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July 5, 2023

MEMORANDUM

TO: Power Committee Members

FROM: Tina Jayaweera, John Ollis

SUBJECT: Considering Emerging Technologies in Power System Planning

BACKGROUND:

Presenters: John Ollis, Tina Jayaweera

Summary: To help sustain an efficient, economical, reliable, and adequate power system, emerging technologies will need to become available. Staff will explain what gaps are currently seen in conventional technologies and how emerging technologies are considered in the power plan development process.

Relevance: As part of preparing for the next plan, staff track potential new technologies that may fit into the future power system. This practice is also consistent with utility integrated resource planning practices throughout the region and within the language of the Northwest Power Act.

Workplan: Track emerging technologies, both supply and demand side, providing periodic updates to the Council.

Background: The resource strategy in the Council's power plan is to give priority to conservation and generation resources that are "cost-effective." To be "cost-effective" under the Northwest Power Act, a resource not only has to meet or reduce load at a cost less than other resources, it also has "to be reliable and available within the time it is needed." Section 3(4)(A)(i).

If a resource is not available but has promise or potential for becoming an available and cost-effective resource within the plan horizon or further in the future, there are a couple of provisions in the Act that make it useful to consider in our planning and to help that development along. One of the required elements of the plan is “recommendations for research and development.” Section 4(e)(3)(B). We typically use this section of the plan to identify and provide development assistance to promising but not yet available resources.

Over the past year, the Council has heard several presentations related to emerging technologies, including in energy efficiency and small modular reactors. In addition, a presentation on evolving trends in battery storage will occur during this month’s meeting.

More Info: In February, Mark Rehley of NEEA presented to the Power Committee on some emerging [energy efficiency options](#) that NEEA is tracking. In the fall of '22 and early winter of '23, the Council had three presentations on small modular reactors (a tour of NuScale facility in October, Grant PUD’s [plans](#) in November, PacifiCorp’s [plans](#) in February).

Considering Emerging Technologies in Power System Planning

Power Committee

11 July 2023



Northwest **Power** and
Conservation Council

Current Landscape


- Electricity grid is rapidly evolving and new resources will be needed to keep the grid reliable, including:
 - Utility and behind-the-meter storage to balance variable energy resources
 - Generation: non-emitting baseload/diverse options (e.g., SMR, “clean” peaker, offshore wind, enhanced geothermal)
 - Demand side:
 - cost-effective energy efficiency measures to maintain a robust pipeline
 - demand response and other distributed energy resources to support the dynamic grid (e.g grid-interactive efficient buildings)
- It is common utility planning practice to track new resource types and availability

Why are these “emerging/new”?

- Power Act requires the Council give priority to cost-effective resources, which in part requires that the technology must be forecast “to be reliable and available within the time it is needed” [Power Act § 3(4)(A)(i)]
- This implies that resources may not be considered cost-effective if the resource is:
 - Not commercially available or widely deployable (are “emerging”)
 - Relatively new in development or use and significant uncertainty when it can be similarly deployed in the region
 - Too costly and the costs are expected to remain significant until global deployment increases lowering their cost or regional needs increase their value
 - Cannot generally be sited or built in region, even if commercially available
 - Otherwise limited due to policy or other considerations
- Timeframe matters, as “emerging” technologies might be “reliable and available” later in the plan horizon (or in future plans)
- Analyzing these technologies, even if thought to be “emerging” throughout the plan time horizon, can provide valuable information


Generating Resource Categories in 2021 Plan

Staff used this category framework to prioritize generating resources in the 2021 Power Plan




Resource Categories*


Prioritization based on a resource's commercial availability, constructability, cost, and quantity of developable resource in the region



Primary; Significant: Resources that are fully commercial and look to play a major role in the future PNW power system.
Assessment: In-depth, quantitative characterization to support system integration and risk analysis modeling. Will be modeled in RPM.



Secondary; Commercial w/ Limited Availability: Resources that are fully commercial but that have limited developmental potential in the PNW.
Assessment: Mix of qualitative and some quantitative analysis sufficient for potential modeling in the RPM.



Emerging/Long-term: Resources that have long-term potential in the PNW but that are not commercially available yet.
Assessment: Qualitative discussion of status & regional potential, quantify key numbers as available. Will not be modeled in RPM.

