Resource-to-Busbar Mapping & Other Modeling Assumptions for the 2026-2027 Transmission Planning Process

CPUC Staff Report – Proposed Decision

January 2026

Contents

1. Document Purpose

Resource-to-busbar mapping ("busbar mapping") is the process of refining the geographically coarse electricity resource portfolios produced in the California Public Utilities Commission's (CPUC) Integrated Resource Planning (IRP) proceeding, into plausible transmission network modeling locations (i.e., busbars) for transmission analysis in the California Independent System Operator's (CAISO) annual Transmission Planning Process (TPP).

The purpose of this Report is to memorialize and communicate the results of the busbar mapping process, performed by the busbar mapping Working Group – CPUC, CAISO and California Energy Commission (CEC) staff – and transmitted to the CAISO for input into the 2026-2027 TPP. The key output of busbar mapping is the locations of the resources in the portfolios, and this Report summarizes those mapping results and the analysis performed to obtain those results. While transmission constraint information and analysis are discussed in this report, busbar mapping and the CPUC do not identify and trigger transmission upgrades. The transmission information utilized and summarized in this Report only helps to inform the mapping locations and identify where potential upgrades may be needed. It is the CAISO's role through the full transmission analysis in the TPP to identify whether transmission upgrades would be necessary to accommodate the resources mapped in this analysis. The CPUC, in its transmittal of the TPP portfolios to the CAISO, also provides additional guidance and requests on how to use the mapped results and other information in the CAISO's TPP analyses.

The CPUC has traditionally provided a document describing planning and modeling assumptions to accompany the portfolios transmitted for study in the TPP annually. It was originally called the "Long-Term Procurement Plan Assumptions and Scenarios" and later the "Unified Inputs and Assumptions". Starting with the 2020-2021 TPP, the CPUC has provided modeling assumptions documentation similar to what is in this Report describing guidance on the mapping results for previous TPP studies. Thus, this Report supersedes earlier guidance and documents.[1]

The approach taken in this Report serves to provide detailed documentation to accompany several Excel workbooks that identify the locations for future generation and storage resources that are expected to be necessary to support the California electric grid. Please see Section 10: Appendices for links to these workbooks along with the previously released busbar mapping methodology document.

[1] Previous busbar mapping Reports for earlier TPP cycles are posted to the IRP webpage. The previous Report for the 25-26 TPP is at the Assumptions for the 25-26 TPP webpage: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2024-26-irp-cycle-events-and-materials/assumptions-for-the-2025-2026-tpp

2. Scope

This Report addresses the busbar mapping and other modeling assumptions for the portfolios being transmitted by the CPUC to the CAISO for the 2026-2027 TPP, as outlined in Table 1 below.

Table 1: Modeling assumptions reported in this document.

IRP Portfolio	**2026-2027 TPP Portfolio Use Case(s)**	**Modeling Assumptions**
2026-27 TPP portfolio (25 MMT GHG target by 2035 Core portfolio using the 2024 CEC IEPR Planning Forecast) — base case portfolio	• Reliability base case • Policy-driven base case assessment • Economic assessments	• Busbar allocations of non-battery resources and battery resources for 2036 and 2041 model years • Baseline reconciliation between the 2024 IRP baseline and the CAISO's 2024 White Paper baseline. • Gas units not retained assumptions
25 MMT limited wind sensitivity portfolio using the 2024 CEC IEPR Planning Forecast— limited wind sensitivity portfolio	• Policy-driven sensitivity assessment	• Busbar allocations of non-battery resources and battery resources for 2036 and 2041 model years • Baseline reconciliation between the new 2024 IRP baseline and the CAISO's 2024 White Paper baseline. • Gas units not retained assumptions

3. Report Summary

The November 3, 2025, Ruling Seeking Comments on Electricity Portfolios for 2026-2027 Transmission Planning Process and Need for Additional Reliability Procurement (November 2025 Ruling)[2] proposed the 25 MMT GHG target by 2035 Core portfolio using the 2024 CEC Integrated Energy Policy Report (IEPR) Planning forecast and including a portion of the long lead-time (LLT) resources considered for central procurement by the Department of Water Resources (DWR) in the need determination adopted in D.24-08-064,[3] per Assembly Bill (AB) 1373 (Stats. 2023, Ch. 367) as the reliability and policy-driven base case portfolio for the 2026-2027 TPP. The ruling proposed mapping and transmitting two study years: 2036 and 2041 for the portfolios in compliance with the requirements of SB 887 (Stats. 2022, Ch. 358).[4] The ruling also proposed transmitting a policy-driven sensitivity portfolio, the limited wind sensitivity portfolio, which limited the in-state wind potential to 2.5 GW, and restricts out-of-state wind potential to the amounts available to be delivered on existing transmission lines where the CAISO has rights (SunZia, SWIP-North, TransWest) as well as an additional 2 GW of additional potential on lines from New Mexico.

The base case portfolio includes over 65,000 MW of new renewable resources and over 25,000 MW of storage in the 2036 model year. The portfolio's 2041 model year includes over 85,000 MW of renewables, including 5,100 MW of geothermal and enhanced geothermal systems (EGS), 17,000 MW of out-of-state wind on new out-of-state transmission, and 4,500 MW of offshore wind, as well as over 25,000 MW of storage, including 5,400 MW of long duration storage. These new resources are incremental to the resources included in the 2024 Baseline Generator List developed for the 25-26 TPP,[5] which includes both existing resources and in-development resources not yet online.

Initial busbar mapping results for the proposed base case portfolio were released with the November 2025 Ruling. Working Group staff conducted an additional round of mapping taking into consideration parties' comments to the November 2025 Ruling. The updated mapping results for the base case portfolio were released with the January 14, 2026, Proposed Decision Transmitting Electricity Resource Portfolios to the California Independent System Operator for the 2026-2027 Transmission Planning Process.[6]

Figure 1 below, includes a graph and map which provide a geographic overview of the updated mapped results for base case portfolio's 2036 model year. The map provides an overview of the locations, amounts, and type of resources mapped through the implementation of the busbar mapping process, while the chart summarizes the amount map by general region. Figure 2 shows the same overview for the base case portfolio's 2041 model year updated mapping results.

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[2] https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M582/K082/582082526.PDF
[3] https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M539/K202/539202613.PDF
[4] SB 887 established PUC § 454.57 which requires, amongst other things, the CPUC to transmit to the CAISO for its TPP resource portfolios for at least 15 years into the future to ensure adequate lead time for transmission planning and development.
[5] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2024-26-irp-cycle-events-and-materials/system-reliability-modeling-datasets-2024
[6] https://docs.cpuc.ca.gov/SearchRes.aspx?docformat=ALL&docid=595083681

Figure 1: Updated busbar mapping results of the 26-27 TPP base case portfolio 2036 model year. (Left) Map of the final busbar mapping results. (Right) Chart showing mapping results summed by region. Resources shown in MWs.

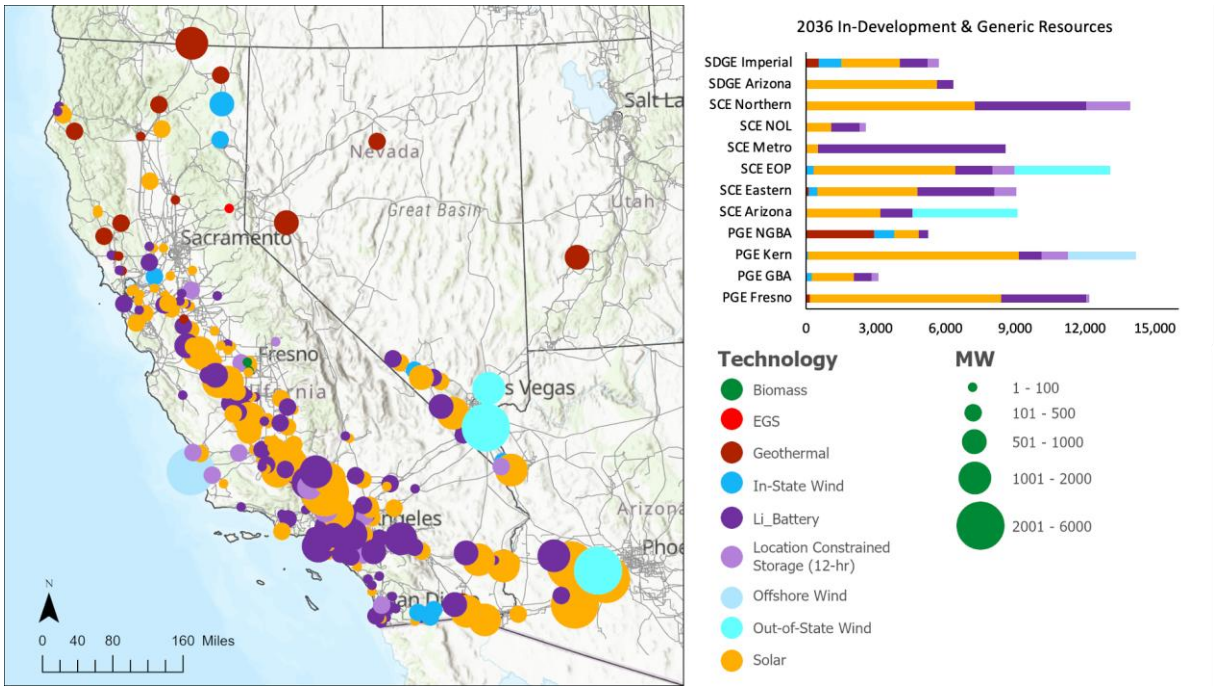
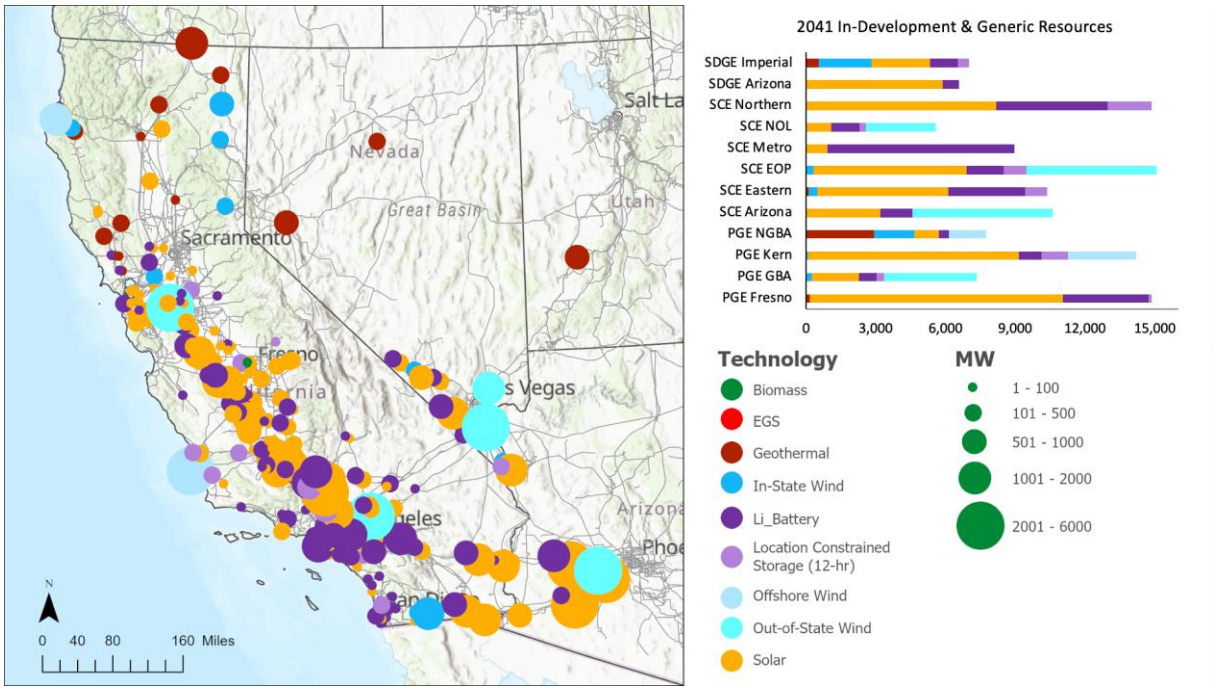


Figure 2: Updated busbar mapping results of the 26-27 TPP base case portfolio 2041 model year. (Left) Map of the final busbar mapping results. (Right) Chart showing mapping results summed by region. Resources shown in MWs.



This Report describes the proposed base case portfolio, the initial mapping results released with the November 2025 Ruling, the updated mapping results and its alignment with the busbar mapping criteria, and CPUC staff's analysis on the potential transmission implications of the mapped portfolio. It also provides additional inputs, and guidance for modeling the mapped portfolios and assessing potential transmission solutions in the CAISO's 2026-2027 TPP. This report describes the Limited Wind sensitivity portfolio and will be updated to include the key mapping results when completed by staff.

This Report is structured as follows:

Section 4 states the objectives of studying the base case and sensitivity portfolios, summarizes the portfolios themselves, and details the RESOLVE modeling outputs for the portfolios.

Section 5 summarizes the updates made to the mapping methodology[7] used by CPUC, CAISO and CEC staff to conduct busbar mapping and to produce other inputs and assumptions for the 2026-2027 TPP.

Section 6 details the initial busbar mapping criteria analysis, remapping steps taken by the Working Group to improve the mapping allocations to meet the criteria, and the updated mapping results and its alignment with the criteria.

Section 7 summarizes the results of the mapping process and potential transmission implications of the mapped resources.

Section 8 presents other information about the portfolios required for TPP modeling including gas retirement assumptions.

Section 9 draws conclusions regarding mapping the portfolios for the 2026-2027 TPP and provides guidance to the CAISO for its 26-27 TPP analysis.

Section 10 lists the appendices for this report including the busbar mapping methodology document, the mapping dashboards that identify the locations for future generation and storage resources and the resulting busbar mapping analysis of those locations, and several other supporting workbooks.

[7] Referring to the version attached to the September 2024 Ruling. Available at: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2025-2026-tpp/mapping_methodology_vruling_2024-09-06.pdf

4. Inputs

To complete the busbar mapping analysis, portfolios of selected resources for the 2036 and 2041 model years by RESOLVE resource area, with Fully Deliverable (FD) and Energy-Only (EO) megawatt (MW) amounts specified, are required. This section provides an overview of those portfolios, for the base case (Section 4.1) and the limited wind sensitivity (Section 4.2), as developed through the IRP modeling efforts using the RESOLVE capacity expansion model and other assumptions. Additionally, Section 4.3 outlines the baseline reconciliation process to align mapping assumptions between the new IRP resource baseline used for portfolio development, the baselines used for CAISO's transmission constraint assumptions and the CEC's geospatial analysis for the land-use and environmental impact criteria datasets.

4.1 Base Case (Partial AB 1373) Portfolio

Objective and Rationale

The objective of transmitting this portfolio to the CAISO for the TPP base case studies is to ensure that transmission planning and development align with resource planning and development. The design of this portfolio achieves this objective by reflecting a possible lowest-cost achievement of the state's greenhouse gas reduction goals as informed by IRP capacity expansion modeling. This Base Portfolio reflects a partial buildout of the maximum procurement volumes considered in the Commission's need determination analysis pursuant to D.24-08-064, related to Assembly Bill (AB) 1373. Additionally, the portfolio is designed around a 25 million metric ton (MMT) annual GHG emissions target by 2035 for the electric sector and is named based on the convention of referring to that target. However, because the resource planning horizon for the 2026-2027 TPP extends to 2041, the emissions of the portfolio in 2041 are lower than 25 MMT. This is described in more detail under the Description of Portfolio section below. The 2024 IEPR planning load scenario utilized in the Base Portfolio is designed to reflect a higher electrification future with increased retail sales and gross peak driven by similar building electrification and energy efficiency impacts as the 2023 IEPR, plus the introduction of significant data center loads and reduced behind-the-meter solar adoption relative to the 2023 IEPR

To improve the degree of accuracy of the transmission upgrade information that comes out of the RESOLVE analysis, the CPUC, for the 2024-2025 TPP and the 2023 Preferred System Plan, updated the modeling of transmission deliverability using data from the 2023 CAISO White Paper: Transmission Capability Estimates for Use in the CPUC's Integrated Resource Planning Process (2023 White Paper)[8] and supplementing it with data from CAISO's 2022-2023 TPP Board approved Transmission Plan.[9] This update further improved the locational information for all solar, wind, battery, geothermal, and pumped hydro storage resources modeled in RESOLVE to be consistent with CAISO's available capacity at a substation level. Ultimately, this resulted in improved information as inputs for the busbar mapping process for assigning all of the locational-specific resources.

[8] "Transmission Capability Estimates for Use in the CPUC's Integrated Resource Planning Process." CAISO, (June 29, 2023). White Paper and support documents: https://www.caiso.com/library/transmission-capability-estimate-inputes-for-cpuc-integrated-resource-plan-jul-05-2023

[9] CAISO Board Approved 2022-2023 Transmission Plan (May 18, 2023). https://www.caiso.com/documents/iso-board-approved-2022-2023-transmission-plan.pdfhttps://www.caiso.com/documents/iso-board-approved-2022-2023-transmission-plan.pdf

For the development of the proposed 26-27 TPP portfolios, CPUC staff made several changes to RESOLVE's modeling capabilities and input assumptions. Most significantly, the RESOLVE model has been refactored for the 26-27 TPP to disaggregate the CAISO optimized zone into three constituent IOU zones, one each for PG&E, SCE, and SDG&E service territories. This update enables improved representation of the load-resource balance within each IOU, as well as captures interzonal transmission flow constraints along Path 26 and Path 15 between SP15 and NP15. Existing Path ratings are used to set the flow limits between PG&E and SCE, with additional interzonal transmission expansion available for selection as candidate options, with costs, quantities, and first available years informed via iteration with the CAISO in Working Group meetings. This update enabled RESOLVE to assess the trade-offs between importing high-capacity factor resources from Southern California and out-of-state resources, through Path 26 and Path 15 and into PG&E to serve Northern California loads, versus opting to site more resources locally or explore other options to import out-of-state resources directly into Northern California. As a result, the resource portfolios identified by RESOLVE locate more resources in PG&E, which addresses one of the major disconnects between the optimized portfolio and the final busbar mapping results.

Additional updates to the RESOLVE model besides an updated zonal topology that allows for the disaggregation of the CAISO optimized zone into three constituent IOU zones (PGE, SCE, SDGE), are additional default candidate resources including enhanced geothermal (EGS) and generic long duration storage (LDES), a modified default candidate resource that classifies both pumped-hydro and adiabatic compressed air storage as "Location-Constrained Storage", updated candidate regions to align with CAISO study areas used in transmission planning, updated resource costs, updated resource potentials for solar, wind, geothermal, EGS, and location-constrained storage, and the addition of near-term minimum build constraints to reflect recent LSE contracts incremental to the baseline resources. These updates are discussed in the supporting documentation[10] released with the September 2025 Ruling. CAISO released an updated White Paper in August 2024 (2024 White Paper),[11] and CPUC staff incorporated the updated transmission information into RESOLVE for developing the proposed 26-27 TPP portfolios, busbar mapping, and criteria analysis.

Relationship Between RESOLVE Selected Resources and the CAISO TPP

RESOLVE is a system-level capacity expansion model with simplified transmission capability and cost assumptions. As an input to the busbar mapping process, the resources selected by RESOLVE and their locations get evaluated based on interconnection feasibility, potential required transmission upgrades, and other criteria. The RESOLVE portfolio for this proposed 2026-2027 TPP base case portfolio indicates the need for 5,515 MW of partial or full transmission upgrades by 2036 and 13,791 MW by 2041 to accommodate the full number of resources selected in 2036 and 2041 that could not be accommodated by the existing transmission system, in addition to 13,938 MW of capacity increases correspond to 2024 White Paper transmission projects that have already been approved by the CAISO.

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[10] "2026-2027 Transmission Planning Process RESOLVE Analysis," (9/30/25), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/ruling_26-27_tpp_results.pdf

[11] "Transmission Capability Estimates for Use in the CPUC's Integrated Resource Planning Process." CAISO, (August 29, 2024). White Paper and support documents: https://www.caiso.com/library/transmission-capability-estimate-inputs-for-cpuc-integrated-resource-plan-aug-29-2024

However, CPUC staff cannot know for certain the transmission implications until they are studied by the CAISO in the TPP at actual busbar locations. For this reason, the CPUC will transmit this portfolio to the CAISO to conduct detailed transmission planning to assess the exact transmission needs. CAISO TPP results will indicate whether any reliability or policy-driven transmission upgrades are found necessary, and if so, those transmission upgrades may be recommended to the CAISO Board of Governors for approval. If any of the approved transmission upgrades are investments made specifically to accommodate the resource development future reflected by the CPUC in this portfolio, this portfolio will have helped ensure that transmission and generation resources are developed concurrently. This should help limit the risk of stranded generation assets later being discovered to be undeliverable to load due to a lack of available transmission capability.

The CPUC expects to receive information from the CAISO regarding which approved transmission projects are developed to accommodate policy-driven resource planning. (Typically, the CAISO TPP clearly identifies the policy-driven projects). The CPUC can then act accordingly to encourage the development of those resources that can utilize the transmission capacity to avoid stranded transmission assets. Further, the CPUC's transmittal cannot be assumed to prejudge the outcome of a future siting application for a specific transmission line (e.g. a Certificate of Public Convenience and Necessity Proceeding). However, the CPUC's transmittal of resource planning assumptions can be considered in the need determination phase of the CPUC's consideration of any specifically proposed transmission project.

Description of Portfolio

For the planning year 2036, the generic and in-development portfolio comprises 20,009 MW of new battery storage (6,822 MW of 4-hr storage, 13,188 MW of 8-hr storage), 5,984 MW of long-duration storage (5,448 MW of location-constrained 12-hr storage, 500 MW of generic 24-hr storage), 58,066 MW of new in-state renewable resources (which includes 2,924 MW of offshore wind), and 7,036 MW of new out-of-state (OOS) wind resources on new OOS transmission, among other resources. For the planning year 2041, the portfolio comprises the same amount of battery and long-duration storage, 68,129 MW of new in-state renewable resources (which includes 4,531 MW of offshore wind), and 17,036 MW of new out-of-state (OOS) wind resources on new OOS transmission, among other resources.[12]

[12] Full RESOLVE results can be found on the CPUC's Portfolios and Modeling Assumptions for the 2026-2027 Transmission Planning Process website: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2024-26-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp

Table 2 summarizes the resource build out in 2036 and 2041, which are the resource planning years needed specifically for the 2026-2027 TPP. The GHG targets modeled in 2036 and 2041 were 19 MMT and 13 MMT, which reflect CAISO's proportional allowances toward the statewide electric sector targets of 25 MMT and 17 MMT, respectively.[13]

[13] This represents the CAISO contribution extrapolated from a 25 MMT by 2035 target to the 8 MMT by 2045 target adopted in the 2023 CARB Scoping Plan.

Table 2. Cumulative Capacity Additions in 2036 and 2041 in the Base Portfolio

RESOLVE 26-27 TPP Base Case Portfolio
2036 & 2041 Results

Resource Type	2036	2041
Natural Gas	-	-
Geothermal	3,400	3,400
Geothermal (Enhanced)	1,705	1,705
Biomass	-	-
In-State Wind	2,576	4,756
Out-of-State Wind	7,036	17,036
Offshore Wind	2,924	4,531
Solar	47,461	53,737
Li-ion Battery (4-hr)	6,822	6,822
Li-ion Battery (8-hr)	13,188	13,188
Location Constrained Storage (12-hr)	5,448	5,448
Generic Storage (12-hr)	-	-
Generic Storage (24-hr)	500	500
Generic Storage (100-hr)	-	-
Shed DR	-	-
Gas Capacity Not Retained	*(1,674)*	*(1,674)*
In-State Renewables	**58,066**	**68,129**
Out-of-State Renewables	**7,036**	**17,036**
Total New Resources	**91,060**	**111,123**
Total Optimized Capacity (incl. Non-Retained Gas)	**89,386**	**109,449**

In addition to the resource selection information from RESOLVE, transmission upgrade results are used to inform the mapping analysis. Figure 3, Figure 4, and Figure 5 summarize the selected upgrades triggered in RESOLVE in the 2036, 2041, and 2045 snapshot years. The transmission upgrades selected by RESOLVE include projects already approved by the CAISO board but not yet online, as well as potential new upgrades. The transmission upgrades available in RESOLVE are based on the 2024 White Paper. As part of the least-cost optimization in RESOLVE, upgrades are selected based on their size and cost, construction lead time, and the quantity and quality of additional resources that can be delivered by the upgrade, among other factors. For the TPP years under consideration, a total of 5,515 MW by 2036 and 13,791 MW by 2041 of new TPD attributable to partial and/or full transmission upgrades are selected by RESOLVE.

By 2036 and 2041, RESOLVE selects 5 and 9 upgrades, respectively. For 2036, just one upgrade is fully selected while the other four upgrades are partially selected. The fully selected upgrade is the new series-compensated 115kV Control-Inyokern line and upgraded Inyo phase shifter. The partially selected upgrades include a re-conductor of the Antelope-Bailey 66 kV lines and Q653F-Davis 115 kV line, an uprate of the 500/230kV transformer bank at Gates Substation, and the development of the Morro Bay substation for offshore wind. The latter is a modeled upgrade for offshore wind resources based on potential projects identified in the 21-22 TPP offshore wind sensitivity study.[14]

[14] CAISO Board Approved 2021-2022 Transmission Plan (March 17, 2022).
https://www.caiso.com/documents/iso-board-approved-2022-2023-transmission-plan.pdf

In addition to the 5 projects fully or partially selected by RESOLVE in 2036, four new upgrades are partially selected by 2041. These include upgrades to the Delevan 500 kV substation, Eldorado-Lugo 500 kV No. 2 line, and Etiwanda-Rancho Vista 220kV No. 1 and No. 2 lines (plus the addition of a No. 3 line). A re-conductor of the Wilson-Storey-Borden 230 kV lines was also selected in 2041. Additionally, between 2036 and 2041, additional incremental capacity on partial upgrades are selected at Gates Substation.

