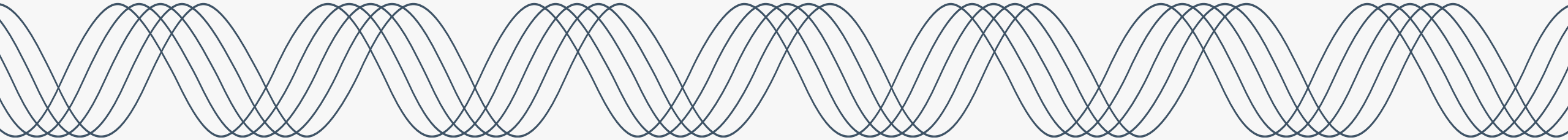
PGE CEP & IRP Roundtable 25-1

January 8th 2025



January 8th, 2025 – Agenda

9:00 – 9:05	Welcome | Meeting Logistics
9:05 – 9:10	Update Filing Date
9:10 – 9:40	75% Transmission Requirements
9:40 – 9:55	Resource Effective Load Carrying Capabilities (ELCCs)
9:55 – 10:25	Energy Values
10:25 – 11:25	Transmission Options | Energy Strategies
11:25 – 11:30	Closing Remarks | Next Steps

Meeting Details

1

Electronic version of presentation

https://portlandgeneral.com/about/who-we-are/resource-planning/combined-cep-and-irp/combined-cep-irp-public-meetings

2

Zoom meeting details

- Join Zoom Meeting https://us06web.zoom.us/j/9291862450?pwd=xVXQI4jljt7FdetDzWD0G35FFvayF8.1&omn=84372774388
- Meeting ID: 929 186 2459
- Passcode: 108198

3

Participation

- Use the raise the hand feature to let us know you have a question
- Unmute with microphone icon or *6

Meeting Logistics

Focus on Learning & Understanding

- There will be no chat feature during the meeting to streamline taking feedback
- Team members will take clarifying questions during the presentation, substantive questions will be saved for the end (time permitting)
- Attendees are encouraged to ‘raise’ their hand to ask questions

Follow Up

If we don’t have time to cover all questions, we will rely on the CEP/IRP feedback form

Update Filing Date

Caroline Sherry, PGE

Extension Request

On October 16, 2024, PGE filed an extension request for the filing of the 2023 CEP/IRP Update as well as the subsequent 2026 CEP/IRP.[1]

PGE's waiver request was made based on the precedence of a prior request for extension/waiver in LC 73, which referenced the acknowledgment decision date as the relevant date that triggers subsequent deadlines.[2]

1. https://edocs.puc.state.or.us/efdocs/HAO/lc80hao332155120.pdf
2. Order No. 21-422

Withdrawal of Extension Request

In conferring with OPUC Staff and representation from the Oregon Department of Justice (DOJ), PGE became aware that Staff's position regarding the deadline for IRPs, CEPs, and associated updates is based on the date of the written acknowledgment order and not the date of the public meeting where the acknowledgment decision was made. Staff's position is based on the plain language of the rule, which PGE agrees is appropriate.[1]

- Accordingly, PGE withdrew the extension request on November 8, 2024.
- PGE's 2023 CEP/IRP Update is due on **April 18, 2025**. The 2026 CEP/IRP will be due **April 18, 2026**.

1. Order No. 24-097

75% Transmission Requirements

Rob Campbell, PGE

IRP Transmission Requirement Modeling Assumptions

Requiring that new off-system resources have associated transmission is an important consideration in resource adequacy planning to ensure the ability to deliver their power to load when it is needed.

Historically, IRP models have assumed that every MW of new off-system renewable resources must be paired with one MW of transmission capacity to deliver power to PGE's service territory.

PGE is updating this assumption for renewable resources to align with the current forward showing transmission reservation requirements of the Western Resource Adequacy Program (WRAP). Capacity resources will continue to be modeled with a 100% firm transmission assumption.

This assumption impacts two important components of IRP modeling:

1. **Quantity of resources accessed with BPA transmission inventories**
2. **Proxy resource ELCCs**

The WRAP 75% Assumption

To improve the likelihood of deliverability of resources claimed for resource adequacy purposes, the WRAP requires that participants demonstrate control of firm transmission rights for resources in Participant's portfolios.

There are distinct requirements for different planning time-horizons, with the Forward Showing Program focused on a seasonal time frame and the Operation Program focused on day-ahead.

- The Forward Showing program requires that resources have associated firm transmission of at least 75% of their capacity contribution secured 7 months in advance of each of two binding seasons.
- The Operational Program requires that 100% of resources have firm or conditional firm transmission.

Because resource decisions in IRP models (where operational realities are often simplified out of necessity) are not made solely on a Capacity contribution basis, aligning assumptions with the requirement of the longer-term focused Forward Showing Program represents an adequate planning assumption.

Source: https://www.westernpowerpool.org/private-media/documents/2023-03-10_WRAP_Draft_Design_Document_FINAL.pdf

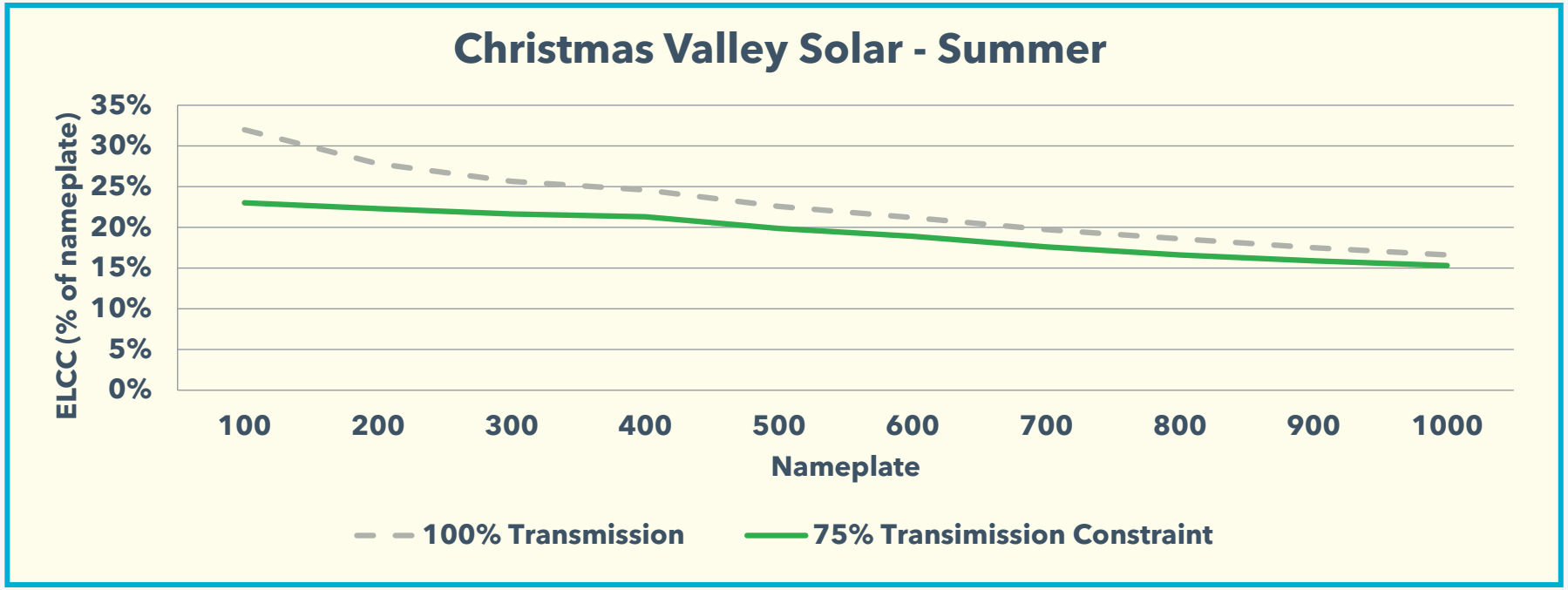
Impact on BPA ATC Inventories

The change from a 100% to a 75% transmission requirement increases the quantity of resources that can be accessed with each MW of ATC directed at PGE's system.

IRP Zone	Firm + Conditional Firm ATC	MW of Resources Accessed
Christmas Valley	667	889
Gorge	597	796
McMinnville	150	200
Montana	320	427
Southeast Washington	104	139
Offshore	668	891
Total	**2506**	**3341**

Impact on ELCCs

Because this assumption means there is less transmission associated with each MW of off-system renewable proxy resources resource, it results in an average decrease in ELCCs.



Proxy battery storage resources are assumed to be on-system and are therefore unaffected by this update to assumptions.

More detail on proxy resource ELCCs will be provided in the next section of today's roundtable.

Resource Effective Load Carrying Capabilities (ELCCs)

Devin Mounts, PGE

Sequoia – Model Basics

Hourly Monte Carlo adequacy model developed in-house after the 2019 IRP

- Created to improve modeling of energy limited resources
- Has been used in the 2019 IRP Update, various PUC dockets, a PGE RFP, and discussed in in various IRP roundtable meetings

Targets a seasonal (winter/summer) loss-of-load-hour metric of 2.4 hours / year

Creates synthetic weeks out of input data – currently simulating 50,000 weeks / year

Incorporates PGE resources, owned/contracted resources, and new proxy resources

- Partial market availability in all light load hours and spring/fall heavy load hours

What is ELCC?

Effective Load-Carrying Capability (ELCC) is a measure of how much capacity a resource provides. It is commonly expressed as a percent of the nameplate MW of a resource added

As more resource is added, we tend to see flat or decreasing ELCCs in percentage terms, and flat or decreasing capacity contribution

$$\text{ELCC}(\%) = \frac{\text{Capacity contribution (MW)}}{\text{Resource nameplate (MW)}}$$

Illustrative Example of ELCC Calculation:

Nameplate	Capacity contribution	ELCC
100	54	54%
200	95	48%
300	125	42%
400	152	38%
500	174	35%

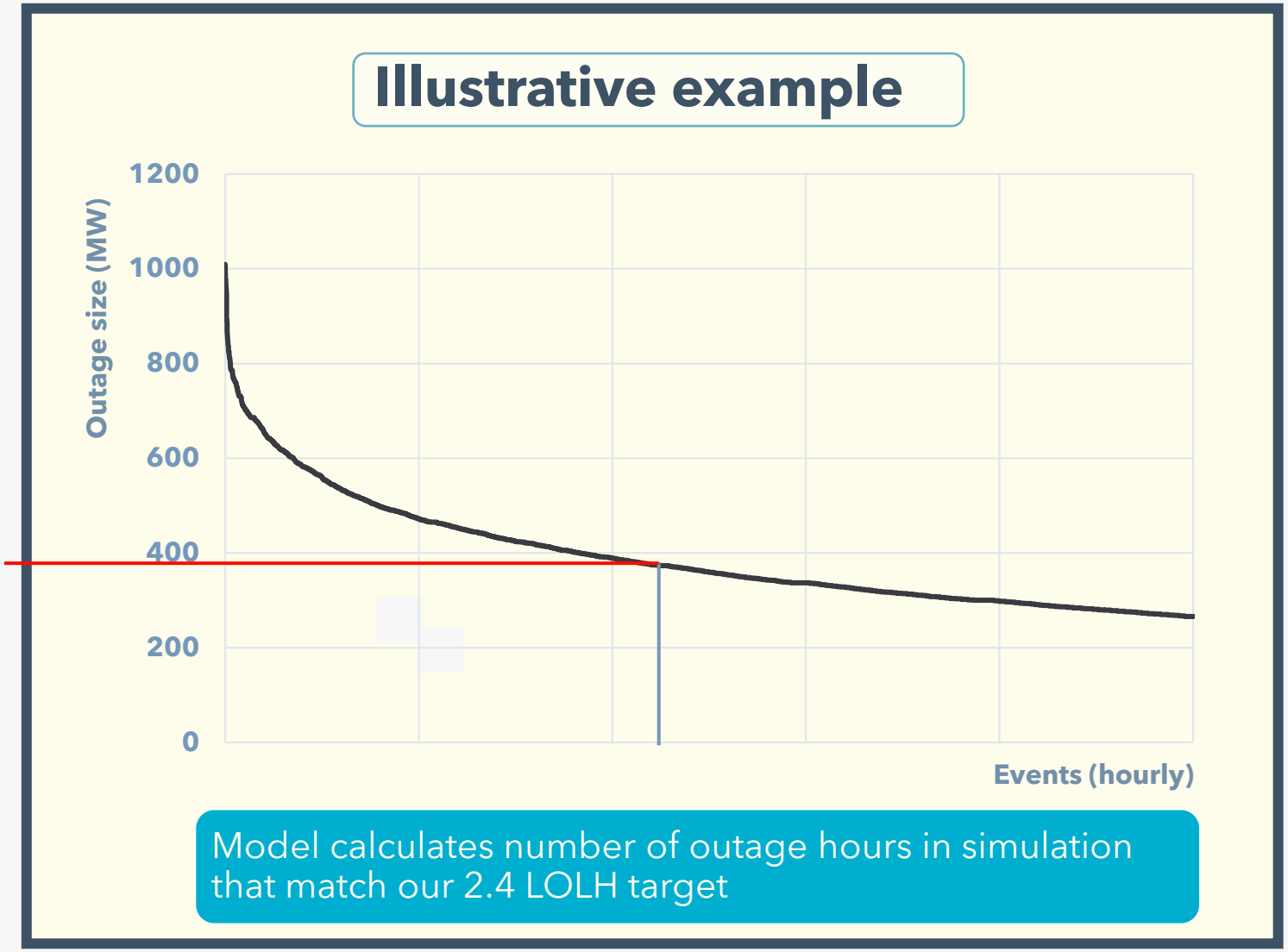
Where Do ELCCs Get Used?

