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

August 6, 2024

MEMORANDUM

TO: **Council Members**

FROM: **Annika Roberts, Resource Policy Analyst**

SUBJECT: **Developing Reference Plants Primer & Assessment of Resource Options in the Plan**

BACKGROUND:

Presenter: Annika Roberts

Summary: In preparation for the Ninth Power Plan, staff will be providing the Council with a series of presentations on different aspects of developing the Plan. This presentation's focus will be how resource options are built up and will include an early look at which resources will be considered in the Plan.

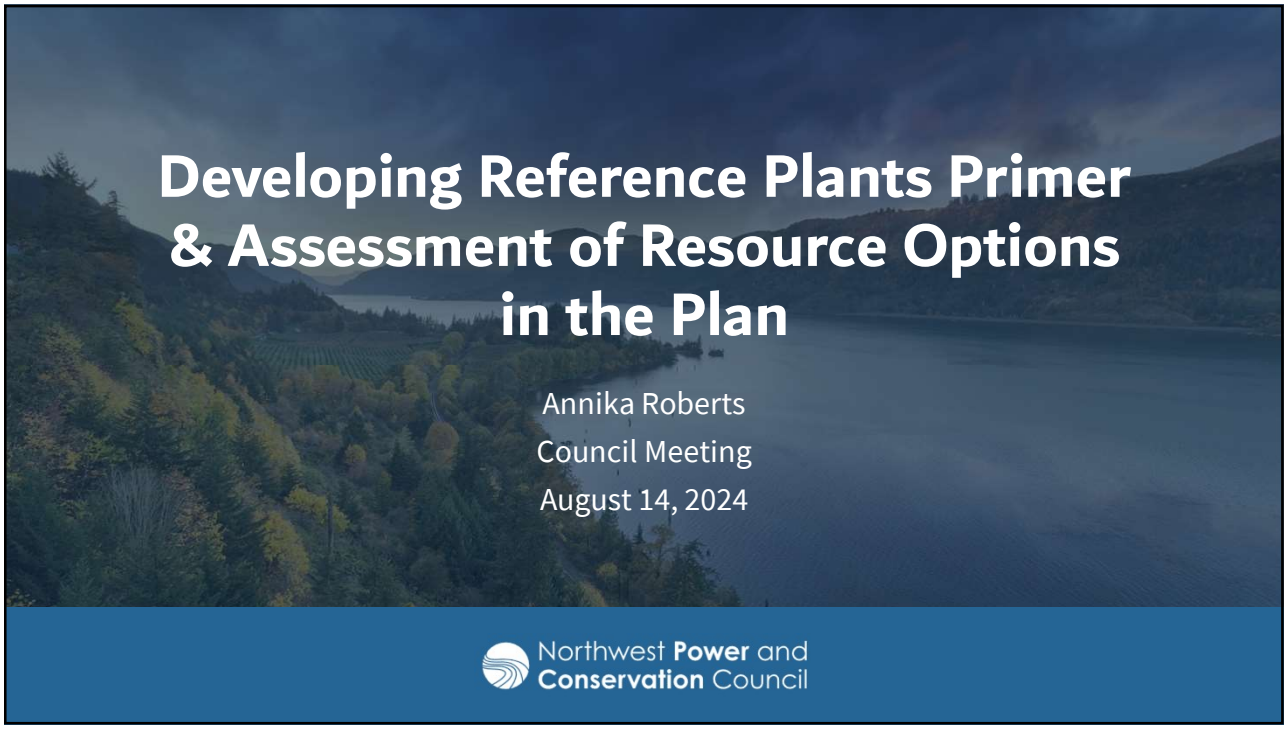
Relevance: The Power Act directs the Council in its power plan to put forth a general strategy for implementing conservation measures and developing generating resources. The Council uses reference plants as a means of characterizing resource options for modeling by representing the different attributes of different resources for the model to weigh.

Workplan: B.2.1 Prepare for the ninth power plan, develop a draft scope, prepare models and inputs, and develop the environmental methodology.

Background: A reference plant is a collection of characteristics that describe a resource technology and its theoretical application in the region. It includes estimates of typical costs, logistics, and operating specifications. These reference plants become resource options—along with energy efficiency,

demand response and distributed energy resources—for the Council's power system models to select to fulfill future resource needs. The Council develops a defined set of reference plants that represent the range of resources to be considered in planning. At this early stage, Council staff are working with its Generating Resources Advisory Committee to scope out likely reference plants to be included in modeling.