Table 3: All resources selected in the Base Portfolio (2036 and 2041 cumulative)

		2036 Selected Resources, MW			2041 Selected Resources, MW		
Technology	Resource	FCDS	EODS	Total	FCDS	EODS	Total
Biomass	PGE_New_Biomass	0	0	*0*	0	0	*0*
	SCE_New_Biomass	0	0	*0*	0	0	*0*
	SDGE_New_Biomass	0	0	*0*	0	0	*0*
Geothermal	PGE_New_Geothermal	1,654	0	*1,654*	1,654	0	*1,654*
	SCE_New_Geothermal	1,218	0	*1,218*	1,218	0	*1,218*
	SDGE_New_Geothermal	529	0	*529*	529	0	*529*
Geothermal (Enhanced)	PGE_Nevada_New_EGS	0	0	*0*	0	0	*0*
	PGE_New_EGS	928	0	*928*	928	0	*928*
	PGE_Northeast_CA_New_EGS	0	0	*0*	0	0	*0*
	PGE_Oregon_New_EGS	777	0	*777*	777	0	*777*
	SCE_Idaho_New_EGS	0	0	*0*	0	0	*0*
	SCE_Nevada_New_EGS	0	0	*0*	0	0	*0*
	SCE_New_EGS	0	0	*0*	0	0	*0*
	SCE_Utah_New_EGS	0	0	*0*	0	0	*0*
	SDGE_New_EGS	0	0	*0*	0	0	*0*
In-State Wind	PGE_GBA_Wind	234	10	*244*	234	10	*244*
	PGE_Kern_Wind	0	0	*0*	0	0	*0*
	PGE_NGBA_Wind	0	760	*760*	879	760	*1,639*
	PGE_Northeast_CA_Wind	0	0	*0*	0	0	*0*
	SCE_Eastern_Wind	263	60	*323*	263	60	*323*
	SCE_EOP_Wind	255	0	*255*	255	0	*255*
	SCE_NOL_Wind	0	0	*0*	0	0	*0*
	SCE_Northern_Wind	0	0	*0*	0	0	*0*
	SDGE_Baja_California_Wind	353	0	*353*	1,654	0	*1,654*
	SDGE_Imperial_Wind	638	0	*638*	638	0	*638*
Offshore Wind	Cape_Mendocino_Offshore_Wind	0	0	*0*	0	0	*0*
	Del_Norte_Offshore_Wind	0	0	*0*	0	0	*0*
	Humboldt_Bay_Offshore_Wind	0	0	*0*	1,607	0	*1,607*
	Morro_Bay_Offshore_Wind	2,924	0	*2,924*	2,924	0	*2,924*
Out-of-State Wind	PGE_Wyoming_Wind	0	0	*0*	4,000	0	*4,000*
	SCE_Idaho_Wind	1,100	0	*1,100*	1,100	0	*1,100*
	SCE_New_Mexico_Wind	2,936	0	*2,936*	8,936	0	*8,936*
	SCE_Wyoming_Wind	3,000	0	*3,000*	3,000	0	*3,000*
Solar	PGE_Distributed_Solar	0	0	*0*	0	0	*0*
	PGE_Fresno_Solar	2,871	580	*3,451*	5,550	580	*6,130*
	PGE_GBA_Solar	482	480	*962*	700	480	*1,180*
	PGE_Kern_Solar	5,009	4,670	*9,679*	5,009	4,670	*9,679*
	PGE_NGBA_Solar	0	1,960	*1,960*	0	1,960	*1,960*
	SCE_Arizona_Solar	0	4,940	*4,940*	0	4,940	*4,940*
	SCE_Distributed_Solar	0	0	*0*	0	0	*0*
	SCE_Eastern_Solar	4,370	620	*4,990*	5,474	1,350	*6,824*
	SCE_EOP_Solar	125	570	*695*	125	570	*695*
	SCE_Metro_Solar	5	0	*5*	387	0	*387*
	SCE_NOL_Solar	278	0	*278*	278	0	*278*
	SCE_Northern_Solar	5,247	1,100	*6,347*	6,179	1,100	*7,279*
	SDGE_Arizona_Solar	6,794	7,180	*13,974*	6,794	7,410	*14,204*
	SDGE_Distributed_Solar	0	0	*0*	0	0	*0*
	SDGE_Imperial_Solar	184	10	*194*	184	10	*194*
Subtotal - Renewables		42,173	22,940	65,113	61,275	23,900	85,175
Li-ion Battery (4-hr)	PGE_New_Li_Battery_4hr	1,521	0	*1,521*	1,521	0	*1,521*
	SCE_New_Li_Battery_4hr	4,541	0	*4,541*	4,541	0	*4,541*
	SDGE_New_Li_Battery_4hr	760	0	*760*	760	0	*760*
Li-ion Battery (8-hr)	PGE_New_Li_Battery_8hr	3,259	0	*3,259*	3,259	0	*3,259*
	SCE_New_Li_Battery_8hr	8,579	0	*8,579*	8,579	0	*8,579*
	SDGE_New_Li_Battery_8hr	1,350	0	*1,350*	1,350	0	*1,350*
Generic Storage (12-hr)	PGE_Generic_LDES_12hr	0	0	*0*	0	0	*0*
	SCE_Generic_LDES_12hr	0	0	*0*	0	0	*0*
Generic Storage (24-hr)	PGE_Generic_LDES_24hr	0	0	*0*	0	0	*0*
	SCE_Generic_LDES_24hr	0	500	*500*	0	500	*500*
Generic Storage (100-hr)	PGE_Generic_LDES_100hr	0	0	*0*	0	0	*0*
	SCE_Generic_LDES_100hr	0	0	*0*	0	0	*0*
Location Constrained Storage (12-hr)	PGE_LDES_12hr	982	0	*982*	982	0	*982*
	SCE_LDES_12hr	3,966	0	*3,966*	3,966	0	*3,966*
	SDGE_LDES_12hr	500	0	*500*	500	0	*500*
Subtotal - Renewables		25,458	500	25,958	25,458	500	25,958
Total		**67,630**	**23,440**	**91,070**	**86,733**	**24,400**	**111,133**

Figure 3. Base Portfolio - Summary of RESOLVE triggered transmission expansion by 2036 and 2041, by transmission constraint.

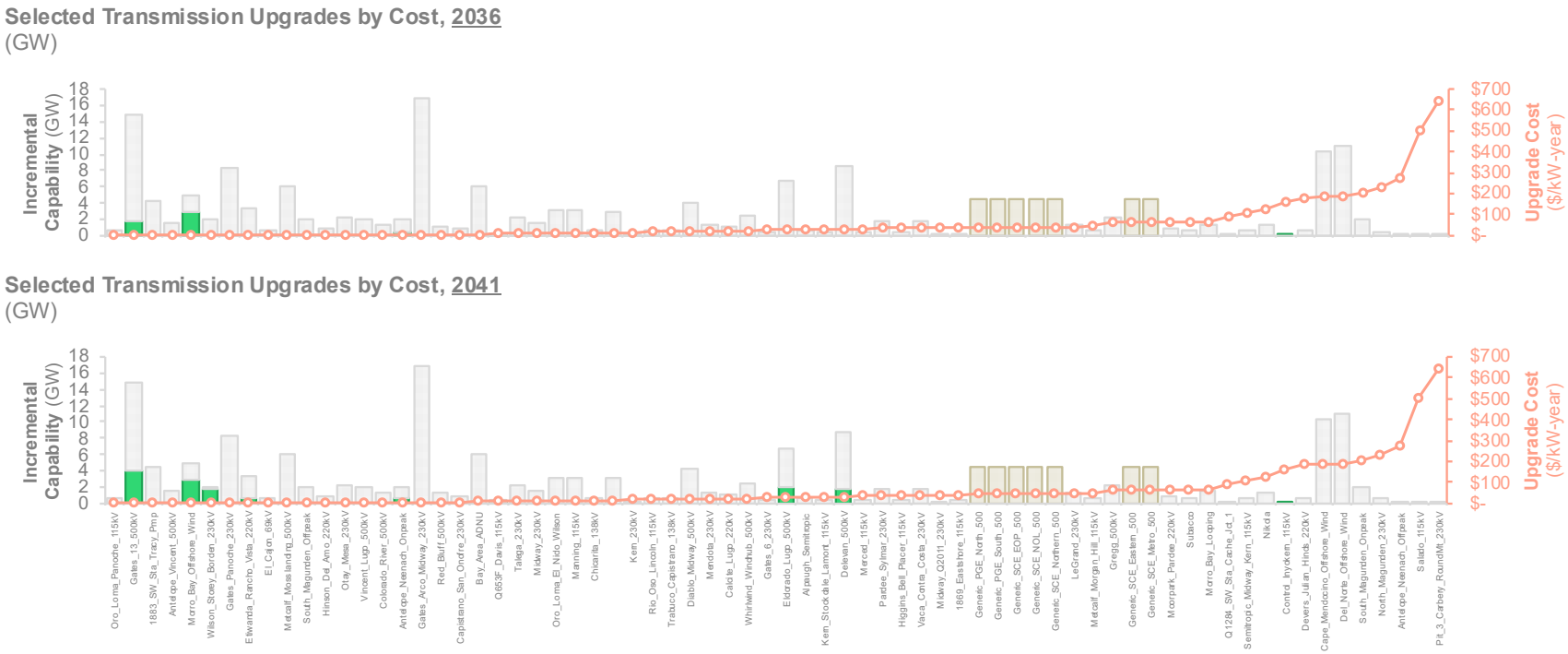


Figure 4. Base Portfolio - Summary of RESOLVE triggered transmission expansion by 2036 and 2041, by study area.

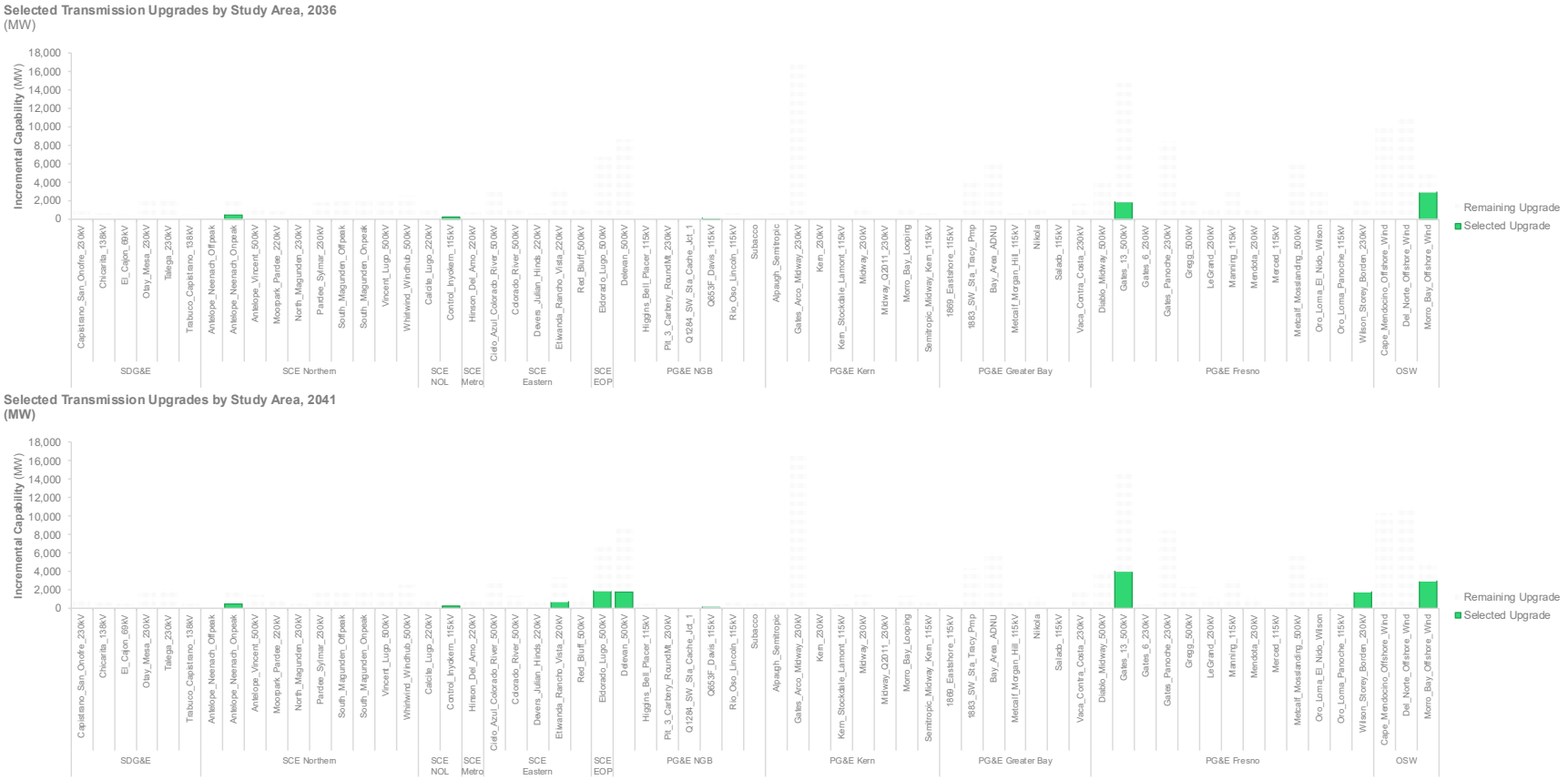
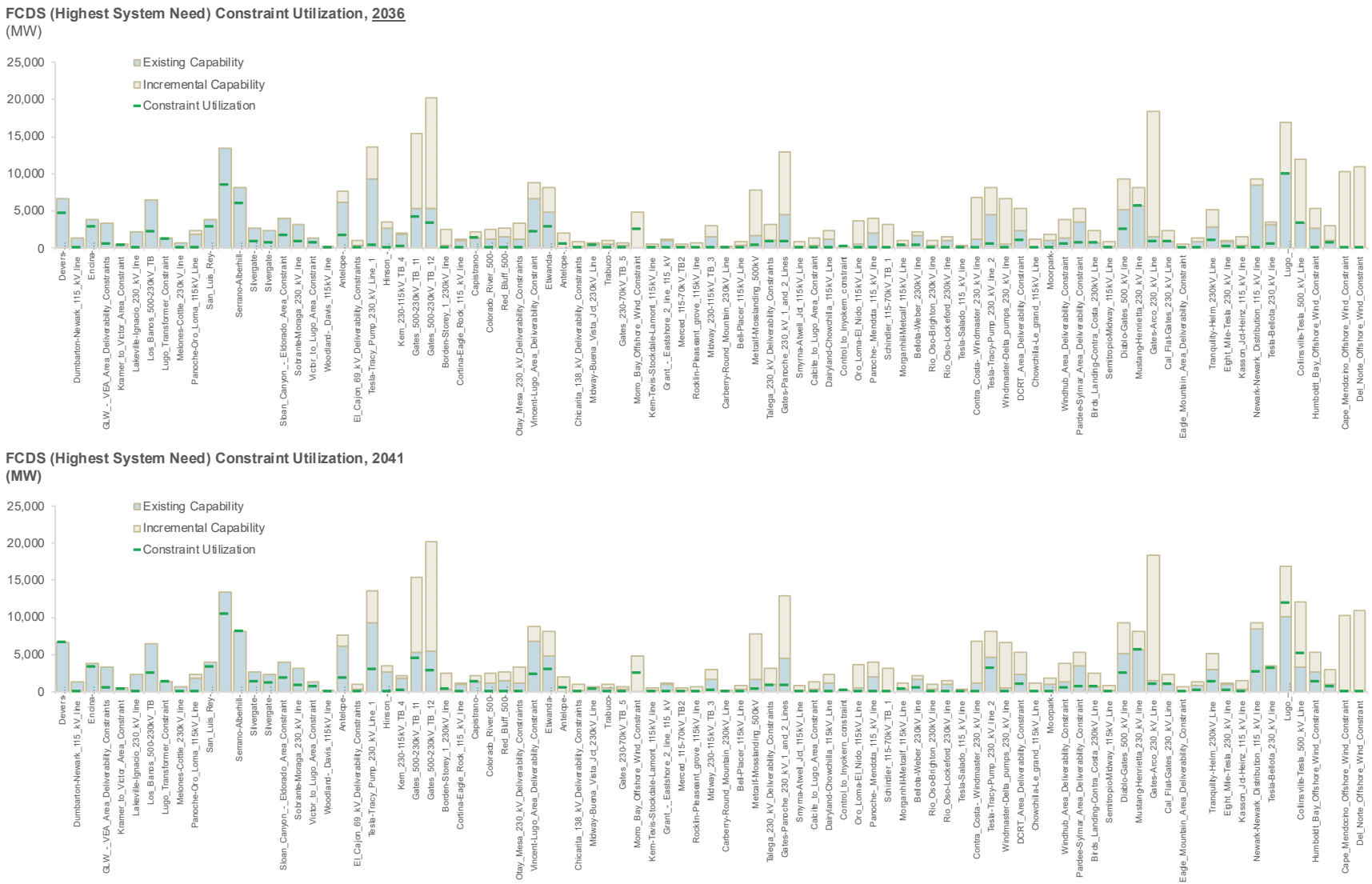


Figure 5. Base Portfolio - Summary of FCDS Highest System Need transmission capacity utilization by 2036 and 2041.



4.2 Limited Wind Sensitivity Portfolio

Objective and Rationale

The objective of transmitting the limited wind portfolio to the CAISO for the 2026-2027 TPP as a policy-driven sensitivity is to collect planning information about the impacts and transmission requirements of a future with reduced in-state and out-of-state wind procurement, and without offshore wind. This reflects the recent lack of wind development in California, the increased difficulty of permitting wind in California, and the current changes in federal policy toward wind projects. This portfolio would provide insights into the resources that would be needed to replace wind in the recommended base case portfolio and the transmission implications of that replacement in the 26-27 TPP portfolio and on recently adopted TPP portfolios if wind development were significantly limited.

This portfolio is designed to serve as a plausible alternative scenario associated with the proposed base case. This portfolio utilizes the same GHG trajectory as the Base Case Portfolio. The portfolio includes the LSE Plans through 2030. All other assumptions remain constant.

Description of Portfolio

The Limited Wind Sensitivity Portfolio reflects material constraints on wind resource availability. These constraints include: (i) a cap on in-state wind development of 2.5 GW; (ii) limitations on out-of-state wind development to existing transmission entitlements - specifically SunZia, SWIP-North, and TransWest - in addition to 2 GW of SunZia capacity; and (iii) the exclusion of offshore wind resources.[15]

Table 4 summarizes the resource build out in 2036 and 2041, the resource planning years needed specifically for the 2026-2027 TPP.

Table 4. Capacity Additions in 2036 and 2041 in the Limited Wind Sensitivity Portfolio

RESOLVE 26-27 TPP Limited Wind Portfolio
2036 & 2041 Results

Resource Type	2036	2041
Natural Gas	-	-
Geothermal	3,385	4,702
Geothermal (Enhanced)	3,610	3,610
Biomass	-	-
In-State Wind	901	2,500
Out-of-State Wind	4,046	5,146
Offshore Wind	-	-
Solar	48,583	67,626

[15] Full RESOLVE results can be found on the CPUC's Portfolios and Modelling Assumptions for the 2024-2025 Transmission Planning Process website: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2022-irp-cycle-events-and-materials/portfolios-and-modeling-assumptions-for-the-2024-2025-transmission-planning-process

Li-ion Battery (4-hr)	6,822	6,822
Li-ion Battery (8-hr)	17,672	17,677
Location Constrained Storage (12-hr)	5,742	7,548
Generic Storage (12-hr)	-	-
Generic Storage (24-hr)	-	-
Generic Storage (100-hr)	-	-
Shed DR	-	-
Gas Capacity Not Retained	(1,214)	(1,214)
In-State Renewables	**56,479**	**79,438**
Out-of-State Renewables	**4,046**	**5,146**
Total New Resources	**90,760**	**115,631**
Total Optimized Capacity (incl. Non-Retained Gas)	**89,547**	**114,417**

In addition to the resource selection information from RESOLVE, transmission upgrade results are used to inform the mapping analysis. Figure 6, Figure 7, and Figure 8 summarize the selected upgrades triggered in RESOLVE for the 2036 and 2041 snapshot years. The transmission upgrades modeled in RESOLVE include projects already approved by the CAISO as well as new upgrades. The transmission upgrades available in RESOLVE are based on the information in the 2024 CAISO White Paper. As part of the least-cost optimization in RESOLVE, upgrades are selected based on their size and cost, construction lead time, and the quantity and quality of additional resources that can be delivered by the upgrade, among other factors. For the TPP years under consideration, 13,938 MW of approved transmission upgrades are modeled and a total of 4,210 MW by 2036 and 12,832 MW by 2041 of partial and full transmission upgrades are utilized by the portfolio, but most of these are already approved in previous TPPs.

Table 5. All resources selected in the Limited Wind sensitivity portfolio (2036 and 2041 cumulative)

		2036 Selected Resources, MW			2041 Selected Resources, MW		
Technology	Resource	FCDS	EODS	Total	FCDS	EODS	Total
Biomass	PGE_New_Biomass	-	-	-	-	-	-
	SCE_New_Biomass	-	-	-	-	-	-
	SDGE_New_Biomass	-	-	-	-	-	-
Geothermal	PGE_New_Geothermal	1,638	-	*1,638*	1,654	-	*1,654*
	SCE_New_Geothermal	1,218	-	*1,218*	2,519	-	*2,519*
	SDGE_New_Geothermal	529	-	*529*	529	-	*529*
Geothermal (Enhanced)	PGE_Nevada_New_EGS	-	-	-	-	-	-
	PGE_New_EGS	1,540	-	*1,540*	1,540	-	*1,540*
	PGE_Northeast_CA_New_EGS	-	-	-	-	-	-
	PGE_Oregon_New_EGS	793	-	*793*	793	-	*793*
	SCE_Idaho_New_EGS	-	-	-	-	-	-
	SCE_Nevada_New_EGS	-	-	-	-	-	-
	SCE_New_EGS	7	-	*7*	7	-	*7*
	SCE_Utah_New_EGS	741	-	*741*	741	-	*741*
	SDGE_New_EGS	529	-	*529*	529	-	*529*
In-State Wind	PGE_GBA_Wind	234	10	*244*	234	10	*244*
	PGE_Kern_Wind	-	-	-	-	-	-
	PGE_NGBA_Wind	-	210	*210*	1,599	210	*1,809*
	PGE_Northeast_CA_Wind	-	-	-	-	-	-
	SCE_Eastern_Wind	-	-	-	-	-	-
	SCE_EOP_Wind	255	-	*255*	255	-	*255*
	SCE_NOL_Wind	-	-	-	-	-	-
	SCE_Northern_Wind	-	-	-	-	-	-
	SDGE_Baja_California_Wind	-	-	-	-	-	-
	SDGE_Imperial_Wind	194	-	*194*	194	-	*194*
Offshore Wind	Cape_Mendocino_Offshore_Wind	-	-	-	-	-	-
	Del_Norte_Offshore_Wind	-	-	-	-	-	-
	Humboldt_Bay_Offshore_Wind	-	-	-	-	-	-
	Morro_Bay_Offshore_Wind	-	-	-	-	-	-
Out-of-State Wind	PGE_Wyoming_Wind	-	-	-	-	-	-
	SCE_Idaho_Wind	-	-	-	1,100	-	*1,100*
	SCE_New_Mexico_Wind	1,436	1,110	*2,546*	2,546	-	*2,546*
	SCE_Wyoming_Wind	1,500	-	*1,500*	1,500	-	*1,500*
Solar	PGE_Distributed_Solar	-	-	-	-	-	-
	PGE_Fresno_Solar	1,632	2,030	*3,662*	5,291	2,030	*7,321*
	PGE_GBA_Solar	329	830	*1,159*	1,926	830	*2,756*
	PGE_Kern_Solar	7,647	2,110	*9,757*	7,668	2,110	*9,778*
	PGE_NGBA_Solar	-	2,450	*2,450*	601	2,450	*3,051*
	SCE_Arizona_Solar	-	6,730	*6,730*	-	6,730	*6,730*
	SCE_Distributed_Solar	-	-	-	-	-	-
	SCE_Eastern_Solar	3,560	620	*4,180*	6,245	2,870	*9,115*
	SCE_EOP_Solar	-	1,080	*1,080*	-	1,080	*1,080*
	SCE_Metro_Solar	5	-	*5*	387	-	*387*
	SCE_NOL_Solar	326	-	*326*	697	340	*1,037*
	SCE_Northern_Solar	5,077	1,470	*6,547*	8,060	1,470	*9,530*
	SDGE_Arizona_Solar	5,446	7,060	*12,506*	6,499	9,960	*16,459*
	SDGE_Distributed_Solar	-	-	-	-	-	-
	SDGE_Imperial_Solar	-	190	*190*	94	300	*394*
Subtotal - Renewables		34,636	25,900	60,536	53,208	30,390	83,598
Li-ion Battery (4-hr)	PGE_New_Li_Battery_4hr	1,521	-	*1,521*	1,521	-	*1,521*
	SCE_New_Li_Battery_4hr	4,541	-	*4,541*	4,541	-	*4,541*
	SDGE_New_Li_Battery_4hr	760	-	*760*	760	-	*760*
Li-ion Battery (8-hr)	PGE_New_Li_Battery_8hr	4,989	-	*4,989*	4,994	-	*4,994*
	SCE_New_Li_Battery_8hr	11,086	-	*11,086*	11,086	-	*11,086*
	SDGE_New_Li_Battery_8hr	1,597	-	*1,597*	1,597	-	*1,597*
Generic Storage (12-hr)	PGE_Generic_LDES_12hr	-	-	-	-	-	-
	SCE_Generic_LDES_12hr	-	-	-	-	-	-
Generic Storage (24-hr)	PGE_Generic_LDES_24hr	-	-	-	-	-	-
	SCE_Generic_LDES_24hr	-	-	-	-	-	-
Generic Storage (100-hr)	PGE_Generic_LDES_100hr	-	-	-	-	-	-
	SCE_Generic_LDES_100hr	-	-	-	-	-	-
Location Constrained Storage (12-hr)	PGE_LDES_12hr	1,276	-	*1,276*	1,282	-	*1,282*
	SCE_LDES_12hr	3,966	-	*3,966*	5,766	-	*5,766*
	SDGE_LDES_12hr	500	-	*500*	500	-	*500*
Subtotal - Storage		30,235	-	30,235	32,047	-	32,047
Total		**64,871**	**25,900**	**90,771**	**85,255**	**30,390**	**115,645**

Figure 6. Limited Wind Sensitivity - Summary of RESOLVE triggered transmission expansion by 2036 and 2041; by transmission constraint.