Sequoia calculates ELCC values running thousands of stochastic simulations for proxy resources

ROSE-E uses ELCCs values, in conjunction with capacity needs, to make sure it is selecting enough capacity to be resource adequate

Sequoia – Capacity Need Math

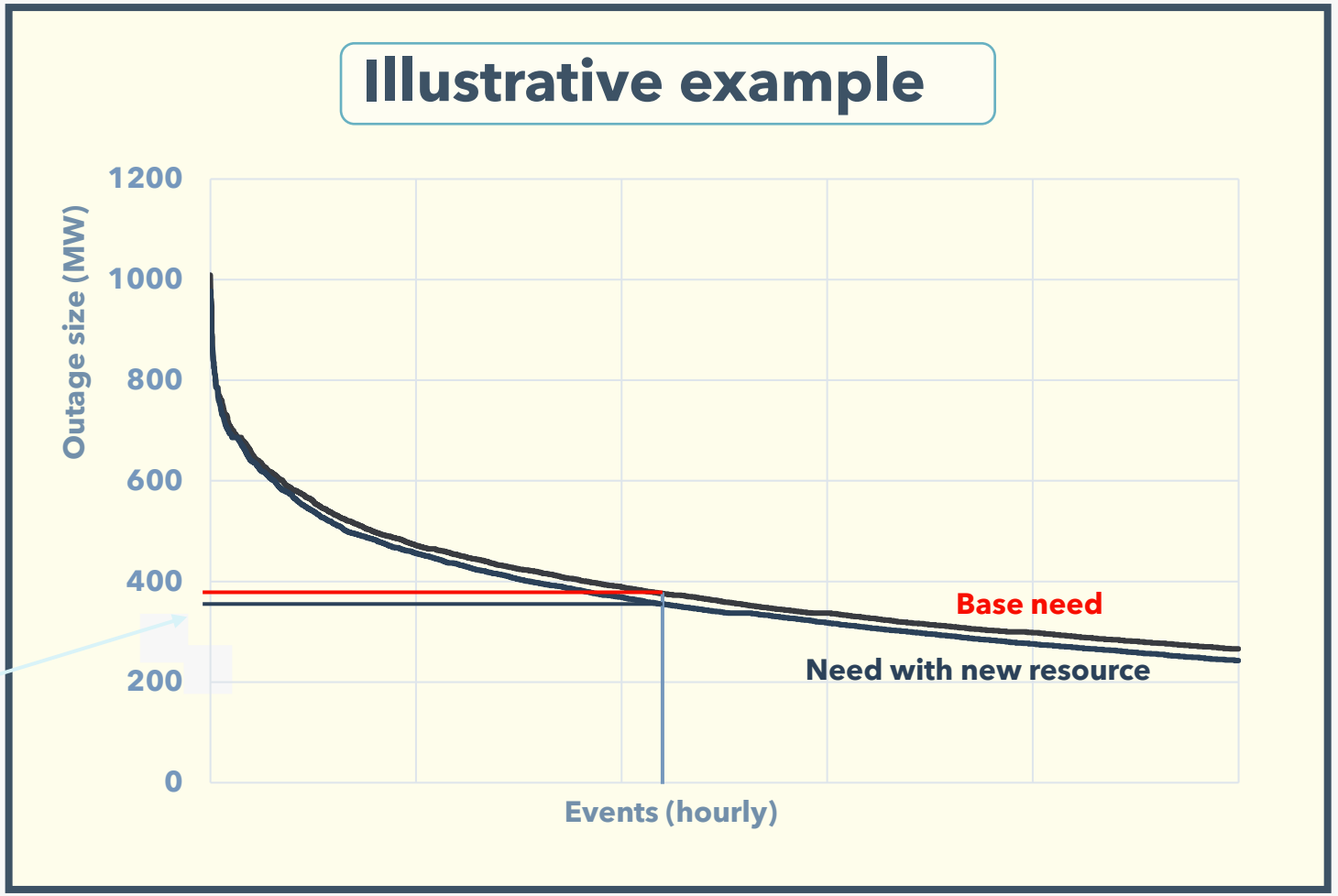
The model finds the amount of perfect capacity needed to bring the system to a 2.4 LOLH. In this case, just under 400 MW



Sequoia – Capacity Reduction Math

The difference in the amount of capacity needed to achieve 2.4 LOLH is the capacity contribution of the new resource

In this example the reduction is around 17 MW from 200 MW of new resource. We divide the reduction (17 MW) by the resource size (200 MW) to arrive at a value of 8.5%



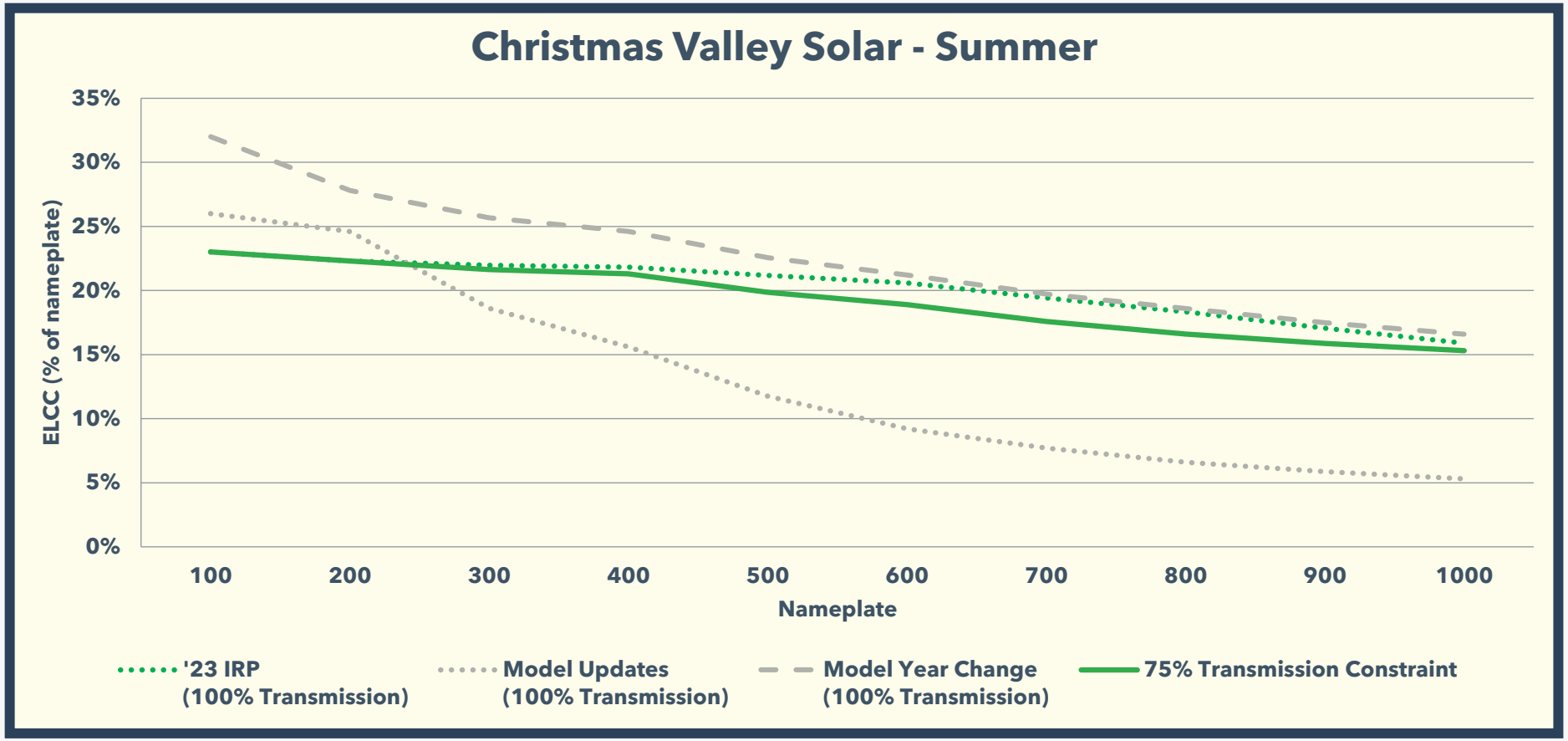
Effect of Modeling Changes on ELCCs

Since the 2023 CEP/IRP, model updates were made to Sequoia, including load forecasts, QF assumptions, addition of RFP proxies, etc. (Roundtables: Aug. & Nov.). These updates reduced 2026 capacity need to 47MW and 0MW for summer and winter, respectively.

The 2023 IRP Update models ELCCs in 2030, as there is adequate capacity need for estimation of resource contribution.

Sequoia changes effecting ELCCs:

- Model updates (Aug. & Nov. Roundtables)
- Modeled Year Change (2030)
- 75% Transmission Constraint

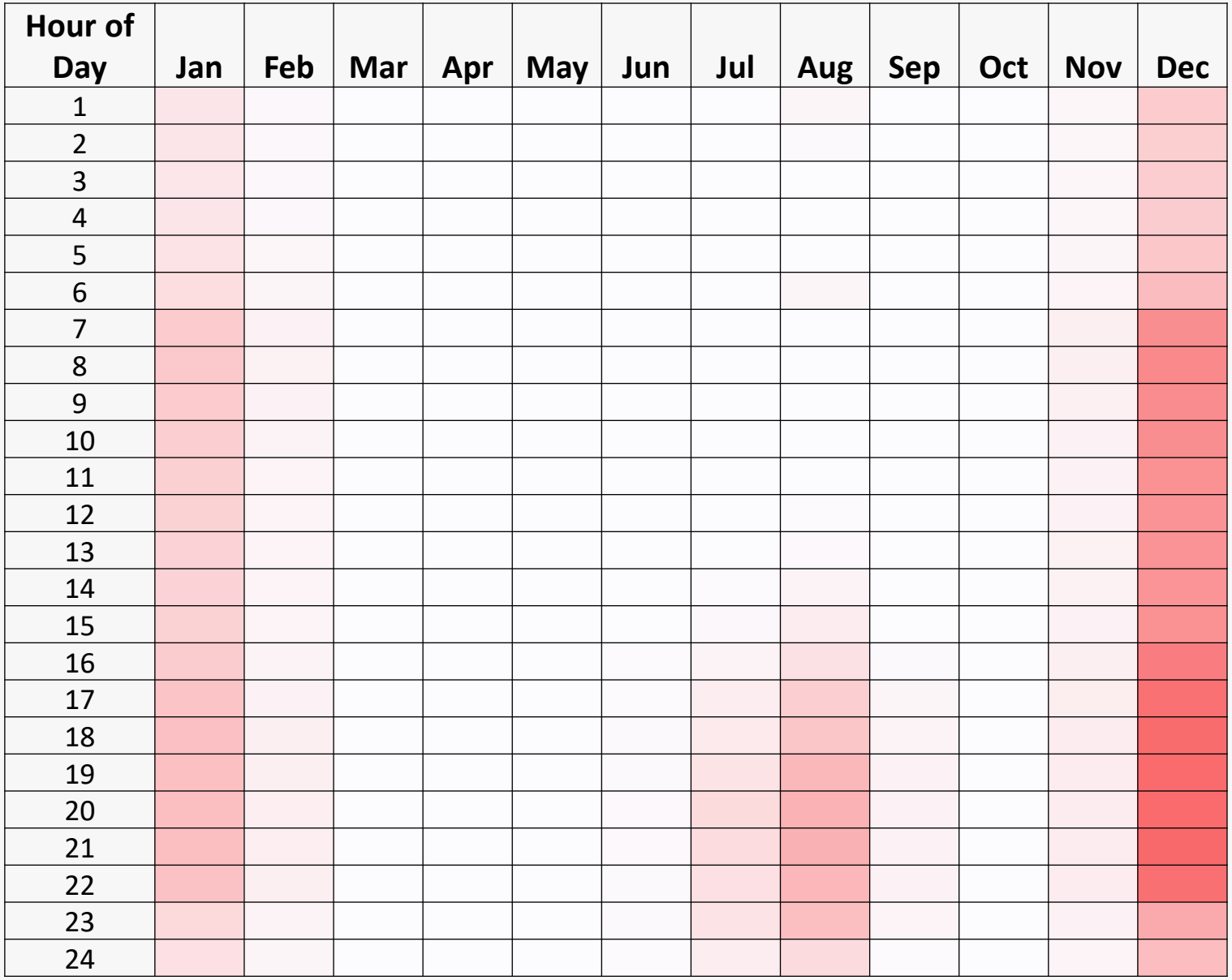


Current 2030 Outage Heatmap

We are evaluating ELCCs in year 2030 in this presentation

The system has similar capacity needs by season (975 MW in summer, 868 MW in winter), but more outage hours in winter

This system has higher capacity needs than the 2023 CEP IRP ELCC year (year 2026, summer need of 506 MW and winter need of 429 MW)



Hour of Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Transmission Options

Firm Transmission

This product assumes 100% transmission availability. If the resource is generating power, all the output is available to the system.