More Info: Reference Plants in the 2021 Plan:
https://www.nwcouncil.org/2021powerplan_generating-resource-reference-plants/
Generating Resource Advisory Committee presentation:
https://nwcouncil.box.com/v/0618202GRACMtgPres



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Agenda

- You are here:
  - Where does this work fit in the Plan process?
  - What other work does this feed?
- Defining a Reference Plant:
  - Defined
  - Components
  - Any new considerations for this Plan
- Resource Categories:
  - Defined
  - 2021 plan recap
  - Early 9th Plan proposal
- Emerging Technology:
  - Defined
  - 2021 Plan method
  - New methodology proposal

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9th Plan

Where are we now, where are we going next?

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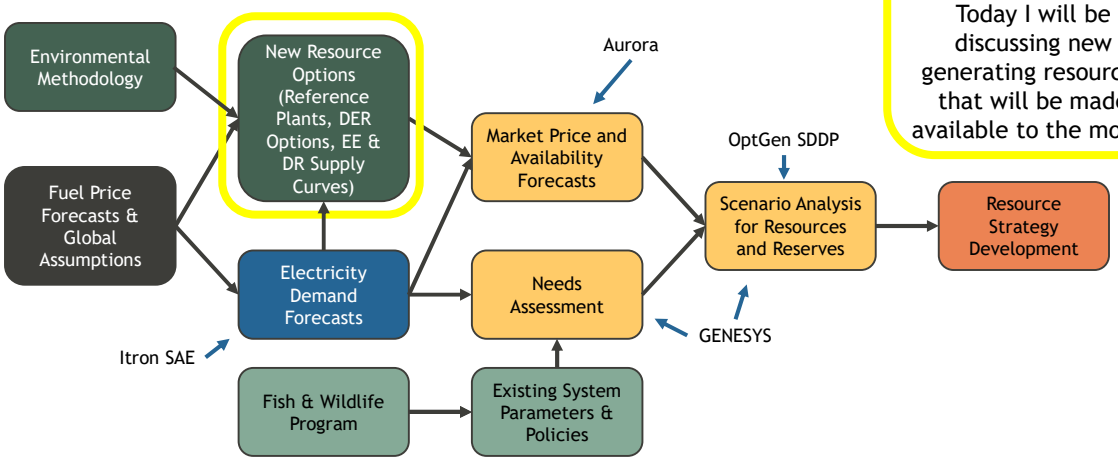
Roadmap to building a Power Plan

We are here: Concurrent processes kicking off in resource option development. Today I will be discussing new generating resources that will be made available to the model



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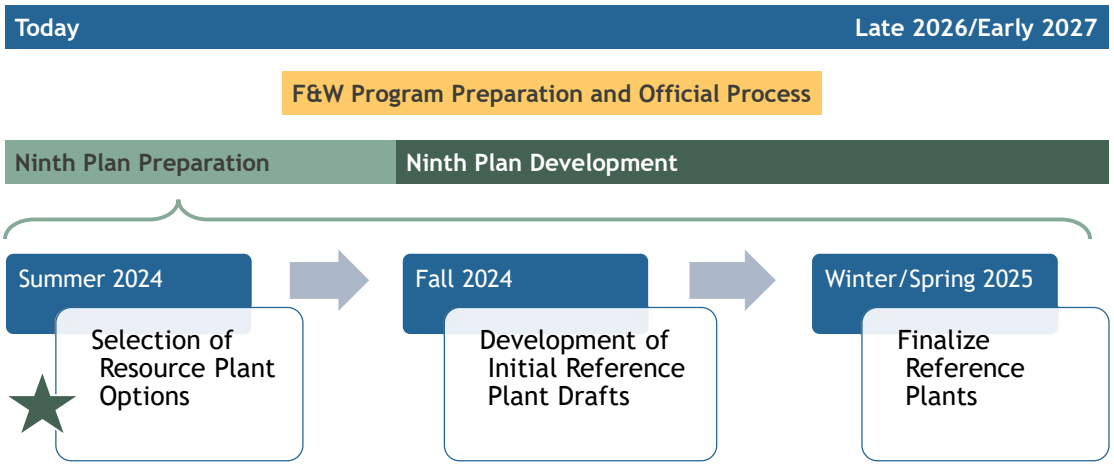
Rough Timeline