***Note:** the categorization is a framework that helps determine the level of analysis (a work plan of sorts); however it can be revisited and revised by the Council at any point in the development of the power plan

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THE 2021
NORTHWEST
POWER PLAN

Generating Resource Categories in 2021 Plan

Staff developed reference plants for only a handful of the resources, including one emerging technology reference plan as a proxy for all the carbon-free options not yet considered “reliable and available”



New Resource Options for 2021 Plan

Primary	Secondary	Emerging/Long-term
Solar PV ⚡	Conv. Geothermal ⚡	Enhanced Geothermal Systems
Onshore Wind ⚡	Offshore Wind	Small Modular Reactors
Gas CCCT ⚡	Distributed Generation	Carbon Capture & Sequestration
Gas SCCT - Frame ⚡	Biomass	Hydrogen Gas Turbine
Battery storage (Li-ion) ⚡	Hydro Upgrades	Allam Cycle Gas
Solar + Storage ⚡	Biogas	Wave, Tidal
Pumped Storage ⚡	Power-to-Gas	
Reciprocating Engine	Small Hydro	
Gas SCCT - Aeroderivative	Combined Heat and Power	



⚡ = reference plant
 Omitted: Advanced nuclear, coal, large hydro

2021 Plan Language on Emerging Technologies

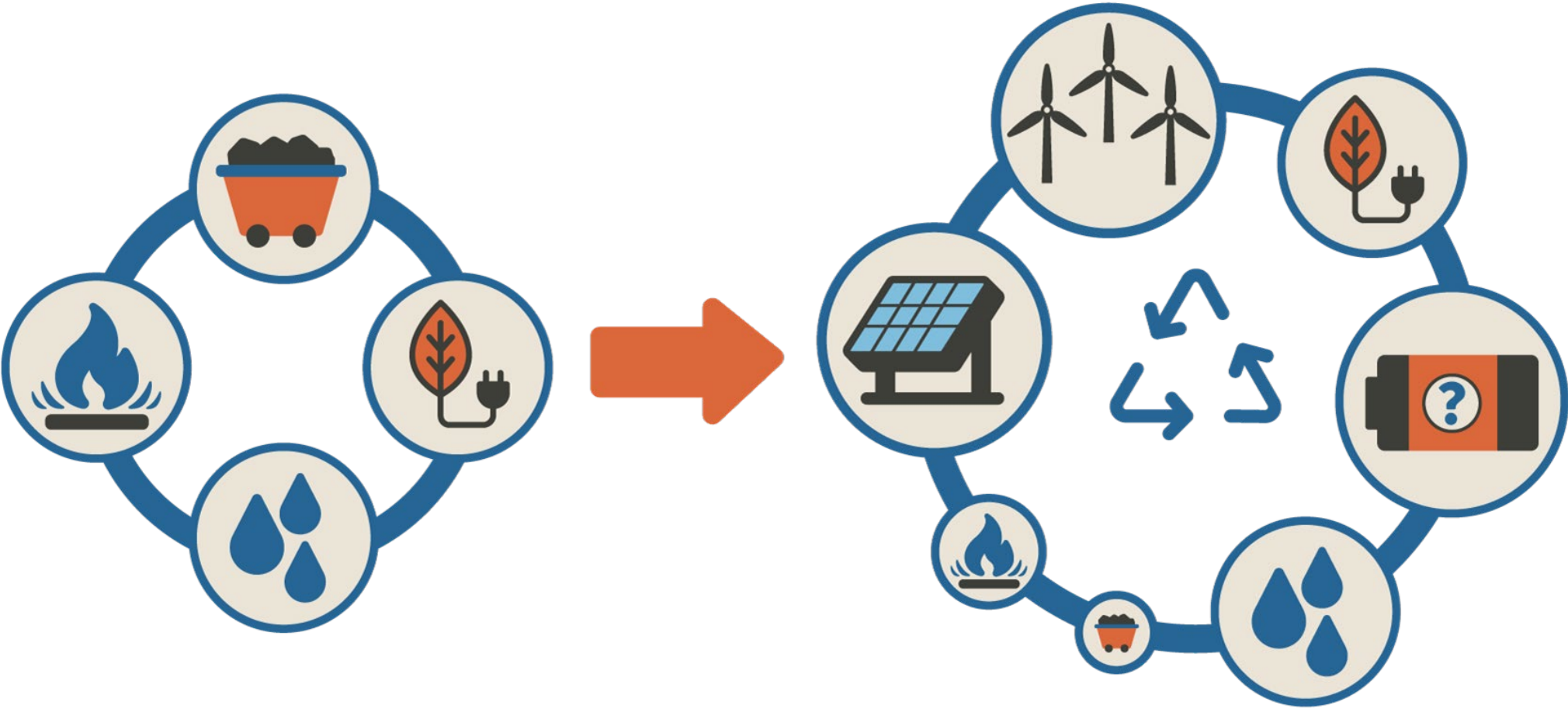
- **Conservation Program:** “To help ensure a robust efficiency infrastructure, work is needed all along the product adoption curve: Continuing research into emerging technologies to introduce new efficiency opportunities ...” so regional utilities should... “Continue to fund research and development on emerging technologies”
- **Recommendations for Research and Development:** “Research of emerging technologies to support development of future resource options”