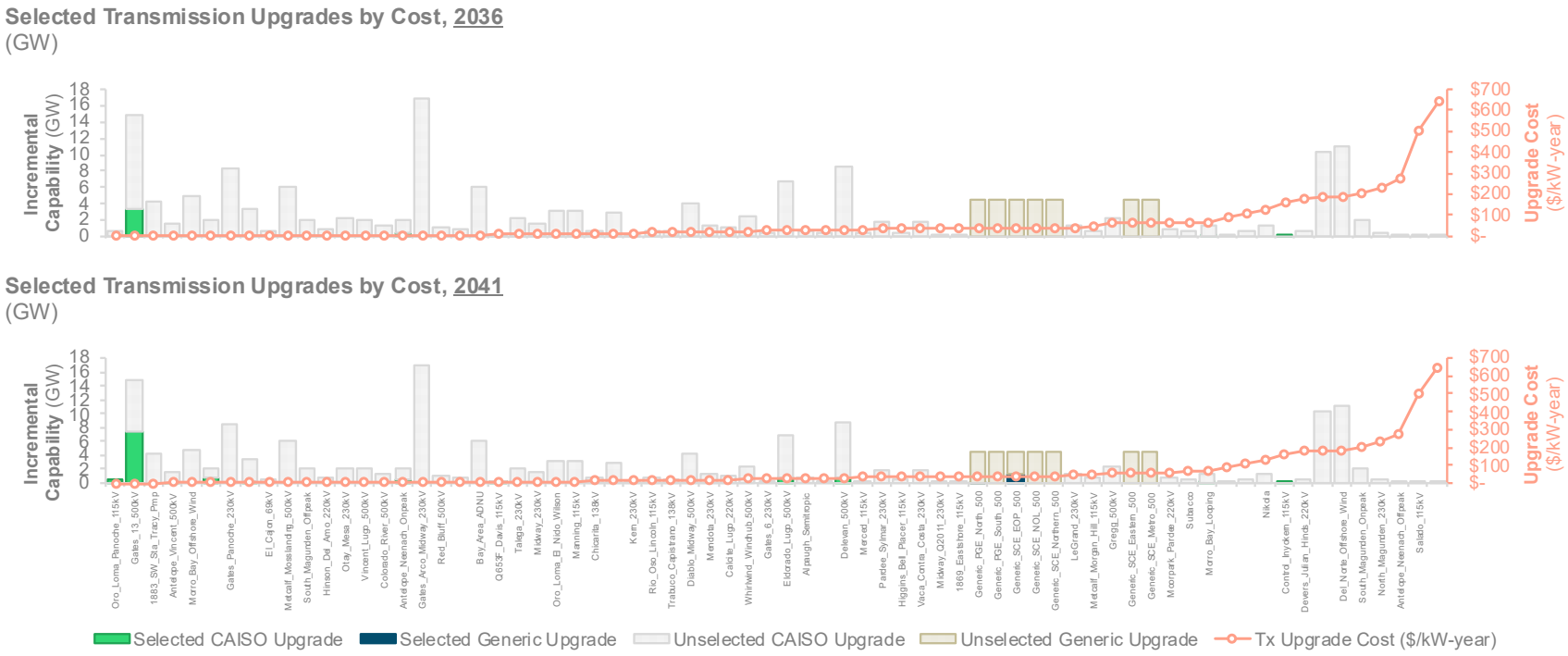


Figure 7. Limited Wind Sensitivity - Summary of RESOLVE triggered transmission expansion by 2036 and 2041; by study area.

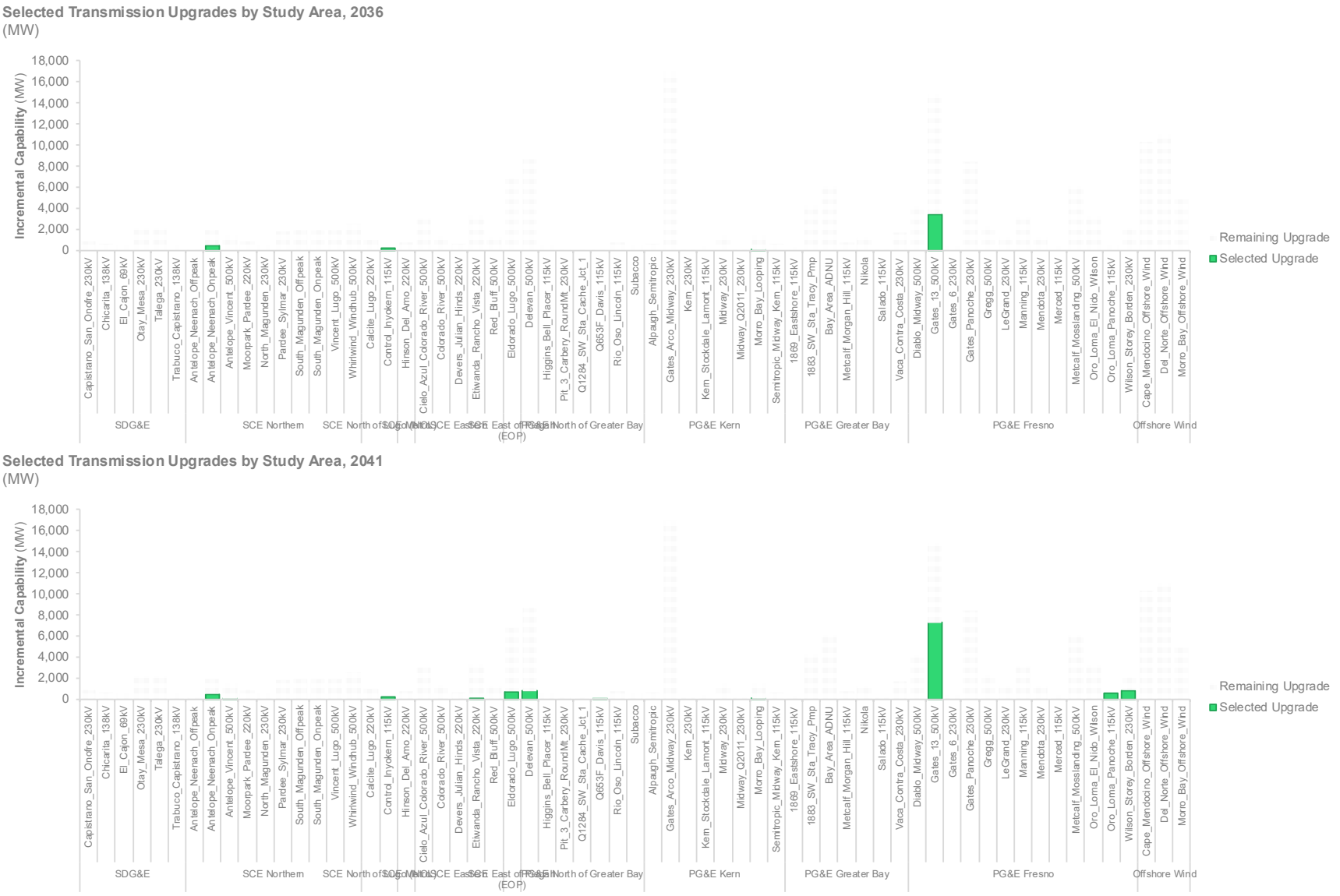
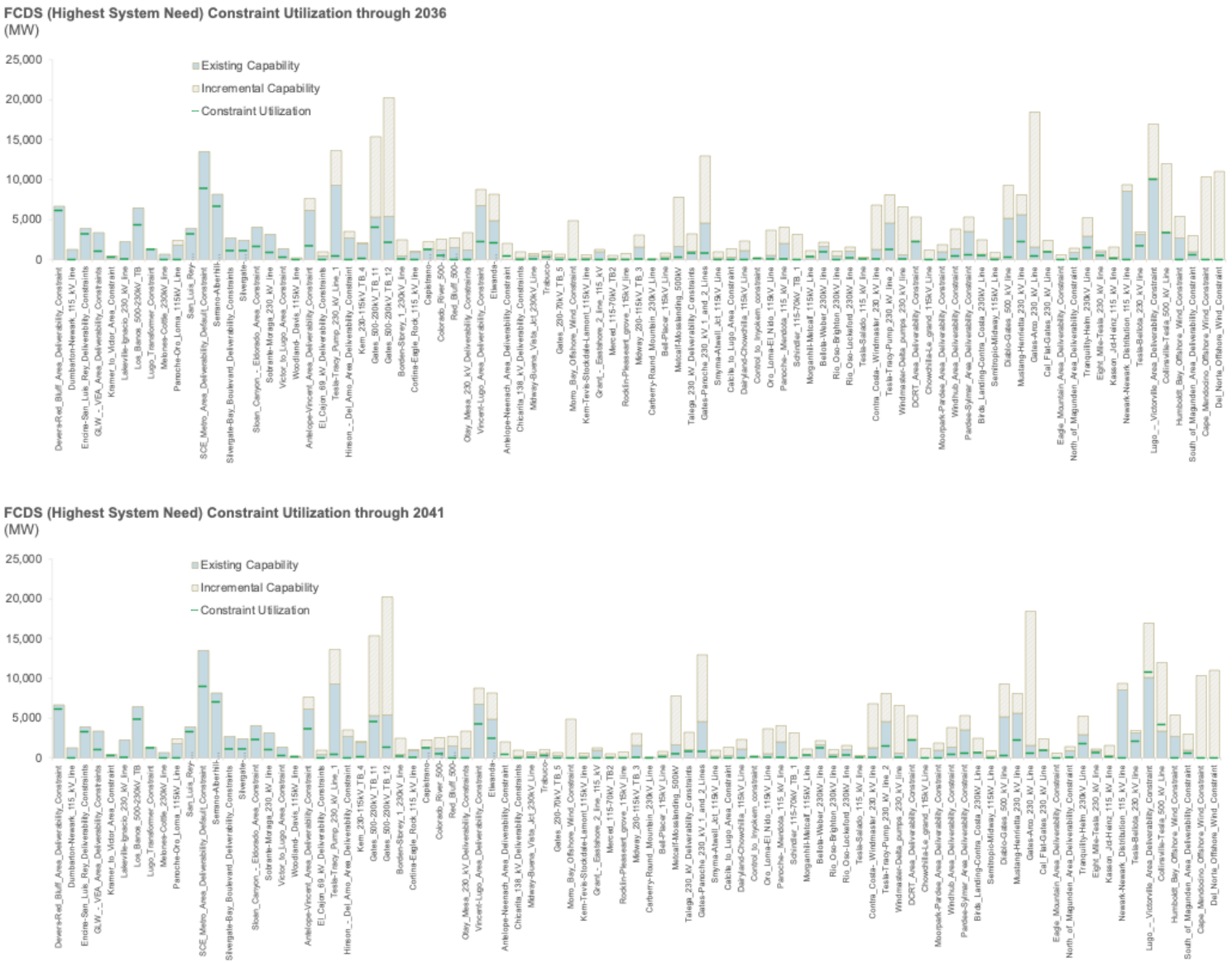


Figure 8. Sensitivity - Summary of FCDS Highest System Need transmission capacity utilization by 2036 and 2041.



4.3 Baseline Reconciliation

For the 26-27 TPP, the list of baseline resources assumed in IRP modeling was updated as a part of the 2024-2026 IRP cycle and corresponding inputs and assumptions to align with the 2024 Baseline Generator List developed for the 25-26 TPP. [16]

The Working Group is using CAISO's 2024 White Paper for the busbar mapping system transmission criteria analysis. The 2024 White Paper uses a baseline that included resources online by January 1, 2024, to calculate available transmission capability on the constraints.

IRP staff conducted baseline reconciliation both between the CAISO 2024 White Paper assumptions and the IRP modeling baseline to ensure accurate representations of resources' impacts on transmission constraints calculation. To reconcile between the 2024 White Paper baseline and the IRP Baseline, staff identified all resources in the IRP baseline with online dates after 01/01/2024. These baseline resources are not part of the published 26-27 TPP portfolio resources amounts and are not busbar mapped but need to be identified for the CAISO's TPP analysis and accounted for in the busbar mapping transmission calculations as the constraint information is based on the 2024 White Paper's 01/01/2024 COD baseline.

The full list of resources needing to be included in the transmission calculations can be seen in the Updated Baseline Reconciliation and In-Development Resources workbook (Appendix E). Table 6 below summarizes these resources by CAISO study area.

Table 6: Summary by CAISO study area of IRP-baseline resources in-development or online after 01/01/2024 and thus need to be included in Tx constraint calculations.

Resources in IRP Modeling Baseline not in Tx White Paper Baseline (i.e., In-Dev or Online after 1/1/24)									
CAISO Study Area	Geothermal (MW)	Biomass (MW)	Wind (MW)	OOS Wind - New Tx (MW)	Offshore Wind (MW)	Solar (MW)	Battery 4-hr (MW)	Battery 8-hr (MW)	LDES (MW)
PG&E Fresno	-	3	-	-	-	630	410	-	-
PG&E Greater Bay	-	-	230	-	-	120	30	2	-
PG&E Kern	-	-	-	-	-	507	230	3	-
PG&E North of Greater Bay	18	-	-	-	-	-	55	-	-
SCE East of Pisgah	-	-	-	-	-	60	304	-	-
SCE Eastern	-	-	57	1,585	-	895	2,866	360	-
SCE Metro	-	-	-	-	-	23	618	-	-
SCE North of Lugo	320	-	-	-	-	150	165	-	-
SCE Northern	-	-	-	-	-	667	1,632	-	200
SDG&E	-	-	-	-	-	149	339	-	-
Total by Type:	**338**	**3**	**287**	**1,585**	**-**	**3,201**	**6,649**	**365**	**200**

CPUC staff conducted analysis to identify what resources need to be captured as in-development in the mapped portfolios. For the purposes of busbar mapping, in-development resources are resources that are recently online, contracted, under construction, or have advanced along the new resource interconnection process (e.g., received a CAISO resource ID) and are not included in the IRP baseline. Per the Busbar Mapping Methodology, staff prioritize mapping resources in alignment with in-development resources first. To identify in-development resources, staff sought to identify new resources operational in the CAISO Master Generating Capability List (accessed September 2025) with listed CODs as of September 2025, not yet online resources in the CAISO New

[16] "Inputs & Assumptions — 2024-2026 Integrated Resource Planning." February 2025. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/2025_draft_inputs_and_assumptions_doc_20250220.pdf

Resources Interconnection Process's Generator Interconnection Resource ID Report (accessed September 2025), generators contracted to CPUC jurisdictional Load Serving Entities (LSEs) not yet online and other resources identified through various IRP filings (June 2025 vintage), and feedback from PTOs and stakeholders, which were not included in the 26-27 TPP baseline. These resources are not part of the IRP baseline and instead are assumed to be imbedded in the published 26-27 TPP portfolio amounts. Table 7 below shows the summary of these resources identified. In-development resources are discussed in the commercial interest mapping alignment criteria analysis in Section 6.7.

Table 7: Summary by CAISO study area of updated in-development resources not included in the 2024-2026 IRP baseline.

In-Development Resources not in IRP Baseline (i.e., resources recently online, contracted, under construction, or undergoing the interconnection process)									
CAISO Study Area	Geothermal (MW)	Biomass (MW)	Wind (MW)	OOS Wind - New Tx (MW)	Offshore Wind (MW)	Solar (MW)	Battery 4-hr (MW)	Battery 8-hr (MW)	LDES (MW)
PG&E Fresno	-	-	-	-	-	1,154	980	35	-
PG&E Greater Bay	-	-	-	-	-	-	628	-	-
PG&E Kern	-	-	-	-	-	500	398	-	-
PG&E North of Greater Bay	11	-	-	-	-	25	363	-	-
SCE East of Pisgah	45	-	-	-	-	715	685	-	-
SCE Eastern	30	-	-	285	-	2,860	1,762	100	-
SCE Metro	-	-	-	-	-	-	1,547	52	-
SCE North of Lugo	40	-	-	-	-	306	339	6	-
SCE Northern	-	-	-	-	-	1,560	1,884	523	-
SDG&E	25	-	-	-	-	626	1,251	50	-
Total by Type:	**151**	**-**	**-**	**285**	**-**	**7,745**	**9,836**	**766**	**-**

As noted above, some of these in-development resources are already online but just not captured in the 2024-2026 IRP baseline. Table 8 below shows the portion of those already online resources with COD's before 01/01/2024 and thus are assumed to be already included in the 2024 White Paper baseline. These resources are embedded in the total portfolio resources but need to be excluded from busbar mappings transmission capability calculations.

Table 8: Summary by CAISO study area of in-development resources with CODs before 01/01/24 and thus need to be excluded from mapping transmission capability calculations.

Resources in Tx Constraint Baseline, but not in IRP Baseline (i.e., resources online before 1/1/24 or in-development resources using existing interconnection deliverability)									
CAISO Study Area	Geothermal (MW)	Biomass (MW)	Wind (MW)	OOS Wind - New Tx (MW)	Offshore Wind (MW)	Solar (MW)	Battery 4-hr (MW)	Battery 8-hr (MW)	LDES (MW)
PG&E Fresno	-	-	-	-	-	-	199	-	-
PG&E Greater Bay	-	-	-	-	-	-	-	-	-
PG&E Kern	-	-	-	-	-	-	-	-	-
PG&E North of Greater Bay	7	-	-	-	-	-	-	-	-
SCE East of Pisgah	-	-	-	-	-	-	-	-	-
SCE Eastern	-	-	-	-	-	-	-	-	-
SCE Metro	-	-	-	-	-	-	82	-	-
SCE North of Lugo	-	-	-	-	-	-	-	-	-
SCE Northern	-	-	-	-	-	-	-	-	-
SDG&E	-	-	-	-	-	-	78	-	-
Total by Type:	**7**	**-**	**-**	**-**	**-**	**-**	**359**	**-**	**-**

5. Busbar Mapping Methodology Updates and Adjustments

Working Group staff from the CPUC, CEC, and the CAISO conducted busbar mapping using the processes and criteria described in the Methodology for Resource-to-Busbar Mapping & Assumptions for the Annual TPP. The full Methodology is available as a separate document (see Appendix A).

Figure 9: Flowchart overviewing the busbar mapping process for the TPP.

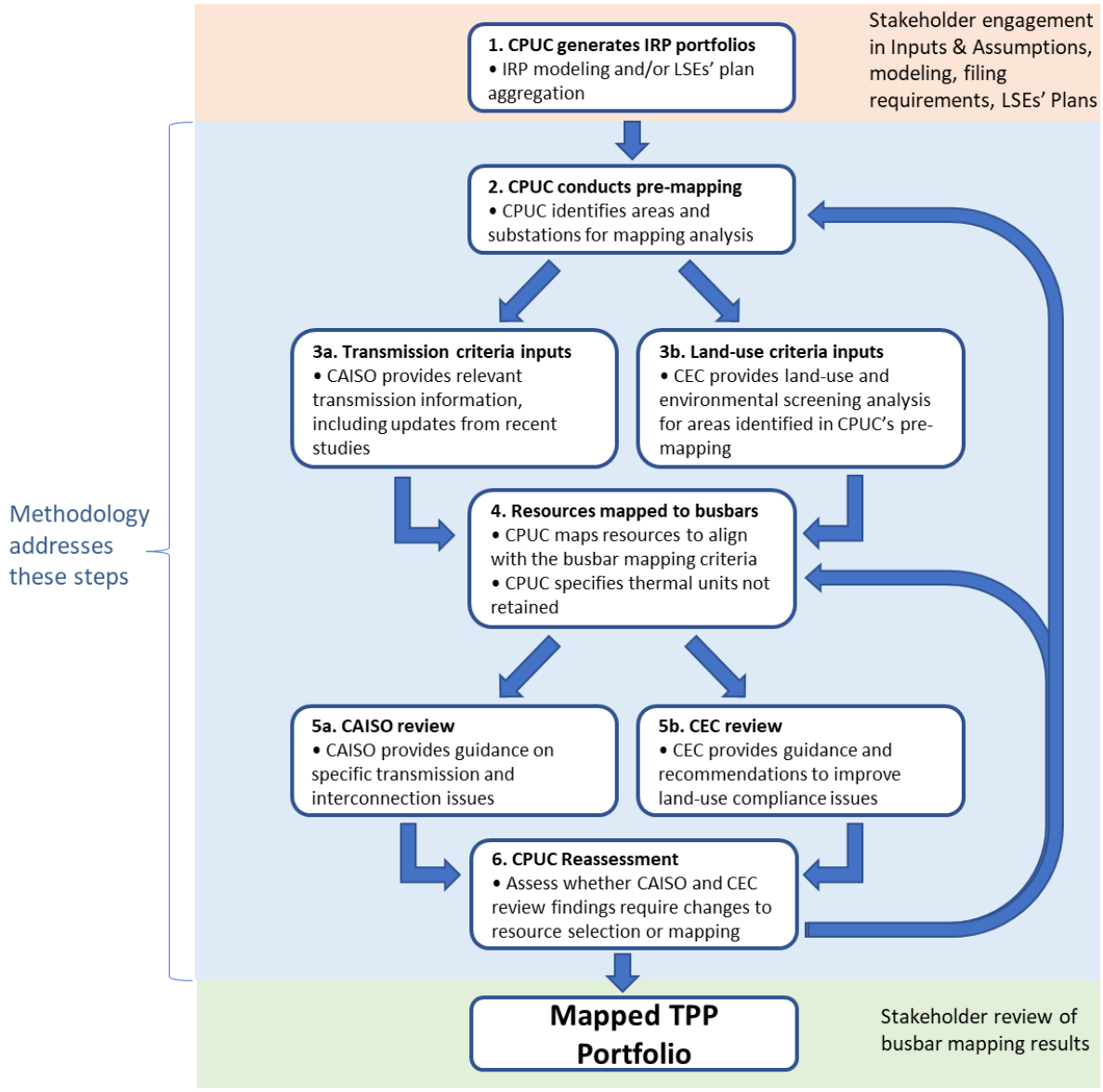


Figure 9 outlines the busbar mapping process, which underwent some revisions prior to the September 2025 Ruling to refine the process and criteria alignment analysis and incorporate new and updated datasets. These changes included:

- Substation-level interconnection upgrade cost criteria

- Integrating Participating Transmission Owner (PTO) feedback and per-unit cost guide data to estimate the economic feasibility to interconnect at individual busbars. Commission staff coordinated with the PTOs to collect and synthesize interconnection data and feedback on:
    - Existing headroom (before transmission plan deliverability (TPD) allocation);
    - Number of available interconnection positions;
    - Upgrade condition; and
    - Available area within the fence line.
- New criteria are initially used for a subset of busbars that have high demonstrated commercial interest and/or have had large mapped total resources from previously-adopted TPPs.
- Data collected from the PTOs is used to estimate interconnection cost for each busbar as a function of PTO, tie-in voltage, and feasibility.
- Substations with higher interconnection costs, including those that would require extensive upgrades or entire substations to facilitate new projects, will be de-prioritized over less expensive alternatives.
- Cost estimates across all busbars are categorized to define thresholds for criteria alignments scores.

- Land-use and environmental criteria
    - Replacing the Commission's High Fire Threat Districts (HFTD) dataset which is no longer being updated, with the U.S. Department of Agriculture Forest Service (USFS) Wildfire Risk to Communities dataset. To assess the fire threat to resources and transmission:
        - The HFTD maps are outdated and will not be maintained going forward, which makes them poor candidates for use in future busbar mapping cycles.
        - Among the alternative data sources reviewed, the 2024 USFS Wildfire Risk maps are a newly-published dataset from a federal agency with nationwide coverage, making it a viable option to replace the current data source.
        - Commission staff classified USFS burn probability data to align with the busbar mapping criteria alignment levels of 1-5.
- CEC land-use screens development and implementation
    - Updated methodology and sources of land-use and environmental criteria that information environmental evaluation:
        - The CEC Protected Area Layer, one component of the Land-Use Screens, was expanded to include coverage for CAISO-interconnecting regions of Southern Nevada and Western Arizona.
- Commercial development interest

- Commission staff added clarification in the methodology document for how interconnection quantity data from neighboring balancing authority areas (BAAs) is used in the commercial interest criteria, due to confusion evidenced in stakeholder comments

6. Analysis

This section analyzes the mapping against the criteria. For the portfolio resources, staff use a dashboard to assess how well busbar allocations comply with the mapping criteria described in the Methodology (see Appendix A.). This informs whether changes to the mapping allocations may be required.