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Developing Reference Plant

Definitions, component parts & process overview

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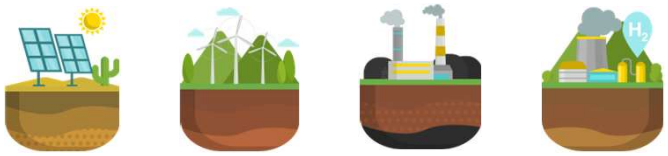
Defining a Reference Plant

A **reference plant** is a collection of characteristics that describe a resource technology and its theoretical application in the region. It includes estimates of typical costs, logistics, and operating specifications.



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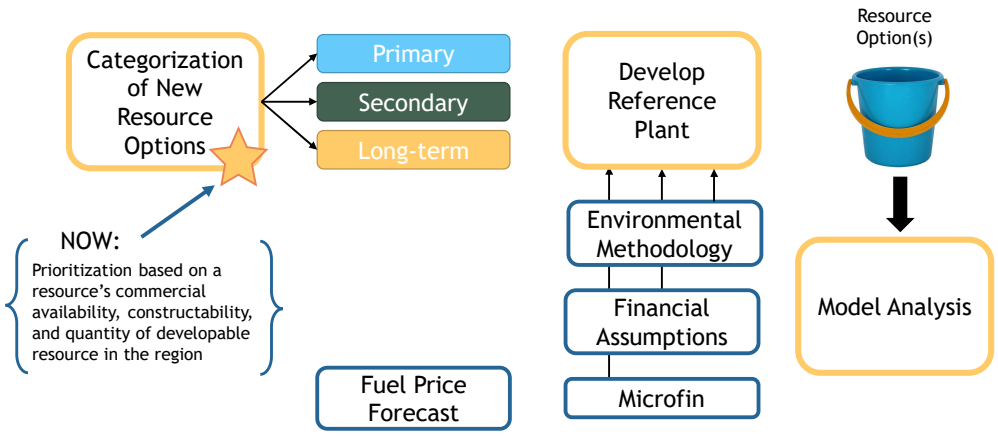
Developing a Reference Plan



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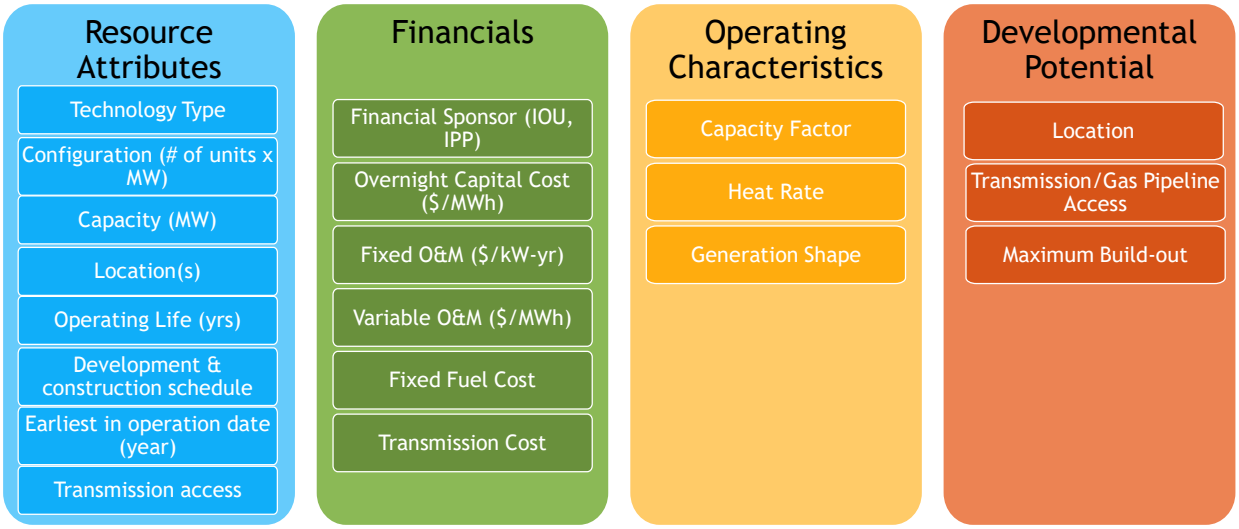
Components of a reference plant