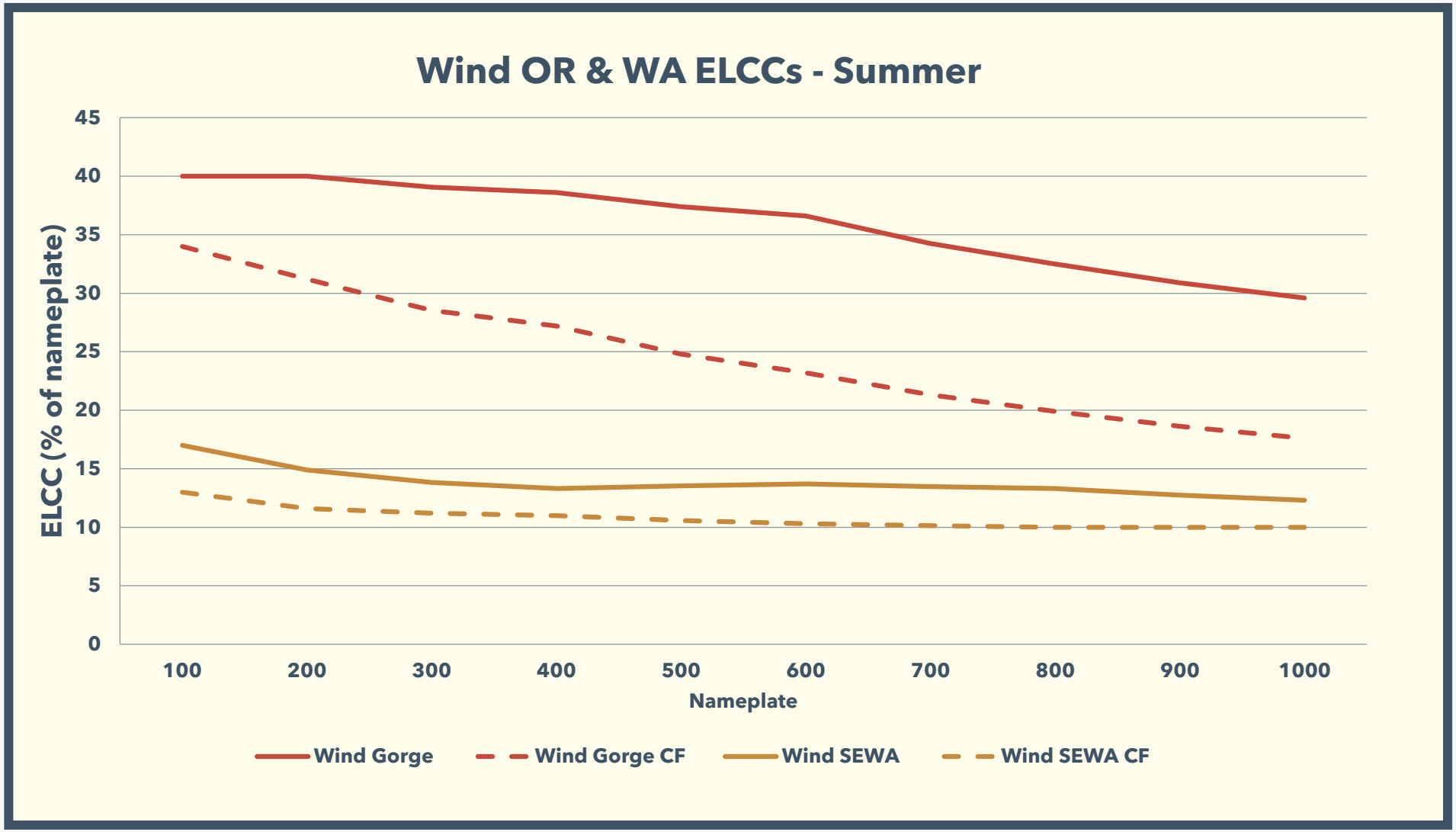
200hr Conditional Firm Transmission

This product assumes lack of transmission during this highest 100 load hours per year. This means that during the highest 100 load hours of the year the resource is essentially not available (even if it is generating). This negatively impacts ELCCs values compared to firm transmission all other factors equal.[1]

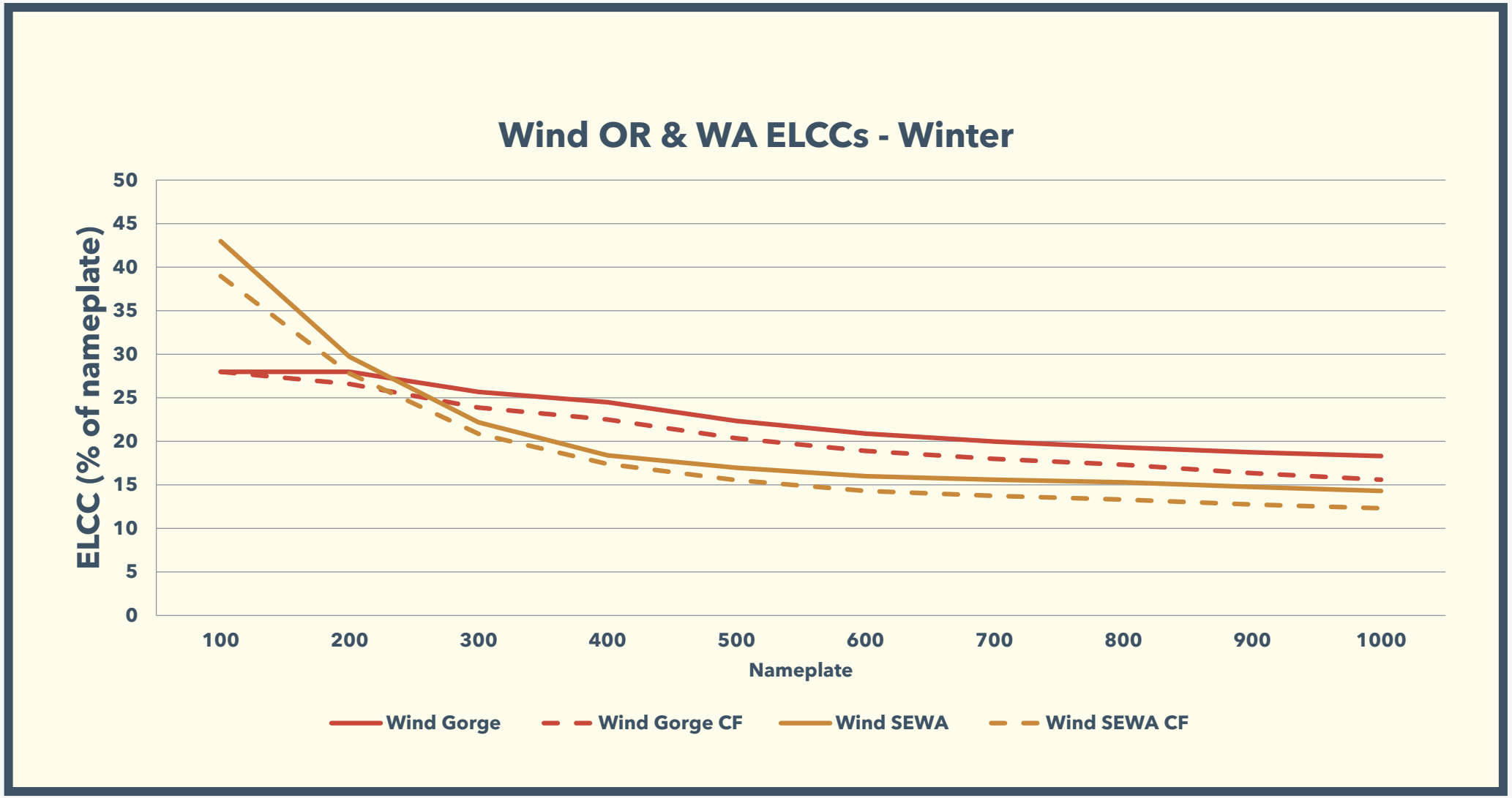
In portfolio analysis, resource ELCCs are a function of the relative quantities of Firm and Conditional Firm transmission product availability in PGE's BPA transmission inventories.

1. PGE should assume that 50% of conditional firm curtailment hours coincide with PGE's hours of highest need. Order 21-320