Section 6.1 summarizes the results of the initial mapping effort the busbar mapping Working Group staff performed to map all resources to substations for the base case portfolio included in the November 2025 Ruling. Full initial results for both the 2036 and 2041 mapped years at a substation level are detailed in the Dashboard for Initial Mapping of Proposed 26-27 TPP Base Case, included as **Appendix B.**

Section 6.2 presents the high-level adjustments made to the mapping post November 2025 Ruling. Working Group staff made these adjustments to improve compliance with the busbar mapping criteria and portfolio policy goals, to account for updated information on transmission, commercial interest, and in-development resources, and to incorporate feedback stakeholders provided through comments and replies to the September 2025 and November 2025 Rulings.

Sections 6.3 through 6.8 summarize the updated busbar mapping analysis and criteria analysis following the mapping changes outlined in Section 6.2. A full accounting of the criteria alignment by substation is in the Dashboard for the Proposed Decision Mapping of the 26-27 TPP Base Case released with this report as Appendix C.

6.1 Initial Mapping Results for 26-27 TPP Base Case Portfolio

This section summarizes the mapping results following the initial rounds of mapping that the busbar mapping Working Group conducted for the base case portfolio and released with the November 2025 Ruling. This section summarizes the initial mapping information included in the Initial Mapping Dashboard (Appendix B).

Table 9 and Table 10 below show a comparison of the RESOLVE-selected base case portfolio resources and the initial mapping results for model years 2036 and 2041 respectively. Additionally, the tables compare these resources to the final mapped results for the 2025-2026 TPP Base Case model years 2035 and 2040 respectively.

Table 9: Summary of the base case portfolio RESOLVE results and initial mapping for 2036 compared to the 25-26 TPP base case (2035 model year) by CAISO study area.

CAISO Study Area	Resource Type	RESOLVE Output (2036)			26-27 TPP Initial Mapping Total (2036)			25-26 TPP Final Mapping Total (2035)		
		FCDS (MW)	EODS (MW)	Total (MW)	FCDS (MW)	EODS (MW)	Total (MW)	FCDS (MW)	EODS (MW)	Total (MW)
In-State Biomass		-	-	-	-		-	171		171
PG&E North of Greater Bay Study A	Geothermal	3,065	-	3,065	2,890		2,890	123		123
PG&E Greater Bay Study Area		29	-	29	30		30	-		-
PG&E Fresno Study Area		265	-	265	270		270	-		-
PG&E Kern Study Area		-	-	-	-		-	-		-
SCE Northern Area		-	-	-	-		-	-		-
SCE Metro Study Area		-	-	-	203		203	389		389
SCE North of Lugo Study Area		303	-	303	117		117	10		10
East of Pisgah Study Area		908	-	908	868		868	517		517
SCE Eastern Study Area		7	-	7	30		30	500		500
SDG&E Study Area		529	-	529	530		530	100		100
Distributed Solar		-	-	-		116	116		294	294
PG&E North of Greater Bay Study A	Solar	-	1,960	1,960	-	1,528	1,528	75	258	333
PG&E Greater Bay Study Area		482	480	962	490	480	970	-	250	250
PG&E Fresno Study Area		2,871	580	3,451	2,860	988	3,848	1,471	2,853	4,324
PG&E Kern Study Area		5,009	4,670	9,679	5,020	4,670	9,690	830	1,972	2,802
SCE Northern Area		5,247	1,100	6,347	4,456	1,363	5,819	1,178	1,608	2,786
SCE Metro Study Area		5	-	5	486	-	486	10	10	20
SCE North of Lugo Study Area		278	-	278	176	236	412	650	524	1,174
East of Pisgah Study Area		125	570	695	4,565	1,633	6,198	886	1,512	2,398
SCE Eastern Study Area		4,370	5,560	9,930	595	4,165	4,760	475	3,399	3,874
SDG&E Study Area		6,977	7,190	14,167	6,980	7,190	14,170	420	1,161	1,581
PG&E North of Greater Bay Study A	Wind	-	780	780	-	712	712	1,705	98	1,803
PG&E Greater Bay Study Area		234	10	244	230	-	230	827	187	1,014
PG&E Fresno Study Area		-	-	-	-	69	69	491	70	561
PG&E Kern Study Area		-	-	-	-	-	-	113	-	113
SCE Northern Area		-	-	-	-	-	-	674	-	674
SCE Metro Study Area		-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area		-	-	-	-	-	-	330	32	362
East of Pisgah Study Area		255	-	255	321	-	321	1,052	177	1,229
SCE Eastern Study Area		263	60	323	263	60	323	288	37	325
SDG&E Study Area		991	-	991	990	-	990	1,260	556	1,816
PG&E North of Greater Bay Study A	OOS Wind	-	-	-	-	-	-	-	-	-
PG&E Greater Bay Study Area		-	-	-	-	-	-	-	-	-
PG&E Fresno Study Area		-	-	-	-	-	-	-	-	-
PG&E Kern Study Area		-	-	-	-	-	-	-	-	-
SCE Northern Area		-	-	-	-	-	-	-	-	-
SCE Metro Study Area		-	-	-	-	-	-	1,750	-	1,750
SCE North of Lugo Study Area		-	-	-	-	-	-	-	-	-
East of Pisgah Study Area		4,100	-	4,100	4,100	-	4,100	4,151	-	4,151
SCE Eastern Study Area		2,936	-	2,936	2,936	-	2,936	3,099	-	3,099
SDG&E Study Area		-	-	-	-	-	-	-	-	-
PG&E North of Greater Bay Study A	Offshore Wind	-	-	-	-	-	-	1,607	-	1,607
PG&E Greater Bay Study Area		-	-	-	-	-	-	-	-	-
PG&E Fresno Study Area		-	-	-	-	-	-	-	-	-
PG&E Kern Study Area		2,924	-	2,924	2,924	-	2,924	2,924	-	2,924
SCE Northern Area		-	-	-	-	-	-	-	-	-
SCE Metro Study Area		-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area		-	-	-	-	-	-	-	-	-
East of Pisgah Study Area		-	-	-	-	-	-	-	-	-
SCE Eastern Study Area		-	-	-	-	-	-	-	-	-
SDG&E Study Area		-	-	-	-	-	-	-	-	-
Renewable Resource Total		**42,173**	**22,960**	**65,133**	**42,330**	**23,209**	**65,539**	**28,073**	**14,996**	**43,069**
PG&E North of Greater Bay Study A	Li-ion Battery (4-hr	314	-	314	363		363	125		125
PG&E Greater Bay Study Area		612	-	612	628		628	719		719
PG&E Fresno Study Area		226	-	226	980		980	2,308		2,308
PG&E Kern Study Area		369	-	369	398		398	493		493
SCE Northern Area		623	-	623	1,884		1,884	3,224		3,224
SCE Metro Study Area		1,365	-	1,365	1,589		1,589	1,891		1,891
SCE North of Lugo Study Area		542	-	542	542		542	507		507
East of Pisgah Study Area		638	-	638	685		685	1,210		1,210
SCE Eastern Study Area		1,374	-	1,374	1,370		1,370	3,985		3,985
SDG&E Study Area		760	-	760	1,251		1,251	1,727		1,727
PG&E North of Greater Bay Study A	Li-ion Battery (8-hr	-	-	-	-		-	95		95
PG&E Greater Bay Study Area		45	-	45	96		96	236		236
PG&E Fresno Study Area		2,845	-	2,845	2,436		2,436	700		700
PG&E Kern Study Area		369	-	369	355		355	410		410
SCE Northern Area		635	-	635	523		523	509		509
SCE Metro Study Area		7,084	-	7,084	6,527		6,527	10		10
SCE North of Lugo Study Area		6	-	6	6		6	113		113
East of Pisgah Study Area		699	-	699	735		735	320		320
SCE Eastern Study Area		156	-	156	100		100	100		100
SDG&E Study Area		1,350	-	1,350	1,114		1,114	100		100
Li-ion Battery Total		20,009	-	20,009	21,581		21,581	18,782		18,782
PG&E North of Greater Bay Study A	LDES	-	-	-	-		-	5		5
PG&E Greater Bay Study Area		165	-	165	170		170	310		310
PG&E Fresno Study Area		-	-	-	-		-	140		140
PG&E Kern Study Area		817	-	817	820		820	-		-
SCE Northern Area		1,280	-	1,280	1,380		1,380	400		400
SCE Metro Study Area		-	-	-	100		100	-		-
SCE North of Lugo Study Area		386	-	386	286		286	-		-
East of Pisgah Study Area		500	-	500	1,100		1,100	-		-
SCE Eastern Study Area		1,800	-	1,800	900		900	-		-
SDG&E Study Area		500	-	500	500		500	409		409
LDES Total		5,448		5,448	5,256		5,256	1,264		1,264
Storage Total		**25,458**		**25,458**	**26,837**		**26,837**	**20,046**		**20,046**
Storage + Resources Total		**67,630**	**22,960**	**90,590**	**69,167**	**23,209**	**92,376**	**48,119**	**14,996**	**63,115**

Table 10: Summary of the base case portfolio RESOLVE results and initial mapping results for 2041 compared to the 25-26 TPP base case (2040 model year) by CAISO study area.

CAISO Study Area	Resource Type	RESOLVE Output (2041)			26-27 TPP Initial Mapping Total (2041)			25-26 TPP Final Mapping Total (2040)		
		FCDS (MW)	EODS (MW)	Total (MW)	FCDS (MW)	EODS (MW)	Total (MW)	FCDS (MW)	EODS (MW)	Total (MW)
In-State Biomass		-	-	-	-		-	171		171
PG&E North of Greater Bay Study A	Geothermal	3,065	-	3,065	2,890		2,890	123		123
PG&E Greater Bay Study Area		29	-	29	30		30	-		-
PG&E Fresno Study Area		265	-	265	270		270	-		-
PG&E Kern Study Area		-	-	-	-		-	-		-
SCE Northern Area		-	-	-	-		-	-		-
SCE Metro Study Area		-	-	-	203		203	389		389
SCE North of Lugo Study Area		303	-	303	117		117	10		10
East of Pisgah Study Area		908	-	908	868		868	517		517
SCE Eastern Study Area		7	-	7	37		37	500		500
SDG&E Study Area		529	-	529	530		530	100		100
Distributed Solar		-	-	-		116	116		294	294
PG&E North of Greater Bay Study A	Solar	-	1,960	1,960	-	1,528	1,528	430	858	1,288
PG&E Greater Bay Study Area		700	480	1,180	720	480	1,200	252	1,150	1,402
PG&E Fresno Study Area		5,550	580	6,130	5,520	988	6,508	5,521	8,013	13,534
PG&E Kern Study Area		5,009	4,670	9,679	5,020	4,670	9,690	1,810	3,787	5,597
SCE Northern Area		6,179	1,100	7,279	5,386	1,363	6,749	1,678	3,718	5,396
SCE Metro Study Area		387	-	387	886	-	886	10	10	20
SCE North of Lugo Study Area		278	-	278	176	236	412	750	1,243	1,993
East of Pisgah Study Area		125	570	695	5,065	1,633	6,698	1,666	4,332	5,998
SCE Eastern Study Area		5,474	6,290	11,764	1,195	4,895	6,090	1,375	4,879	6,254
SDG&E Study Area		6,977	7,420	14,397	6,980	7,420	14,400	798	2,321	3,119
PG&E North of Greater Bay Study A	Wind	879	780	1,659	880	712	1,592	1,705	98	1,803
PG&E Greater Bay Study Area		234	10	244	230	-	230	827	187	1,014
PG&E Fresno Study Area		-	-	-	-	69	69	491	70	561
PG&E Kern Study Area		-	-	-	-	-	-	113	-	113
SCE Northern Area		-	-	-	-	-	-	674	-	674
SCE Metro Study Area		-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area		-	-	-	-	-	-	330	32	362
East of Pisgah Study Area		255	-	255	321	-	321	1,052	177	1,229
SCE Eastern Study Area		263	60	323	3,263	60	3,323	288	37	325
SDG&E Study Area		2,292	-	2,292	2,290	-	2,290	1,260	556	1,816
PG&E North of Greater Bay Study A	OOS Wind	-	-	-	-	-	-	-	-	-
PG&E Greater Bay Study Area		4,000	-	4,000	4,000	-	4,000	1,707	-	1,707
PG&E Fresno Study Area		-	-	-	-	-	-	-	-	-
PG&E Kern Study Area		-	-	-	-	-	-	-	-	-
SCE Northern Area		-	-	-	-	-	-	-	-	-
SCE Metro Study Area		3,000	-	3,000	3,000	-	3,000	1,750	-	1,750
SCE North of Lugo Study Area		-	-	-	-	-	-	-	-	-
East of Pisgah Study Area		4,100	-	4,100	4,100	-	4,100	4,151	-	4,151
SCE Eastern Study Area		5,936	-	5,936	2,936	-	2,936	3,099	-	3,099
SDG&E Study Area		-	-	-	-	-	-	-	-	-
PG&E North of Greater Bay Study A	Offshore Wind	1,607	-	1,607	1,607	-	1,607	1,607	-	1,607
PG&E Greater Bay Study Area		-	-	-	-	-	-	-	-	-
PG&E Fresno Study Area		-	-	-	-	-	-	-	-	-
PG&E Kern Study Area		2,924	-	2,924	2,924	-	2,924	2,924	-	2,924
SCE Northern Area		-	-	-	-	-	-	-	-	-
SCE Metro Study Area		-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area		-	-	-	-	-	-	-	-	-
East of Pisgah Study Area		-	-	-	-	-	-	-	-	-
SCE Eastern Study Area		-	-	-	-	-	-	-	-	-
SDG&E Study Area		-	-	-	-	-	-	-	-	-
Renewable Resource Total		**61,275**	**23,920**	**85,195**	**61,444**	**24,169**	**85,613**	**38,075**	**31,760**	**69,835**
PG&E North of Greater Bay Study A	Li-ion Battery (4-hr	314	-	314	363		363	125		125
PG&E Greater Bay Study Area		612	-	612	628		628	719		719
PG&E Fresno Study Area		226	-	226	980		980	2,308		2,308
PG&E Kern Study Area		369	-	369	398		398	493		493
SCE Northern Area		623	-	623	1,884		1,884	3,224		3,224
SCE Metro Study Area		1,365	-	1,365	1,589		1,589	1,891		1,891
SCE North of Lugo Study Area		542	-	542	542		542	507		507
East of Pisgah Study Area		638	-	638	685		685	1,210		1,210
SCE Eastern Study Area		1,374	-	1,374	1,370		1,370	3,985		3,985
SDG&E Study Area		760	-	760	1,251		1,251	1,727		1,727
PG&E North of Greater Bay Study A	Li-ion Battery (8-hr	-	-	-	-		-	305		305
PG&E Greater Bay Study Area		45	-	45	96		96	1,508		1,508
PG&E Fresno Study Area		2,845	-	2,845	2,436		2,436	2,765		2,765
PG&E Kern Study Area		369	-	369	355		355	1,210		1,210
SCE Northern Area		635	-	635	523		523	1,584		1,584
SCE Metro Study Area		7,084	-	7,084	6,527		6,527	610		610
SCE North of Lugo Study Area		6	-	6	6		6	463		463
East of Pisgah Study Area		699	-	699	735		735	1,635		1,635
SCE Eastern Study Area		156	-	156	100		100	780		780
SDG&E Study Area		1,350	-	1,350	869		869	910		910
Li-ion Battery Total		20,009	-	20,009	21,335		21,335	27,959		27,959
PG&E North of Greater Bay Study A	LDES	-	-	-	-		-	5		5
PG&E Greater Bay Study Area		165	-	165	170		170	310		310
PG&E Fresno Study Area		-	-	-	-		-	140		140
PG&E Kern Study Area		817	-	817	820		820	-		-
SCE Northern Area		1,280	-	1,280	1,380		1,380	400		400
SCE Metro Study Area		-	-	-	100		100	-		-
SCE North of Lugo Study Area		386	-	386	286		286	-		-
East of Pisgah Study Area		500	-	500	1,100		1,100	-		-
SCE Eastern Study Area		1,800	-	1,800	900		900	-		-
SDG&E Study Area		500	-	500	500		500	409		409
LDES Total		5,448		5,448	5,256		5,256	1,264		1,264
Storage Total		**25,458**		**25,458**	**26,591**		**26,591**	**29,223**		**29,223**
Storage + Resources Total		**86,733**	**23,920**	**110,653**	**88,035**	**24,169**	**112,204**	**60,041**	**21,956**	**81,998**

The initial mapping features significantly higher renewable builds, lower lithium-ion battery builds, and slightly higher long-duration storage builds than the 25-26 TPP base case. A small portion of this change can be attributed to the fact that the 26-27 TPP portfolio is one year further out, but most of the difference is driven by the updated load forecast which features much higher energy demand. The additional energy is primarily supplied by solar, but there were also notable increases in geothermal and out-of-state wind builds. In-state wind builds remained the same but were reallocated among study areas. By 2041, offshore wind builds are consistent between portfolios.

6.2 Mapping Adjustments for the Base Case Portfolio

The tables below display the adjustments to the 2036 and 2041 mapping results between the initial mapping and updated mapping for the Proposed Decision.

The net MW mapping adjustments for the 2036 base case portfolio are summarized by resource type and CAISO study area in Table 11. Table 12 shows the number of substations by CAISO study area at which resources were added or removed for the 2036 portfolio, and Table 13 shows a narrower, focused number of substations where staff either added or removed 50 MW or more of a single resource. For both Table 12 and Table 13, the top table shows the number of substations with mapping increases and the bottom table shows the number with decreases.

Overall, in the remapping of resources in the 2036 portfolio there are a few key trends:

- 500 MW of solar originally placed in SDG&E AZ were moved to Tesla 500 kV and Delta PP 230 kV to avoid triggering upgrades in SDG&E AZ while also avoiding further transmission upgrades in PG&E GBA.
- 2,500 MW of solar originally placed in SDG&E AZ were moved Los Banos 230 kV (500 MW), Los Banos 500 kV (1,500 MW), Tranquility 500 kV (890MW), and Gates 500 kV (110 MW) to avoid triggering upgrades in SDG&E AZ.
- 900 MW of solar originally placed in SDG&E AZ were moved to Antelope 230 kV (300 MW) and Vincent 230 kV (600 MW) to avoid triggering upgrades in SDG&E AZ.
- 470 MW of solar originally placed in SDG&E AZ were moved to Lathrop 230 kV to avoid triggering upgrades in SDG&E AZ.
- 1,800 MW of solar originally placed in SDG&E AZ were moved to Cielo Azul 500 kV (300 MW), Colorado River 230 kV (1,000 MW), and Red Bluff 230 kV (500 MW) to avoid triggering upgrades in SDG&E AZ.
- Staff remapped 2,100 MW of solar from SDG&E AZ to Imperial Valley 230 kV (750 MW), Imperial Valley 500 kV (200 MW), and the new 500 kV substation between North Gila and Imperial Valley (1,150 MW). These three SDG&E Imperial substations were chosen for remapping due to their unmet commercial interest, high resource potential, and available headroom. Remapping to the Ocotillo 500 kV and ECO 500 kV substations was considered but ultimately decided against due to a lack of commercial interest at those substations.
- In 2036, staff remapped 8,270 MW of solar out of SDG&E Arizona to avoid triggering unstudied, but likely costly, transmission upgrades in the region. 2,100 MW were moved into

SDG&E Imperial, 3,170 MW into SCE and 3,000 MW into PG&E as part of this remapping.

- Slightly over 5,000 MW remain of the 13,500 MW of generic solar that were initially mapped to Hassayampa 500 kV (2,286 MW), Hoodoo Wash 500 kV (2,388 MW) and North Gila (400 MW). CPUC Staff left this amount at the guidance of CAISO staff, who counseled that this amount of solar would likely not trigger transmission upgrades or chronic curtailment.
- Staff preserved RESOLVE selected ratios of FCDS to EODS solar in SDG&E in the remapping and distributed roughly equal amounts of FCDS and EODS solar to both SCE and PG&E.
- An additional 757 MW of 8-hr battery were also moved out of SDG&E AZ and placed in SCE Northern to preserve RESOLVE selected ratios of batteries to solar.
- Staff remapped 200 MW of PSH from Sycamore Canyon 138 kV to Sycamore Canyon 230 kV. The resulting 500 MW of PSH at Sycamore Canyon 230 kV represent the San Vicente PSH project, which was mapped in both the 24-25 and 25-26 TPP and was optimally selected by RESOLVE at its full capacity in the 26-27 TPP.
- Staff remapped 505 MW of geothermal from Imperial Valley 500 kV to Imperial Valley 230 kV to match commercial interest and to better align with the 25-26 mapping, which placed 100 MW of geothermal at Imperial Valley 230 kV.
- Staff identified 500 MW for the Helm's Uprate that needed to be included in the mapped portfolio. The additional 192 MW delta is a result of LDES mapping that was not completed in time for the initial ruling.

Table 11. Summary of the net MW adjustments between initial and updated mapping results for the 2036 base case portfolio by CAISO study area and resource type.

Summary of Mapping Changes between Initial and PD Mapping for the 2036 Portfolio (MW)									
2036 Portfolio: Net Change to Mapped Resource (PD - Initial)	Geothermal	Biomass	Wind	OOS Wind	Offshore Wind	Solar	Battery	LDES	All Res
PG&E North of Greater Bay Study Area	296	-	161	-	-	(500)	-	-	(43)
PG&E Greater Bay Study Area	(30)	-	(230)	-	-	715	-	140	595
PG&E Fresno Study Area	(100)	-	-	-	-	3,684	31	140	3,755
PG&E Kern Study Area	-	-	-	-	-	(1,155)	-	302	(853)
SCE Northern Area	-	-	-	-	-	721	757	300	1,778
SCE Metro Study Area	-	-	-	-	-	-	(62)	(100)	(162)
SCE North of Lugo Study Area	(117)	-	-	-	-	500	(55)	-	328
East of Pisgah Study Area	47	-	-	-	-	(180)	(128)	(140)	(401)
SCE Eastern Study Area	70	-	-	-	-	1,850	(29)	50	1,942
SDG&E Study Area	-	-	-	-	-	(6,170)	(757)	-	(6,928)
All Areas	166	-	(69)	-	-	(535)	(243)	692	11

Table 12: Summary by CAISO study area of the number of substations with any mapping changes for the 2036 base case portfolio.

2036 Mapping: No. of Subs w/ Increase in Res. Mapped (PD - Initial)	Geothermal FCDS	Biomass FCDS	Wind FCDS	Wind EODS	OOS Wind FCDS	Offshore Wind FCDS	Distributed Solar EODS	Solar FCDS	Solar EODS	Battery_4 hr FCDS	Battery_8 hr FCDS	LDES FCDS	All Res Total
PG&E North of Greater Bay Study Area	10	-	1	1	-	-	-	-	3	-	-	-	15
PG&E Greater Bay Study Area	-	-	-	-	-	-	-	3	4	-	1	1	9
PG&E Fresno Study Area	-	-	-	-	-	-	-	9	7	-	6	1	23
PG&E Kern Study Area	-	-	-	-	-	-	-	9	3	-	1	3	16
SCE Northern Area	-	-	-	-	-	-	-	3	-	-	2	2	7
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	11	-	11
SCE North of Lugo Study Area	-	-	-	-	-	-	-	2	1	1	1	-	5
East of Pisgah Study Area	1	-	2	-	-	-	-	-	1	-	3	1	8
SCE Eastern Study Area	1	-	-	1	-	-	-	2	4	-	-	2	10
SDG&E Study Area	1	-	1	-	-	-	-	4	3	-	-	1	10
All Areas	13	0	4	2	0	0	0	32	26	1	25	11	114

2036 Mapping: No. of Subs w/ Decrease in Res. (PD - Initial)	Geothermal FCDS	Biomass FCDS	Wind FCDS	Wind EODS	OOS Wind FCDS	Offshore Wind FCDS	Distributed Solar EODS	Solar FCDS	Solar EODS	Battery_4 hr FCDS	Battery_8 hr FCDS	LDES FCDS	All Res Total
PG&E North of Greater Bay Study Area	11	-	-	7	-	-	-	-	7	-	-	-	25
PG&E Greater Bay Study Area	1	-	5	-	-	-	-	7	5	-	2	2	22
PG&E Fresno Study Area	3	-	-	-	-	-	-	12	-	-	5	-	20
PG&E Kern Study Area	-	-	-	-	-	-	-	7	14	-	3	3	27
SCE Northern Area	-	-	-	-	-	-	-	5	-	-	-	2	7
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	14	1	15
SCE North of Lugo Study Area	1	-	-	-	-	-	-	-	-	2	-	-	3
East of Pisgah Study Area	-	-	1	-	-	-	-	2	-	-	5	1	9
SCE Eastern Study Area	-	-	-	1	-	-	-	-	2	1	-	3	7
SDG&E Study Area	1	-	1	-	-	-	-	2	2	-	2	1	9
All Areas	17	0	7	8	0	0	0	35	30	3	31	13	144

Table 13: Summary by CAISO study area of the number of substations with mapping changes 50 MW or larger for the 2036 base case portfolio.