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Resource Attributes: *How the technology/resource serves the grid*

Technology Type	Configuration	Capacity	Operating/ Economic Life	Development and Construction Schedule:	Transmission Access
	• The number of units (and installed nameplate capacity of each unit) that make up the complete reference plant. Also includes other plant specifications such as air emissions controls, cooling (wet vs. dry).	• Nameplate Capacity: the maximum amount of electricity a plant can generate when it is fully functional, in optimal conditions, and, if applicable, using the maximum amount of fuel. The manufacturer's rated output of the generator.	• The assumed useful operating life of the plant	• Development period includes planning & development, from the identification of need to establishment of contracts, citing & licensing • Construction lead time, the amount of assumed time for a project to come online. • Earliest in Operation Year	• Assumed transmission type (long-term firm, short term, IOU network etc.)

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Financials: *What the resource costs and how it's paid for*

Financial Sponsor	Overnight Capital Costs	Fixed O&M	Variable O&M	Fixed Fuel Costs	Transmission Costs
• Different entities use different project financing mechanisms. These differing mechanisms and incentives available for some resources result in different total investment costs and annual capital service requirements for otherwise identical projects. (IOU, POU, IPP)	• An estimate of the project development and construction cost. "Overnight" refers to what the cost would be if the plant were built instantly, or over one night. This cost constitutes the engineering, procurement, and construction (EPC) costs, owner's costs (costs incurred by the project developer – permits, licenses, land, project development costs, infrastructure, taxes, regulatory compliance costs, etc.), and decommissioning costs	• An estimate of the fixed operation and maintenance cost for the reference plant, including operating and maintenance, labor and materials, and administrative overhead. Both routine maintenance, and major maintenance and capital replacement are assumed to be included.	• An estimate of the variable operation and maintenance cost for the reference plant, including all costs that are a function of the amount of power produced. This includes consumables such as water, chemicals, lubricants, catalysts, and waste disposal.	• The primary type of fuel burned (natural gas, oil, coal, etc.), its location of origin, and cost.	•Cost of the assumed transmission type, incorporated into the cost of the resource.

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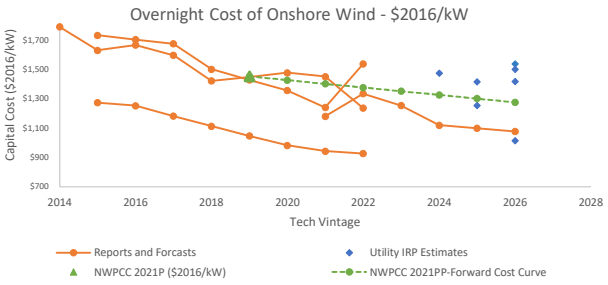
Financials: *Process*

- **Overnight capital costs and O&M**:
  - *Gather* analysis of available cost data from manufacturers, developers, PPAs, project-specific publicly available reported info, technical handbooks, reports from EIA, DOE, national labs, IRPs, etc.
  - *Normalize* the cost data to a consistent year dollars, configuration, capacity, heat rate, etc.
  - *Plot* the normalized data and look for trends and outliers – determine best estimate of current and future costs
- **Cost curves**:
  - Estimate costs through the 20-yr planning period
- **MicroFin**:
  - Financial revenue requirements model used to calculate levelized fixed cost and LCOE



Overnight cost update for the adequacy study

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Operating Characteristics: *How the technology works*

Capacity Factor
- An estimate of the ratio of actual annual output to nameplate capacity, can vary by location esp. for renewables

Capacity Factor Multiplier
- Built in assumptions of improved technology efficiency over time

Heat Rate
- A measure of the efficiency of which a generator converts fuel into electricity. The reference plant heat rates are based on full load, expressed as higher heating values (HHV).

Heat Rate Multiplier
- Reflects assumed heat rate efficiency improvements of reference plants over the planning period.

Generation Shape
- When a plant generates power, which can vary by time of day, time of year, location etc.

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Developmental Potential: *How the resource fits into the grid & works with other resources*

Transmission/Gas Pipeline Access

Maximum Buildout
- The maximum amount of reference plant units (in megawatts) that the model can select over the 20-year planning horizon

Location
- The general geographic location of the reference plant, which is important in properly accounting for plant attributes (e.g. capacity factor, transmission access).

