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

April 27, 2021

MEMORANDUM

TO: **Council Members**

FROM: **Tina Jayaweera, John Ollis**

SUBJECT: **Demand Response Sensitivity Study**

BACKGROUND:

Presenter: Tina Jayaweera

Summary: At the April 21, 2021 Power Committee webinar, staff presented results from a demand response sensitivity study exploring the impact of modifying the DR supply curve. Members requested additional background information on the development of the supply curves and motivation for the modification.

The DR supply curves were developed by staff, with significant input from the Demand Response Advisory Committee (DRAC). Starting in 2019, DRAC meetings were focused on determining and vetting the inputs and assumptions, such as: products incorporated, impacts, and costs. The starting point for many of the assumptions were based on the Seventh Plan DR supply curve and regional utility potential assessments, but were modified and enhanced through stakeholder expertise and utility experience. For example, Portland General Electric has recently launched several DR programs that informed the supply curve.

A notable update from the Seventh Plan is that non-firm demand response products were added. These include price-based DR, such as time-of-use, critical peak pricing, and peak time rebates. These price-based demand response products are considered “non-firm” because the utility has less

control over the impact – end-use customers will determine how they will respond to that price signal. Time-of-use (TOU) DR is also non-dispatchable in that the on- and off-peak time periods and rates are pre-determined and generally long-standing (e.g. for an entire season or year).

In addition, demand voltage regulation (DVR) was a new product not previously incorporated. Several BPA utility customers have successfully utilized DVR during peak hours to trim demand charges. BPA staff were instrumental in developing our assumptions for DVR, as well as the related energy efficiency option of conservation voltage regulation (CVR) that reduces the voltage for all hours.

When the supply curves were developed, the primary expected purpose of DR in the power system was reducing demand during peak hours to support adequacy needs. Thus, the assumptions built into the curves was around this attribute of how to reduce a short-term need during what would be assumed to be a very high-price period. The bins representing DR were developed to represent this need and differentiated by levelized cost. In addition, a conservative dispatch assumption of 4 hours per event, 5 events per season was used uniformly, along with a dispatch cost of $150 per megawatt-hour.

However, as the plan analysis proceeded, staff learned that the system needs were less about peak adequacy and more about a persistent need to mitigate rapid changes in net load (load net of primarily renewable resources). Due to these effects on the power system, the peak pricing in the Regional Portfolio Model (RPM) can be high and the emissions associated with it may be considerable. However, the price of peak energy in the RPM is not necessarily high enough to dispatch DR very often at $150 per megawatt-hour. Since that dispatch price assumption was primarily formulated for certain products, and the assumption was used for all products principally for simplicity in binning strategy, this meant that by binning lower dispatch price DR with higher dispatch price DR we might be missing a signal that DR might play a role in peak energy cost mitigation. With this learning came a recognition that likely some DR could provide value within this system, but not as currently incorporated in the supply curves.

Specifically, the DR products that could provide the most value are those that either have minimal customer impact when deployed and thus could be dispatched frequently, or are intended to result in a day-to-day shift in usage pattern (namely TOU). For products that have minimal customer impact and could be dispatched frequently, DVR is a key option. (Another option could be load control of grid-enabled water heaters, but this product is still expensive with current limited applicability and so were not considered in this sensitivity analysis).

To test this sensitivity, staff reconfigured the supply curve bins to:

1. Only include DVR and residential TOU in bin 1 – all other previous bin 1 products were moved into bin 2.
2. The hours of deployment for DVR and TOU were assumed to be all peak hours of 6pm – 10pm Monday through Saturday, or 288 hours per quarter, except spring when needs are different.
3. The dispatch cost was reduced to $0 per megawatt hour for TOU and DVR. The dispatch cost was meant to reflect an economic hurdle to dispatch the product only during times of peak need to minimize customer inconvenience. Given the limited customer impact of DVR and the lack of dispatch for TOU, a zero or negligible dispatch cost is more realistic.

The result of this test was the RPM found value in acquiring the DVR and TOU bin to reduce greenhouse gas emissions and reduce cost.

Relevance: Demand response could be a recommended part of the 2021 plan's resource strategy and better understanding its potential value will inform that recommendation.