2036 Mapping: No. of Subs w/ >50 MW Increase (PD - Initial)	Geothermal FCDS	Biomass FCDS	Wind FCDS	Wind EODS	OOS Wind FCDS	Offshore Wind FCDS	Distributed Solar EODS	Solar FCDS	Solar EODS	Battery_4 hr FCDS	Battery_8 hr FCDS	LDES FCDS	All Res Total
PG&E North of Greater Bay Study Area	8	-	1	1	-	-	-	-	3	-	-	-	13
PG&E Greater Bay Study Area	-	-	-	-	-	-	-	3	4	-	-	1	8
PG&E Fresno Study Area	-	-	-	-	-	-	-	6	7	-	4	1	18
PG&E Kern Study Area	-	-	-	-	-	-	-	9	3	-	1	3	16
SCE Northern Area	-	-	-	-	-	-	-	3	-	-	2	2	7
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	11	-	11
SCE North of Lugo Study Area	-	-	-	-	-	-	-	2	1	-	1	-	4
East of Pisgah Study Area	-	-	2	-	-	-	-	-	1	-	3	1	7
SCE Eastern Study Area	1	-	-	1	-	-	-	2	4	-	-	2	10
SDG&E Study Area	1	-	1	-	-	-	-	4	3	-	-	1	10
All Areas	10	0	4	2	0	0	0	29	26	0	22	11	104

2036 Mapping: No. of Subs w/ >50 MW Decrease in Res. (PD - Initial)	Geothermal FCDS	Biomass FCDS	Wind FCDS	Wind EODS	OOS Wind FCDS	Offshore Wind FCDS	Distributed Solar EODS	Solar FCDS	Solar EODS	Battery_4 hr FCDS	Battery_8 hr FCDS	LDES FCDS	All Res Total
PG&E North of Greater Bay Study Area	8	-	-	6	-	-	-	-	7	-	-	-	21
PG&E Greater Bay Study Area	-	-	4	-	-	-	-	6	4	-	-	2	16
PG&E Fresno Study Area	1	-	-	-	-	-	-	10	-	-	4	-	15
PG&E Kern Study Area	-	-	-	-	-	-	-	7	14	-	2	3	26
SCE Northern Area	-	-	-	-	-	-	-	5	-	-	-	2	7
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	14	1	15
SCE North of Lugo Study Area	1	-	-	-	-	-	-	-	-	2	-	-	3
East of Pisgah Study Area	-	-	1	-	-	-	-	2	-	-	4	1	8
SCE Eastern Study Area	-	-	-	1	-	-	-	-	2	-	-	3	6
SDG&E Study Area	1	-	1	-	-	-	-	2	2	-	2	1	9
All Areas	11	0	6	7	0	0	0	32	29	2	26	13	126

The adjustments to the 2041 mapping results between the initial mapping and updated mapping are consistent with the adjustments made in the 2036 mapped portfolio. Additional adjustments were part of the general effort to limit and optimize transmission exceedances and improve criteria alignment.

The net MW mapping adjustments for the 2041 base case portfolio are summarized by resource type and CAISO study area in Table 14. Table 15 shows the number of substations by CAISO study area at which resources were added or removed for the 2041 portfolio, and Table 16 shows a narrower focused number of substations where staff remapped 50 MW or more of a single resource, either added or removed. For both Table 15 and Table 16, the top table shows the number of substations with mapping increases, and the bottom table shows the number with decreases.

In addition to the trends in the 2036 portfolio remapping, the 2041 portfolio remapping had the following trends:

- Wind resources were moved between and within study areas to increase alignment with resource potential, commercial interest, and environmental and land use criteria.
- OOS wind resources totaling 3,000 MW that were previously labeled as in-state wind were re-mapped, with 1,500 MW moved from SCE Eastern to East of Pisgah to more accurately reflect likely delivery locations.
- Solar was moved within SCE Northern for better alignment with commercial interest and transmission capability criteria.

Table 14: Summary of the net MW adjustments between initial and updated mapping results for the 2041 base case portfolio by CAISO study area and resource type.

Summary of Mapping Changes between Initial and PD Mapping for the 2041 Portfolio (MW)									
2041 Portfolio: Net Change to Mapped Resource (PD - Initial)	Geothermal	Biomass	Wind	OOS Wind	Offshore Wind	Solar	Battery	LDES	All Res
PG&E North of Greater Bay Study Area	296	-	161	-	-	(500)	-	-	(43)
PG&E Greater Bay Study Area	(30)	-	(230)	-	-	715	-	140	595
PG&E Fresno Study Area	(100)	-	-	-	-	3,684	31	140	3,755
PG&E Kern Study Area	-	-	-	-	-	(1,155)	-	302	(853)
SCE Northern Area	-	-	-	-	-	717	757	300	1,774
SCE Metro Study Area	-	-	-	-	-	-	(62)	(100)	(162)
SCE North of Lugo Study Area	(117)	-	-	-	-	500	(55)	-	328
East of Pisgah Study Area	47	-	-	1,500	-	(180)	(128)	(140)	1,099
SCE Eastern Study Area	63	-	(3,000)	1,500	-	1,850	(29)	50	435
SDG&E Study Area	-	-	-	-	-	(6,170)	(512)	-	(6,682)
All Areas	159	-	(3,069)	3,000	-	(539)	3	692	246

Table 15: Summary by CAISO study area of the number of substations with any mapping changes for the 2041 base case portfolio.

2041 Mapping: No. of Subs w/ Increase in Res. Mapped (PD - Initial)	Geothermal FCDS	Biomass FCDS	Wind FCDS	Wind EODS	OOS Wind FCDS	Offshore Wind FCDS	Distributed Solar EODS	Solar FCDS	Solar EODS	Battery_4 hr FCDS	Battery_8 hr FCDS	LDES FCDS	All Res Total
PG&E North of Greater Bay Study Area	10	-	4	2	-	-	-	-	3	-	-	-	19
PG&E Greater Bay Study Area	-	-	-	-	-	-	-	3	4	-	1	1	9
PG&E Fresno Study Area	-	-	-	-	-	-	-	10	7	-	6	1	24
PG&E Kern Study Area	-	-	-	-	-	-	-	9	3	-	1	3	16
SCE Northern Area	-	-	-	-	-	-	-	3	-	-	2	2	7
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	11	-	11
SCE North of Lugo Study Area	-	-	-	-	-	-	-	2	1	1	1	-	5
East of Pisgah Study Area	1	-	2	-	1	-	-	-	1	-	3	1	9
SCE Eastern Study Area	1	-	-	1	1	-	-	2	5	-	-	2	12
SDG&E Study Area	1	-	1	-	-	-	-	4	3	-	-	1	10
All Areas	13	0	7	3	2	0	0	33	27	1	25	11	122

2041 Mapping: No. of Subs w/ Decrease in Res. (PD - Initial)	Geothermal FCDS	Biomass FCDS	Wind FCDS	Wind EODS	OOS Wind FCDS	Offshore Wind FCDS	Distributed Solar EODS	Solar FCDS	Solar EODS	Battery_4 hr FCDS	Battery_8 hr FCDS	LDES FCDS	All Res Total
PG&E North of Greater Bay Study Area	11	-	6	7	-	-	-	-	7	-	-	-	31
PG&E Greater Bay Study Area	1	-	5	-	-	-	-	7	5	-	2	2	22
PG&E Fresno Study Area	3	-	-	-	-	-	-	12	-	-	5	-	20
PG&E Kern Study Area	-	-	-	-	-	-	-	7	14	-	3	3	27
SCE Northern Area	-	-	-	-	-	-	-	6	-	-	-	2	8
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	14	1	15
SCE North of Lugo Study Area	1	-	-	-	-	-	-	-	-	2	-	-	3
East of Pisgah Study Area	-	-	1	-	-	-	-	2	-	-	5	1	9
SCE Eastern Study Area	1	-	1	1	-	-	-	1	3	1	-	3	11
SDG&E Study Area	1	-	1	-	-	-	-	2	2	-	2	1	9
All Areas	18	0	14	8	0	0	0	37	31	3	31	13	155

Table 16: Summary by CAISO study area of the number of substations with mapping changes 50 MW or larger for the 2041 base case portfolio.

2041 Mapping: No. of Subs w/ >50 MW Increase (PD - Initial)	Geothermal FCDS	Biomass FCDS	Wind FCDS	Wind EODS	OOS Wind FCDS	Offshore Wind FCDS	Distributed Solar EODS	Solar FCDS	Solar EODS	Battery_4 hr FCDS	Battery_8 hr FCDS	LDES FCDS	All Res Total
PG&E North of Greater Bay Study Area	8	-	4	2	-	-	-	-	3	-	-	-	17
PG&E Greater Bay Study Area	-	-	-	-	-	-	-	3	4	-	-	1	8
PG&E Fresno Study Area	-	-	-	-	-	-	-	6	7	-	4	1	18
PG&E Kern Study Area	-	-	-	-	-	-	-	9	3	-	1	3	16
SCE Northern Area	-	-	-	-	-	-	-	3	-	-	2	2	7
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	11	-	11
SCE North of Lugo Study Area	-	-	-	-	-	-	-	2	1	-	1	-	4
East of Pisgah Study Area	-	-	2	-	1	-	-	-	1	-	3	1	8
SCE Eastern Study Area	1	-	-	1	1	-	-	2	5	-	-	2	12
SDG&E Study Area	1	-	1	-	-	-	-	4	3	-	-	1	10
All Areas	10	0	7	3	2	0	0	29	27	0	22	11	111

2041 Mapping: No. of Subs w/ >50 MW Decrease in Res. (PD - Initial)	Geothermal FCDS	Biomass FCDS	Wind FCDS	Wind EODS	OOS Wind FCDS	Offshore Wind FCDS	Distributed Solar EODS	Solar FCDS	Solar EODS	Battery_4 hr FCDS	Battery_8 hr FCDS	LDES FCDS	All Res Total
PG&E North of Greater Bay Study Area	8	-	6	6	-	-	-	-	7	-	-	-	27
PG&E Greater Bay Study Area	-	-	4	-	-	-	-	6	4	-	-	2	16
PG&E Fresno Study Area	1	-	-	-	-	-	-	10	-	-	4	-	15
PG&E Kern Study Area	-	-	-	-	-	-	-	7	14	-	2	3	26
SCE Northern Area	-	-	-	-	-	-	-	6	-	-	-	2	8
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	14	1	15
SCE North of Lugo Study Area	1	-	-	-	-	-	-	-	-	2	-	-	3
East of Pisgah Study Area	-	-	1	-	-	-	-	2	-	-	4	1	8
SCE Eastern Study Area	-	-	1	1	-	-	-	1	3	-	-	3	9
SDG&E Study Area	1	-	1	-	-	-	-	2	2	-	2	1	9
All Areas	11	0	13	7	0	0	0	34	30	2	26	13	136

The updated mapping results for the base case portfolio by CAISO study area are shown below in Table 17 for 2036 and Table 18 for 2041. Table 19 below shows the updated mapping results summarized by CAISO study area for 2036 and 2041.

Table 17: Summary of the updated mapping results for the 2036 base case portfolio and changes from initial mapping by CAISO study area.

RESOLVE Resource Name	In-Development Resources			2036 - Mapped Total (In-Dev & Generic)			2036 - Change in Mapping (PD - Initial)		
	FCDS (MW)	EODS (MW)	Total (MW)	FCDS (MW)	EODS (MW)	Total (MW)	FCDS (MW)	EODS (MW)	Total (MW)
In-State Biomass	-		-	-		-	-	-	-
PG&E North of Greater Bay Study Area _Geothermal	11.2		11.2	3,186.2		3,186.2	296.2	-	296.2
PG&E Greater Bay Study Area _Geothermal	-		-	-		-	(30.0)	-	(30.0)
PG&E Fresno Study Area_Geothermal	-		-	170.0		170.0	(100.0)	-	(100.0)
PG&E Kern Study Area_Geothermal	-		-	-		-	-	-	-
SCE Northern Area_Geothermal	-		-	-		-	-	-	-
SCE Metro Study Area_Geothermal	203.0		203.0	203.0		203.0	-	-	-
SCE North of Lugo Study Area_Geothermal	-		-	-		-	(116.8)	-	(116.8)
East of Pisgah Study Area _Geothermal	45.0		45.0	914.8		914.8	46.8	-	46.8
SCE Eastern Study Area_Geothermal	30.0		30.0	100.0		100.0	70.0	-	70.0
SDG&E Study Area_Geothermal	25.0		25.0	530.0		530.0	-	-	-
Distributed Solar		116.4	116.4		116.4	116.4	-	-	-
PG&E North of Greater Bay Study Area _Solar	-	25.0	25.0	-	1,027.5	1,027.5	-	(500.0)	(500.0)
PG&E Greater Bay Study Area _Solar	-	-	-	755.0	930.0	1,685.0	265.0	450.0	715.0
PG&E Fresno Study Area_Solar	166.0	987.5	1,153.5	3,854.2	3,677.5	7,531.7	994.2	2,690.0	3,684.2
PG&E Kern Study Area_Solar	60.0	440.0	500.0	5,005.0	3,530.0	8,535.0	(15.0)	(1,140.0)	(1,155.0)
SCE Northern Area_Solar	197.0	1,363.0	1,560.0	5,177.0	1,363.0	6,540.0	721.0	-	721.0
SCE Metro Study Area_Solar	-	-	-	486.0	-	486.0	-	-	-
SCE North of Lugo Study Area_Solar	70.0	235.8	305.8	626.0	285.8	911.8	450.0	50.0	500.0
East of Pisgah Study Area _Solar	65.0	650.0	715.0	3,915.0	2,103.0	6,018.0	(650.0)	470.0	(180.0)
SCE Eastern Study Area_Solar	175.0	2,685.0	2,860.0	1,395.0	5,215.0	6,610.0	800.0	1,050.0	1,850.0
SDG&E Study Area_Solar	237.5	388.4	625.9	3,940.5	4,059.4	7,999.9	(3,039.5)	(3,130.6)	(6,170.1)
PG&E North of Greater Bay Study Area _Wind	-	-	-	172.5	700.0	872.5	172.5	(11.7)	160.8
PG&E Greater Bay Study Area _Wind	-	-	-	-	-	-	(230.0)	-	(230.0)
PG&E Fresno Study Area_Wind	-	69.3	69.3	-	69.3	69.3	-	-	-
PG&E Kern Study Area_Wind	-	-	-	-	-	-	-	-	-
SCE Northern Area_Wind	-	-	-	-	-	-	-	-	-
SCE Metro Study Area_Wind	-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area_Wind	-	-	-	-	-	-	-	-	-
East of Pisgah Study Area _Wind	-	-	-	321.0	-	321.0	-	-	-
SCE Eastern Study Area_Wind	-	-	-	263.0	60.0	323.0	-	-	-
SDG&E Study Area_Wind	-	-	-	990.0	-	990.0	-	-	-
PG&E North of Greater Bay Study Area _OOS Wind	-	-	-	-	-	-	-	-	-
PG&E Greater Bay Study Area _OOS Wind	-	-	-	-	-	-	-	-	-
PG&E Fresno Study Area_OOS Wind	-	-	-	-	-	-	-	-	-
PG&E Kern Study Area_OOS Wind	-	-	-	-	-	-	-	-	-
SCE Northern Area_OOS Wind	-	-	-	-	-	-	-	-	-
SCE Metro Study Area_OOS Wind	-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area_OOS Wind	-	-	-	-	-	-	-	-	-
East of Pisgah Study Area _OOS Wind	-	-	-	4,100.0	-	4,100.0	-	-	-
SCE Eastern Study Area_OOS Wind	285.0	-	285.0	2,936.0	-	2,936.0	-	-	-
SDG&E Study Area_OOS Wind	-	-	-	-	-	-	-	-	-
PG&E North of Greater Bay Study Area _Offshore Wind	-	-	-	-	-	-	-	-	-
PG&E Greater Bay Study Area _Offshore Wind	-	-	-	-	-	-	-	-	-
PG&E Fresno Study Area_Offshore Wind	-	-	-	-	-	-	-	-	-
PG&E Kern Study Area_Offshore Wind	-	-	-	2,924.0	-	2,924.0	-	-	-
SCE Northern Area_Offshore Wind	-	-	-	-	-	-	-	-	-
SCE Metro Study Area_Offshore Wind	-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area_Offshore Wind	-	-	-	-	-	-	-	-	-
East of Pisgah Study Area _Offshore Wind	-	-	-	-	-	-	-	-	-
SCE Eastern Study Area_Offshore Wind	-	-	-	-	-	-	-	-	-
SDG&E Study Area_Offshore Wind	-	-	-	-	-	-	-	-	-
Renewable Resource Total	**1,569.7**	**6,960.4**	**8,530.1**	**41,964.2**	**23,136.9**	**65,101.1**	**(365.6)**	**(72.3)**	**(437.9)**
PG&E North of Greater Bay Study Area _Li-ion Battery (4-hr)	362.7		362.7	362.7		362.7	-	-	-
PG&E Greater Bay Study Area _Li-ion Battery (4-hr)	628.0		628.0	628.0		628.0	-	-	-
PG&E Fresno Study Area_Li-ion Battery (4-hr)	979.6		979.6	979.6		979.6	-	-	-
PG&E Kern Study Area_Li-ion Battery (4-hr)	398.1		398.1	398.1		398.1	-	-	-
SCE Northern Area_Li-ion Battery (4-hr)	1,884.0		1,884.0	1,884.0		1,884.0	-	-	-
SCE Metro Study Area_Li-ion Battery (4-hr)	1,589.0		1,589.0	1,589.0		1,589.0	-	-	-
SCE North of Lugo Study Area_Li-ion Battery (4-hr)	338.5		338.5	358.5		358.5	(183.5)	-	(183.5)
East of Pisgah Study Area _Li-ion Battery (4-hr)	685.0		685.0	685.0		685.0	-	-	-
SCE Eastern Study Area_Li-ion Battery (4-hr)	1,341.5		1,341.5	1,341.5		1,341.5	(28.5)	-	(28.5)
SDG&E Study Area_Li-ion Battery (4-hr)	1,251.2		1,251.2	1,251.2		1,251.2	-	-	-
PG&E North of Greater Bay Study Area _Li-ion Battery (8-hr)	-		-	-		-	-	-	-
PG&E Greater Bay Study Area _Li-ion Battery (8-hr)	-		-	95.7		95.7	-	-	-
PG&E Fresno Study Area_Li-ion Battery (8-hr)	35.0		35.0	2,467.0		2,467.0	31.0	-	31.0
PG&E Kern Study Area_Li-ion Battery (8-hr)	-		-	355.0		355.0	-	-	-
SCE Northern Area_Li-ion Battery (8-hr)	523.0		523.0	1,280.0		1,280.0	757.0	-	757.0
SCE Metro Study Area_Li-ion Battery (8-hr)	10.0		10.0	6,464.5		6,464.5	(62.0)	-	(62.0)
SCE North of Lugo Study Area_Li-ion Battery (8-hr)	6.0		6.0	134.4		134.4	128.4	-	128.4
East of Pisgah Study Area _Li-ion Battery (8-hr)	-		-	606.5		606.5	(128.0)	-	(128.0)
SCE Eastern Study Area_Li-ion Battery (8-hr)	100.0		100.0	100.0		100.0	-	-	-
SDG&E Study Area_Li-ion Battery (8-hr)	50.0		50.0	357.0		357.0	(757.4)	-	(757.4)
LI-ion Battery Total	**10,181.6**		**10,181.6**	**21,337.7**		**21,337.7**	**(243.0)**	-	**(243.0)**
PG&E North of Greater Bay Study Area _LDES	-		-	-		-	-	-	-
PG&E Greater Bay Study Area _LDES	-		-	310.0		310.0	140.0	-	140.0
PG&E Fresno Study Area_LDES	-		-	140.0		140.0	140.0	-	140.0
PG&E Kern Study Area_LDES	-		-	1,122.0		1,122.0	302.0	-	302.0
SCE Northern Area_LDES	-		-	1,680.0		1,680.0	300.0	-	300.0
SCE Metro Study Area_LDES	-		-	-		-	(100.0)	-	(100.0)
SCE North of Lugo Study Area_LDES	-		-	286.0		286.0	-	-	-
East of Pisgah Study Area _LDES	-		-	960.0		960.0	(140.0)	-	(140.0)
SCE Eastern Study Area_LDES	-		-	950.0		950.0	50.0	-	50.0
SDG&E Study Area_LDES	-		-	500.0		500.0	-	-	-
Other Storage Total	**-**		**-**	**5,948.0**		**5,948.0**	**692.0**	**-**	**692.0**
Storage Total	**10,181.6**		**10,181.6**	**27,285.7**		**27,285.7**	**449.0**	**-**	**449.0**
Total Storage + Resources	11,751.3	6,960.4	18,711.7	69,249.9	23,136.9	92,386.8	**83.4**	**(72.3)**	**11.1**

Table 18: Summary of the updated mapping results for the 2041 base case portfolio and changes from initial mapping by RESOLVE resource area.

RESOLVE Resource Name	In-Development Resources			2041 - Mapped Total (In-Dev & Generic)			2041 - Change in Mapping (PD - Initial)		
	FCDS (MW)	EODS (MW)	Total (MW)	FCDS (MW)	EODS (MW)	Total (MW)	FCDS (MW)	EODS (MW)	Total (MW)
In-State Biomass	-		-	-		-	-	-	-
PG&E North of Greater Bay Study Area _Geothermal	11.2		11.2	3,186.2		3,186.2	296.2	-	296.2
PG&E Greater Bay Study Area _Geothermal	-		-	-		-	(30.0)	-	(30.0)
PG&E Fresno Study Area_Geothermal	-		-	170.0		170.0	(100.0)	-	(100.0)
PG&E Kern Study Area_Geothermal	-		-	-		-	-	-	-
SCE Northern Area_Geothermal	-		-	-		-	-	-	-
SCE Metro Study Area_Geothermal	203.0		203.0	203.0		203.0	-	-	-
SCE North of Lugo Study Area_Geothermal	-		-	-		-	(116.8)	-	(116.8)
East of Pisgah Study Area _Geothermal	45.0		45.0	914.8		914.8	46.8	-	46.8
SCE Eastern Study Area_Geothermal	30.0		30.0	100.0		100.0	63.0	-	63.0
SDG&E Study Area_Geothermal	25.0		25.0	530.0		530.0	-	-	-
Distributed Solar		116.4	116.4		116.4	116.4	-	-	-
PG&E North of Greater Bay Study Area _Solar	-	25.0	25.0	-	1,027.5	1,027.5	-	(500.0)	(500.0)
PG&E Greater Bay Study Area _Solar	-	-	-	985.0	930.0	1,915.0	265.0	450.0	715.0
PG&E Fresno Study Area_Solar	166.0	987.5	1,153.5	6,514.2	3,677.5	10,191.7	994.2	2,690.0	3,684.2
PG&E Kern Study Area_Solar	60.0	440.0	500.0	5,005.0	3,530.0	8,535.0	(15.0)	(1,140.0)	(1,155.0)
SCE Northern Area_Solar	197.0	1,363.0	1,560.0	6,103.0	1,363.0	7,466.0	717.0	-	717.0
SCE Metro Study Area_Solar	-	-	-	886.0	-	886.0	-	-	-
SCE North of Lugo Study Area_Solar	70.0	235.8	305.8	626.0	285.8	911.8	450.0	50.0	500.0
East of Pisgah Study Area _Solar	65.0	650.0	715.0	4,415.0	2,103.0	6,518.0	(650.0)	470.0	(180.0)
SCE Eastern Study Area_Solar	175.0	2,685.0	2,860.0	1,995.0	5,945.0	7,940.0	800.0	1,050.0	1,850.0
SDG&E Study Area_Solar	237.5	388.4	625.9	3,940.5	4,289.4	8,229.9	(3,039.5)	(3,130.6)	(6,170.1)
PG&E North of Greater Bay Study Area _Wind	-	-	-	952.5	800.0	1,752.5	72.5	88.3	160.8
PG&E Greater Bay Study Area _Wind	-	-	-	-	-	-	(230.0)	-	(230.0)
PG&E Fresno Study Area_Wind	-	69.3	69.3	-	69.3	69.3	-	-	-
PG&E Kern Study Area_Wind	-	-	-	-	-	-	-	-	-
SCE Northern Area_Wind	-	-	-	-	-	-	-	-	-
SCE Metro Study Area_Wind	-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area_Wind	-	-	-	-	-	-	-	-	-
East of Pisgah Study Area _Wind	-	-	-	321.0	-	321.0	-	-	-
SCE Eastern Study Area_Wind	-	-	-	263.0	60.0	323.0	(3,000.0)	-	(3,000.0)
SDG&E Study Area_Wind	-	-	-	2,290.0	-	2,290.0	-	-	-
PG&E North of Greater Bay Study Area _OOS Wind	-	-	-	-	-	-	-	-	-
PG&E Greater Bay Study Area _OOS Wind	-	-	-	4,000.0	-	4,000.0	-	-	-
PG&E Fresno Study Area_OOS Wind	-	-	-	-	-	-	-	-	-
PG&E Kern Study Area_OOS Wind	-	-	-	-	-	-	-	-	-
SCE Northern Area_OOS Wind	-	-	-	-	-	-	-	-	-
SCE Metro Study Area_OOS Wind	-	-	-	3,000.0	-	3,000.0	-	-	-
SCE North of Lugo Study Area_OOS Wind	-	-	-	-	-	-	-	-	-
East of Pisgah Study Area _OOS Wind	-	-	-	5,600.0	-	5,600.0	1,500.0	-	1,500.0
SCE Eastern Study Area_OOS Wind	285.0	-	285.0	4,436.0	-	4,436.0	1,500.0	-	1,500.0
SDG&E Study Area_OOS Wind	-	-	-	-	-	-	-	-	-
PG&E North of Greater Bay Study Area _Offshore Wind	-	-	-	1,607.0	-	1,607.0	-	-	-
PG&E Greater Bay Study Area _Offshore Wind	-	-	-	-	-	-	-	-	-
PG&E Fresno Study Area_Offshore Wind	-	-	-	-	-	-	-	-	-
PG&E Kern Study Area_Offshore Wind	-	-	-	2,924.0	-	2,924.0	-	-	-
SCE Northern Area_Offshore Wind	-	-	-	-	-	-	-	-	-
SCE Metro Study Area_Offshore Wind	-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area_Offshore Wind	-	-	-	-	-	-	-	-	-
East of Pisgah Study Area _Offshore Wind	-	-	-	-	-	-	-	-	-
SCE Eastern Study Area_Offshore Wind	-	-	-	-	-	-	-	-	-
SDG&E Study Area_Offshore Wind	-	-	-	-	-	-	-	-	-
Renewable Resource Total	**1,569.7**	**6,960.4**	**8,530.1**	**60,967.2**	**24,196.9**	**85,164.1**	**(476.6)**	**27.7**	**(448.9)**
PG&E North of Greater Bay Study Area _Li-ion Battery (4-hr)	362.7		362.7	362.7		362.7	-	-	-
PG&E Greater Bay Study Area _Li-ion Battery (4-hr)	628.0		628.0	628.0		628.0	-	-	-
PG&E Fresno Study Area_Li-ion Battery (4-hr)	979.6		979.6	979.6		979.6	-	-	-
PG&E Kern Study Area_Li-ion Battery (4-hr)	398.1		398.1	398.1		398.1	-	-	-
SCE Northern Area_Li-ion Battery (4-hr)	1,884.0		1,884.0	1,884.0		1,884.0	-	-	-
SCE Metro Study Area_Li-ion Battery (4-hr)	1,589.0		1,589.0	1,589.0		1,589.0	-	-	-
SCE North of Lugo Study Area_Li-ion Battery (4-hr)	338.5		338.5	358.5		358.5	(183.5)	-	(183.5)
East of Pisgah Study Area _Li-ion Battery (4-hr)	685.0		685.0	685.0		685.0	-	-	-
SCE Eastern Study Area_Li-ion Battery (4-hr)	1,341.5		1,341.5	1,341.5		1,341.5	(28.5)	-	(28.5)
SDG&E Study Area_Li-ion Battery (4-hr)	1,251.2		1,251.2	1,251.2		1,251.2	-	-	-
PG&E North of Greater Bay Study Area _Li-ion Battery (8-hr)	-		-	-		-	-	-	-
PG&E Greater Bay Study Area _Li-ion Battery (8-hr)	-		-	95.7		95.7	-	-	-
PG&E Fresno Study Area_Li-ion Battery (8-hr)	35.0		35.0	2,467.0		2,467.0	31.0	-	31.0
PG&E Kern Study Area_Li-ion Battery (8-hr)	-		-	355.0		355.0	-	-	-
SCE Northern Area_Li-ion Battery (8-hr)	523.0		523.0	1,280.0		1,280.0	757.0	-	757.0
SCE Metro Study Area_Li-ion Battery (8-hr)	10.0		10.0	6,464.5		6,464.5	(62.0)	-	(62.0)
SCE North of Lugo Study Area_Li-ion Battery (8-hr)	6.0		6.0	134.4		134.4	128.4	-	128.4
East of Pisgah Study Area _Li-ion Battery (8-hr)	-		-	606.5		606.5	(128.0)	-	(128.0)
SCE Eastern Study Area_Li-ion Battery (8-hr)	100.0		100.0	100.0		100.0	-	-	-
SDG&E Study Area_Li-ion Battery (8-hr)	50.0		50.0	357.0		357.0	(511.7)	-	(511.7)
LI-ion Battery Total	**10,181.6**		**10,181.6**	**21,337.7**		**21,337.7**	**2.7**	-	**2.7**
PG&E North of Greater Bay Study Area _LDES	-		-	-		-	-	-	-
PG&E Greater Bay Study Area _LDES	-		-	310.0		310.0	140.0	-	140.0
PG&E Fresno Study Area_LDES	-		-	140.0		140.0	140.0	-	140.0
PG&E Kern Study Area_LDES	-		-	1,122.0		1,122.0	302.0	-	302.0
SCE Northern Area_LDES	-		-	1,680.0		1,680.0	300.0	-	300.0
SCE Metro Study Area_LDES	-		-	-		-	(100.0)	-	(100.0)
SCE North of Lugo Study Area_LDES	-		-	286.0		286.0	-	-	-
East of Pisgah Study Area _LDES	-		-	960.0		960.0	(140.0)	-	(140.0)
SCE Eastern Study Area_LDES	-		-	950.0		950.0	50.0	-	50.0
SDG&E Study Area_LDES	-		-	500.0		500.0	-	-	-
Other Storage Total	**-**		**-**	**5,948.0**		**5,948.0**	**692.0**	**-**	**692.0**
Storage Total	**10,181.6**		**10,181.6**	**27,285.7**		**27,285.7**	**694.7**	**-**	**694.7**
Total Storage + Resources	11,751.3	6,960.4	18,711.7	88,252.9	24,196.9	112,449.8	**218.1**	**27.7**	**245.8**

