM) with a benchmark power price for heavy and low load hours at the Mid C; assuming average hydro generating conditions. The RPM then addresses the price volatility that can occur due to various hydro, load, and natural gas price conditions. Market prices are used by the model to help value the future mix of generation and conservation.

The power price forecasting work can also be used to evaluate trends in the mix of future generation, and greenhouse gas emissions. For instance, under average hydro and load forecast conditions, the CO2 emissions from regional power generation can be expected to decline as coal unit retirements occur in 2020 and 2025.

Workplan: 1. D. Update major deliverables for Seventh Plan

Background: Progress on the 2014 power price forecast was presented to the Power Committee at the January 14 and April 8 meetings.

More Info: The report on the 2013 forecast is available at <http://www.nwcouncil.org/energy/forecast/>

Draft Wholesale Power Price Forecast Range

**Power Committee
November 4 ,2014
Steven Simmons**

Today's Content

- 1. Key Points**
- 2. Forecast approach and setup**
- 3. Case definition and results**
- 4. Forecast range**
- 5. Hourly/Monthly/Annual results**
- 6. Generation resource mix**
- 7. CO2 emission**
- 8. Influence of natural gas prices**

4 Key Points

1. Little change from previous forecast cycle
2. Electricity prices are strongly influenced by the price of natural gas
3. The span of average forecasted wholesale electricity prices is defined by the high and low natural gas price forecast
4. The forecast range provides RPM with a benchmark, or central tendency of electric price futures. RPM takes care of the price volatility that can occur under various hydro, load, natural gas price, and resource/load imbalance conditions.

Forecast Approach

Council utilizes the AURORAxmp Electric Market Model by EPIS

1. Hourly dispatch model, price is based on the variable cost of the marginal generating unit
2. Produces hourly, monthly, annual on and off peak power prices for the entire WECC – our focus is on the Mid-C (PNW East region)

Power Council Model Setup

- NW Region is broken in 3 zones – PNW W, PNW E, S ID – the PNW E zone is proxy for the Mid C pricing hub
- Generation that sits physically outside the region but serves load within the region is counted as in-region
- Forecasts for demand (net of conservation) and fuel price are sourced from the Council
- Average hydro conditions are used for each year
- RPS targets are assumed to be met with actual resources, not RECs.

Power Council Model Setup

- CO2 cost modeling
 1. British Columbia Carbon Tax initiated in July 2008 at 10 \$/tonne – increased 5 \$ per year until reaching \$30/tonne in 2012
 2. California Cap & Trade
 - a. Allowance cost \$/ton for generation within state beginning in 2013 from CARB quarterly auction
 - b. Hurdle rate \$/MWh for imports based on import region carbon intensity

Forecast Case Definition

Case	Demand	Fuel Price
Mid	Mid	Mid
High Demand	High	Mid
Low Demand	Low	Mid
High Fuel ¹	Mid	High
Low Fuel ²	Mid	Low

¹ defines high price boundary

² defines low price boundary

Forecast Case - by the Numbers

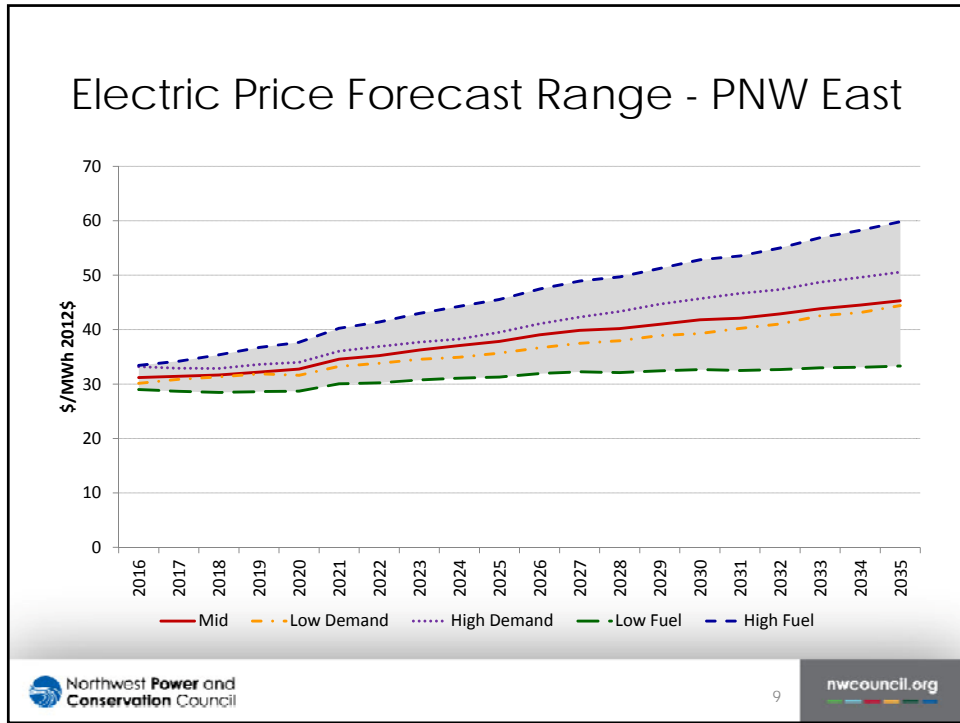
Case	Ave Annual ¹ Demand ² Growth %	Levelized ³ Natural Gas Price ⁴ \$/mmbtu in 2012\$	Levelized ³ Electric Price ⁴ \$/MWh in 2012\$
Mid	0.4	4.44	37.01
High Demand	1	4.44	39.45
Low Demand	0.2	4.44	35.55
High Fuel	0.4	5.78	44.45
Low Fuel	0.4	3.29	30.77