THE 2021
NORTHWEST

POWER PLAN

Power system of the past is changing



Planning Challenge During Energy Transition: *Maintaining Adequacy While Meeting Policies*



Fuel Diversity

- Is the fuel on-call and always available?



- If not, is the fuel available at a different time?



Locational Value

- Does the resource make good use of existing infrastructure/transmission requirements to serve load?

- Does the resource defer or replace additional infrastructure/requirements?



Either



Both

Meet Policies

- Is the resource non-emitting or qualify as renewable energy?



- Does it shift or reduce curtailment of qualifying energy?



Leveraging The Existing Generation Wisely

Existing Hydropower Resources

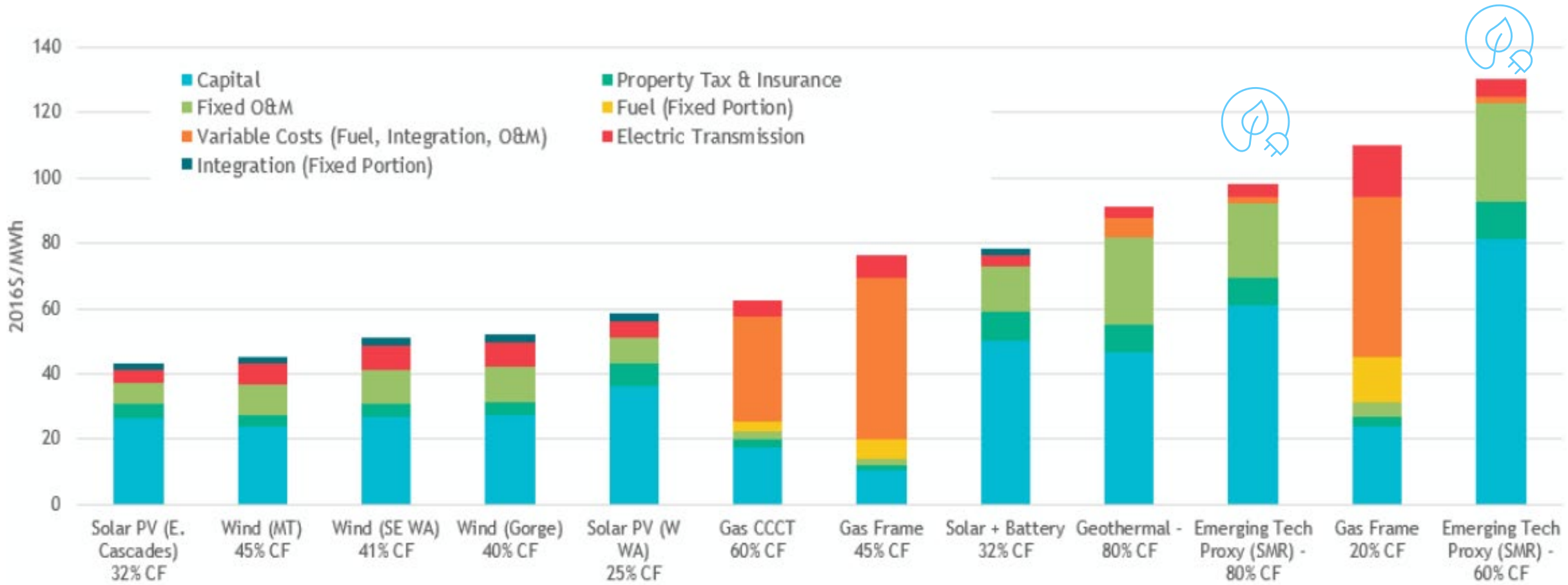
- Shifting use of the existing hydro system will likely defer the need in the region for emerging resources
- Can be used for meeting policies and/or for integrating other resources that meet policy
- Very difficult to build new hydropower resources



Existing Thermal Resources

- Shifting use of the existing thermal system will likely defer the need in the region for emerging resources
- Can be used to integrate other resources that meet policy
- Very difficult to build new coal and gas resources































Limited

What Should Be Considered for Planning?