Table 19: Updated mapping results of the base case portfolio summarized by CAISO study area and resource type for both 2036 (Top) and 2041 (Bottom) model years.

2036 - Mapped Total Resources (In-Dev & Generic), MW	Geothermal	Biomass	Wind	OOS Wind	Offshore Wind	Solar	Battery	LDES	Total 2036 Resources
PG&E North of Greater Bay Study Area	3,186	-	873	-	-	1,028	363	-	**5,449**
PG&E Greater Bay Study Area	-	-	-	-	-	1,685	724	310	**2,719**
PG&E Fresno Study Area	170	-	69	-	-	7,532	3,447	140	**11,358**
PG&E Kern Study Area	-	-	-	-	2,924	8,535	753	1,122	**13,334**
SCE Northern Area	-	-	-	-	-	6,540	3,164	1,680	**11,384**
SCE Metro Study Area	203	-	-	-	-	486	8,054	-	**8,743**
SCE North of Lugo Study Area	-	-	-	-	-	912	493	286	**1,691**
East of Pisgah Study Area	915	-	321	4,100	-	6,018	1,292	960	**13,605**
SCE Eastern Study Area	100	-	323	2,936	-	6,610	1,442	950	**12,361**
SDG&E Study Area	530	-	990	-	-	8,000	1,608	500	**11,628**
Distributed Solar	-	-	-	-	-	116	-	-	**116**
All Areas	**5,104**	**-**	**2,576**	**7,036**	**2,924**	**47,461**	**21,338**	**5,948**	**92,387**

2041 - Mapped Total Resources (In-Dev & Generic), MW	Geothermal	Biomass	Wind	OOS Wind	Offshore Wind	Solar	Battery	LDES	Total 2041 Resources
PG&E North of Greater Bay Study Area	3,186	-	1,753	-	1,607	1,028	363	-	**7,936**
PG&E Greater Bay Study Area	-	-	-	4,000	-	1,915	724	310	**6,949**
PG&E Fresno Study Area	170	-	69	-	-	10,192	3,447	140	**14,018**
PG&E Kern Study Area	-	-	-	-	2,924	8,535	753	1,122	**13,334**
SCE Northern Area	-	-	-	-	-	7,466	3,164	1,680	**12,310**
SCE Metro Study Area	203	-	-	3,000	-	886	8,054	-	**12,143**
SCE North of Lugo Study Area	-	-	-	-	-	912	493	286	**1,691**
East of Pisgah Study Area	915	-	321	5,600	-	6,518	1,292	960	**15,605**
SCE Eastern Study Area	100	-	323	4,436	-	7,940	1,442	950	**15,191**
SDG&E Study Area	530	-	2,290	-	-	8,230	1,608	500	**13,158**
Distributed Solar	-	-	-	-	-	116	-	-	**116**
All Areas	**5,104**	**-**	**4,756**	**17,036**	**4,531**	**53,737**	**21,338**	**5,948**	**112,450**

6.3 System Level Transmission Criteria Alignment

This section summarizes the updated mapping results' utilization of system level transmission and discusses the exceedances to the CAISO 2024 White Paper constraints identified through the transmission calculations and their potential upgrade needs. The system level transmission criteria focus on mapped resources utilizing transmission capabilities in the existing CAISO system. The analysis relies on transmission constraints and identified upgrades from the CAISO's 2024 White Paper "Transmission Capability Estimates as an input to the CPUC Integrated Resource Plan Portfolio Development" (2024 White Paper)[17]

Table 20 below shows the updated 2036 portfolio's mapping results transmission constraint exceedance criteria alignment before any potential White Paper upgrades are applied. The table summarizes by resource type whether the resources are mapped to buses that are in transmission constraints with capability exceedances due to the mapped portfolio. Table 21 shows the same analysis for the updated mapping of the 2041 portfolio. As noted in Section 4.3, the portfolio's IRP modeling baseline and transmission baseline include different sets of resources. The total MW amounts in these tables reflect the total resources impacting the transmission constraints, thus resources in the IRP modeling baseline only after 01/01/2024 are included in the calculations and

[17] "Transmission Capability Estimates as an input to the CPUC Integrated Resource Plan Portfolio Development" (2024). CAISO White Paper. https://www.caiso.com/documents/transmission-capability-estimates-white-paper2024.pdf

mapped portfolio resources that are in-development resources online before 01/01/2024 are excluded.

The resource totals in Table 20 and Table 21 are greater than the total resources mapped in the 26-27 TPP portfolio because the same resource may be behind both an un-exceeded and exceeded constraint. Additionally, default and actual constraints differ in the degree to which they have been studied by the CAISO. As identified by the 2024 White Paper, actual constraints are constraints with binding capability limits as identified in CAISO studies whereas default constraints have non-binding limits, which represent the largest amount of resources the CAISO has studied for it. Generally, the 2024 White Paper has identified transmission upgrades for actual constraints but not default constraints. Default constraints include capability amounts from approved upgrades that have not yet been subsequently studied to identify a binding capability limit of the upgrade.

Table 20: Updated mapping (2036 Portfolio) alignment with transmission constraint exceedance criteria summarized by resource type before any upgrades.

2036 Transmission Criteria Alignment	No Constraint Exceedances	Only Default Constraint	Actual Constraint Exceedances
Geothermal (MW)	1,223	-	4,212
Biomass (MW)	-	-	3
Onshore Wind (MW)	1,379	-	1,483
OOS Wind (MW)	-	-	8,621
Offshore Wind (MW)	-	-	2,924
Solar (MW)	21,185	-	29,521
Battery (MW)	20,101	-	7,891
LDES (MW)	3,926	-	2,222
Total by Status (MW)	**47,815**	**-**	**56,876**

Table 21: Updated mapping (2041 Portfolio) alignment with transmission constraint exceedance criteria summarized by resource type before any upgrades.

2041 Transmission Criteria Alignment	No Constraint Exceedances	Only Default Constraint Exceedances	Actual Constraint Exceedances
Geothermal (MW)	1,203	-	4232
Biomass (MW)	-	-	3
Onshore Wind (MW)	2,290	320	2,433
OOS Wind (MW)	3,000	-	15,621
Offshore Wind (MW)	-	-	4531
Solar (MW)	17,567	3,418	35,997
Battery (MW)	15,357	2,666	9,969
LDES (MW)	3,416	200	2532
Total by Status (MW)	**42,834**	**6,604**	**75,317**

Table 22 shows the number of constraint exceedances by CAISO study area and whether the constraints exceeded are actual values or default values per the information provided in the 2024 White Paper. The updated mapping of the base case portfolio results in 10 exceedances (on-peak, off-peak, or both) in actual constraints for the 2036 model year, per Working Group staff calculations, and 14 actual and two default exceedances in the 2041 model year.

Table 22: Number of transmission constraint exceedances by CAISO study area in the updated mapping results for the 2036 and 2041 portfolios.

Tx Constraint Exceedances	2036		2041	
	Actual	Default	Actual	Default
PG&E North of Greater Bay	1	-	3	-
PG&E Greater Bay	2	-	3	-
PG&E Fresno	5	-	6	-
PG&E Kern	-	-	-	-
SCE North	-	-	-	-
SCE Metro	-	-	-	-
SCE North of Lugo (NOL)	-	-	-	-
East of Pisgah (EOP)	1	-	1	-
SCE East	1	-	1	2
SDG&E	-	-	-	-
Total	**10**	**0**	**14**	**2**

A calculated exceedance does not determine if the identified upgrade in the 2024 White Paper will necessarily occur; calculated exceedances only highlight locations of potential need for transmission upgrades within the CAISO system due to the mapped resources. Only the full TPP analysis can accurately assess what upgrades may be needed if at all.

Additionally, the table also does not reflect additional transmission upgrade needs beyond the current CAISO transmission system including upgrades or new transmission for out-of-CAISO resources to reach the CAISO system or new transmission likely needed to interconnect resources in new areas of California such as offshore wind. The updated mapped resources' alignment with the transmission criteria and additional analysis of the calculated constraint exceedance are discussed further by CAISO study area below.

Northern California – PG&E North of Greater Bay (NGBA) and PG&E Greater Bay (GBA) Study Areas

Three exceedances with corresponding upgrades are triggered in the 2036 model year with two additional exceedances and corresponding upgrades in the 2041 model year. The NGBA zone includes 3,186 MW of generic and in-development geothermal resources that are locationally

constrained. This includes over 2 GW mapped to Malin 500 kV, tying in out of state geothermal resources. Staff attempted to remap a portion of the resources chosen to tie in at Malin 500kV to an alternative tie-in location in SCE. However, SERVM results showed that this scenario caused too high of a loss of load probability. Further, Northeast CA geothermal resources were mapped to Hilltop 345 kV and New Sub - Near existing Leavitt to their respective maximum resource potentials. While all the PGE out-of-state geothermal resources could be tied in and mapped to Malin 500 kV, stakeholder comments expressed concern with the amount of mapping at Malin 500 kV. CAISO may provide further input on preference and context for out of state geothermal resource tie-ins. The 2041 model year includes 1,607 MW of offshore wind mapped to Humboldt 500 kV in NGBA and 4 GW of out of state wind mapped to Tesla 500 kV in GBA. The additional constraints exceeded in 2041 is the Bellota-Weber 230kV line and Tesla-Bellota 230 kV line in NGBA and GBA respectively. Transmission exceedances showing in this mapping were also part of the 25-26 portfolio model years.

Table 23: Summary of the updated mapped resources alignment with available transmission criteria in the PG&E Greater Bay and North of Greater Bay study areas.

PG&E North of Greater Bay and PG&E Greater Bay Study Areas	No Constraint Exceedances		Default Constraint Exceedances		Actual Constraint Exceedances	
Criteria Alignment	2036	2041	2036	2041	2036	2041
Geothermal (MW)	-	-	-	-	3,197	3,197
Biomass (MW)	-	-	-	-	-	-
Onshore Wind (MW)	-	-	-	-	1,102	1,982
OOS Wind (MW)	-	-	-	-	-	4,000
Offshore Wind (MW)	-	-	-	-	-	1,607
Solar (MW)	566	-	-	-	2,298	3,094
Battery (MW)	444	188	-	-	729	985
LDES (MW)	310	-	-	-	-	310
Total by Status (MW)	**1,319**	**188**	**-**	**-**	**7,327**	**15,176**

For the North of Greater Bay study area, the Collinsville-Tesla 500 kV Line constraint has on-peak actual exceedance in both the 2036 and 2041 model years. There is an additional on-peak exceedance for the Bellota-Weber 230kV line only in 2041. The exceedance without an upgrade is 856 MW which grows to 2.6 GW in 2041. While the constraint is displayed in the NGBA portion of the dashboard, some substations behind the constraint are also located in PG&E GBA and PG&E Fresno. Due to this, it is difficult to pinpoint a specific driver of the constraint. Although, it is notable that NGBA mapping included a significant amount of geothermal resources that are inherently location constrained. In the Working Group, CAISO staff noted that the likelihood of this upgrade being triggered will be affected by the amount of unaccounted TPD mapped and the substation to which it is mapped (based on effectiveness factors of the substations). It also depends on changes in the system from the time these estimates were provided and the load forecast changes. Further study will be needed to confirm. This upgrade was also triggered in the 25-26 portfolio.

In 2036, the exceedance in the Bellota-Weber 230 kV line constraint is narrowly avoided through precise remapping. The exceedance in 2041 is small, 221 MW, which is lower than the exceedance

shown in the 2035 model year for the 25-26 cycle. At the time, CAISO staff gave feedback through the Working Group that this level exceedance and study amounts may or may not trigger the identified White Paper upgrade; however, as always, the full TPP analysis will be necessary to confirm if any upgrades would be needed and the scope of such upgrades.

For the GBA study area, the two constraints exceeded in 2036 were also shown in the 2035 model year in the 25-26 cycle, although only one transmission upgrade was triggered in the dashboard. The Windmaster-Delta pumps 230 kV Line exceedance is 347 MW on-peak in 2036 and goes up slightly to 382 MW in 2041. These exceedances are much lower than the respective model years in the 25-26 cycle. In Working Group discussions, CAISO staff indicated that there is low likelihood of the exceedance triggering the identified White Paper upgrade which costs an estimated $417 million and provides over 6,000 MW additional capability. Final determination will be made based on results of the 26-27 TPP Policy Assessment. The Birds Landing-Contra Costa 230kV Line shows an exceedance for both years, but these are fairly low. The White Paper identified upgrade costs $700 million and provides 1,766 MW of additional capability. In discussion at the Working Group, CAISO staff indicated that an upgrade is expected however the final determination will be made based on results of the 26-27 TPP Policy Assessment.

Southern PG&E — PG&E Fresno and PG&E Kern Study Areas

As shown in Table 24, resources mapped in 2036 to the Fresno and Kern study areas result in 5 constraint exceedances and the possibility of corresponding triggered upgrades only in Fresno and not Kern. In 2041, an additional exceedance in Fresno leads to a total of 6 corresponding triggered upgrades.

Morro Bay offshore wind is mapped to the Diablo Canyon 500 kV substation in the PG&E Kern area. Staff note that the interconnection of Morro Bay wind to Diablo Canyon may have technical and cost challenges as detailed in last year's Modeling Assumptions Report and stakeholder comments. Nonetheless, staff have chosen to maintain precedent and continue mapping Morro Bay offshore wind to Diablo Canyon until a better-informed decision can be made.

As in the 25-26 cycle model years, no exceedances are shown in PG&E Kern. Resources were remapped from buses in the PG&E Kern area to better align with other criteria and to limit the exceedance on the Cal Flat-Gates 230 kV line, which has an identified White Paper upgrade with an estimated cost of $1,008 million. These resources (940 MW) were placed in PG&E Fresno.

Table 24: Summary of updated mapped resources alignment with available transmission criteria in the PG&E Fresno and Kern study areas.

PG&E Fresno and PG&E Kern Study Areas	No Constraint Exceedances		Default Constraint Exceedances		Actual Constraint Exceedances	
Criteria Alignment	2036	2041	2036	2041	2036	2041
Geothermal (MW)	170	150	-	-	-	20
Biomass (MW)	-	-	-	-	3	3
Onshore Wind (MW)	69	-	-	-	-	69
OOS Wind (MW)	-	-	-	-	-	-
Offshore Wind (MW)	-	-	-	-	2,924	2,924
Solar (MW)	5,586	3,065	-	-	11,686	16,867
Battery (MW)	2,264	442	-	-	2,380	4,202
LDES (MW)	-	-	-	-	1,262	1,262
Total by Status (MW)	**8,089**	**3,657**	**-**	**-**	**18,255**	**25,347**

In 2036, the exceedances in the Fresno area are: Gates 500/230kV TB #12, Gates 500/230kV TB #11, Chowchilla-Le grand 115kV Line, Borden-Storey #1 230kV line, and Mustang-Henrietta 230 kV line. In Working Group discussions, CAISO staff indicated that these upgrades had a fair likelihood of being triggered, although final determination will be made based on results of the 26-27 TPP Policy Assessment. In 2041, the one additional exceedance in the Fresno area was the Tranquility-Helm 230 kV line. Most of these constraints, aside from Gates 500/230kV TB #12 and Gates 500/230kV TB #11, were also exceedances in the 25-26 cycle model years. A majority of the resources mapped at PG&E Fresno are solar resources, including over one GW mapped to Manning 500 kV. Staff mapped additional solar resources beyond RESOLVE-selected amounts to PG&E Fresno by moving them from other study areas, including 2.5 GW remapped from SDG&E Arizona.

The identified White Paper upgrades for the 5 2036 exceedances cost an estimated $1.5 billion and provides a calculated 29,800 MW of additional on-peak capacity. The identified White Paper upgrades for the 6 2041 exceedances cost an estimated $3 billion and provide a calculated 32,074 MW of additional on-peak capacity.

Greater Tehachapi & LA Metro — SCE Northern and SCE Metro Study Areas

As seen in Table 25, most resources in these two areas are mapped to substations with no constraint exceedances. The only resources in these two areas behind an exceedance constraint are solar and batteries mapped to substations in the Moorpark Local Capacity Sub-Area, and they are included in the Lugo - Victorville area constraint, which is exceeded and discussed as part of the East of Pisgah study area.

Preliminary 25-26 TPP policy results indicate the potential need for a transmission upgrade for the Midway-Whirlwind 500 kV line constraint, with a range of potential upgrade solutions that are ongoing further assessment as part of the 25-26 TPP.[18] This observation aligns with the updated RESOLVE analysis for the 26-27 TPP, which suggests that an expansion along Path 26 will be

[18] https://stakeholdercenter.caiso.com/InitiativeDocuments/Presentation-2025-2026-Transmission-planning-process-policy-and-Economic-Preliminary-Assessment-and-Study-updates-Nov-19-25.pdf, page 47.

required to reduce congestion and improve resource adequacy within PG&E. The updated mapping maintains out-of-state wind on new transmission interconnecting to the Lugo 500 kV substation; whereas the 25-26 TPP assumed 1,750 MW from New Mexico to be delivered by 2040, the 26-27 TPP assumes 3,000 MW in 2041. These resources were mapped based on the high-level transmission solutions identified in the CAISO's 20-year Transmission Outlook (2023-2024),[19] which identified a new HVDC line to Lugo with a rough cost of estimate of $3.5-4.9 billion. CPUC staff note that this solution is not driven by any specific transmission project being planned and is not a mandate to assume this specific intertie if alternative, more effective solutions are available.

Table 25: Summary of updated mapped resources alignment with available transmission criteria in the SCE Northern and Metro study areas.

SCE Northern and SCE Metro Study Areas	No Constraint Exceedances		Default Constraint Exceedances		Actual Constraint Exceedances	
Criteria Alignment	2036	2041	2036	2041	2036	2041
Geothermal (MW)	523	523	-	-	-	-
Biomass (MW)	-	-	-	-	-	-
Onshore Wind (MW)	-	-	-	-	-	-
OOS Wind (MW)	-	3,000	-	-	-	-
Offshore Wind (MW)	-	-	-	-	-	-
Solar (MW)	7,322	8,648	-	-	437	437
Battery (MW)	12,730	12,730	-	-	655	655
LDES (MW)	1,880	1,880	-	-	-	-
Total by Status (MW)	**22,455**	**26,781**	**-**	**-**	**1,092**	**1,092**

Greater Kramer & Southern Nevada — SCE North of Lugo and East of Pisgah Study Areas

Table 26 shows most of the resources mapped to these two study areas in both 2036 and 2041 are still within at least one exceeded constraint.

[19] https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/20-Year-transmission-outlook-2023-2024

Table 26: Summary of updated mapped resources alignment with available transmission criteria in the SCE North of Lugo and East of Pisgah study areas.

SCE North of Lugo and East of Pisgah Study Areas	No Constraint Exceedances		Default Constraint Exceedances		Actual Constraint Exceedances	
Criteria Alignment	2036	2041	2036	2041	2036	2041
Geothermal (MW)	-	-	-	-	915	915
Biomass (MW)	-	-	-	-	-	-
Onshore Wind (MW)	-	-	-	-	321	321
OOS Wind (MW)	-	-	-	-	4,100	5,600
Offshore Wind (MW)	-	-	-	-	-	-
Solar (MW)	1,079	1,079	-	-	6,078	6,578
Battery (MW)	658	658	-	-	1,596	1,596
LDES (MW)	286	286	-	-	960	960
Total by Status (MW)	**2,023**	**2,023**	**-**	**-**	**13,969**	**15,969**

In the 25-26 TPP, the Lugo-Victorville area constraint (East of Pisgah) was exceeded in the 2035 mapped portfolio. In the 26-27 TPP, there are significantly more resources behind this constraint, primarily including large amounts of OOS wind and solar in the portfolio, as well as driven by significant commercial interest in the area.

The 5,600 MW of out-of-state wind mapped to East of Pisgah by 2041 includes two planned projects, including 1,100 MW of Idaho wind delivered via SWIP-North and 1,500 MW via TransWest, as well as several tranches of Wyoming wind that would require new transmission to deliver to CAISO. Of the 3,000 MW of Wyoming wind mapped in 2036, 6.31,500 MW cannot utilize the full TransWest line, as the line is only 3,000 MW HVDC to its Utah intertie with the Intermountain Power Plant (IPP) transmission system. From there, TransWest has planned only 1,500 MW of capacity on an AC line to the CAISO system at Eldorado-Harry Allen. CPUC staff note that additional new transmission would likely be necessary to connect the remaining 1,500 MW of Wyoming wind to the CAISO system. One potential option is a second new transmission line from Utah to Nevada, if the full 3,000 MW of the first segment of TransWest is available. The now dated cost for that AC line segment of TransWest from Utah to Harry Allen was estimated at $660 million in the 2021-2022 TPP, utilizing 2020 cost assumptions. Costs for this project were assumed when mapping an additional 1,500 MW of Wyoming wind to Eldorado in 2036. More recently, CAISO's 20-year Transmission Outlook (2023-2024) identified a conceptual new HVDC line from Wyoming to the Eldorado or Lugo areas, with an estimated cost of $4-5.2 billion. For the 26-27 TPP, this transmission solution is assumed to bring an additional 1,500 MW of Wyoming wind to Eldorado in 2041. CPUC staff note that further study is necessary to better assess these transmission alternatives to identify optimal and cost-effective solutions.