¹ 20 year period: 2016 – 2035

² Demand is for 3 zone region (incl OR, WA, ID, W MT)

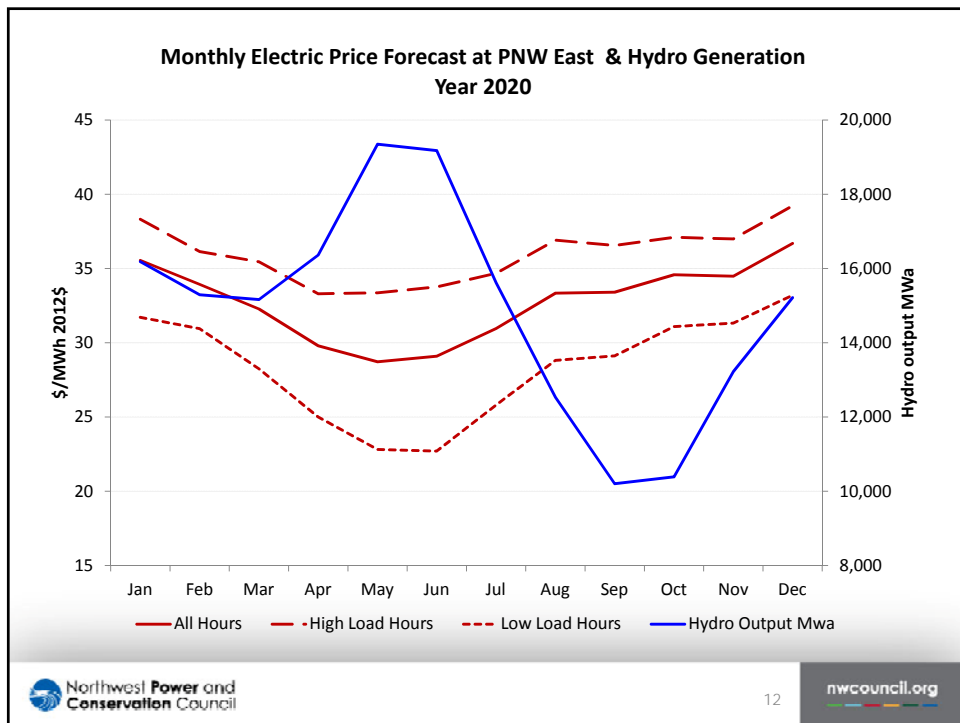
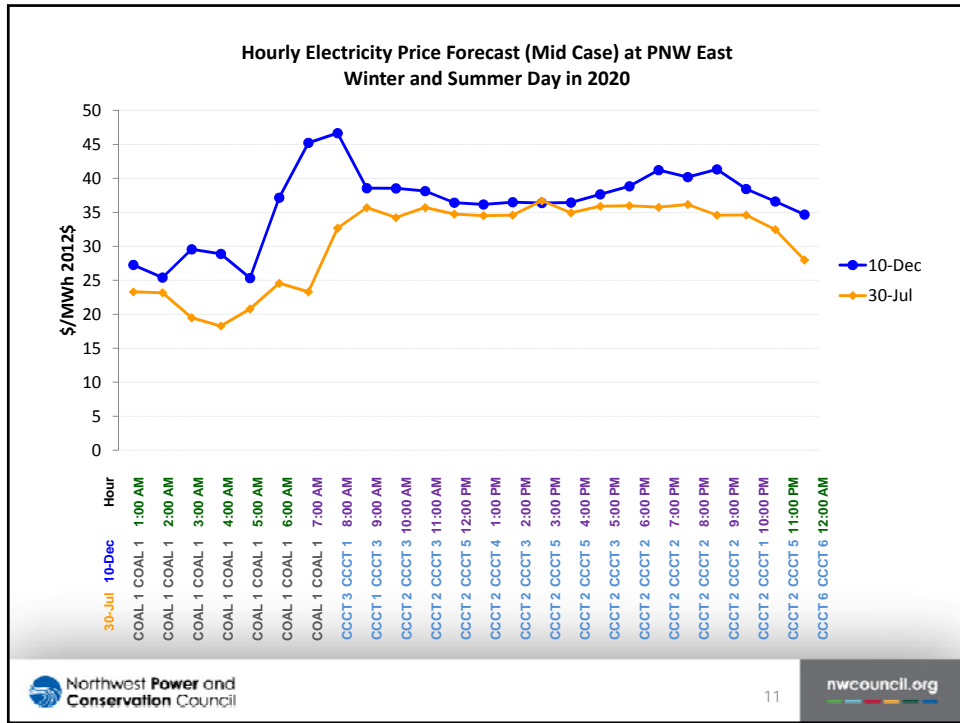
³ 4% Discount rate