Workplan: A.3 Finalize recommended DR and related findings for the power plan

Background: The draft DR supply curves were presented at the March 2020 Power Committee: https://www.nwcouncil.org/sites/default/files/2020_03_p3.pdf

More Info: In July 2018, a representative from Kootenai Electric Cooperative presented on a DVR program they implemented: https://www.nwcouncil.org/sites/default/files/2018_0710_2.pdf

Demand Response Sensitivity Study

Power Committee

May 4, 2021

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FOR A SECURE & AFFORDABLE ENERGY FUTURE

1

Purpose

- At the April 21, 2021 webinar, Power Committee member asked for more clarification around the DR sensitivity study performed as part of the GHG tipping point scenario
- The original supply curves were developed to explore value of DR to reduce peak impacts during critical short-term periods (4 hours)
- This sensitivity altered the characteristics of two DR products and re-binned
  - Increased frequency of dispatch
  - Decreased cost of dispatch

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2

High-Level Takeaway

Low fixed cost demand response programs that can be used frequently at little dispatch cost with minimal change in customer experience can be designed to be effective at not just meeting adequacy needs but also

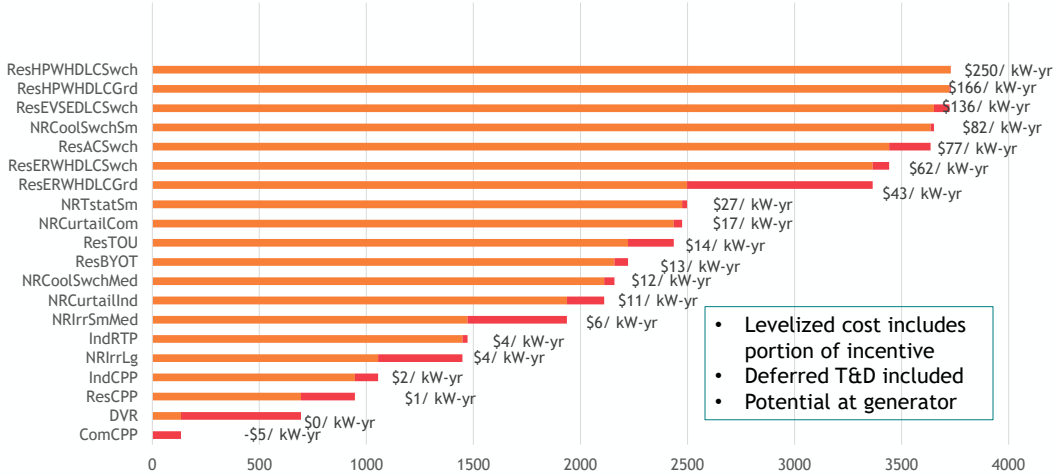
1. Reducing energy costs associated with meeting peak times
2. Reducing emissions associated with meeting peak times

3

Supply Curves - Review

4

Summer – Total 3730 MW



- Levelized cost includes portion of incentive
- Deferred T&D included
- Potential at generator

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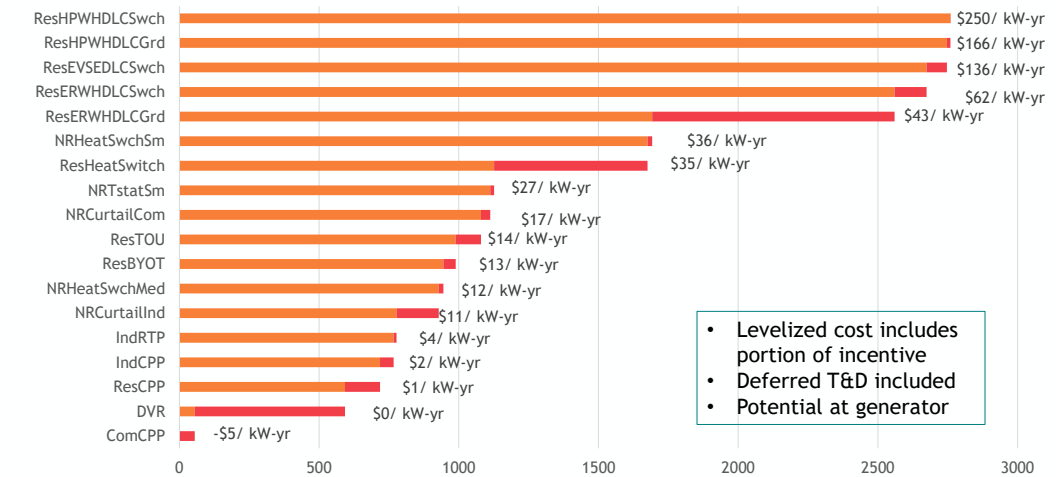
5