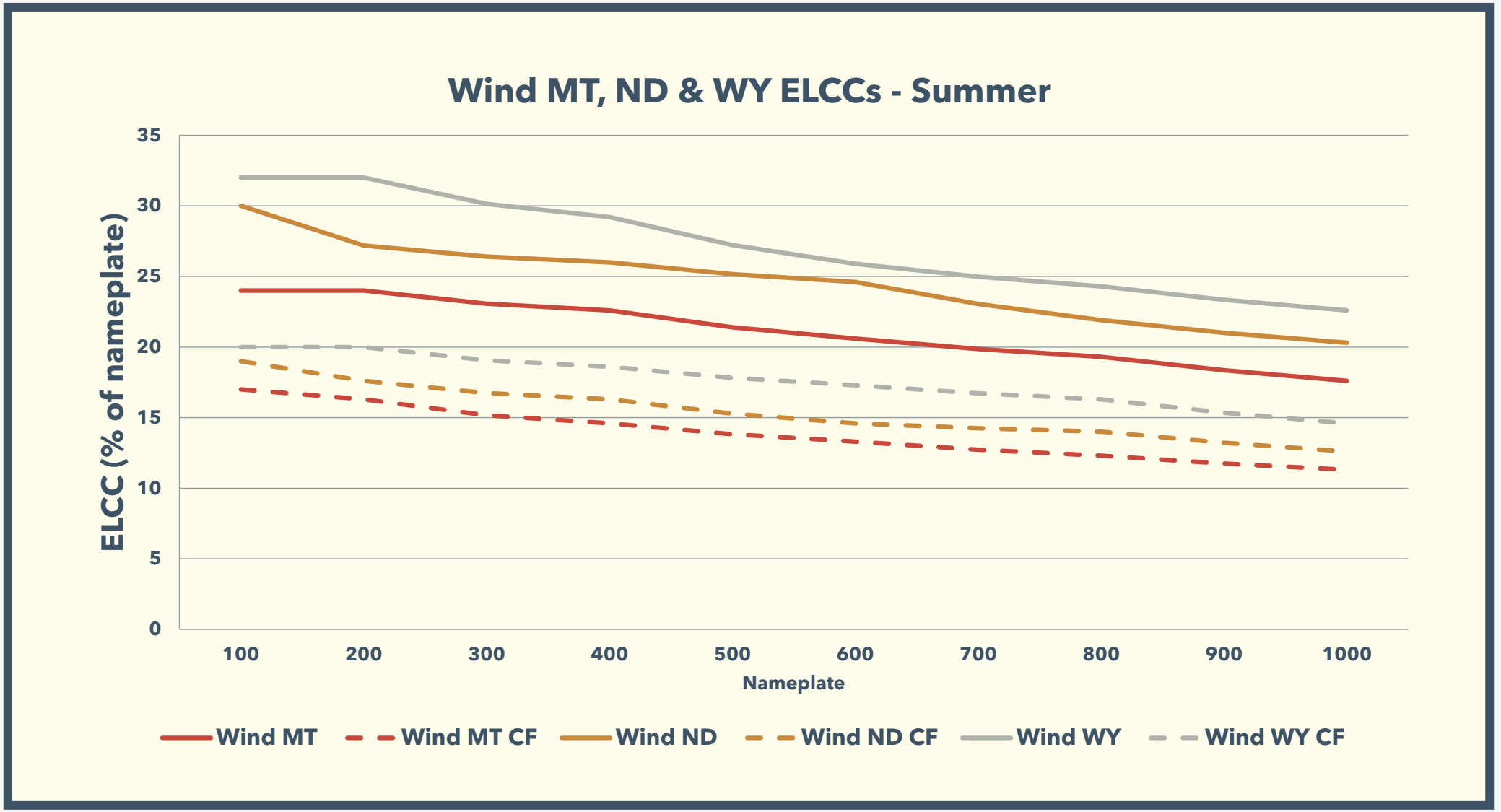
Wind ELCCs – Summer OR & WA



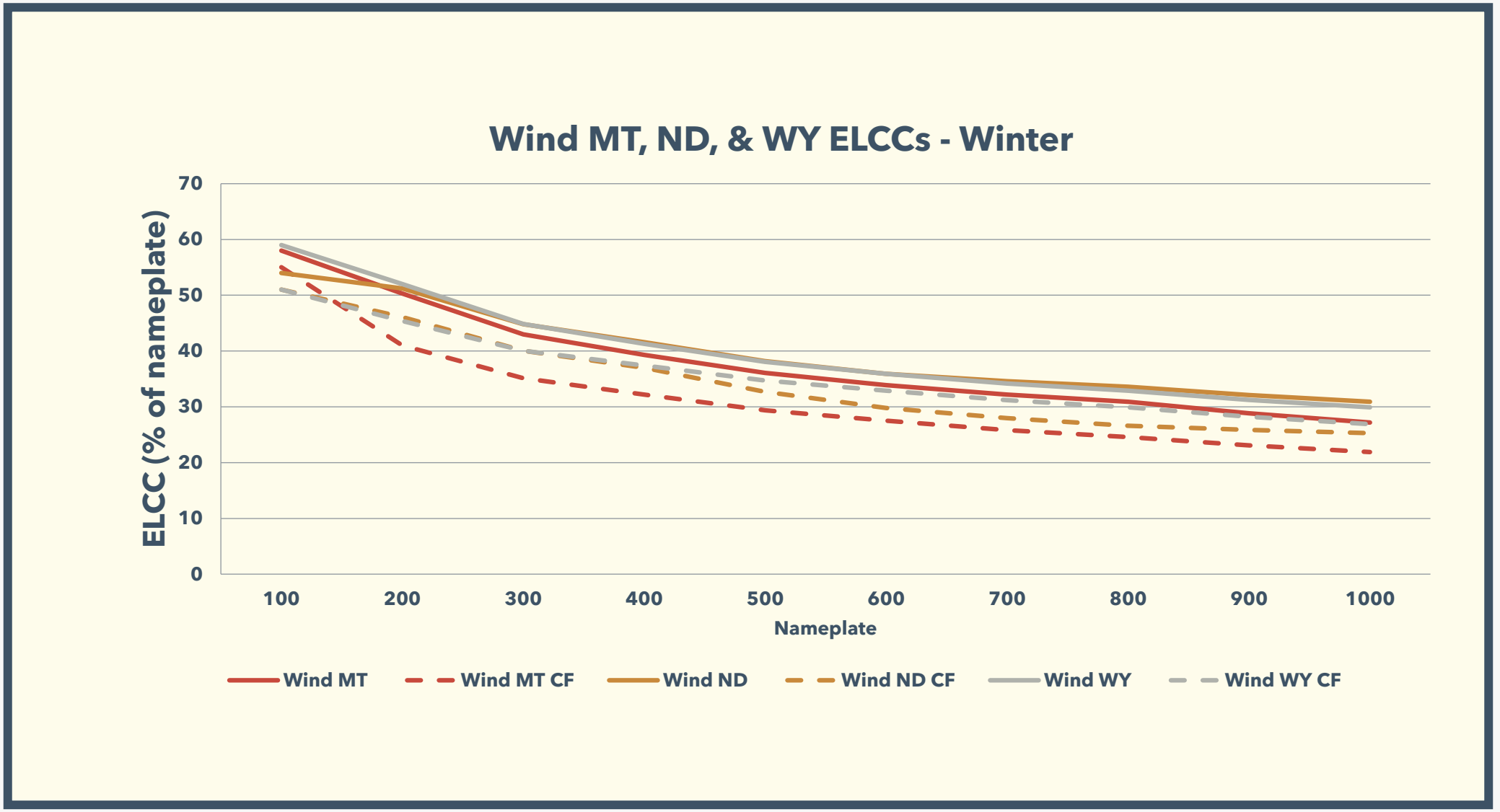
Wind ELCCs – Winter OR & WA



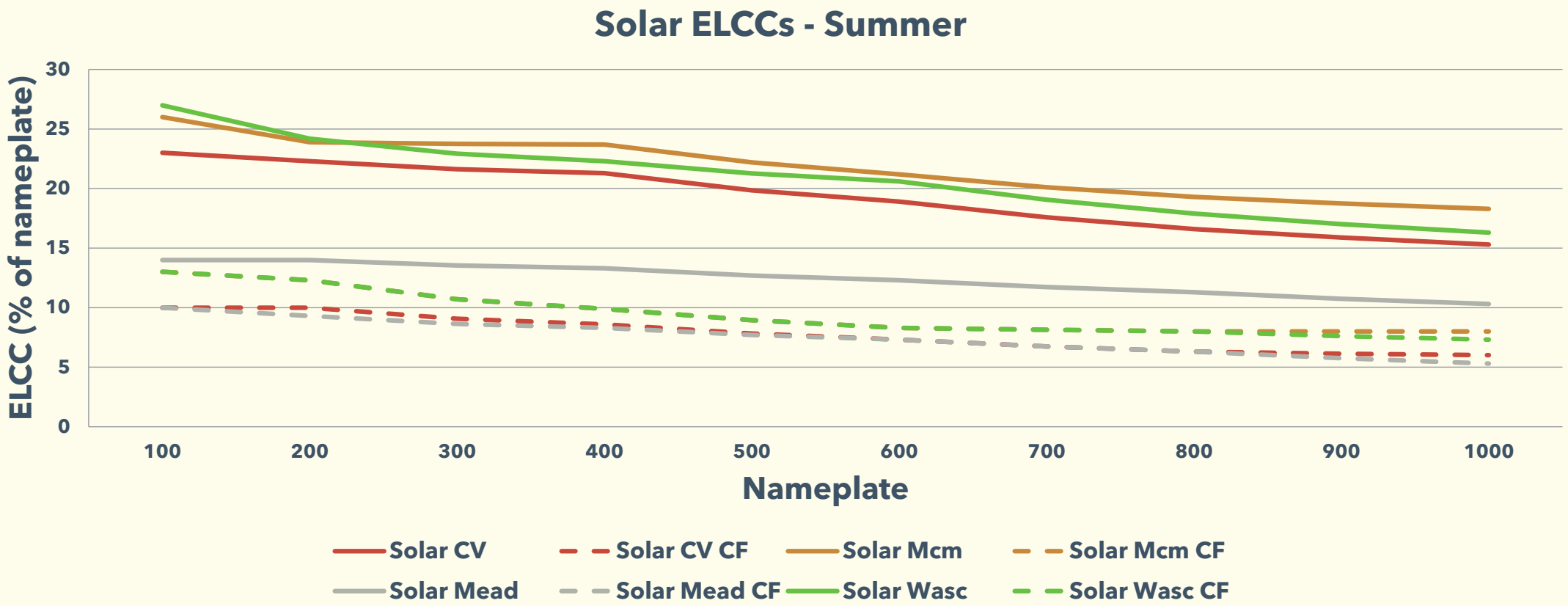
Wind ELCCs – Summer MT, ND, & WY



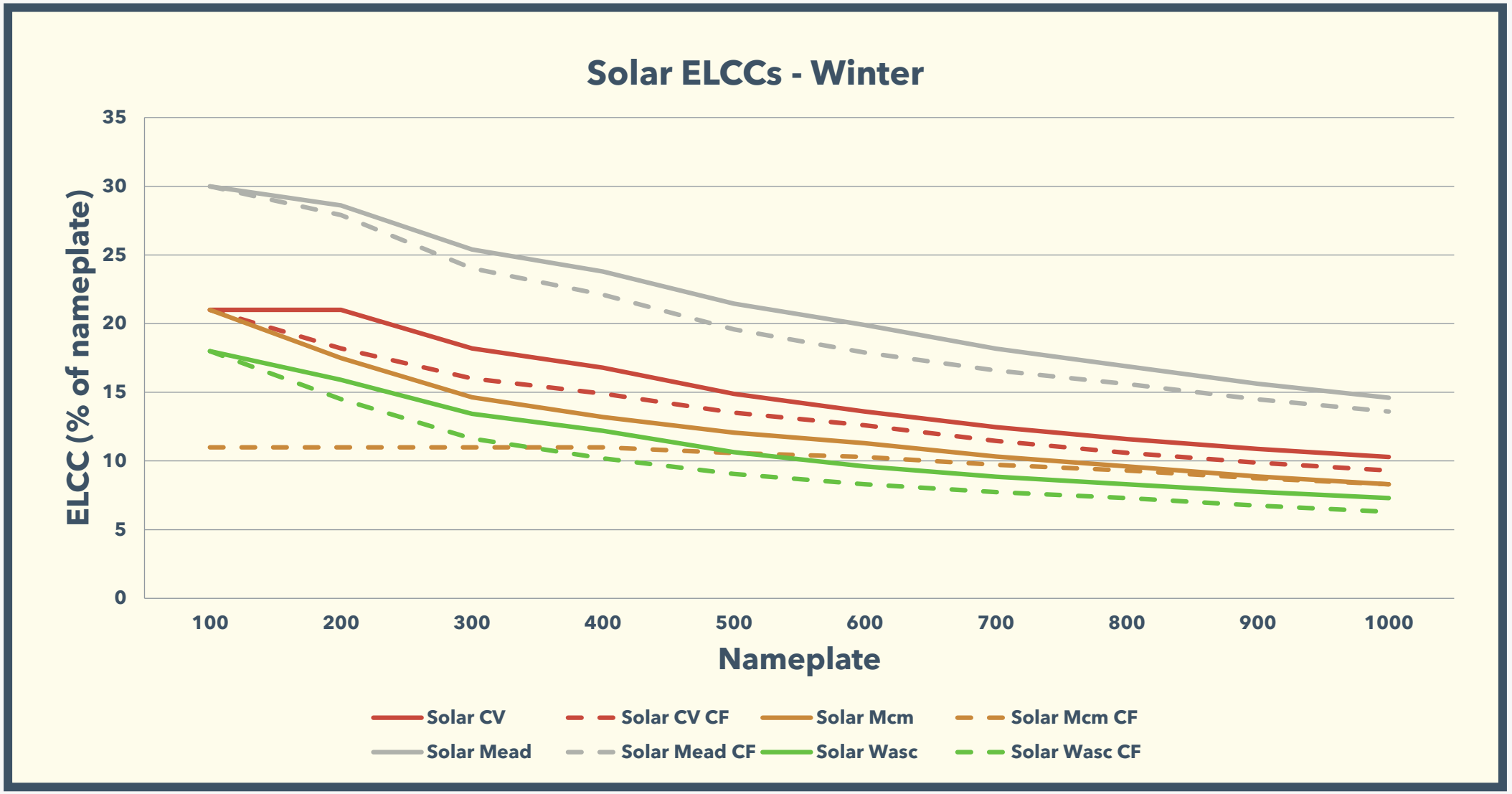
Wind ELCCs – Winter MT, ND, & WY



Solar ELCCs – Summer

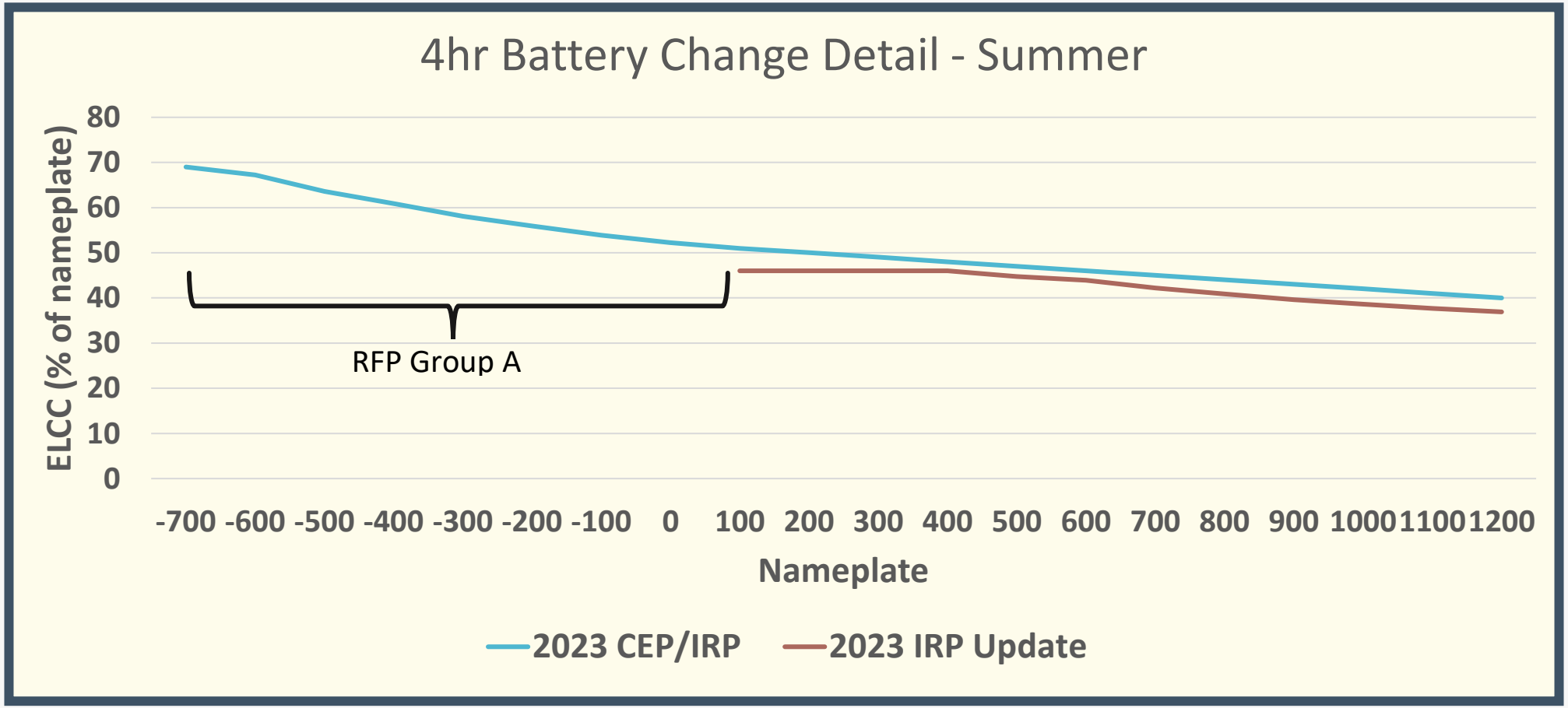


Solar ELCCs – Winter

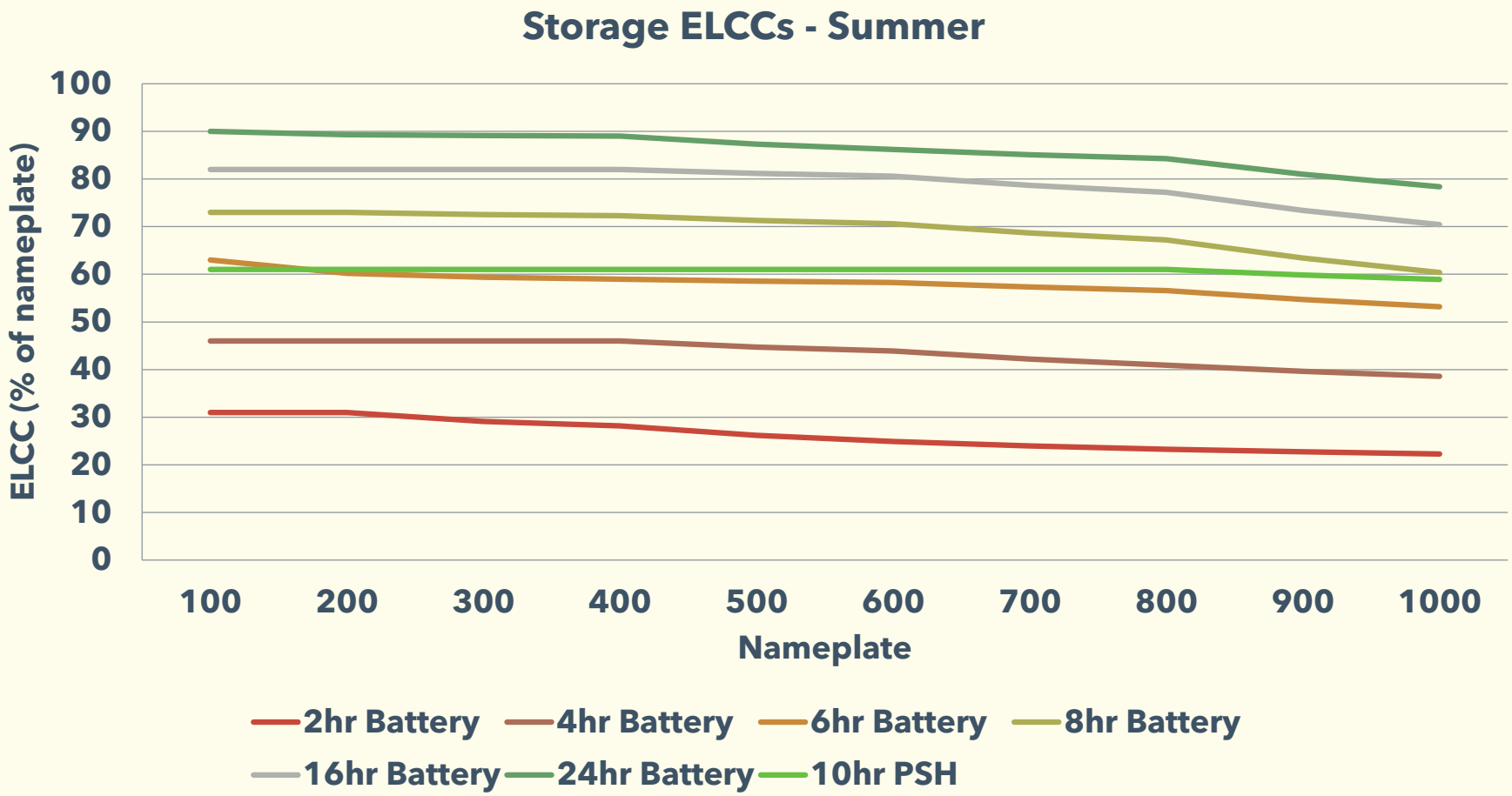


Storage ELCCs – Highlight of 4hr Battery Changes

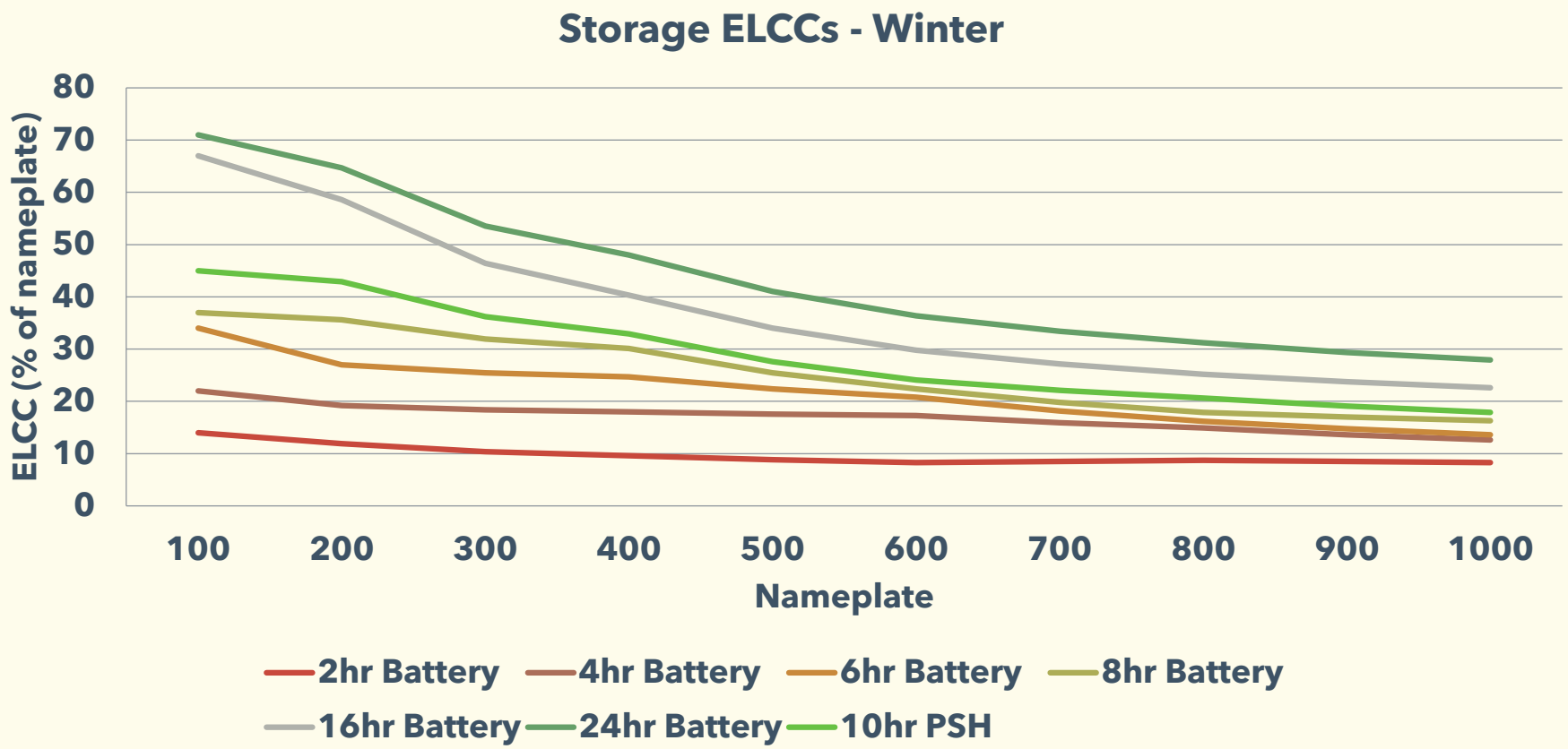
Updated results of 4-hour battery ELCCs are very similar to previous estimates after moving down the previous ELCC curve. This can be seen by shifting the previous curve to the left by the size of the 4-hour batteries included in the RFP Proxy.



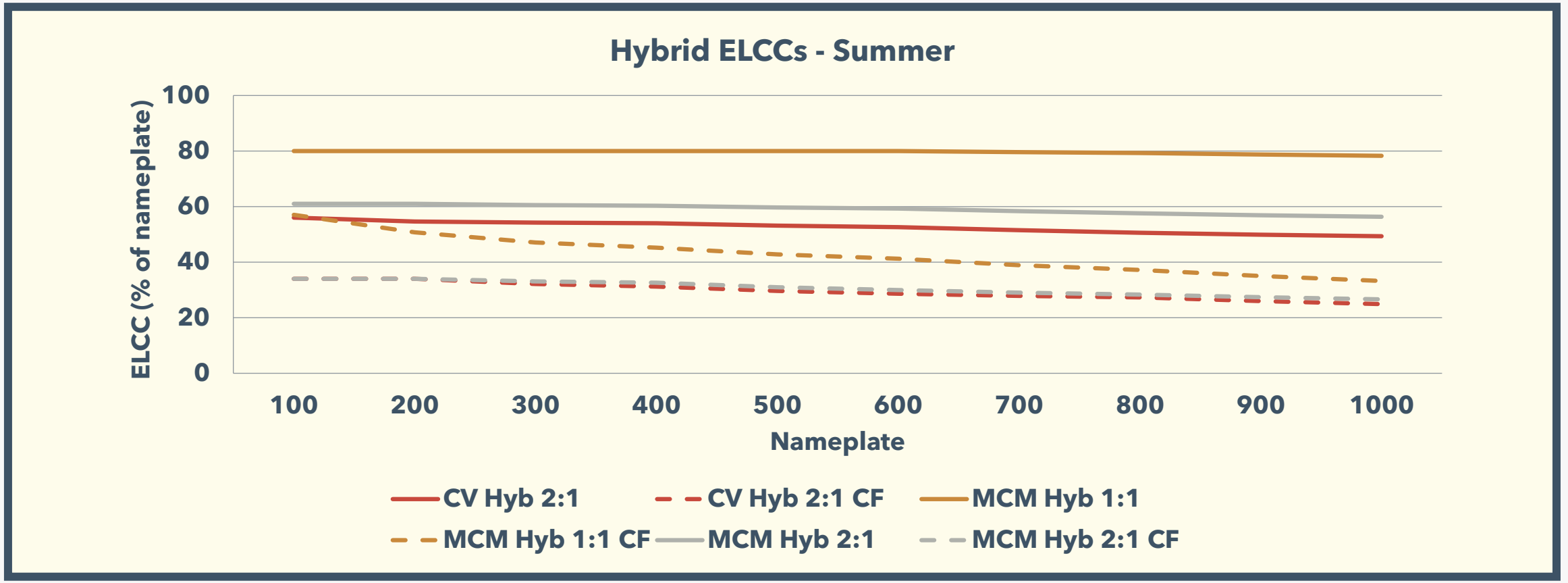
Storage ELCCs – Summer



Storage ELCCs – Winter

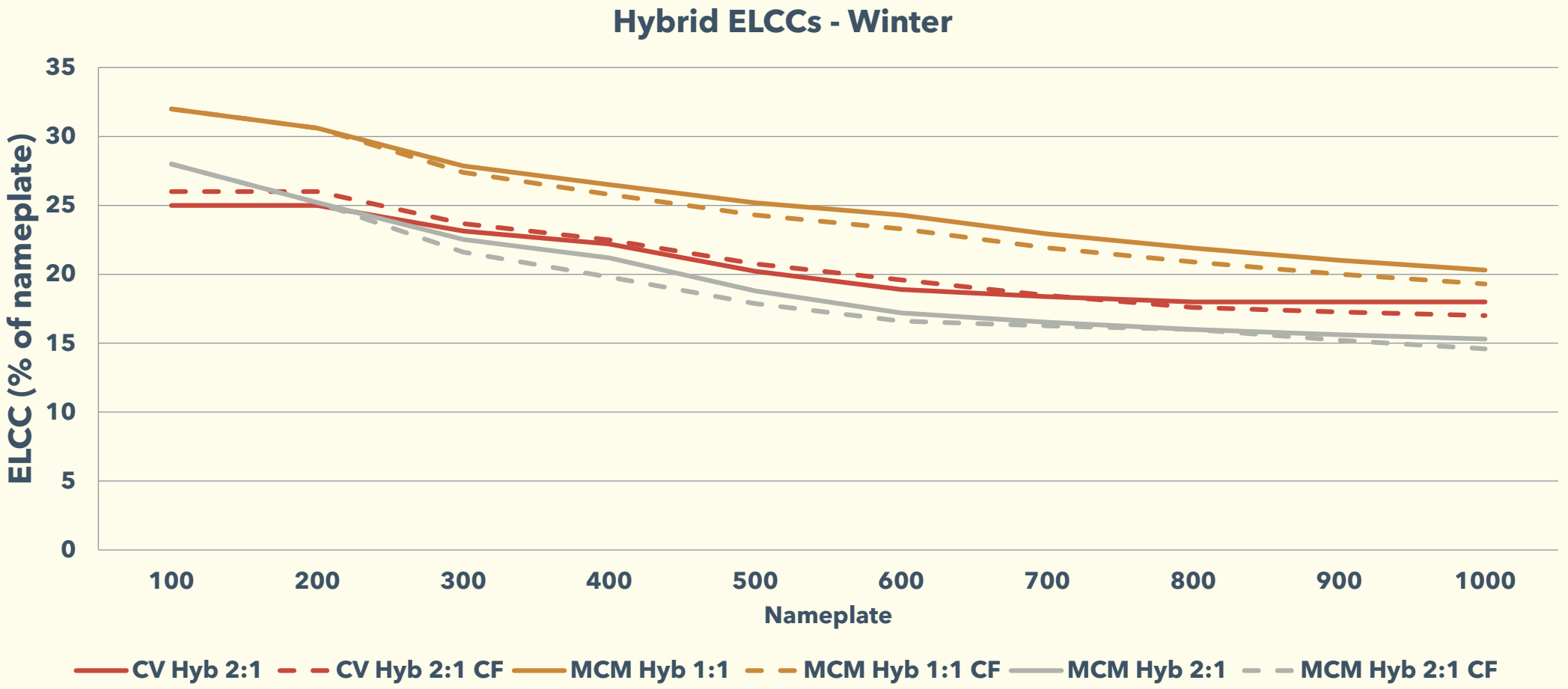


Hybrid ELCCs – Summer



Differentiation of Hybrid Resources:	**1:1 resources indicate nameplate storage is equal to the quantity of nameplate generation**	**(i.e. Nameplate of 100MW => 100MW Generation & 100MW of Storage)**
	2:1 resources indicate nameplate storage is half the quantity of nameplate generation	**(i.e. Nameplate of 100MW => 100MW Generation & 50MW of Storage)**

Hybrid ELCCs – Winter



Energy Values

Chris White, PGE

2023 CEP/IRP Update Energy Values

Calculation of Energy Value:

$$Energy\ Value = \left(\sum_{h=1}^{N}\left(\frac{Revenue_h}{Output_h}\right)\right)/N$$

- For each year in IRP Study Period.
- For each resource in Selected Portfolio.

PGE uses the *Portland Zonal Model (PZM)* simulation to estimate the economic dispatch of existing generation resources, contracts and potential new resources using electricity prices and associated risk variable inputs from each price future.

Dispatchable resources generate when their dispatch costs are less than the market electricity price, subject to all modeled operational constraints.