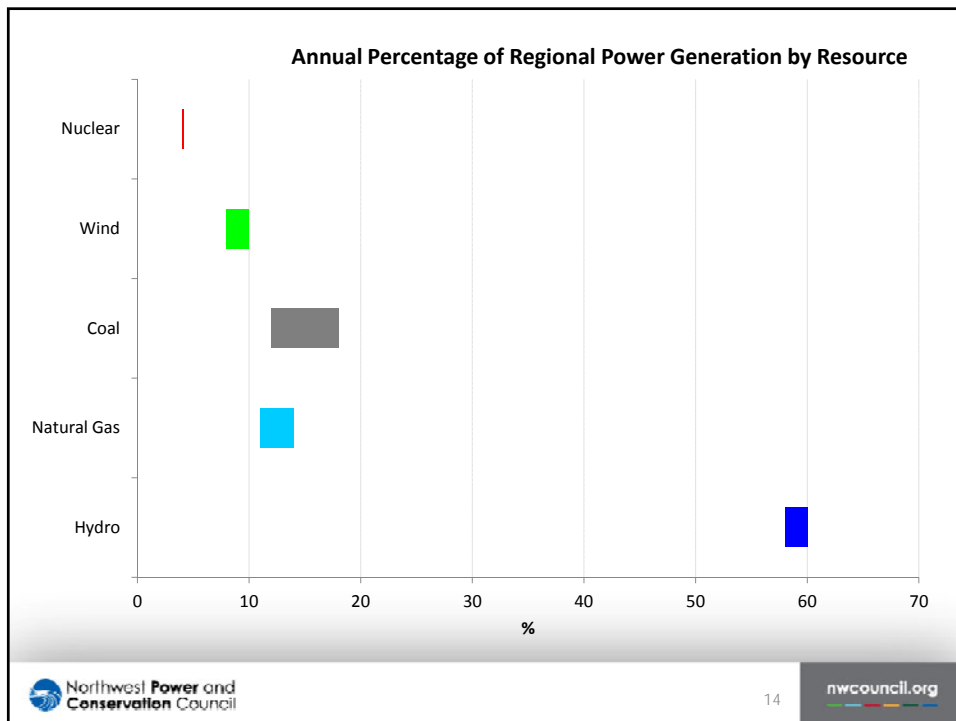
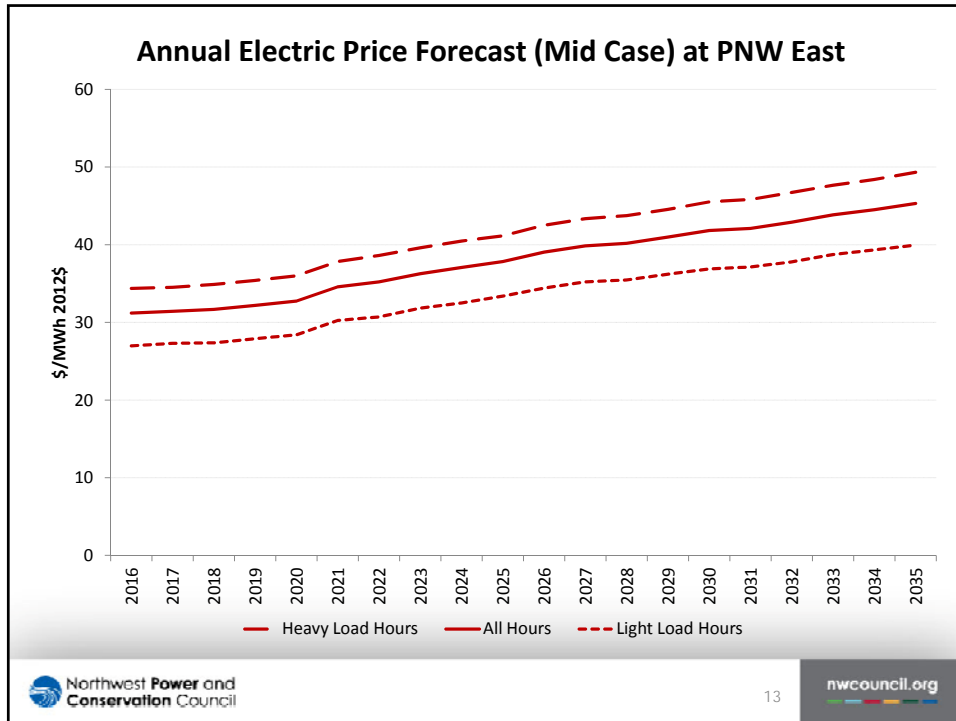
⁴ Price at PNW E