5

Winter – Total 2761 MW



- Levelized cost includes portion of incentive
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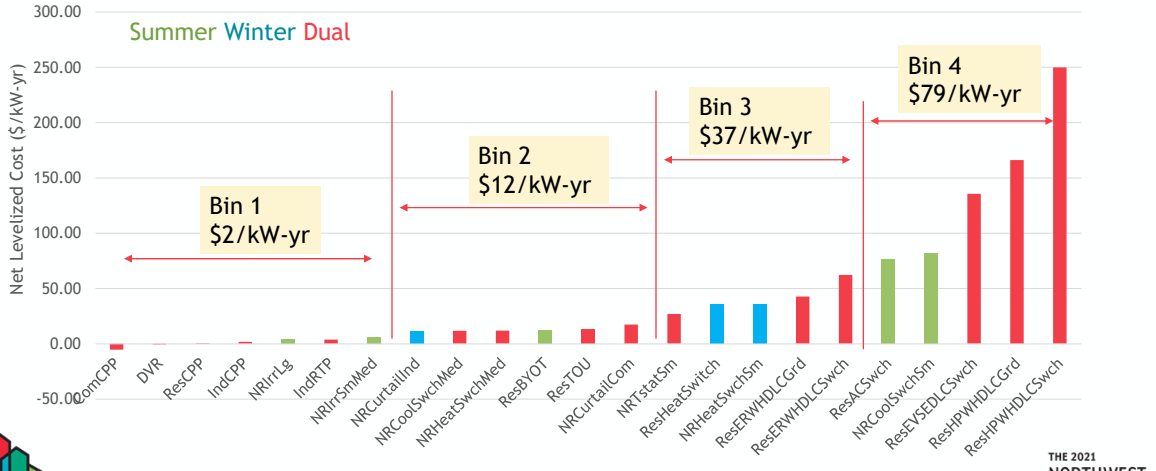
6

6

Original Binning



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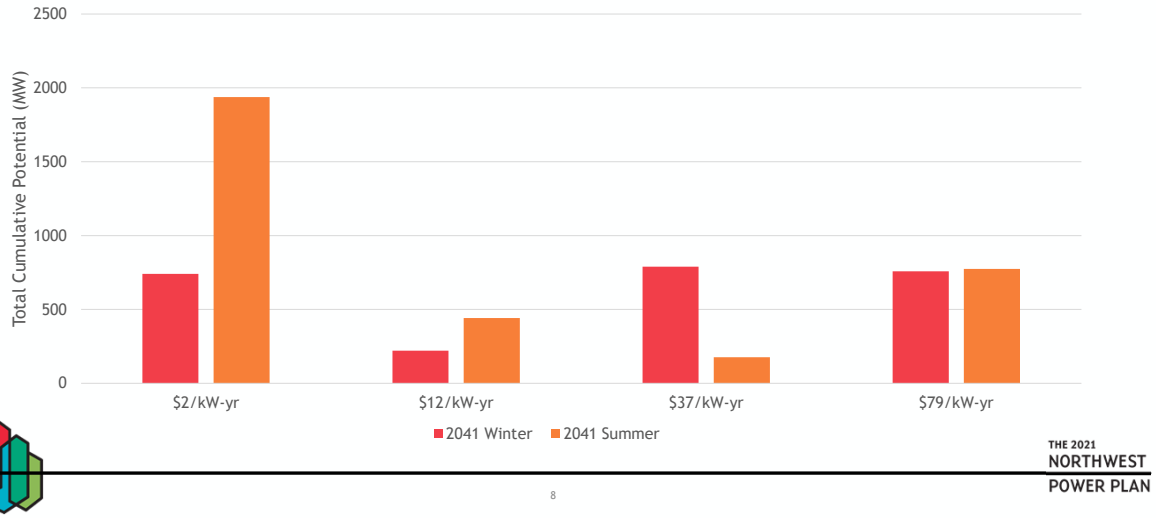
Total Potential by Price Bin & Season