Riverside, Arizona, San Diego, & Greater Imperial — SCE Eastern and SDG&E Study Areas

The majority of resources mapped to the SCE Eastern and the SDG&E are not mapped to

constraints with exceedances. Most of the resources behind an exceeded constraint are solar, battery, and New Mexico wind resources mapped to Arizona buses, which are within the Lugo-Victorville Area constraint discussed in the previous section.

Table 27: Summary of mapped resources alignment with available transmission criteria in the SCE Eastern and SDG&E study areas.

SCE Eastern and SDG&E Study Areas	No Constraint Exceedances		Default Constraint Exceedances		Actual Constraint Exceedances	
Criteria Alignment	2036	2041	2036	2041	2036	2041
Geothermal (MW)	530	530	-	-	100	100
Biomass (MW)	-	-	-	-	-	-
Onshore Wind (MW)	1,310	2,290	-	320	60	60
OOS Wind (MW)	-	-	-	-	4,521	6,021
Offshore Wind (MW)	-	-	-	-	-	-
Solar (MW)	6,633	4,775	-	3,418	9,021	9,021
Battery (MW)	4,005	1,339	-	2,666	2,531	2,531
LDES (MW)	1,450	1,250	-	200	-	-
Total by Status (MW)	**13,929**	**10,185**	**-**	**6,604**	**16,233**	**17,733**

In 2036, there is one exceedance in SCE Eastern in the Eagle mountain constraint. The identified White Paper upgrade is a new Devers – Julian Hinds 220 kV line, estimated at $1.2 billion, with a duration of 10 years, enabling an incremental 600 MW. Most of the resources behind this constraint are geothermal and some solar/storage mapped as importing into the CAISO at Mirage from IID. In the Working Group for the 25-26 TPP, CAISO staff noted that the studies that identified this constraint and upgrade were centered on overloads did not center on resources imported from IID and that such resources would likely not require the identified white paper upgrade. Thus, the large amount of resources mapped as being imported at Mirage from IID would likely not require the identified White Paper upgrade but a different upgrade along the IID-SCE intertie system. The identified upgrade or a similar one may still be needed to accommodate resources mapped to or imported at Blythe, however. In 2041, SCE Eastern has two additional constraints that are exceeded, the Devers-Red Bluff Constraint, and the Serrano-Alberhill-Valley Constraint. The Devers-Red Bluff exceedance is of an upgrade that was approved in the 22-23 TPP. Given the on-peak exceedance's small size and fact that it does not occur until 2041, CPUC staff estimate a low likelihood of additional upgrades being triggered for this constraint in the 26-27 TPP. The Serrano-Alberhill-Valley constraint exceedance is of an upgrade that was approved in the 22-23 TPP. Given that this exceedance does not occur until 2041, CPUC staff do not expect to trigger an additional upgrade behind this constraint to give CAISO an opportunity to study the cost-effectiveness of further upgrades on this constraint.

The 4,521 MW of New Mexico wind mapped to the Palo Verde substation in the SCE Eastern area in 2036 represents delivery via several planned and new transmission alternatives. The first tranche of wind resource will utilize the already approved subscriber PTO SunZia transmission line. The HVDC SunZia line from central New Mexico to Pinal Central in central Arizona has a capacity of

3,021 MW; however, from Pinal Central to Palo Verde, SunZia only has 2,131 MW of secured transmission rights. Thus, additional new transmission or wheeling may be needed between Palo Verde and Pinal Central to enable the additional 890 MW of New Mexico wind to be delivered to Palo Verde. There is a proposed AC transmission line that would run parallel to the SunZia line, RioSol, as another potential transmission route for additional 1,500 MW of New Mexico wind. By 2041, an additional 1,500 MW of New Mexico wind requiring new transmission is mapped to SCE Eastern. The 20-year Transmission Outlook (2023-2024) identified new HVDC lines from New Mexico to Palo Verde to Imperial Valley as a high-level alternative option with a rough cost of $4.9 – 6 billion; these costs are assumed in the 2041 mapping.

6.4 Substation Interconnection Viability Criteria Alignment

The substation interconnection viability criteria assess the alignment of the mapped portfolio with factors that are expected to impact the cost of interconnecting new generic resources. Three assessments are performed to analyze (i) the distance of mapped portfolio projects to points of interconnection, which impacts spur line costs; (ii) alignment between the voltage of each busbar and the mapped capacity totals to mitigate overloads; and (iii) specific information for individual substations that impact the engineering feasibility and cost of new resource interconnections. For the 2026-2027 TPP, Staff included specific substation information made available by PTOs in the analysis, including fault duty limits, space limitations, and position availability. The analysis and dashboard results focus on the approximate distances to interconnection based on land-use and environmental impact criteria analysis radii used, upgrade availability, estimated interconnection upgrade cost, and the interconnection bus voltage.

The updated mapping criteria alignment for solar, in-CAISO wind, and in-CAISO geothermal resources for the distance from interconnection analysis is shown in Table 28 below. The table summarizes the criteria alignment by CAISO study area for the generic utility-scale solar, wind, and geothermal resources mapped in the 2041 model year, respectively. The MW number of generic resources mapped in each area is shown by likely maximum distance from substation based on the land-use and environmental criteria analysis radii and by criteria alignment flag, which reflects that larger amounts of resources can economically be sited further from the substation.

As seen in Table 28, over 90% of the generic solar is mapped to substations where the resource potential likely to be utilized is within 10 miles of the interconnection point. Less than 10% of the mapped solar is modeled at distances up to 15 miles from the point of interconnection, and this solar is mostly associated with larger amounts of solar connecting to higher voltage substations. Analysis of existing solar development and stakeholder feedback have shown that larger projects are generally still economically viable at such distances, and thus this mapping still has a level-2 alignment flag. Only one bus has a level-3 flag for having smaller amounts of solar at the up to 15-mile radius: Midway 115 kV. This location has significant solar development and commercial interest, and staff view the alignment flags as acceptable.

For onshore wind, interconnection distances are generally longer than for solar, with some locations where the mapped wind is modeled at distances up to 20 or 30 miles from the point of interconnection. To compensate for this trend, larger wind projects are aggregated at fewer, higher-voltage busbars to maintain criteria alignment. There are three locations where level-4 flags are observed: Humboldt in PG&E NGBA, and Imperial Valley and Ocotillo Express in SDG&E. Staff

chose to continue mapping resources to these locations to maintain consistency with previous TPPs. No location with mapped generic resources has higher than level-2 criteria alignment.

For geothermal, the mapping of 436 MW of geothermal to the Beatty 230 kV substation has a level-4 flag as the known geothermal areas in Southern and Central Nevada are a significant distance from the Beatty substation. Given the large MW mapped, the limited availability of geothermal, and historical cases of long gen-ties being constructed for geothermal, staff find this alignment flag acceptable.

Table 28: Proposed Decision mapping results alignment with the distance to interconnection criteria for generic solar (top), onshore in-CAISO wind (center) and in-CAISO geothermal (bottom) in the 2041 portfolio. Table summarizes by CAISO study area the likely maximum distance from transmission and criteria alignment flags.

Interconnection Distance Criteria	Maximum Distance from Substation				Criteria Alignment Flag			
Solar Generic MWs Mapped (2041)	5 mi	10 mi	15 mi	20 mi	1	2	3	4
PG&E North of Greater Bay Study Area	-	1,003	-	-	458	545	-	-
PG&E Greater Bay Study Area	-	1,915	-	-	445	1,470	-	-
PG&E Fresno Study Area	-	9,038	-	-	5,053	3,985	-	-
PG&E Kern Study Area	-	6,630	1,405	-	4,020	3,810	205	-
SCE Northern Area	-	5,906	-	-	4,986	920	-	-
SCE Metro Study Area	-	886	-	-	886	-	-	-
SCE North of Lugo Study Area	-	606	-	-	-	606	-	-
East of Pisgah Study Area	400	4,352	1,051	-	4,752	1,051	-	-
SCE Eastern Study Area	-	3,280	1,800	-	3,280	1,800	-	-
SDG&E Study Area	750	6,854	-	-	7,204	400	-	-
Total Generic	**1,150**	**40,470**	**4,256**	**-**	**31,084**	**14,587**	**205**	**-**

Interconnection Distance Criteria	Maximum Distance from Substation				Criteria Alignment Flag			
In-CAISO Wind Generic MWs Mapped (2041)	10 mi	15 mi	20 mi	30 mi	1	2	3	4
PG&E North of Greater Bay Study Area	-	-	290	1,463	-	220	1,433	100
PG&E Greater Bay Study Area	-	-	-	-	-	-	-	-
PG&E Fresno Study Area	-	-	-	-	-	-	-	-
PG&E Kern Study Area	-	-	-	-	-	-	-	-
SCE Northern Area	-	-	-	-	-	-	-	-
SCE Metro Study Area	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area	-	-	-	-	-	-	-	-
East of Pisgah Study Area	-	-	321	-	-	-	321	-
SCE Eastern Study Area	60	-	-	263	60	-	263	-
SDG&E Study Area	180	-	1,650	460	180	1,650	280	180
Total Generic	**240**	**-**	**2,261**	**2,186**	**240**	**1,870**	**2,297**	**280**

Interconnection Distance Criteria	Maximum Distance from Substation				Criteria Alignment Flag			
Geothermal Generic MWs Mapped (2041)	10 mi	15 mi	20 mi	>30 mi	1	2	3	4
PG&E North of Greater Bay Study Area	-	108	-	-	-	108	-	-
PG&E Greater Bay Study Area	-	-	-	-	-	-	-	-
PG&E Fresno Study Area	-	-	-	-	-	-	-	-
PG&E Kern Study Area	-	-	-	-	-	-	-	-
SCE Northern Area	-	-	-	-	-	-	-	-
SCE Metro Study Area	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area	-	-	-	-	-	-	-	-
East of Pisgah Study Area	-	-	-	436	-	-	-	436
SCE Eastern Study Area	70	-	-	-	70	-	-	-
SDG&E Study Area	505	-	-	-	505	-	-	-
Total Generic	**575**	**108**	**-**	**436**	**575**	**108**	**-**	**436**

Table 29 shows updated mapping results' alignment with the interconnection to buses of appropriate voltage criteria for solar and battery storage (top) and onshore in-CAISO wind (bottom). This analysis is designed to provide general high-level guidance on the potential difficulty and cost of interconnecting to buses. It is not designed to be the firm assessment of where resources are mapped, as each substation will have its own specific technical capabilities and limitations even across the same voltages. The criteria are generally seeking to limit mapping small MW amounts to high voltage buses with their higher costs per interconnection and significant MW amounts to lower voltage buses, which are unlikely to be able to accommodate such resource amounts without significant upgrades. This is particularly the case for solar and battery storage as those resources are the most location-fungible.

For utility-scale solar and battery storage, most of the mapping results align well with the voltage criteria. Three buses have a level-5 non-alignment for solar and battery driven by mapped generic resources: Encina 230 kV (SDG&E), Kearney 230 kV (PG&E Fresno), and Pisgah 230 kV (SCE NOL). In all three cases, the amount of solar and storage mapped to the bus (20 MW at each) is significantly lower than the criteria's guided minimum amounts for a 230 kV busbar. Another five busbars have a level-5 non-alignment, but those results are driven by in-development resources, which are not reflected in Table 29. Two additional substations, Imperial Valley 500 kV (SDG&E) and Humboldt 60 kV (PG&E NGBA), have level-5 alignment flags for onshore wind. Given the limited geographic locations for wind and the transmission system alignment in the PG&E NGBA and SDG&E Study Areas, staff view the potential need for larger interconnections upgrades as warranted.

The level-4 non-alignment flags are split into four categories. At seven 115-kV busbars in PG&E, including Eastshore (PG&E GBA), Schindler (PG&E Fresno), and Kern PP, Live Oak, Magunden, Midway, and Poso Mountain (PG&E Kern), the amount of generic solar and storage mapped to each bus slightly exceeds the recommended threshold for level-3 alignment (200 MW); similarly, two 115-kV busbars in PG&E NGBA (Bridgeville, Summit) and one in SDG&E (Boulevard East) slightly exceeded the threshold for mapped onshore wind. Staff deemed these exceedances tolerable. Next, two sub-100-kV buses in PG&E Fresno (Crescent 70 kV, Lemoore 70 kV) and one in SDG&E (Pendleton 69 kV) also saw the amount of solar and storage mapped to each bus exceed the 50-MW threshold for level-3 alignment; at Cresent, the exceedance is due to an in-development project. Two 500-kV busbars, Mohave (EOP) and Ocotillo Express (SDG&E) were found to have level-4 non-alignment due to the mapped generic wind being undersized relative to the substation voltage. Given the limited geographic locations for wind and the transmission system alignment in the EOP and SDG&E Study Areas, Staff view the potential need for larger interconnections upgrades as warranted. Finally, at five busbars, level-4 non-alignment is attributable to in-development solar and storage resources at these locations.

Table 29: Proposed Decision mapping results alignment with the interconnection to appropriate voltage criteria for solar and storage (top) and onshore wind (bottom).

Interconnection Voltage Criteria	Interconnection Bus Voltage				Criteria Alignment Flag				
Solar & Battery Generic MWs Mapped (2041)	<100 kV	100-200 kV	230 kV /345 kV	500 kV	1	2	3	4	5
PG&E North of Greater Bay Study Area	-	-	320	683	778	225	-	-	-
PG&E Greater Bay Study Area	-	451	1,260	300	1,120	670	-	221	-
PG&E Fresno Study Area	70	787	7,758	2,855	6,037	4,923	210	280	20
PG&E Kern Study Area	-	1,865	4,730	1,795	3,850	2,770	665	1,105	-
SCE Northern Area	-	-	5,305	1,358	2,234	588	3,841	-	-
SCE Metro Study Area	-	-	5,740	1,601	6,338	1,003	-	-	-
SCE North of Lugo Study Area	-	-	754	-	628	106	-	-	20
East of Pisgah Study Area	-	-	4,058	2,352	5,209	150	1,051	-	-
SCE Eastern Study Area	-	-	3,910	1,170	1,220	3,860	-	-	-
SDG&E Study Area	-	120	830	6,961	1,780	3,693	2,388	30	20
Total Generic	**70**	**3,223**	**34,665**	**19,074**	**29,193**	**17,988**	**8,155**	**1,636**	**60**

Interconnection Voltage Criteria	Interconnection Bus Voltage				Criteria Alignment Flag				
In-CAISO Wind Generic MWs Mapped (2041)	<100 kV	100-200 kV	230 kV /345 kV	500 kV	1	2	3	4	5
PG&E North of Greater Bay Study Area	100	435	1,218	-	1,148	70	-	435	100
PG&E Greater Bay Study Area	-	-	-	-	-	-	-	-	-
PG&E Fresno Study Area	-	-	-	-	-	-	-	-	-
PG&E Kern Study Area	-	-	-	-	-	-	-	-	-
SCE Northern Area	-	-	-	-	-	-	-	-	-
SCE Metro Study Area	-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area	-	-	-	-	-	-	-	-	-
East of Pisgah Study Area	-	-	171	150	-	171	-	150	-
SCE Eastern Study Area	-	-	323	-	-	323	-	-	-
SDG&E Study Area	-	180	350	1,760	1,650	280	-	310	50
Total Generic	**100**	**615**	**2,062**	**1,910**	**2,798**	**844**	**-**	**895**	**150**

New to the 2026-2027 TPP, Staff performed an additional upgrade cost analysis for the Interconnection Viability Criteria Alignment that incorporates information received from PTOs on the interconnection availability and anticipated upgrade or expansion need at select busbars. Information collected from the PTOs were used to estimate the cost of upgrades that might be required to interconnect additional resources at those locations, with cost estimates determining criteria alignment. The PTO per-unit cost guides were used to develop cost estimates. With this analysis, it is important to note that the Working Group is not estimating interconnection costs for individual projects and the analysis does not replace the CAISO generator interconnection process.

Level-5 criteria non-alignment for the upgrade cost analysis were observed at ten busbars, predominantly major 230- or 500-kV buses where PTO feedback indicated that the substation has either reached its short-circuit duty limit, or that a new substation would be required to accept any additional project interconnections. Busbars with significant generic resource mappings include Tesla 500 kV (PG&E GBA), Gates 500 kV (PG&E Fresno), Midway 500 kV (PG&E Kern), Whirlwind 230 kV and 500 kV (SCE Northern), Devers 230 kV and Etiwanda 230 kV (SCE Eastern), Eldorado 500 kV and Mohave 500 kV (EOP), and Imperial Valley 500 kV (SDG&E). Level-4 criteria non-alignments were identified at Eastshore 115 kV (PG&E GBA), Midway 115 kV and 230 kV (PG&E Kern), Antelope 230 kV and Vincent 230 kV (SCE Northern), Victor 230 kV

(SCE NOL), Colorado River 230 kV (SCE Eastern), Eldorado 230 kV (EOP), and Imperial Valley 230 kV (SDG&E).

In most cases, Staff addressed these findings by mapping large volumes of generic solar and storage resources to these locations to lower any potential costs on a per-MW basis. Also, many of these busbars exist along major transmission corridors where transmission projects approved by CAISO, transmission exceedances resulting from mapped generic resources and discussed in the Transmission Criteria Alignment, or delivery of LLT resources including out-of-state and offshore wind, will likely result in facility upgrades at these locations separately from new generator interconnection requests.

Table 30. Proposed Decision mapping results alignment with the interconnection upgrade criteria for solar (top (middle), and geothermal (bottom).

Interconnection Upgrade Criteria	Upgrade						Criteria Alignment Flag				
Solar Generic MWs Mapped (2041)	Info not Available	Low	Mid	High	Short Circuit Duty	New Substation	1	2	3	4	5
PG&E North of Greater Bay Study Area	683	-	-	-	-	320	-	-	320	-	-
PG&E Greater Bay Study Area	1,485	-	-	-	430	-	-	-	-	130	300
PG&E Fresno Study Area	3,618	2,345	-	1,595	-	1,480	-	2,345	2,845	-	230
PG&E Kern Study Area	4,170	90	-	2,125	1,555	95	90	-	2,220	355	1,200
SCE Northern Area	920	-	-	-	1,441	3,545	-	-	-	2,513	2,473
SCE Metro Study Area	886	-	-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area	300	-	106	200	-	-	-	-	106	200	-
East of Pisgah Study Area	3,451	-	1,752	-	600	-	-	-	-	-	2,352
SCE Eastern Study Area	1,170	500	-	-	2,110	1,300	500	-	-	1,300	2,110
SDG&E Study Area	6,624	30	-	-	-	950	30	-	-	750	200
Total Generic	**23,307**	**2,965**	**1,858**	**3,920**	**6,136**	**7,690**	**620**	**2,345**	**5,491**	**5,248**	**8,865**

Interconnection Upgrade Criteria	Upgrade						Criteria Alignment Flag				
In-CAISO Wind Generic MWs Mapped (2041)	Info not Available	Low	Mid	High	Short Circuit Duty	New Substation	1	2	3	4	5
PG&E North of Greater Bay Study Area	1,753	-	-	-	-	-	-	-	-	-	-
PG&E Greater Bay Study Area	-	-	-	-	-	-	-	-	-	-	-
PG&E Fresno Study Area	-	-	-	-	-	-	-	-	-	-	-
PG&E Kern Study Area	-	-	-	-	-	-	-	-	-	-	-
SCE Northern Area	-	-	-	-	-	-	-	-	-	-	-
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area	-	-	-	-	-	-	-	-	-	-	-
East of Pisgah Study Area	171	-	150	-	-	-	-	-	-	-	150
SCE Eastern Study Area	60	-	-	-	263	-	-	-	-	-	263
SDG&E Study Area	2,060	180	-	-	-	50	180	-	-	-	50
Total Generic	**4,044**	**180**	**150**	**-**	**263**	**50**	**180**	**-**	**-**	**-**	**463**

Interconnection Upgrade Criteria	Upgrade						Criteria Alignment Flag				
Geothermal Generic MWs Mapped (2041)	Info not Available	Low	Mid	High	Short Circuit Duty	New Substation	1	2	3	4	5
PG&E North of Greater Bay Study Area	3,155	-	-	-	-	20	-	-	20	-	-
PG&E Greater Bay Study Area	-	-	-	-	-	-	-	-	-	-	-
PG&E Fresno Study Area	160	-	-	10	-	-	-	-	10	-	-
PG&E Kern Study Area	-	-	-	-	-	-	-	-	-	-	-
SCE Northern Area	-	-	-	-	-	-	-	-	-	-	-
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area	-	-	-	-	-	-	-	-	-	-	-
East of Pisgah Study Area	436	-	-	186	248	-	-	-	-	186	248
SCE Eastern Study Area	70	-	-	-	-	-	-	-	-	-	-
SDG&E Study Area	-	-	-	-	-	505	-	-	-	505	-
Total Generic	**3,821**	**-**	**-**	**196**	**248**	**525**	**-**	**-**	**30**	**691**	**248**

6.5 Land-use Feasibility and Environmental Implications Criteria Alignment

This section summarizes the mapping's alignment with the land-use implications and environmental (conservation and biological) impacts criteria categories. The mapping of utility-scale solar, onshore wind, geothermal, and pumped storage hydro (PSH) for the 2041 portfolio alignment with criteria is discussed below. As 2041 portfolio results do not reduce resources mapped to locations compared with the 2036 mapping, the 2041 mapping criteria alignment reflects the largest potential implications of the portfolio. Full criteria alignment of the 2036 and 2041 mapping results for the initial base case portfolio can be found in the Initial Mapping Dashboard (Appendix B).

With this analysis, it is important to note that the Working Group is not siting individual projects, and the analysis does not replace environmental review processes and permitting. This analysis assesses the general potential implications, competing priorities, and impacts of the resource type and amount mapped being developed on land in the analyzed area. In addition to potential direct impacts, these implications also can affect how difficult and costly to ratepayers the development of the resources in the area could be, in a qualitative manner. This approach holds true even for the PSH analysis discussed below. Although the analysis focuses on and uses data from specific projects, it is not a review or endorsement of the specific project but an assessment of the implications of PSH in the area using some of the project specific details to estimate general potential trends.

Utility-Scale Solar

The general alignment with the land-use implications and feasibility of the updating solar mapping results are shown in Table 31. similarly shows the updated mapping alignment for the environmental impacts criteria. In both tables, out-of-state solar mapping to Southern Nevada and Arizona substations does not have analysis for the land-use and environmental impacts criteria beyond the Core Land-use screen category. There is a Level 5 core screen exceedance for 400 MW solar at the Innovation substation (East of Pisgah), and Level 4 core screen exceedances for 1,752 MW at Mohave (East of Pisgah), and 630 MW at North Gila (SDG&E), among others.

In remapping the significant amount of solar from Arizona to avoid possibly large, unknown upgrades, staff prioritized substations with available transmission capability and low-implication land. The remaining solar at Kramer with higher criteria flags is in-development and was not remapped. Overall, the remapping improved the alignment in the study areas that had level-3 or higher non-alignment flags in both the ACE Connectivity and the All ACE criteria compared to the initial mapping. Staff prioritized mapping to buses in overdrafted groundwater basins in the Central Valley.

Core Land Use Screen:

In the SCE Eastern study area, the 1,630 MW of solar mapped to the Etiwanda substation has a level-5 alignment flag for the Core Land-use screen, as does the 1,150 MW of solar mapped to the New North Gila substation in the SDG&E study area, and the 857 MW of solar mapped to the Imperial Valley substation also in SDG&E. There are level-5 alignment flags for solar resources (less than 500 MW) mapped to Arcogen and Del Amo (SCE Metro), Eastshore (PG&E GBA), and Innovation (East of Pisgah). These flags indicate the mapped resources would require a significant portion of the lower implication resource potential available around the substation.

Parcelization

The key areas where mapped resources have high flags for the parcelization criteria are the SCE Northern and SCE Eastern study areas. Both areas have multiple substations with level-5 non-alignment. However, stakeholders have asserted that both areas, particularly the Tehachapi area, are unique locations regarding parcelization that industry has overcome. CPUC staff view the recent large-scale development of solar in the area as confirmation that high-parcelization may not be a significant barrier to development particularly if there is higher-confidence commercial interest at the substations. (This is true for Vincent and Whirlwind in SCE Eastern, which have 1,800 and 2,705 MW of solar mapped respectively, but there is no solar in the queue at Etiwanda in SCE North which has 1,630 MW of solar mapped).

Cropland Index

Only three substations, Colorado River (SCE Eastern) Vincent (SCE Northern), and New North Gila (SDG&E), have over 1,000 MW of solar resources mapped with level-5 alignment flags for the Cropland Index criteria, indicating that the amount of solar mapped will likely impact a large portion of the cropland in the area inclusive of the high value cropland. Additional analysis by CEC staff noted that the main driver of the high-value status for the land in the area is attributes from the soil quality datasets within the CEC's Cropland Index model. There is a level-5 alignment flag for solar mapped to the Imperial Valley substation in the SDG&E area. Several substations in the PG&E Fresno area have level-3 alignment flags indicating the solar amounts mapped likely would need a large portion of the low-value cropland or the area around the substation had high levels of high-value cropland. Given that the solar mapped to this area also corresponds to a large portion of solar mapped to overdrafted groundwater basins, Working Group staff are less concerned about the amount of solar mapped to these areas.

Fire Threat

One substation in the SCE Eastern study area, Etiwanda, has more than 500 MW of solar mapped with a level-5 alignment flag for the Fire Threat Criteria. The high flag arises from the substation's location relatively near forested mountains and thus a large portion of the areas near the substations have a very high fire risk; however, the solar resource potential land near the substation is mostly in low fire threat regions.