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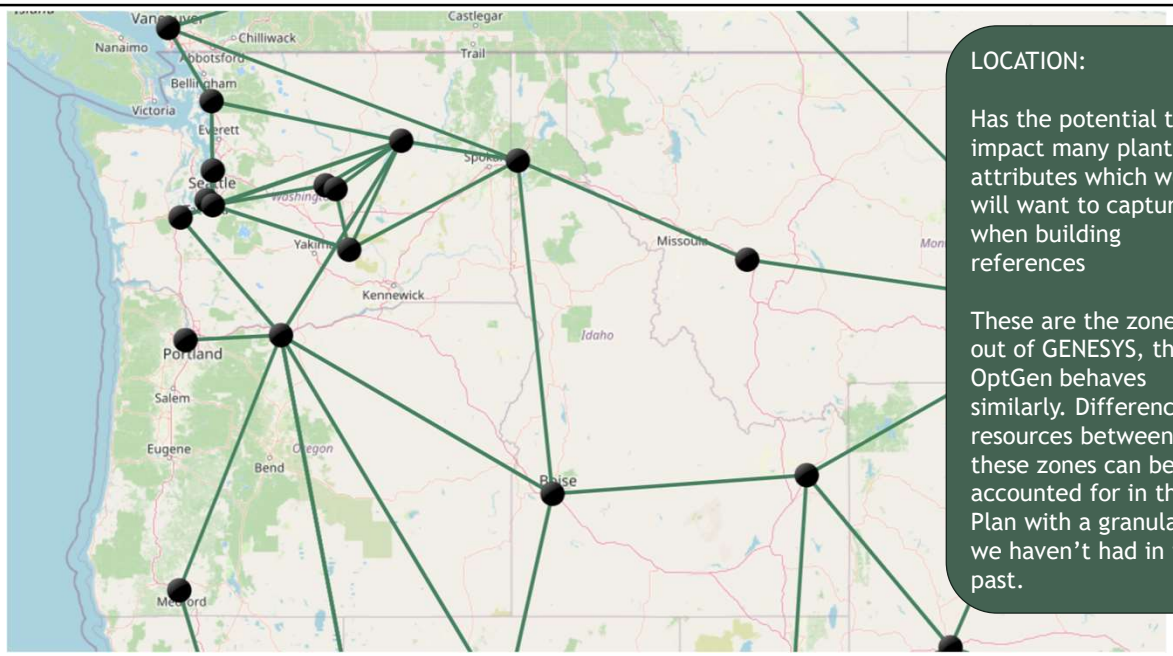

LOCATION:

Has the potential to impact many plant attributes which we will want to capture when building references

These are the zones out of GENESYS, though OptGen behaves similarly. Differences in resources between these zones can be accounted for in this Plan with a granularity we haven't had in the past.

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Example Reference Plant: *Onshore Wind*

Multiple wind reference plants based on:

- Location
- Transmission availability
- Potential MW (maximum build-out)

Which will become resource options for OptGen to select, based on:

- Resource need
- Cost
- Availability/location
- Seasonal shape etc.

2021 Plan

Reference Plant	Wind - Columbia Gorge	Wind - SE Washington	Wind - Montana
Technology Type	3.6 MW, 105m hub height	3.6 MW, 105m hub height	3.6 MW, 105m hub height
Configuration	60 x 3.6 MW wind turbine generators	60 x 3.6 MW wind turbine generators	60 x 3.6 MW wind turbine generators
Nameplate Capacity (MW)	216 MW	216 MW	216 MW
Location	Columbia Gorge	SE Washington	Montana
Avg. Annual Capacity Factor	39.8%	41.2%	45.5%
Economic Life (Years)	30	30	30
Tax Benefits	-	-	-
Financial Sponsor	IOU	IOU	IOU
Development Period (Yrs)	1	1	1
Construction Period (Yrs)	1	1	1
Earliest In-Operation Date	2021	2021	2021
Overnight Capital Cost ($/kW)	$1,450/kW	$1,450/kW	$1,450/kW
All-in Capital Cost ($/kW)	$1,525/kW	$1,525/kW	$1,525/kW
Fixed O&M Cost ($/kW-yr)	$30/kW-yr	$30/kW-yr	$30/kW-yr
Variable O&M Cost ($/MWh)	$0/MWh	$0/MWh	$0/MWh
Transmission	BPA P2P Long-term Firm	BPA P2P Long-term Firm	PSE CTS + MT Int + BPA P2P
Maximum build-out (MW)	1,944 MW (9 units)	1,944 MW (9 units)	5,400 MW (25 units)