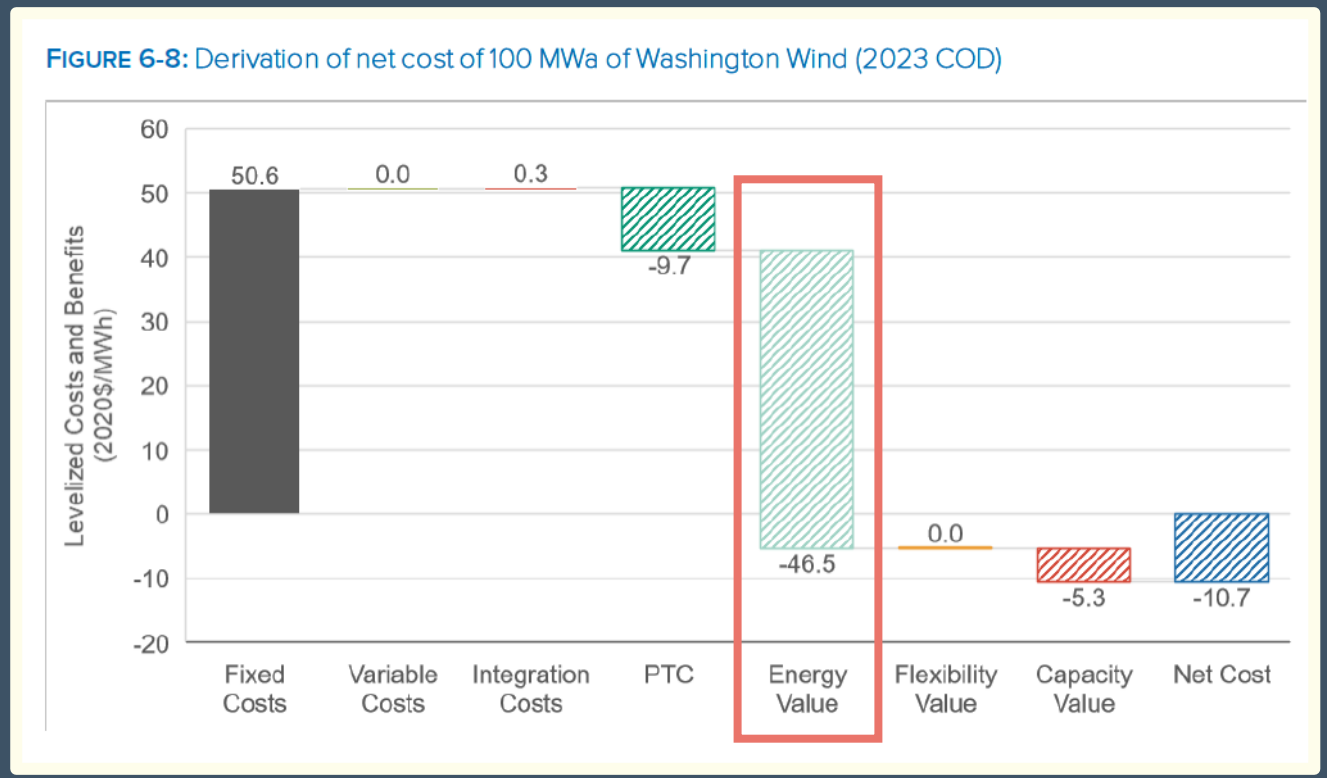
The **Energy Value** of a resource represents the average hourly revenue per MWh of the resource being considered.

Energy Values Methodology Continued

Energy Values represent one component in the calculation of the annualized net costs of adding a new resource.

The positive energy value created by a new resource is considered a negative cost in the resource net cost calculation.

The calculation of net cost allows PGE to represent the economic tradeoffs between specific resource actions.



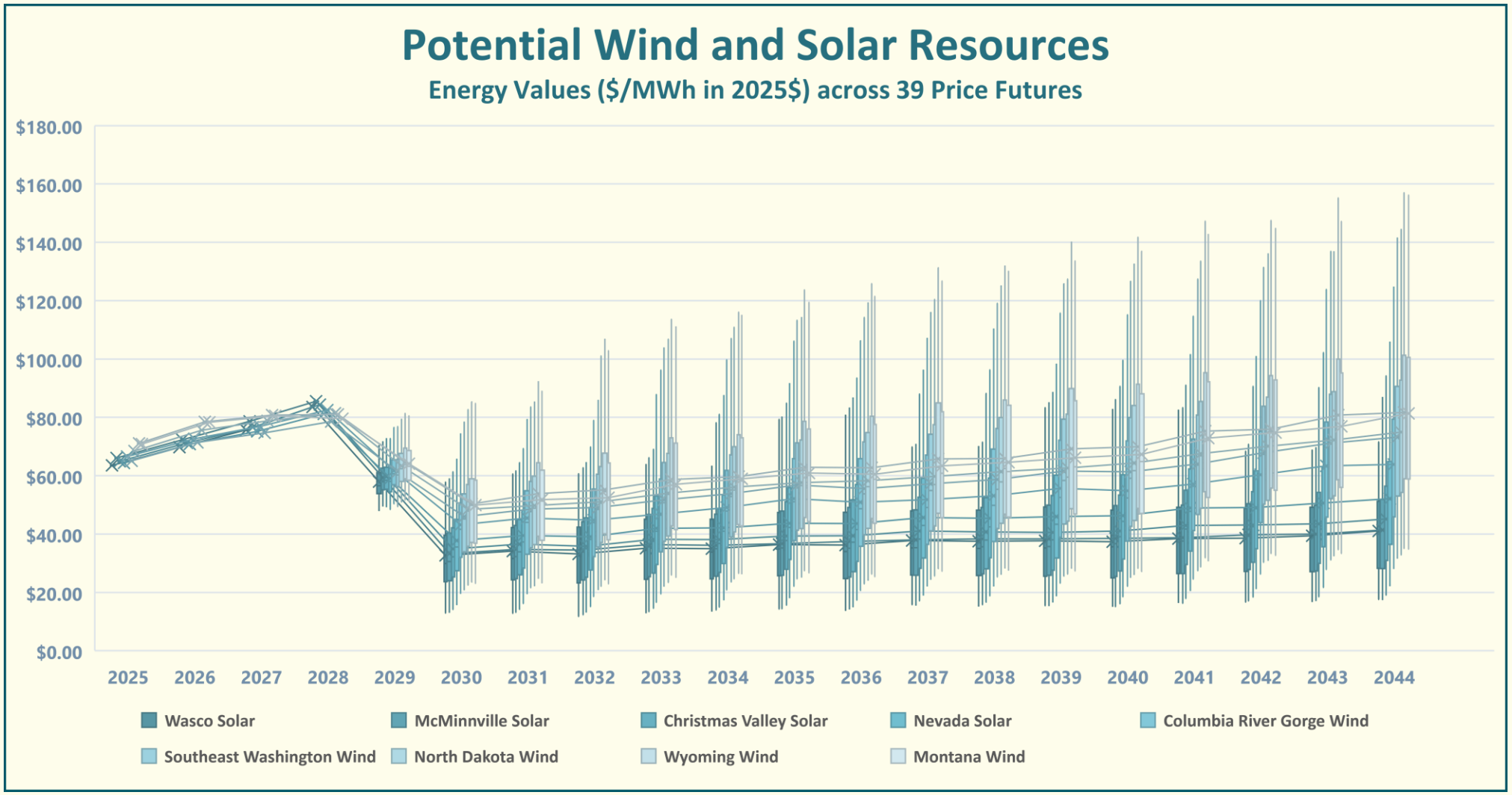
*Derivation of net cost above from 2019 IRP

2023 CEP/IRP Update Energy Values

	2023 CEP/IRP (2024-2043)		2023 CEP/IRP Update (2025-2044)	
Resource	**Reference**	**Range (across 39 simulations)**	**Reference**	**Range (across 39 simulations)**
Christmas Valley Solar	$39.18	($14.03 - $90.76)	$47.86	($13.07 - $94.19)
McMinnville Solar	$37.18	($13.26 - $85.44)	$46.21	($12.31 - $86.78)
Nevada Solar	$43.04	($15.13 - $101.9)	$51.13	($15.16 - $105.7)
Wasco Solar	$36.42	($12.69 - $82.79)	$45.06	($11.76 - $85.99)
Gorge Wind	$49.46	($16.12 - $123.35)	$57.64	($18.57 - $124.83)
SW Washington Wind	$53.86	($17.22 - $136.67)	$61.40	($20.81 - $141.43)
North Dakota Wind	NA	NA	$63.80	($22.12 - $144.43)
Wyoming Wind	$60.15	($19.52 - $154.93)	$68.18	($23.58 - $157.04)
Montana Wind	$58.44	($19.1 - $146.99)	$66.62	($22.93 - $156.2)

*Non-Levelized Prices ($/MWh) in $2025

2023 CEP/IRP Update Energy Values



Transmission Options

Keegan Moyer, Energy Strategies
Seth Wiggins, PGE

2023 CEP/IRP Transmission Modeling

PGE's geography necessitates an analysis with three components:

1. A characterization of the existing transmission system

How much transmission capacity is available to PGE today?

2. A characterization of the future transmission system

How much transmission capacity will be available to PGE when expected upgrades are made?

3. A description of actions PGE can take to increase transmission capacity for network load service

What can PGE do to bring more transmission capacity?

2023 CEP/IRP Transmission Modeling

PGE's geography necessitates an analysis with three components:

1. A characterization of the existing transmission system [Discussed at the July and October 2024 roundtables]

How much transmission capacity is available to PGE today?

2. A characterization of the future transmission system [Discussed at the September and October 2024 roundtables]

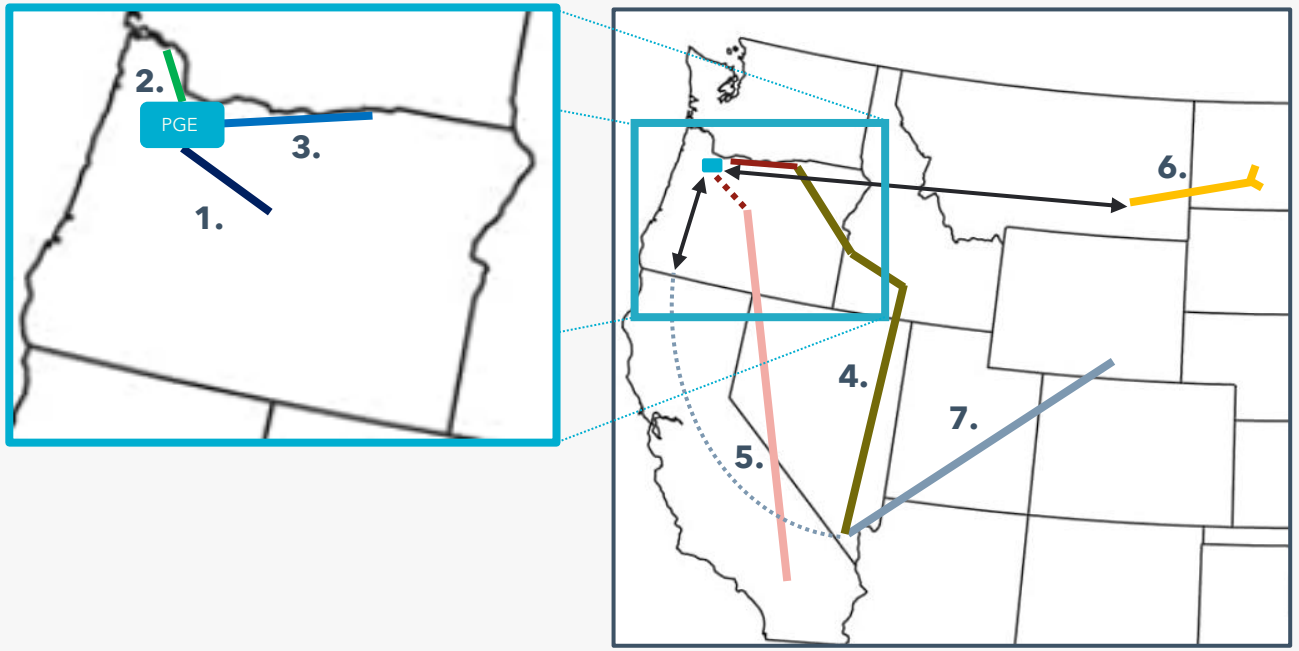
How much transmission capacity will be available to PGE when anticipated upgrades are made?

3. A description of actions PGE can take to increase transmission capacity for network load service [Discussed at the September, October and November 2024 roundtables, and today]

What can PGE do to bring more transmission capacity?

2023 CEP/IRP Update Transmission Options

1.	Bethel-Round Butte
2.	Trojan-Harborton
3.	Cascade Renewable Transmission Project
4.	SWIP N + Gateway West 8 + B2H
5.	Western Bounty
6.	North Plains Connector
7.	TransWest Express



Transmission pathways and the differences in both color and patterns are described for each individual option in the September Roundtable.

PGE CEP-IRP Update Transmission Options Review

Energy Strategies Review of Transmission Options Developed by PGE for CEP-IRP Update Process

January 2025

Prepared for:

PGE

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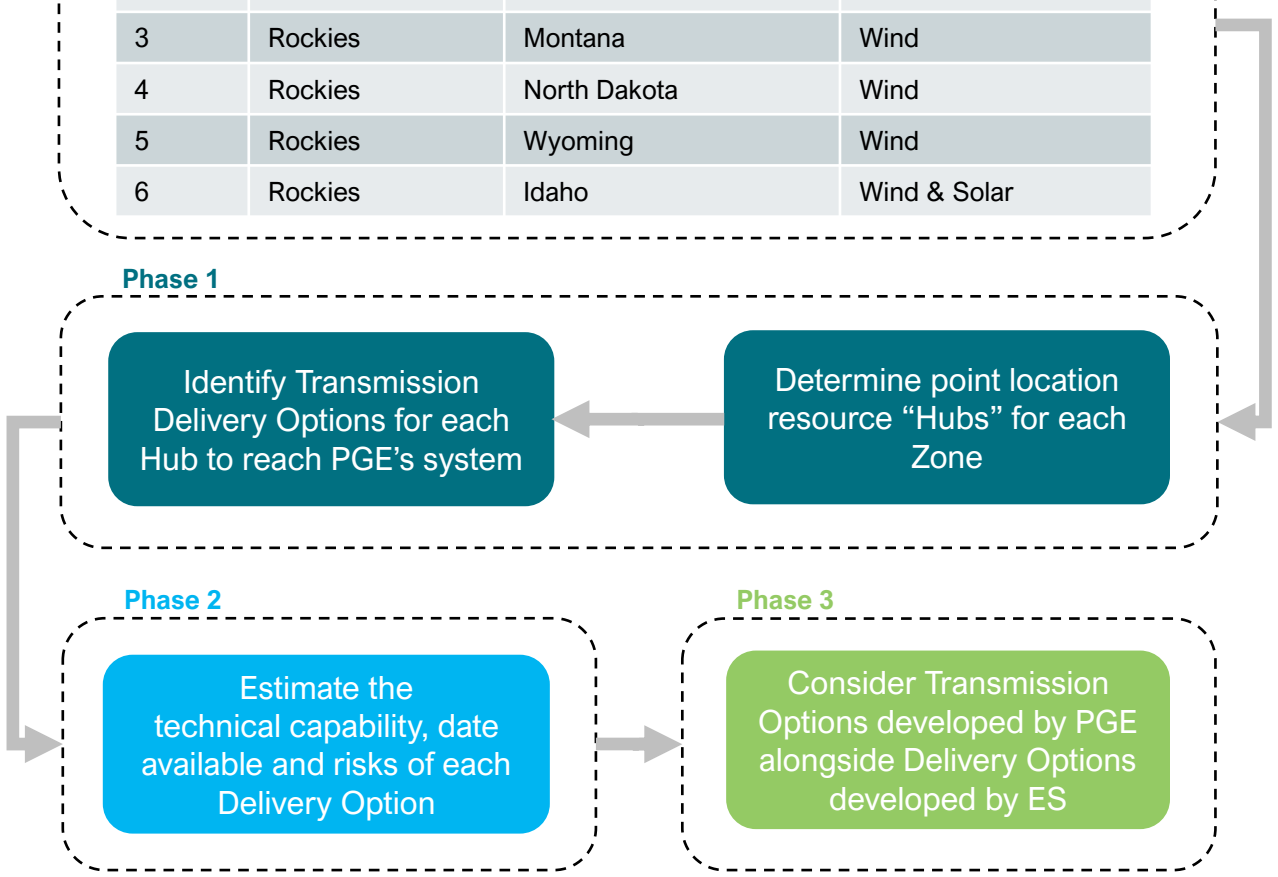
ENERGY STRATEGIES

Work Scope

- **Portland General Electric (PGE) engaged Energy Strategies (ES) to identify and evaluate transmission strategies to access remote resources.**
  - Designed to help PGE evaluate options to efficiently meet load and policy requirements in its Clean Energy Plan and Integrated Resource Plan (CEP-IRP).
- **The study consists of three phases:**
  1. **Identify Transmission Delivery Options** for six Resource Zones, considering:
     - Existing transmission system (e.g., Available Transfer Capacity (ATC))
     - Known or previously proposed transmission upgrades
     - New transmission upgrades
  2. **Characterize technical and risk profiles** of each feasible delivery option.
  3. **Review Transmission Options** developed by PGE and propose alternatives based on assessment.