The **stand-alone cost** may be high or uncertain, but the **portfolio benefit** of adding resources has the potential to be high.

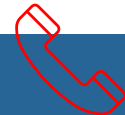
1. Only considering the current commercial resource types may result in a less efficient, higher cost and riskier power system.
2. The cost and availability may become more certain over the next few years.

Resource Type	Cost	Availability	Attributes
“Clean” Peakers	Uncertain	Uncertain	  
Small Modular Reactors	High/Uncertain	Uncertain	  
Offshore Wind	High	Timing Uncertain	  
Utility Scale Storage (long duration)	Uncertain	Now	  
Distributed Storage	High	Now	  
Emerging Tech EE	Uncertain	Uncertain	  
Emerging Tech DR	Uncertain	Uncertain	  
Transmission Upgrade/Add	High/Uncertain	Uncertain	  
Coal to Gas Conversion	Medium	Limited	 

Recently Completed Regional Resource Plans – Baseload/Peaker Substitutes



Utility	“Clean” Peaking Capacity	Small Modular Reactors	Coal to Gas Conversion
Puget Sound Energy	711 MW by 2030 1,588 MW by 2045 (biodiesel/H2 peakers)	0 MW	0 MW
Avista	88 MW by 2036 696 MW by 2045 (ammonia/H2 peakers)	0 MW	0 MW
Portland General Electric	Discussion of over 1800 MW of gas converted to ammonia or H2 by 2040	0 MW	0 MW
Pacificorp	606 MW by 2030 1,240 MW by 2037 Non-emitting peaking resources	500 MW by 2030 1,500 MW by 2032	Continue conversion on Jim Bridger 1 and 2 by 2024. Begin conversion on Jim Bridger 3 and 4 by 2030 All units planned retirement in 2037



Recently Completed Regional Resource Plans - Storage



Utility	Distributed Storage	Utility Scale Storage
Puget Sound Energy	187 MW by 2030 267 MW by 2045	1,000 MW by 2030 1,800 MW by 2045 (4 - 6 hour Lithium-Ion batteries, 8 hour pumped hydro)
Avista	0 MW	52 MW by 2039 195 MW by 2045 (most long-duration iron oxide batteries)
Portland General Electric	0 MW	176-503 MW by 2030 (4 hour Lithium-Ion batteries)
Pacificorp	2,400 residential and commercial batteries	7,560 MW of lithium ion storage, 35 MW of pumped storage by 2028 Additional 350 MW of long duration battery storage by 2036

Recently Completed Regional Resource Plans – Transmission and Other Resources

- Many investigations of offshore wind in Oregon and enhanced geothermal but no resources selected
- Emerging tech energy efficiency and demand response occasionally discussed

Utility	Transmission
Puget Sound Energy	Evaluating repurposing current transmission rights to implement current plan. Identifies 2030 regional Cross Cascades transmission need of 3,849 MW.
Avista	Anticipates need for up to 500 MW of new transmission by the 2030s to provide transport for future wind resources.
Portland General Electric	South of Allston: 400 MW by 2030 Wyoming: 206 MW by 2030 Desert SW: 49 MW by 2030
Pacificorp	Gateway South: 500 kV line WY to UT by 2024 Gateway West D1: 2 230 kV lines within Wyoming by 2024 Boardman to Hemingway: 500 kV lines from OR to ID by 2026 Gateway West D3: 500 kV lines within WY to SE ID by 2028



Matching Resources to Needs More Effectively

- Per current utility plans, investments in cost-effective solutions that adhere to policies and maintain an adequate system will likely rely on some of these riskier and newer resources within the next plan's time horizon
- Continued work on refining regional adequacy metrics and monitoring wholesale market dynamics will help to better understand where best to invest staff effort and research on developing future resources to be analyzed in the next plan