Mid Case Results

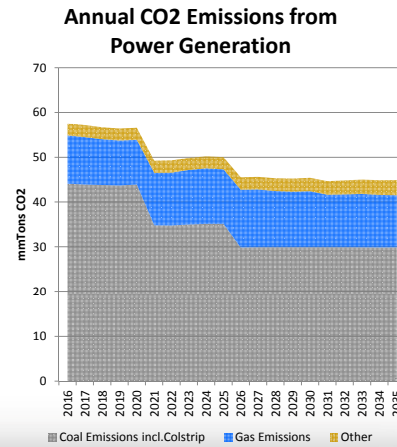
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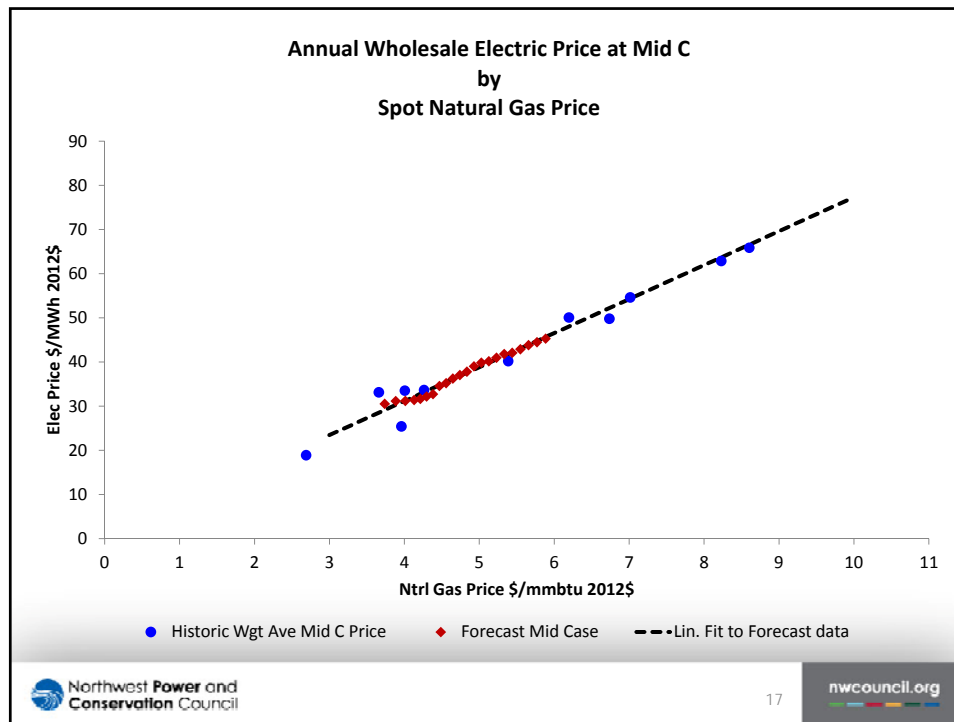
Power System Carbon Dioxide Emissions

- Relatively low CO₂ emissions - abundant hydro and wind power, energy efficiency and retiring coal plants
- CO₂ intensity – lbs CO₂ per kWh of electricity – 0.51 in 2016, drops to 0.41 by 2031



Influence of Natural Gas Price

1. Historic electricity prices at Mid-C strongly influenced by natural gas price
2. Forecast electricity prices also strongly influenced by natural gas price – linear fit
3. Forecast bounds defined by high/low gas price forecast
4. Future bounds can be defined with new gas prices based on linear fit relating electricity price to gas price



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