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Sensitivity Test

9

Sensitivity Test

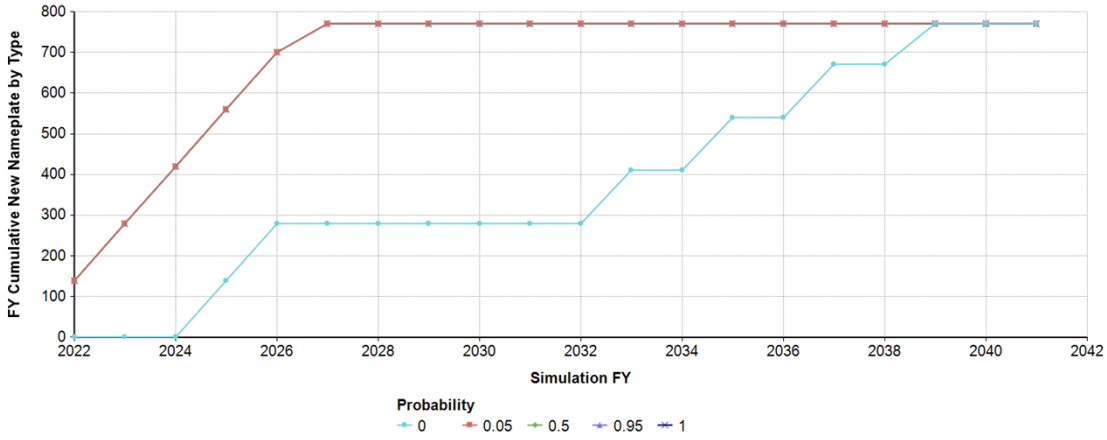
- Through the plan analysis, staff understanding of the system needs evolved
- Short term, limited application (4 hours/event, 5 events/season) DR was not found to be acquired in RPM
- Rather, products that could be deployed more frequently during daily peak hours would likely provide value - some DR could fit this need
  - Products with limited customer impact (e.g. Demand Voltage Regulation)
  - Tariff-based products that are long-standing (e.g. Time Of Use)
- Staff updated assumptions of DVR and TOU to reflect this alternate application and binned them together
  - Increased hours of deployment – 288 hours/quarter (except spring) to reflect 4 hours/day x 6 days per week
  - Decrease dispatch cost to $0/MWh to better reflect actual costs for these products

10

Sensitivity Results

- DVR and TOU bin was acquired in RPM
- Reduces cumulative Greenhouse Gas Emissions by 1.4 MMT
- Reduces system cost by 1.87% and residential bills by 0.1%
- No substantive change in EE, Renewable, or Thermal builds from the baseline

High Probability of DR Builds



Extra Slides

13

Types of DR

- Firm/Controlled
  - Allows either interruptions of electrical equipment or appliances that are directly controlled by the utility or are scheduled ahead of time.

- Non-firm/Price-Based
  - Outside of the utility's direct control and are driven by pricing.
  - May or may not be "dispatched"

14

Products Considered - Residential

Summer Only	Winter Only	Dual Season
AC Switch	Heating Switch	Bring-Your-Own-Thermostat
		Water heater (heat pump and electric resistance) - switch
		Water heater (heat pump and electric resistance) - grid-connected
		Electric Vehicle Supply Equipment control
		Critical Peak Pricing
		Time-of-Use

Black text indicates controllable DR
Blue text indicates price-based DR

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15

15

Products Considered – Non-Residential

Summer Only	Winter Only	Dual Season
Irrigation Control (Large & Small)	Heating Switch (Small & Medium Com)	BYOT (Small Com)
AC Switch (Small & Medium Com)		Demand Curtailment (industrial & commercial)
		Demand Voltage Regulation*
		Critical Peak Pricing
		Real Time Pricing

Black text indicates controllable DR
Blue text indicates price-based DR

*DVR is a system-wide product and not sector specific

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16

16

Chart Abbreviation Key

Abbreviation	Product	Abbreviation	Product
ResCPP	Residential Critical Peak Pricing	ComCPP	Commercial Critical Peak Pricing
ResTOU	Residential Time of Use	IndCPP	Industrial Critical Peak Pricing
ResEVSEDLCSwch	Residential Electric Vehicle Supply Equipment Control	IndRTP	Industrial Real Time Pricing
ResERWHDLCGrd ResERWHDLCSwch	Residential Electric Resistance Water Heater Control Grid/Switch	NRIrrLg NRIrrSmMed	Irrigation Control Large/Sm Med Farms
ResHPWHDLCGrd ResHPWHDLCSwch	Residential Heat Pump Water Heater Control Grid/Switch	NRTstatSm	Nonresidential (small bldg) Bring-Your-Own-Thermostat
ResACSwch ResHeatSwch	Residential AC/Heat Control Switch	NRCurtailCom	Commercial Curtailable Load
ResBYOT	Residential Bring-Your-Own-Thermostat	NRCurtailInd	Industrial Curtailable Load
DVR	Demand Voltage Regulation	NRCoolSwchSm NRHeatSwchSm	Nonresidential Small Bldg Control Switch Cool/Heat
		NRCoolSwchMed NRHeatSwchMed	Nonresidential Medium Bldg Control Switch Cool/Heat