Northwest **Power** and **Conservation** Council

February 7, 2017

MEMORANDUM

TO: **Council Members**

FROM: **John Ollis, Power System Analyst**

SUBJECT: **Marginal Carbon Emissions Study Preview**

BACKGROUND:

Presenter: John Ollis, Gillian Charles

Summary: This presentation will be a preview to the release of the draft Marginal Carbon Emissions study next month.

Relevance: The study of marginal carbon dioxide production rates of the northwest power system will evaluate what resources are marginal in every hour of four years (2016, 2021, 2026 and 2031) and the implications for conservation replacing the need for that production. The results will summarize the findings into an annual average marginal carbon dioxide rate (lbs per MWh) for the years of the study for two scenarios analyzed in the 7th Power Plan: Existing Policy and Average Social Cost of Carbon.

Workplan: N/A

Background: The cost of future carbon dioxide regulation has been a significant factor in resource planning in the Pacific Northwest. To avoid making higher cost resource choices, a direct evaluation of this risk requires an estimate of the carbon dioxide emissions avoided by purchasing conservation or another resource. The Council has periodically produced this study using

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the AURORAxmp model to help inform Council staff and regional stakeholder analysis.

Per the discussion in the January 2017 Power Committee, AURORAxmp has been used as the Council's wholesale market electricity price forecasting model. Since the wholesale electricity price is determined by the variable costs of the most expensive, available supply or demand-side resource necessary to meet the load, the Council can also use AURORAxmp, to determine the average CO2 emissions of the marginal unit.

More Info: Marginal Carbon Emissions Study scope

2008 Marginal Carbon Emissions Study:
https://www.nwcouncil.org/media/29611/2008_08.pdf

For more information please contact John Ollis.

Marginal Carbon Dioxide Production Rate in the Pacific NW Power System: Preview

John Ollis

Gillian Charles

February 14, 2017

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Original Study

- Staff released its original marginal carbon study in June 2008
  - *Marginal Carbon Dioxide Production Rates of the Northwest Power System*
- Council received requests during and after the Seventh Power Plan to update this analysis
  - ODOE, OPUC, NW Natural, other stakeholders

What does the marginal cost of carbon mean? (1)

- **Marginal resource** – The most economic way to meet an additional one MW of load
  - The next least *variable* cost resource available
- In the PNW, the average CO_2 production of all resources is *typically* less than the average CO_2 production of the marginal resource

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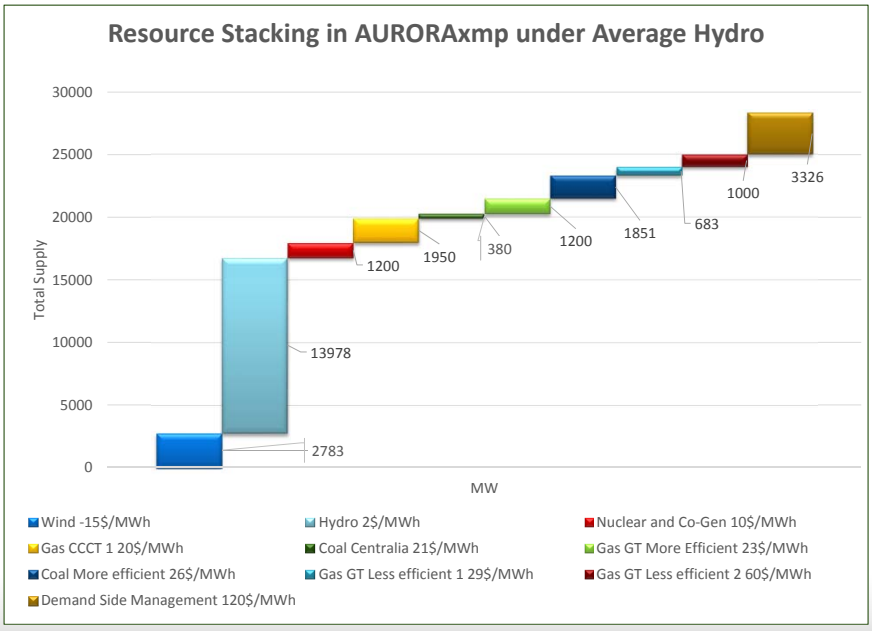

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What does the marginal cost of carbon mean? (2)

- If you could replace the marginal resource with conservation or a low/zero carbon emitting resource, what would the value of that resource be?
- Through analysis, determine the average emissions per unit of production and multiply it by the CO_2 price assumption per ton

Example: If the average hourly marginal resource is **0.362 tons of CO_2/MWh** and the CO_2 price is **$14/ton**, the marginal cost of carbon is ~ **$5/MWh**

→ This would increase the value of conservation (or a zero carbon emitting resource) by **$5/MWh**

Uses for the analysis - Council

- Inform current and future policy issues and model scenarios
  - How does the marginal carbon production change when/if certain resources are retired?
- Input to ProCost as a way to incorporate carbon costs directly based on physical carbon and cost per physical unit

Uses for the analysis - Stakeholders

- Inputs to regulatory proceedings
  - Regulatory commissions have requested hourly marginal physical carbon impacts for various dockets
- Cumulative carbon offset tracking
  - For entities tracking or forecasting net carbon change from mitigation strategies to meet state or Federal compliance requirements

Study Methodology

- Use AURORAxmp to determine marginal unit of production in the region.
- Evaluate CO2 emissions of the marginal resource.