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Resource Categories

Resource proposal for the 9th Plan

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Resource Categories

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

Primary; Significant: Resources that play a major role in the future of the regional power system

- Assessment: In-Depth, quantitative characterization to support system integration and risk analysis

Secondary; Commercial w. Limited Availability: Resources that are fully commercial but that have limited developmental potential in the region

- Assessment: Mix of qualitative and some quantitative analysis

Long-Term/Emerging: Resources that have long-term potential in the region but aren't yet commercially available

- Assessment: Qualitative discussion of status and regional potential, quantify key numbers as available

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New Resource Options in the 2021 Plan

PRIMARY	SECONDARY	LONG-TERM
Solar PV	Conventional 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 & Power	

: Reference Plant Developed for 2021PP

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* The emerging technology proxy resource was representative of SMRs

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Proposed Categorization of Resource Options for the 9th Plan

PRIMARY	SECONDARY	LONG-TERM/EMERGING
Solar PV	Pumped Storage	Small Modular Reactors
Onshore Wind	Geothermal (Conventional/Enhanced)	Long Duration Storage
Gas (CCCT, SCCT—Frame/—Aeroderivative, Recip)	Offshore Wind	Hydrogen
Battery Storage (varying durations)	Biomass/Biogas	Ocean Energy (Wave, Tidal etc.)
Renewables+ Storage (Solar/Wind)	Small Hydro & Hydro Upgrades	
Community Storage/Solar	Combined Heat & Power	

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NOTE: Not every resource listed will necessarily be built into a reference plant

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GRAC Says:

- When presented with the proposed resources, we got the following feedback from the advisory committee:
  - General sense of support, nothing explicitly missing.
  - A few comments around the resources listed and ways we might want to think about them, which we will continue to consider with the group
    - Storage:
      - Multiple long term storage technologies?
      - Multiple durations (include a mid duration option (~8 hours))
    - Geothermal:
      - Support for enhanced geothermal being included, lots of recent developments since the last plan
    - Community Solar:
      - Support for its inclusion, different enough from utility scale and rooftop solar to warrant a separate reference plant
    - Lots of opinions and excitement around emerging technology

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Emerging Technology

Proposed methodologies

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Emerging Technology

We are not bound to only analyzing resources that are considered "reliable and available" or the last plans treatment of emerging resources.

Emerging Technology Defined

- 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"
- Emerging resources and technologies have a long-term potential in the Pacific Northwest but are not commercially available or deployable on a large scale at the beginning of the power planning period—so are not *yet* 'available and reliable'

How Emerging Technology was Treated in the 2021 Plan:

- Opted to model one emerging technology as a proxy to represent the potential of any emerging technology that could be commercially available in the next ten years.
- Considered: offshore wind, SMRs, enhanced geothermal, wave energy & carbon sequestration
- Selecting the proxy resource was a heavily GRAC influenced process and the group eventually landed on SMRs
  - Making clear that if/when it the proxy was selected in the models or the plan's resource strategy, it should be assumed to be representative of *any* emerging technology

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Emerging Tech Methodology for the 9th Plan

When presented w. these options the advisory committee supported staff proposal

1. Multiple Proxies

- Build multiple proxy ref. plants that each fill a system need
  - Baseload
  - Clean Peaker
  - Long Duration Storage

+ Pros
- Speaks to a system need we believe technology will fill
- More representative

- Cons
- We cannot know the future, the need might not get filled, or it might get filled a different way

2. Single Proxy

- Select viable/applicable emerging technology to use as a stand in for an unknown future resource

+ Pros
- Simple/straightforward

- Cons
- Picking a 'winning' resource as the most likely technology suggests a certainty we don't have

3. Reference Plants for all

- Build individual reference plants for every resource

+ Pros
- Resources all treated the same

- Cons
- Don't have complete/reliable data for most of these resources
- A lot of work for resources that the model may not pick