Resource Zones Identified by PGE as Input to Study Scope

Zone	Region	State	Resource Type
1	Desert Southwest	Arizona	Solar
2	Desert Southwest	Nevada	Solar
3	Rockies	Montana	Wind
4	Rockies	North Dakota	Wind
5	Rockies	Wyoming	Wind
6	Rockies	Idaho	Wind & Solar

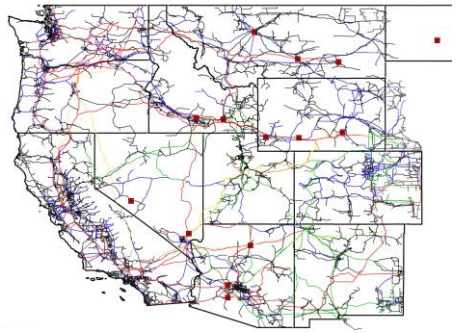


Transmission Delivery Options Development Methodology & Results

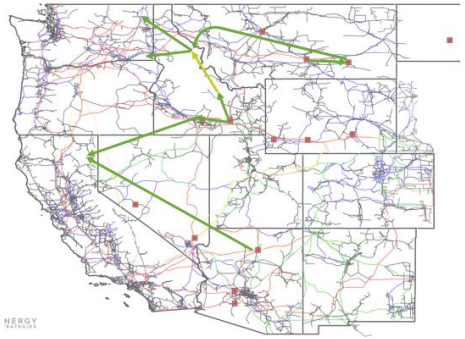
1 Resource Zones identified by PGE

Zone	State and Resource(s)
1	Arizona Solar
2	Nevada Solar
3	Montana Wind
4	North Dakota Wind
5	Wyoming Wind
6	Idaho Wind & Solar

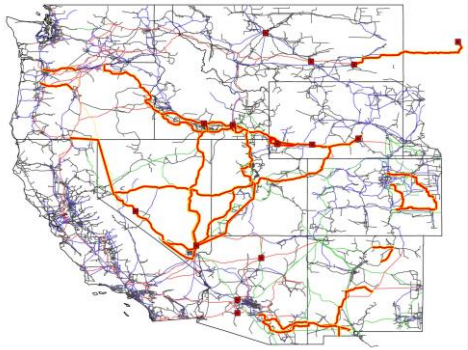
2 Establish Resource Hubs



3 Review ATC Postings on OASIS



4 Include Likely Transmission Upgrades



Interim selection of Transmission Delivery Options by Energy Strategies:

State and Resource	Description	Capacity (MW)	Date Available
Arizona Solar	APS ATC + NVE Expansion + existing NWACI + PGE Rights	183	~2035-2040
	APS Upgrade + NVE Expansion + existing NWACI + PGE Rights	550	2040+
Nevada Solar	NVE Expansion + updated NWACI + Bethel Round Butte	~600	~2035-2040
	SWIP N + Gateway West 8 + B2H + new BPA TSRs	400	~2035-2040
Montana Wind	Existing PGE Rights after Colstrip retired	270	2030
	PGE rights + new BPA & possibly NWMT TSRs	~1000	~2035-2040
North Dakota Wind	North Plains Connector + PGE rights + new BPA + NWMT TSRs	~1000	~2035-2040
Wyoming Wind	Gateway West & B2H + new BPA TSRs	400	~2035-2040
Idaho Wind & Solar	Gateway West & B2H + new BPA TSRs	400	~2035-2040
	New Hemingway -> Grizzly line + Bethel Round Butte	~1000	2040+

Highlighted Transmission Options Correspond to PGE Transmission Options from prior IRP roundtables

Review of PGE's Transmission Options from Prior Roundtables

- **Energy Strategies work scope included a review of Transmission Options developed by PGE:**
  - At the direction of the Oregon Public Utility Commission (PUC), PGE to update 2023 CEP-IRP Transmission Options.
  - As part of the CEP-IRP Update process and monthly public roundtables, PGE has developed 7 Transmission Options and asked Energy Strategies to review these options as a part of its broader work scope:
    1. **Are these options appropriate to meet the PUC's direction?**
    2. **What are the risks for each?**
    3. **Of the transmission alternatives identified by Energy Strategies, do any serve as viable alternatives?**

Seven Transmission Options Identified in PGE CEP-IRP Roundtables

1.	Bethel-Round Butte
2.	Trojan-Harborton
3.	Cascade Renewable Transmission Project
4.	SWIP N + Gateway West 8 + B2H
5.	Western Bounty
6.	North Plains Connector
7.	TransWest Express

Oregon/PNW specific transmission options

As the ES work scope did not consider stand alone intra-Oregon transmission, we will provide comments but cannot propose alternatives at this time.

Remote resource transmission options

With the consideration of remote resource zones in the ES scope, we assess the viability of these transmission options and propose alternatives as needed.

Overview of Findings from Review of PGE Transmission Options

Resource Area	PGE Transmission Option	ES Alternatives to Consider	Recommendation
North Dakota (Wind)	**North Plains Connector**	No alternatives recommended	• With PGE's Colstrip rights and NWMT + BPA TSRs, North Plains Connector is the best option. • Based on development status and need for downstream upgrades, recommend first available date no sooner than 2035 (perhaps later).
Wyoming (Wind)	**TransWest Express + CAISO**	Gateway West & B2H	• There is significant policy and pricing risk to using TransWest Express, without providing firm transmission access. • Using Gateway West may require upgrades to existing lines to increase transfer capacity.
Nevada (Solar)	**Western Bounty**	Greenlink and PGE's Rights + Upgrades	• Western Bounty likely too early in development to reach service before mid- to late-2030s. • Combining NVE's Greenlink with PGE's rights and upgrades provides a lower risk alternative to consider.
Nevada (Solar)	**SWIP N + Gateway West 8 + B2H**	No alternatives recommended	• This transmission option represents a strong option but would require additional TSRs on the BPA introducing timing risk.

- **Resource areas evaluated by ES not captured by PGE transmission options:**
  - Arizona
  - Idaho
  - Montana
- **Resource areas and transmission options in PGE CEP/IRP Roundtables outside ES scope:**
  - OR/WA/BPA
    - Bethel – Round Butte
    - Trojan – Harborton
    - Cascades Renewable Transmission
  - CAISO

"Evolving Grid" Status Improves Transmission Service-Driven Upgrades, but Significant Uncertainty Remains

- **BPA's Evolving Grid initiative prioritizes significant transmission projects that are critical to meet regional needs in the PNW.**
  - Initiative supports upgrades that will improve resource deliverability in the coming decade, attempting to address cyclical nature of TSRs triggering recurring upgrades in TSEP cycles and eventually dropping out.
  - Evolving Grid is designed to provide an actionable path forward primarily for projects that were identified in BPA's 2021, 2022 and 2023 TSEP processes and relate to specific TSRs.
- **Despite this step, BPA has not yet committed to constructing these projects and many still have several years of scoping, design and NEPA milestones prior to a BPA decision to fund and construct.**
  - In-service dates for EVG 1 projects: ~2026-2032.
  - In-service dates for EVG 2 projects: not announced, but possibly mid-late 2030s.
- **Conclusion for this work: Evolving Grid 1.0 projects create capacity that is likely "already spoken for" by existing TSRs (and generation projects PGE is likely aware of via RFPs) and Evolving Grid 2.0 projects have too many uncertainties to forecast impact at this time.**
  - Therefore, for this study we assume generic "new BPA TSRs" are needed for service on or through BPA to reach PGE and recommend continued monitoring of both sets of Evolving Grid projects.

Evolving Grid 1.0	
1	Cross Cascades North Upgrades • Schultz-Raver 500 kV Line Upgrade • Paul 500 kV Substation Upgrade • Olympia 230 kV Substation Upgrade
2	Big Eddy-Chemawa 230/500 kV Line Upgrade
3	Portland Area Upgrades • Pearl-Sherwood McLoughlin 230 kV Line Upgrade • Keeler-Horizon 230 kV Line • Keeler 230/500 kV Transformer Addition
4	Chehalis-Covington 230 kV Line Upgrade
5	Ross-Rivergate 230 kV Line Upgrade
6	Rock Creek-John Day 500 kV Line Upgrade
7	Six Mile Canyon 230/500 kV Substation (New Construction)
8	Bonanza 230/500 kV Substation (New Construction)
9	La Pine-Bonanza 230 kV Line (New Construction)
10	Buckley 500 kV Substation Rebuild

Evolving Grid 2.0	
1	Grand Coulee-Columbia-Schultz 500 kV Line Upgrade
2	Schultz-Olympia 500 kV Line Upgrade
3	North of Pearl Upgrades
4	Central Oregon 500 kV Dynamic Reactive Upgrades
5	RATS: Reno-Alturas Reactive Addition
6	Salem Area Upgrades #1 (North of Marion)
7	Salem Area Upgrades #2 (North of Marion)
8	NOB Substation (New Construction)
9	Lower Columbia-Bonanza 500 kV Line (New Construction)
10	Bonanza to NOB 500 kV Line (New Construction)
11	Ostrander-Pearl 500 kV Line Upgrade
12	Big Eddy-Quenett Creek Upgrade
13	Big Eddy-The Dalles Line Rebuild

Review of PGE Proposed Transmission Options and Selected Alternatives

PGE Transmission Options Review – Overview of Contents

1. **PGE Transmission Options to access remote resources:**
   - SWIP N + Gateway West 8 + B2H
   - Western Bounty
   - North Plains Connector
   - TransWest Express Transmission Project

2. **Appendix: PGE Transmission Options specific to Oregon/PNW:**
   1. Bethel – Round Butte 500kV Upgrade
   2. Trojan – Harborton Upgrade
   3. Cascades Renewable Transmission Project

SWIP N + Gateway West 8 + B2H

Details from PGE's CEP-IRP Update Roundtable:

- *This option entails PGE purchasing access on five transmission lines leading to the desert southwest:*
  1. *Boardman to Hemingway (B2H)*
  2. *Gateway West segment E8*
  3. *Southwest Intertie Project (SWIP) – North*
  4. *One Nevada Transmission Line (ON Line)*
  5. *Desert Link*
- *This is achievable by **2027** (line COD). However, this option would require additional access across BPA's system, which is plausibly expected by **2032** (IRP COD).*
- *Up to **600 MW** of Nevada solar is modeled to be enabled through this option.*

SWIP N + Gateway West 8 + B2H:

- **Energy Strategies' conclusions:**
  - SWIP N + Gateway West 8 + B2H is a viable transmission option to access Nevada generation – it involves transactions with three transmission providers: 1. NVE, 2. PacifiCorp or Idaho Power, and 3. BPA.
  - Up to 400 MW of Nevada solar can be accessed, with unallocated transmission capacity on B2H as the limiting segment (see details on next slide).
  - Boardman (Longhorn) to PGE requires additional TSRs on the BPA system.
  - Earliest Date: 2035-2040, with greatest timing risk related to receiving additional TSRs on BPA system and availability of capacity on B2H.

SWIP N + Gateway West 8 + B2H: Details

- **Energy Strategies' determination of rights on each segment:**

Segment	Description	Rights MW	Est. Date Available
NVE	ATC from Greenlink projects (Southsys to Northsys)	~550 (1)	2029
SWIP North	Utilizing DOE's northbound entitlements	500 (2)	2027 COD
Gateway West E8	Utilizing forecasted available transmission	600 (3)	2028 COD
B2H	Use currently unallocated 218MW of PAC rights and 182MW of IPCo rights	400 (4)	2026 COD
Longhorn to PGE	New BPA TSRs – see prior slides	400	2035-2040
	Rights and Date Available entire path:	**400**	**2035-2040**

SWIP N + Gateway West 8 + B2H:

(1) ATC from OASIS Postings, Southsys to Northsys, 550MW represents minimum during 2029-2033 period (Expansion entails Greenlink West, Greenlink North).
(2) For SWIP-North, CAISO and the DOE hold a combined 1072.5 MW of entitlements in the northbound direction. We assume that PGE could request and acquire up to 500 MW (equal to DOE's entitlements) (sources: here and here).
(3) Gateway West Segment E8 will have a transfer capacity of 2000 MW. Energy Strategies assumes PGE can request and receive 600 MW of capacity (source: PacifiCorp here).
(4) From IPCO for B2H (CPCN documents filed by IPCO here and here).