Changes in Study Methodology

- Instead of using AURORAxmp for resource expansion, use RPM results from 7th Power Plan.
- Each of the 10 scenarios will be considered under all 80 hydro conditions instead of just average hydro conditions.
- All scenarios will be run with regional reserve requirements and hydro methodology similar to what was used the 7th Power Plan Balancing and Flexibility study

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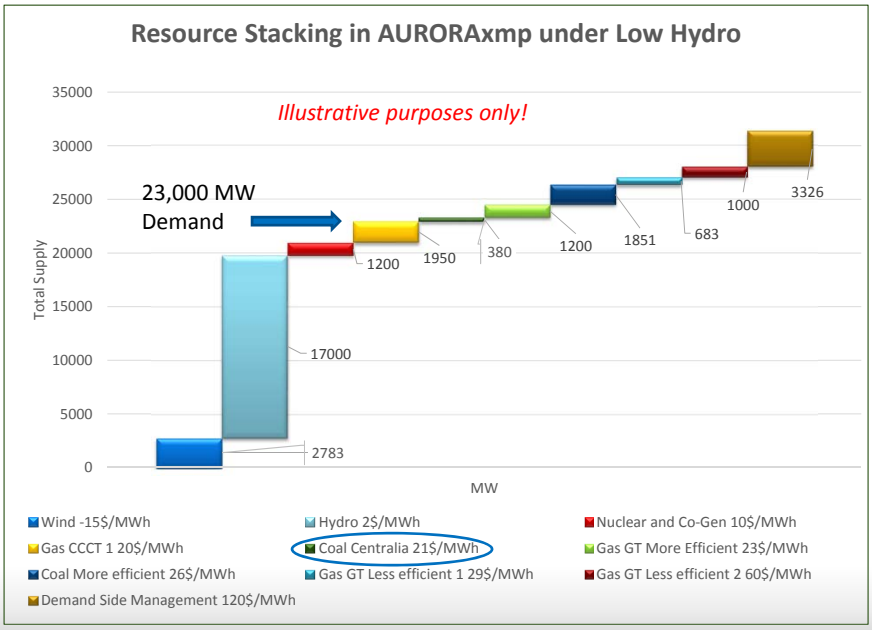

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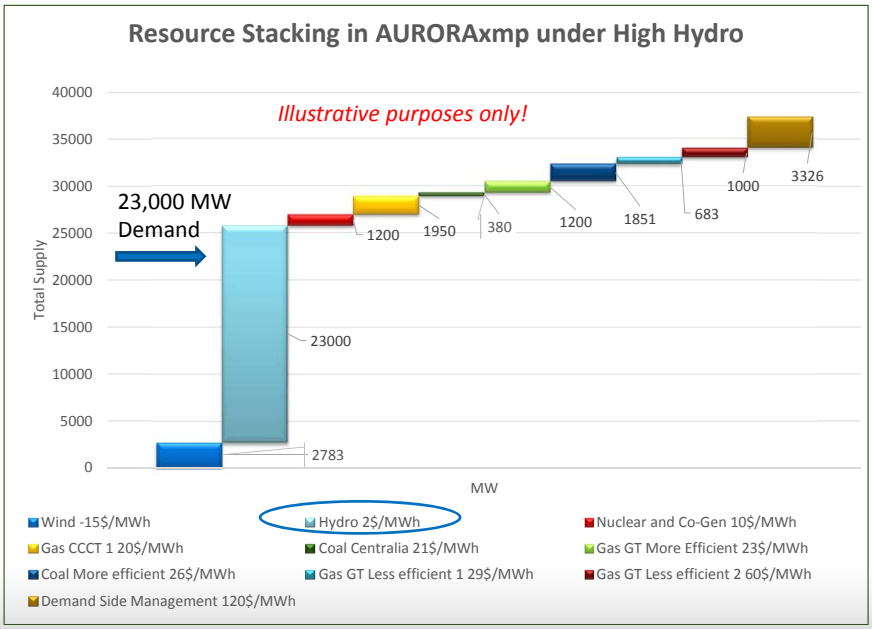

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Study Timeline

2016
Tests current conditions

2021
Tests the end of Action Plan time period and coincides with plant retirements

2026
Coincides with further plant retirements and higher regional RPS requirements.

2031
Higher regional RPS requirements.

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Scope for analysis: Scenarios

Sensitivity	2016	2021	2026	2031
Existing Policy Scenario	1 scenario • Plan EE • No new DR • No new generation	2 scenarios • Plan EE • Minimum and Expected DR • No new generation	1 scenario • Expected EE • Expected new DR • Expected new generation *(All from RPM: Existing Policy scenario results)*	1 scenario • Expected EE • Expected new DR • Expected new generation *(All from RPM: Existing Policy scenario results)*
Average Social Cost of Carbon Scenario	Same as above	Same as above	Same as above except buildout of resources from RPM: SCC-Mid Scenario results	Same as above except buildout of resources from RPM: SCC-Mid Scenario results

Updated Inputs

- WECC generation resource data outside the region will be updated per 2026 Common Case dataset and AURORAxmp database updates
- In the region, generation data will be updated per the Council's Generating Resource Database
- Loads and fuel prices are updated per most recent Council forecasts.

Next Steps

- AURORAxmp database updates and model setup will be complete in Mid-February.
- Results of study presented at an upcoming Council meeting.
- Paper released at end of March

Early Results

If early results are available, staff will show them at the Power Committee…