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GRAC Says:

1. Multiple Proxies

- Build multiple proxy ref. plants that each fill a system need
  - Baseload: based on the characteristics of an SMR
  - Clean Peaker: based on the characteristics of a Hydrogen Peaker
  - Long Duration Storage: Thermal, electrochemical, mechanical, or chemical (maybe in addition to iron air batteries+)

- When presented with the options, the GRAC was receptive to option one:
  - It mirrors what many of them had done in their IRPs
  - Agree it would tell us something important about what the system is missing and might need an emerging tech to fill in for
  - Were obviously very interested in which resources we select to base the proxies on & especially believe the costs will be difficult

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NEXT STEPS

- This summer we have a series of GRAC meeting scheduled to start fleshing out these reference plants
  - Finalize resource list, their categorizations, and which resources warrant a reference plant
  - Develop draft reference plants for use in early model testing
  - Finalize reference plants

These two items will be happening concurrently

Reminder

Summer 2024	Fall 2024	Winter/Spring 2025
Selection of Resource Plant Options	Development of Initial Reference Plant Drafts	Finalize Reference Plants

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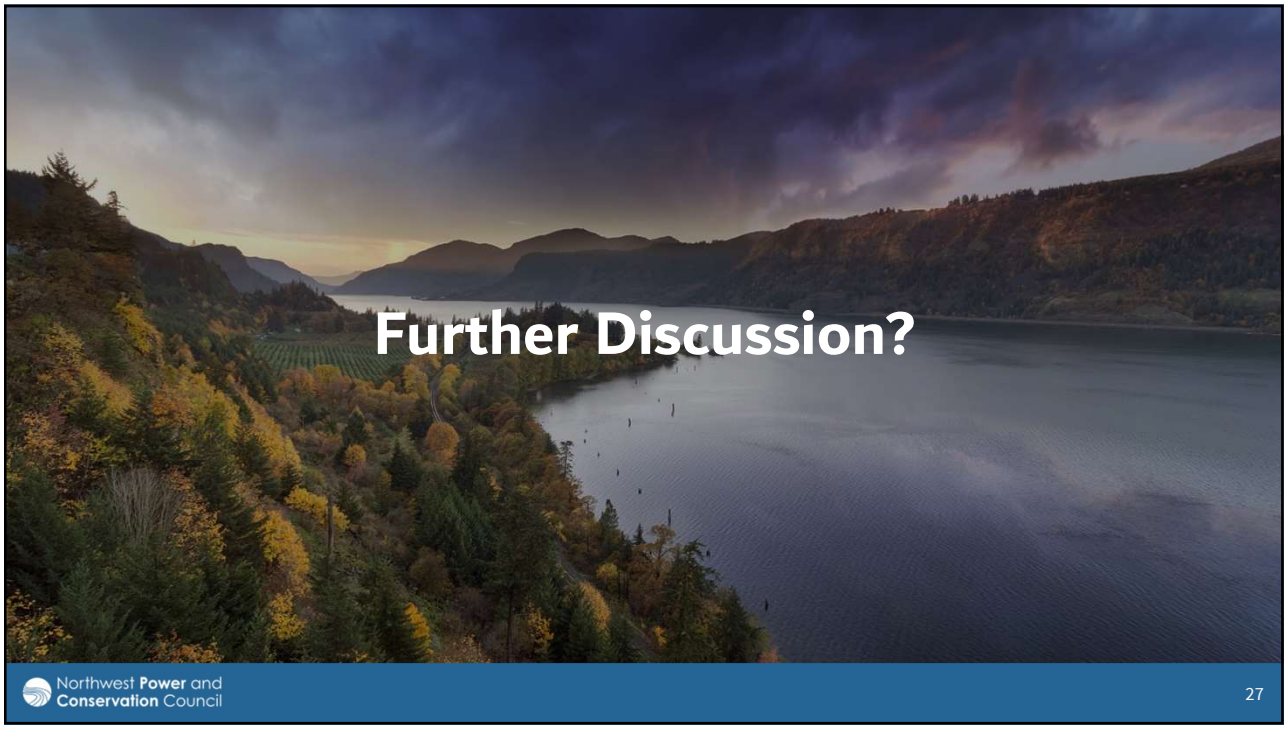
Further Discussion?
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