Western Bounty

Details from PGE's CEP-IRP Update Roundtable:

- *The Western Bounty Transmission System is a proposed 3000 MW HVDC line that could connect southern California to the Grizzly substation*
- *The projected commercial operation date (COD) is **2033***
- *Up to **3000 MW** of Nevada solar is modeled to be enabled through this option*
- *This option would provide access to the SP-15 market hub*
- *Additional BPA upgrades would be required for this option to reach PGE*

Western Bounty

- **Energy Strategies' conclusions:**
  - Western Bounty early in its development cycle and unlikely to materialize before mid- to late-2030s based on historical transmission development rates.
    - Development started in 2023 with the Interregional Transmission Project (ITP) joint evaluation process only starting in 2024. Project is early stage.
  - The scope, timing and available capacity of necessary BPA upgrades would likely limit PGE's 3000 MW of proposed solar access to a smaller amount – we do not recommend assuming 3000 MW of availability.
  - As an alternative, NVE's Greenlink expansion that increases ATC on their system, together with PGE's rights on the Northwestern AC Intertie (NWACI) and the Bethel – Round Butte upgrade, could be utilized to access resources within a similar proposed timeframe (details provided on next slide).

Western Bounty Alternative: NVE Expansion and PGE rights

- **NVE Greenlink expansion and PGE's rights and projects as an alternative to Western Bounty for access to southwest solar:**
  - With NVE's Greenlink expansion, Southsys to Northsys capacity increases, creating additional ATC which PGE can utilize.
  - Pros:
    - Less risk in terms of parties involved and permitting timelines: NVE taking lead on "Greenlink 3" (Fort Churchill -> Captain Jack).
    - The expected route for Greenlink 3 roughly falls within the "Mountain – Northwest" National Interest Electric Transmission Corridor meaning any environmental review process under NEPA could be expedited as part of DOE's National Transmission Needs Study.
  - Cons:
    - Available capacity is less than considered with Western Bounty, however the 3000 MW envisioned capacity on Western Bounty would be limited by BPA upgrades.
- **Conclusion: Less risk and same desired timeframe and capacity potential as Western Bounty.**

Greenlink vs. Western Bounty:

ID	Element	Description	Rights MW	Est. Date Available
1	NVE	ATC from Greenlink projects (Southsys to Northsys)	~550 (1)	2029
2	Greenlink 3	Fort Churchill -> Captain Jack (early stage proposed by NVE)	725 (2)	2035-2040
3	Captain Jack -> Grizzly	Planned contractual updates to allow intra-region scheduling on the Northwest AC Intertie (NWACI) and use PGE's existing rights.	627 (3)	2029
4	Bethel – Round Butte Upgrade	TTC depends on configuration but not limiting segment in path	~3000 (4)	2032
		Rights and Date Available entire path:	**627**	**2035-2040**

(1) ATC from OASIS Postings, Southsys to Northsys, 550MW represents minimum during 2029-2033 period (Expansion entails Greenlink West, Greenlink North).
(2) NVE IRP Filing on initial study work related to Fort Churchill -> Captain Jack (Greenlink 3) (sources: here and here)
(3) Data from PGE.
(4) Data from PGE.

North Plains Connector

Details from PGE's CEP-IRP Update Roundtable:

- *This project is a 412-mile HVDC transmission line to be constructed with endpoints near Bismarck, North Dakota and Colstrip, Montana.*
- *PGE currently has **270 MW** of rights from Colstrip to PGE.*
- *If nothing changes between now and 2032, only a combined 270 MW NPC will be available for model selection.*
- *However, the company has submitted TSRs for an additional 720 MW across both BPA's and NorthWestern's systems.*
- *Up to 3000 MW of North Dakota wind is modeled to be enabled through this option, subject to the constraints mentioned above.*
- *Additionally, this option would provide access to the MISO Resource Zone 1 market.*
- *This option's COD is expected by **2032**.*

North Plains Connector:

- **Energy Strategies' conclusions:**
  - With PGE's existing rights from Colstrip, this project represents the best option to access North Dakota wind.
  - However, the timing to receive requested BPA and NWMT TSRs, as well as early stage of project development, are not consistent with a 2032 availability - we suggest a late 2030s timeframe may be more appropriate given historical greenfield transmission development timelines.
  - As already noted above, the actual MW capacity of access will be limited by PGE rights from Colstrip and pending TSRs.

TransWest Express Transmission Project

Details from PGE's CEP-IRP Update Roundtable:

- *This project is a two-part line that connects near Sinclair, WY and near Boulder City, NV:*
  - *Near Sinclair, WY to near Delta, UT: 3000 MW DC*
  - *Near Delta, UT to near Boulder City, NV: 1500 MW AC*
- *This option is being structured as a gen-tie through CAISO, which PGE can access using its rights at the California-Oregon Border (COB) trading hub.*
  - *This line could add up to approximately 3,000 MW of transmission access, however PGE's COB rights limit access to 600 MW of Wyoming Wind.*
  - *No other market access benefits assumed.*
- *The anticipated COD for this option is 2027 and would not require any additional transmission expansion.*

TransWest Express Transmission Project:

- **Energy Strategies' conclusions:**
  - PGE would need to be a subscriber on TWE and deliver to Eldorado; then make a market purchase at California Oregon Border (COB) which may be subject to paying CAISO transmission access charge (TAC).
    - This strategy would also be subject to basis risk between Eldorado and COB (or require a developer to carry this risk).
    - Would also likely need to ensure the transaction was designated as a high priority wheel-through.
    - This results in potentially high cost of transmission to access WY wind.
  - Other factors to consider include CAISO LSEs obtaining all TWE capacity (for reliability/clean energy needs), lack of ability to document delivery to PGE given lack of firm service, significant policy risk and dependence on CAISO market rules.
  - An alternative using Gateway West and B2H may be viable but has risks in timing and availability of capacity.

TransWest Express Alternative: Utilizing Gateway

- **Utilizing the Gateway buildout as an alternative to TransWest Express for access to Wyoming wind:**
  - Pros:
    - Provides access to Wyoming wind on a firm basis while avoiding the policy and pricing risks that would be associated with CAISO market transactions.
  - Cons:
    - Puts PGE in competition with PAC and IPCo and would require timely granting of TSRs on all systems.
- **Conclusions: Neither TransWest Express nor the Gateway alternative are ideal options**
  - PGE may be unable to secure affordable transmission access to Wyoming wind on a firm basis in the 2030s.

Gateway West vs. Transwest Express:

ID	Element	Description	Rights MW	Est. Date Available
1	Gateway West: Anticline -> Populus	Completing construction of Gateway West segment D-3	400 (1)	2031
2	Gateway West: Populus -> Hemingway	Completing construction of Gateway West segment E	400 (1)	2036
3	B2H	Use currently unallocated 218MW of PAC rights and 182MW of IPCo rights	400 (2)	2026 COD
4	Longhorn to PGE	New BPA TSRs.	400	2035-2040
		Rights and Date Available entire path:	**400**	**2035-2040**

(1) Gateway West segment E8 will have a transfer capacity of 2000 MW. Energy Strategies assumes PGE can apply for 400 MW of capacity (source: PacifiCorp here).
(2) (2) From IPCO for B2H (sources: IPCO here and here).

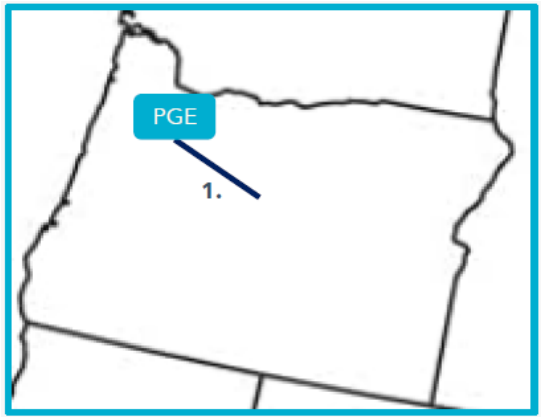
Appendix: Review of PGE Oregon/PNW Specific Transmission Options

Bethel – Round Butte 500kV Upgrade

Details from PGE's CEP-IRP Update Roundtable:

- *The Bethel-Round Butte reconductoring would increase the capacity on the existing line.*
- *The line is 98 miles, running from the Bethel substation (near Salem) to the Round-Butte substation.*
- *The projected commercial operation date (COD) is **2032** and will not require any other transmission expansion for PGE to access these benefits.*
- *Rebuilding the line from 230 kV to 500 kV will increase capacity.*
- *This could support an increase of **2,385-4,770 MW** increase in 'BPA' resources (off-system resources in the PNW region), depending on specification and subsequent path rating processes.*
- *This option provides market access to the California-Oregon border.*

Bethel – Round Butte 500kV Upgrade:



- **Energy Strategies' conclusions:**
  - As noted in the PGE 2023 CEP/IRP this upgrade is a "no regrets" option and facilitates significant access to queued resources.
  - However, depending on the reconductoring configuration chosen, the total transfer capacity is likely to reach only 3000 MW.

Trojan – Harborton Upgrade

Details from PGE's CEP-IRP Update Roundtable:

- Approximately 34 miles long, running between PGE's Trojan and Harborton substations, paralleling two existing lines in service since the 1970s.
- PGE currently owns the additional unused ROW necessary for the project and has since the 1970s.
- The projected commercial operation date (COD) is **2032** and will not require any other transmission expansion for PGE to access these benefits.
- This transmission project will enable **800 MW** from BPA's generation resources, subject to cooperative study and agreement with other South of Allston path owners, BPA and PacifiCorp.

Trojan – Harborton Upgrade:

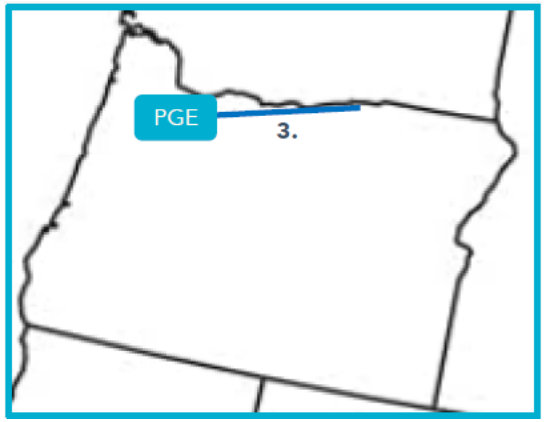
- **Energy Strategies' conclusions:**
  - With the importance of South of Allston and the control over right of way and facilities PGE possesses which are necessary to complete this upgrade, completing Trojan – Harborton upgrades appears "no regrets" similar to the Bethel – Round Butte upgrade.
  - In addition to the mentioned need to coordinate with other South of Allston path owners, timing of benefits from this upgrade is not certain:
    - Realizing the 800MW of BPA generation resources seemingly requires receipt of TSRs PGE has applied for on the BPA system and likely date to receive these TSRs is closer to 2035 than the proposed 2032 COD of this upgrade option.

Cascade Renewable Transmission Project

Details from PGE's CEP-IRP Update Roundtable:

- This project involves an electric transmission cable bundle, buried entirely underground and underwater, along with two converter stations located next to existing substations.
- This travels approximately 100 miles, primarily beneath the Columbia River, from the Big Eddy substation to the Harborton substation.
- The projected commercial operation date (COD) is **2032** and will require additional BPA and PGE transmission expansion for PGE to access these benefits.
- This is modeled to enable the transfer of **1,100 MW** of 'BPA' resources (off-system resources in the PNW region).
- PGE is not currently participating in this project, but involvement may be possible if selected as part of PGE's preferred portfolio.

Cascade Renewable Transmission Project:



- **Energy Strategies' conclusions:**
  - The point of delivery at Harborton makes PGE well-positioned to realize benefits from access to BPA resources.
  - The timing for 1260 MW of solar + storage projects in BPA's Queue at Big Eddy as well as the Cascade Renewable Transmission Project's own queue position (all seeking interconnection/energization in 2029) seems aggressive given the early stage of development for this project.
    - With the challenges to work in the Columbia River, especially from a permitting perspective, late 2030s more likely as a time for project COD.

Questions

NEXT STEPS

A recording from today's webinar will be available on our website in one week

Upcoming Roundtable: February 19th

Distribution System Workshop: February 20th

Thank you

Contact us at
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ACRONYMS

AC: alternating current
ARIMA: autoregressive integrated moving average
ART: annual revenue-requirement tool
ATC available transfer capability
BPA: Bonneville Power Administration
C&I: commercial and industrial
CBI: community benefit indicators
CBIAG: community benefits and impacts advisory group
CBRE: community based renewable energy
CDD: colling degree day
CEC: California energy commission
CEP: clean energy plan
CF conditional firm
DC: direct current
DER: distributed energy resource
DR: demand response
DSP: distribution system plan
EE: energy efficiency
ELCC: effective load carrying capability
EJ: environmental justice
ETO: energy trust of Oregon
EUI: energy use intensity
GHG: greenhouse gas
HB2021: House Bill 2021
HDD: heating degree day
HVDC: high-voltage direct current
IE: independent evaluator
IOU: investor-owned utilities
ITE: information technology equipment
ITC: investment tax credit
kW: kilowatt
LOLH: loss of load hours
LT/ST: long term/ short term
LTF long-term firm
MW: megawatt
MWa: mega watt average
NAICS: North American industry classification system
NCE: non-cost effective
NG: natural gas
NPVRR: net present value revenue requirement
OASIS Open Access Same Time Information System
ODOE: Oregon department of energy
PPA: power purchase agreement
PSH: pumped storage hydro
PUC: public utility commission
PURPA: Public Utility Regulatory Policies Act
PV: photovoltaic
REC: renewable energy credit
RLRR: low carbon price future
ROSE-E: resource option strategy engine
RPS: renewable portfolio standard
RRRR: reference case price future
RTO: regional transmission organization
SoA: South of Allston
T&D: transmission and distribution
TSR: transmission service request
TSEP: TSR study and expansion process
Tx: transmission
UPC: usage per customer
UPS: uninterruptible power supply
VER: variable energy resources
VPP: virtual power plant
WECC: western electricity coordinating council