Other Environmental Criteria

This section discusses the various environmental implications criteria. Arcogen, Del Amo, Eastshore, Etiwanda, and Kramer have level-5 flags for the All-ACE Criteria, the dataset that combines high implication acres from all three ACE datasets used in mapping.

The Etiwanda substation (SCE Eastern) has the most solar with the highest non-alignment flags. It has 1,630 MW solar mapped, with level-5 flags for all environmental criteria (biodiversity, irreplaceability, intactness, wetlands). Del Amo (SCE Metro) has over 400 MW of solar mapped with level-5 flags for all environmental criteria. Arcogen (SCE Metro) and Eastshore (PGE GBA) both have over 400 MW of solar mapped with level-5 flags in ACE-All Criteria. Arcogen has level 5 for irreplaceability while Eastshore is 4 for irreplaceability, indicating potential impacts if additional solar is mapped to the substations.

The remaining high non-alignment flags, predominantly in the SCE Northern and SCE Eastern study areas, are acceptable to the Working Group given the discussion on those flags above.

Table 31: Summary of updated solar mapping results alignment with the land-use implications and feasibility criteria for the 2041 portfolio. Criteria alignment is summarized by category and CAISO study area.

2041 Portfolio Mapping	Core Land-use Screen Criteria Alignment				Parcelization Criteria Alignment - Highest Flag				Cropland Index Criteria Alignment - Highest Flag				Overdrafted Groundwater Basin		Fire Threat Criteria Alignment - Highest Flag			
Solar	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**In**	**Out**	**1 or 2**	**3**	**4**	**5**
PG&E North of Greater Bay Study Area	1,028	-	-	-	1,028	-	-	-	1,028	-	-	-	-	1,028	803	-	-	225
PG&E Greater Bay Study Area	350	180	810	575	1,160	180	-	575	1,615	300	-	-	100	1,815	490	1,425	-	-
PG&E Fresno Study Area	6,443	1,260	2,345	-	9,465	583	-	-	7,183	2,865	-	-	9,708	340	6,220	3,263	-	565
PG&E Kern Study Area	6,895	1,165	570	-	7,750	880	-	-	6,535	1,675	-	420	8,015	615	7,960	250	-	420
SCE Northern Area	5,312	437	1,800	-	1,503	1,541	-	4,505	5,417	332	-	1,800	644	6,905	5,149	2,400	-	-
SCE Metro Study Area	-	-	-	886	-	-	-	886	886	-	-	-	-	886	886	-	-	-
SCE North of Lugo Study Area	638	-	274	-	300	412	-	200	912	-	-	-	32	880	612	300	-	-
East of Pisgah Study Area	2,900	1,701	1,752	400	-	-	-	-	-	-	-	-	-	6,753	-	-	-	-
SCE Eastern Study Area	3,355	480	2,475	1,630	2,635	-	-	2,110	640	675	1,630	1,800	-	7,940	3,115	-	-	1,630
SDG&E Study Area	2,508	2,885	830	2,007	1,347	200	-	877	197	220	-	2,007	-	8,230	2,287	-	-	137
Total:	**29,429**	**8,108**	**10,856**	**5,498**	**25,188**	**3,796**	**-**	**9,153**	**24,413**	**6,067**	**1,630**	**6,027**	**18,499**	**35,391**	**27,522**	**7,638**	**-**	**2,977**

Table 32: Summary of updated solar mapping results alignment with the environmental impacts criteria for the 2041 portfolio. Criteria alignment is summarized by category and CAISO study area.

2041 Portfolio Mapping	ACE Connectivity Criteria Alignment - Highest Flag				ACE Biodiversity Criteria Alignment - Highest Flag				ACE Irreplaceability Criteria Alignment - Highest Flag				All ACE Criteria Alignment - Highest Flag				Intactness and Wetlands Criteria Alignment - Highest Flag			
Solar	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**
PG&E North of Greater Bay Study Area	790	238	-	-	1,028	-	-	-	1,028	-	-	-	790	13	225	-	1,028	-	-	-
PG&E Greater Bay Study Area	940	975	-	-	1,915	-	-	-	1,150	190	575	-	610	690	40	575	1,340	575	-	-
PG&E Fresno Study Area	9,493	555	-	-	10,048	-	-	-	10,048	-	-	-	9,493	555	-	-	9,483	565	-	-
PG&E Kern Study Area	8,380	250	-	-	8,630	-	-	-	8,630	-	-	-	6,880	1,750	-	-	8,630	-	-	-
SCE Northern Area	7,549	-	-	-	5,749	1,800	-	-	7,549	-	-	-	5,749	1,800	-	-	5,749	1,800	-	-
SCE Metro Study Area	-	-	486	400	-	-	486	400	-	-	-	886	-	-	-	886	-	-	486	400
SCE North of Lugo Study Area	638	-	274	-	612	300	-	-	912	-	-	-	338	300	-	274	912	-	-	-
East of Pisgah Study Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCE Eastern Study Area	3,115	-	-	1,630	3,115	-	-	1,630	3,115	-	-	1,630	3,115	-	-	1,630	3,115	-	-	1,630
SDG&E Study Area	1,567	857	-	-	1,567	-	857	-	1,507	60	857	-	1,397	170	857	-	1,567	857	-	-
Total:	**32,472**	**2,875**	**760**	**2,030**	**32,664**	**2,100**	**1,343**	**2,030**	**33,939**	**250**	**1,432**	**2,516**	**28,372**	**5,278**	**1,122**	**3,365**	**31,824**	**3,797**	**486**	**2,030**

Onshore Wind

Table 32 shows the mapping alignment for the wind resources with the land-use and environmental impacts criteria. The mapped wind resources (in MW) are summarized by CAISO study area and alignment flag for the various criteria. The structure is the same as for the solar analysis summary, except that the parcelization and Cropland Index criteria are not applied to onshore wind. The analysis covers mapped wind resources in California or connecting to the existing CAISO transmission system. This includes Southern Nevada wind, for which the WECC dataset is used for the Core Land-use Screen, but excludes Wyoming, Idaho, and New Mexico wind. Although interconnecting directly to the CAISO system, Baja California wind is not analyzed as the Working Group was not able to incorporate comparable data for resource potential areas in Mexico.

Suitable locations for utility-scale wind are more scarce than for solar, which limits Staff's ability to shift to alternative locations. For the 2026-2027 TPP, the wind resource potential maps were updated to incorporate Global Wind Atlas data, which enabled higher-resolution analysis in accordance with wind industry stakeholder recommendations. Level-5 flags for the Core Land Use Screen were observed at Cabrillo (PG&E Kern) and Los Banos (PG&E Fresno), both of which correspond to baseline or in-development projects that could not be remapped. At other locations, level-5 flags were avoided by increasing the distance radius to 20-30 miles to encompass more of the suitable low-implication land area. Additional level-5 flags for the Fire Threat criteria were observed in PG&E NGBA (Bridgeville), SDG&E (New Suncrest-Ocotillo Substation), and Northeastern California (New Madeline, New Leavitt).

Working Group staff sought consistency with the 25-26 TPP mapping where possible. Staff did not map wind resources to the Caliente and Round Mountain substations, two substations which were mapped to in the 24-25 TPP, as both had higher land-use and environmental implications but no commercial interest.

Table 33: Summary of onshore in-CAISO wind mapping results alignment with the land-use implications and environmental impacts criteria for the 2041 portfolio. Criteria alignment is summarized by category and CAISO study area.

2041 Portfolio Mapping	Core Land-use Screen Criteria Alignment				Fire Threat Criteria Alignment - Highest Flag				ACE Connectivity Criteria Alignment - Highest Flag				ACE Biodiversity Criteria Alignment - Highest Flag			
Onshore Wind	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**
PG&E North of Greater Bay Study Area	70	100	1,583	-	535	70	-	1,148	1,753	-	-	-	1,753	-	-	-
PG&E Greater Bay Study Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PG&E Fresno Study Area	-	-	-	69	-	-	-	69	-	-	-	69	69	-	-	-
PG&E Kern Study Area	-	-	-	95	-	-	-	95	-	95	-	-	95	-	-	-
SCE Northern Area	83	-	-	-	83	-	-	-	83	-	-	-	83	-	-	-
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
East of Pisgah Study Area	-	171	150	-	-	-	-	-	-	-	-	-	-	-	-	-
SCE Eastern Study Area	323	-	-	-	60	263	-	-	323	-	-	-	323	-	-	-
SDG&E Study Area	180	180	280	-	50	-	130	460	640	-	-	-	640	-	-	-
Total:	**656**	**451**	**2,013**	**165**	**727**	**333**	**130**	**1,773**	**2,798**	**95**	**-**	**69**	**2,963**	**-**	**-**	**-**

2041 Portfolio Mapping	ACE Irreplaceability Criteria Alignment - Highest Flag				All ACE Criteria Alignment - Highest Flag				Intactness Criteria Alignment - Highest Flag				Wetlands Criteria Alignment - Highest Flag			
Onshore Wind	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**
PG&E North of Greater Bay Study Area	1,753	-	-	-	1,753	-	-	-	290	1,015	448	-	1,753	-	-	-
PG&E Greater Bay Study Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PG&E Fresno Study Area	69	-	-	-	-	-	-	69	-	-	-	69	69	-	-	-
PG&E Kern Study Area	95	-	-	-	-	-	95	-	95	-	-	-	95	-	-	-
SCE Northern Area	83	-	-	-	-	83	-	-	83	-	-	-	83	-	-	-
SCE Metro Study Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCE North of Lugo Study Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
East of Pisgah Study Area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCE Eastern Study Area	323	-	-	-	323	-	-	-	323	-	-	-	323	-	-	-
SDG&E Study Area	640	-	-	-	640	-	-	-	590	50	-	-	640	-	-	-
Total:	**2,963**	**-**	**-**	**-**	**2,716**	**83**	**95**	**69**	**1,381**	**1,065**	**448**	**69**	**2,963**	**-**	**-**	**-**

Geothermal

Table 33 depicts a summary of the 2041 portfolio's mapped geothermal resources alignment with the Core land-use screen, which for geothermal utilizes the Protected Area layer, and the land-use implications and environmental impacts criteria that have flags higher than level-1 alignment. Again, the analysis is for geothermal resources mapped to known geothermal areas in California only. Geothermal imports from Oregon and Nevada totaling 1,585 MW at the Malin substation in the PG&E North of Greater Bay Area are excluded from the analysis.

There are 378 MW at the Geysers with a level-5 flag for the Fire Threat criteria; the Geysers geothermal resource field is location-constrained and thus cannot be moved. An additional 20 MW at Carson River (Palermo substation, PG&E NGBA) has a level-5 flag for the ACE Connectivity Criteria Alignment.

Table 34: Summary of updated in-state geothermal mapping results alignment with the land-use implications and environmental impacts criteria for the 2041 portfolio. Criteria alignment summarized by category and Known Geothermal Resource Area.

2041 Portfolio Mapping	Core Land-use Screen Criteria Alignment				Fire Threat Criteria Alignment - Highest Flag				ACE Connectivity Criteria Alignment - Highest Flag			
Geothermal	1 or 2	3	4	5	1 or 2	3	4	5	1 or 2	3	4	5
Geysers	378	-	-	-	-	-	-	378	378	-	-	-
Mono - Long Valley	-	-	-	-	-	-	-	-	-	-	-	-
Salton Sea	100	-	-	-	100	-	-	-	100	-	-	-
East Brawley	530	-	-	-	530	-	-	-	530	-	-	-
Truckhaven	44	-	-	-	44	-	-	-	44	-	-	-
Lake City - Surprise Valley 1	159	-	-	-	159	-	-	-	159	-	-	-
Boyes HS	20	-	-	-	20	-	-	-	20	-	-	-
Glass Mountain	548	-	-	-	548	-	-	-	-	548	-	-
Wendel - Amedee	19	-	-	-	-	19	-	-	19	-	-	-
Carson River	20	-	-	-	-	-	-	20	-	-	-	20
Calistoga	50	-	-	-	50	-	-	-	50	-	-	-
Sierra Valley	-	9	-	-	9	-	-	-	-	9	-	-
Total (MW):	**1,869**	**9**	**-**	**-**	**1,460**	**19**	**-**	**398**	**1,300**	**557**	**-**	**20**

Pumped Storage Hydro

Table 34 below shows the environmental impacts criteria for potential PSH locations with the addition of the protected area layer analysis. For both the 500 MW mapped to Sycamore Canyon 230 kV with its analysis using the San Vicente potential location and the 310 MW mapped to Bellota 230 KV and its analysis using the Mokelumne potential location or the Salt Springs potential location, the Protected Area layer analysis results in a level-1 alignment flag. The other locations, LEAPS, Twitchell and Whale Rock Pumped Storage, also have level-1 alignment flags for the Protected Area layer analysis.

Table 35: Updated summary of environmental implications analysis for potential pumped storage hydro locations considered in busbar mapping.

		Land-use & Env. Impacts Criteria Alignment							Staff Assessment of Criteria based on FERC filings					
2041 LDES Res. Mapped	Potential Pumped Storage Site (FERC Application Name)	Protected Area Layer	Terrestrial Biodiversity	Terrestrial Connectivity	Terrestrial Irreplaceability	Intactness	Aquatic Rare Species Richness	Aquatic Irreplaceability	Probable Lower Reservoir		Probable Upper Reservoir		Probable Water Source	
-	Eagle_Mountain	2	1	1	1	3	1	1	Brownfield	2	Brownfield	2	Ground water	3
-	Swan Lake North Pumped Storage								New off-stream	3	New off-stream	3	Ground water	3
200	LEAPS	1	1	1	2	1	1	1	Existing off-stream	1	New off-stream	3	Existing off-stream	1
500	San_Vicente	1	3	3	2	1	3	2	Existing off-stream	1	New off-stream	3	Existing off-stream	1
310	Mokulumne Pumped Storage	1	1	1	1	1	1	2	Existing on-stream	2	Existing on-stream	2	Existing on-stream	2
-	Bison_Peak	1	1	3	1	3	1	1	New off-stream	3	New off-stream	3	Ground water	3
-	Tehachapi Pumped Storage	1	3	3	3	2	1	1	New off-stream	3	New off-stream	3	Ground water	3
-	Nacimiento Pumped Storage	1	1	2	1	2	1	1	Existing on-stream	2	New off-stream	3	Existing on-stream	2
150	Twitchell Pumped Storage	1	1	1	1	2	2	1	Existing on-stream	2	New off-stream	3	Existing on-stream	2
362	Whale Rock Pumped Storage	1	1	3	1	2	4	1	Existing off-stream	1	New off-stream	3	Existing off-stream	1
-	Vandenberg Pumped Storage	1	1	2	1	2	1	1	Ocean	4	New off-stream	3	Ocean	5
-	Haiwee Pumped Storage	5	2	1	1	3	1	1	Existing on-stream	2	New off-stream	3	Existing on-stream	2
-	MQR Pumped Storage	1	3	3	3	1	5	5	New off-stream	3	New off-stream	3	Existing off-stream	1
-	Salt Springs Pumped Storage	1	1	1	1	2	1	1	Existing on-stream	2	New off-stream	3	Existing on-stream	2
-	Isabella Pumped Storage	1	2	1	2	1	1	1	Existing on-stream	2	New off-stream	3	Existing on-stream	2
-	Maxwell Pumped Storage	1	1	2	1	2	1	1	Brownfield	2	New off-stream	3	Existing off-stream	1

6.6 Community Environmental Impacts Criteria Alignment

The alignment of the updated mapped resources with the community and societal environmental impacts criteria is shown for the 2036 and 2041 model years in Table 35 and Table 36. In the 2036 mapping, approximately 29% of generation MWs and 46% of storage MWs are mapped to substations in a disadvantaged community. In the 2041 mapping, the generation percentage falls slightly to 26% while the storage percentage remains the same. Additionally, 45% of storage is mapped to substations within five miles of a fossil fuel plant. In both model years, more than half of mapped generation and three quarters of mapped storage is in an Inflation Reduction Act (IRA) Energy Community area. The updated mapping also places 61% of generation and 86% of storage in an air quality non-attainment area by 2041.

Table 36 shows the change between the initial and updated mapping for the 2041 portfolio in the amount of generation and storage aligning with the criteria. Remapping was predominately directed by the need to align with a variety of busbar mapping criteria, primarily environmental criteria, aligning resource potentials, and commercial interest.

Table 36: Summary of updated mapping results (2036 portfolio) alignment with the community environmental impacts criteria. The table summarizes the mapped generation and storage amounts meeting prioritized criteria goals by CAISO study area.

2036 Portfolio Mapping	In Non-Attainment Zone (O3 or PM2.5)		Substation Near Fossil Fuel Plant (<1 mile)		Substation Near Fossil Fuel Plant (<5 mile)		In IRA Energy Community		In DAC		In or near (<5 mi) DAC	
Total MWs by Criteria	Generation	Storage	Generation	Storage	Generation	Storage	Generation	Storage	Generation	Storage	Generation	Storage
PG&E North of Greater Bay Study Area	127	360	192	300	212	300	1,371	300	-	-	73	-
PG&E Greater Bay Study Area	1,695	1,034	143	105	1,301	516	1,590	499	491	208	1,553	724
PG&E Fresno Study Area	7,805	3,587	337	896	1,424	1,308	-	151	7,752	3,517	7,805	3,587
PG&E Kern Study Area	7,734	1,363	425	-	1,515	772	6,034	925	7,461	753	8,034	1,513
SCE Northern Area	6,561	4,834	332	-	619	90	6,561	4,744	477	275	1,832	800
SCE Metro Study Area	694	8,054	486	2,918	489	6,153	694	8,054	489	5,816	694	8,054
SCE North of Lugo Study Area	890	779	-	-	-	114	922	779	-	134	510	548
East of Pisgah Study Area	-	-	-	-	4,079	710	11,354	2,252	-	-	-	200
SCE Eastern Study Area	4,859	1,630	743	300	1,203	1,590	6,313	2,392	460	1,180	460	1,490
SDG&E Study Area	6,315	1,811	80	128	1,807	668	1,027	888	1,697	578	2,847	590
Total	**36,680**	**23,451**	**2,737**	**4,647**	**12,648**	**12,219**	**35,865**	**20,983**	**18,827**	**12,459**	**23,807**	**17,505**

Table 37: Summary of updated mapping results (2041 portfolio) alignment with the community environmental impacts criteria. The table summarizes the mapped generation and storage amounts meeting prioritized criteria goals by CAISO study area.

2041 Portfolio Mapping	In Non-Attainment Zone (O3 or PM2.5)		Substation Near Fossil Fuel Plant (<1 mile)		Substation Near Fossil Fuel Plant (<5 mile)		In IRA Energy Community		In DAC		In or near (<5 mi) DAC	
Total MWs by Criteria	Generation	Storage	Generation	Storage	Generation	Storage	Generation	Storage	Generation	Storage	Generation	Storage
PG&E North of Greater Bay Study Area	417	360	537	300	557	300	1,716	300	-	-	73	-
PG&E Greater Bay Study Area	5,925	1,034	143	105	5,491	516	5,820	499	621	208	5,783	724
PG&E Fresno Study Area	10,465	3,587	967	896	2,346	1,308	75	151	9,847	3,517	9,900	3,587
PG&E Kern Study Area	7,734	1,363	425	-	1,515	772	6,034	925	7,461	753	8,034	1,513
SCE Northern Area	7,487	4,834	332	-	619	90	7,487	4,744	477	275	1,832	800
SCE Metro Study Area	4,094	8,054	486	2,918	489	6,153	4,094	8,054	489	5,816	4,094	8,054
SCE North of Lugo Study Area	890	779	-	-	-	114	922	779	-	134	510	548
East of Pisgah Study Area	-	-	-	-	5,579	710	13,354	2,252	-	-	-	200
SCE Eastern Study Area	7,689	1,630	743	300	2,533	1,590	7,643	2,392	1,790	1,180	1,790	1,490
SDG&E Study Area	7,615	1,811	80	128	1,807	668	2,327	888	1,697	578	2,847	590
Total	**52,316**	**23,451**	**3,713**	**4,647**	**20,935**	**12,219**	**49,471**	**20,983**	**22,382**	**12,459**	**34,862**	**17,505**

Table 38: Change in mapped generation and storage amounts meeting prioritized criteria goals by CAISO study area between the initial and updated mapping results for the 2041 portfolio.

2036 Portfolio Mapping Difference: Final – Initial	In Non-Attainment Zone (O3 or PM2.5)		Substation Near Thermal Plant (<1		Substation Near Fossil Fuel Plant (<5		In IRA Energy Community		In DAC		In or near (<5 mi) DAC	
MWs Difference	Generation	Storage	Generation	Storage	Generation	Storage	Generation	Storage	Generation	Storage	Generation	Storage
PG&E North of Greater Bay	(1,735)	0	(609)	-	(824)	-	(494)	-	(308)	-	(238)	-
PG&E Greater Bay	615	145	(10)	(90)	475	(165)	665	5	345	5	555	(75)
PG&E Fresno	3,704	171	155	150	940	130	-	0	3,709	151	3,584	171
PG&E Kern	5	240	100	-	(20)	752	75	340	(495)	20	(1,245)	140
SCE Northern Area	721	1,057	332	-	332	-	913	1,057	332	-	332	(480)
SCE Metro	(0)	(163)	-	381	(0)	587	(0)	(163)	(0)	1,406	(0)	238
SCE North of Lugo	500	(55)	-	-	-	(1)	383	(55)	-	20	500	(55)
East of Pisgah	(450)	-	-	-	47	(180)	(133)	(269)	-	-	-	-
SCE Eastern	420	21	50	(150)	(10)	50	1,680	200	(10)	200	(310)	200
SDG&E	(2,147)	(393)	-	(0)	(550)	(0)	0	0	(550)	(0)	600	(0)
Total	**1,633**	**1,023**	**18**	**291**	**390**	**1,172**	**3,089**	**1,116**	**3,023**	**1,800**	**3,777**	**138**

6.7 Commercial Development Interest Criteria Alignment

For assessing commercial development interest, the Working Group utilizes the CAISO interconnection queue, the wholesale distribution access tariff (WDAT) queues from major CAISO transmission operators such as PG&E and SCE, and other transmission operators outside of CAISO's balancing area, including but not limited to Imperial Irrigation District (IID), Bonneville Power Administration (BPA), and Nevada Energy (NVE). For these out-of-CAISO interconnection queues, the Working Group focused on key resource types such as geothermal, LDES, and onshore wind.

The Working Group also incorporates development interest beyond the projects identified in the queues listed and not reflected in the commercial interest queue summaries such as interest identified through LSE IRP plans and contract information, stakeholder comments, federal permitting and leasing, and Working Group communications. Such information is key for identifying development resources and potential locations for long duration energy storage, out-of-state wind, and offshore wind. Key examples of resource development interest utilized in the busbar mapping process this cycle included:

- LDES projects awarded grants through the CEC's Long-Duration Energy Storage program
- State budget funding through the 2021 budget for design, permitting, and licensing of a pumped storage project in the San Diego area.
- Offshore wind leases awarded by the Bureau of Ocean Energy Management (BOEM)
- Permitting and licensing applications through the Federal Energy Regulatory Commission (FERC)

The commercial interest criteria prioritize mapping resources in alignment with identified in-development resources first. For the purpose of busbar mapping, these are resources contracted by LSEs, under construction, or recently online but not yet incorporated into the new IRP resource baseline used for the portfolio modeling (introduced in Section 4.3). These resources are either already online or very certain to come online in the next few years and need to be accounted for in transmission planning. In-development resources are identified through CPUC information on LSE contracts, the CAISO's Master Generating Master Generating Capability List, CAISO's Generator Interconnection Resource ID Report, and feedback from PTOs. Detailed information on the in-development resources can be found in the Baseline Reconciliation and In-Development Resources workbooks (See Appendix E).

CPUC staff also update the in-development resources to include newer information incorporated from the updated Generator Interconnection Resource ID Report, additional CPUC jurisdictional Load Serving Entities (LSEs) contract information, and feedback from PTOs and stakeholders. Table 39 shows a summary of the in-development resources incorporated into the proposed mapping. Additionally, these in-development resources were removed from the totals for commercial interest criteria analysis for generic resource mapping.

Table 39: Summary, by CAISO study area, of the updated in-development resources

In-Development Resources Summary									
CAISO Study Area	Geothermal	Biomass	Wind	OOS Wind	Offshore Wind	Solar	Battery_4 hr	Battery_8 hr	LDES
PG&E North of Greater Bay	11	-	-	-	-	43	363	-	-
PG&E Greater Bay	-	-	-	-	-	10	628	-	-
PG&E Fresno	-	-	69	-	-	1,187	980	35	-
PG&E Kern	-	-	-	-	-	519	398	-	-
SCE Northern Area	-	-	-	-	-	1,581	1,884	523	-
SCE Metro	203	-	-	-	-	5	1,589	10	-
SCE North of Lugo	-	-	-	-	-	316	339	6	-
East of Pisgah	45	-	-	-	-	715	685	-	-
SCE Eastern	30	-	-	285	-	2,860	1,342	100	-
SDG&E	25	-	-	-	-	626	1,251	50	-
Total by Type:	314	-	69	285	-	7,862	9,458	724	-

After in-development resources, the commercial interest criteria prioritize higher-confidence commercial interest which includes resources in queue which have been allocated Transmission Plan Deliverability (TPD) (applies to CAISO queue resources only), have executed an interconnection agreement (CAISO queue and WDAT queues), and have completed Phase II of interconnection studies (CAISO queue only). These resource categories are not mutually exclusive or inclusive (i.e. not all projects TPD have signed an interconnection agreement). If a project has one of these attributes, then the resources are considered higher-confidence commercial interest. Lower-confidence commercial interest, projects in Phase I in the CAISO interconnection process or that have not completed any interconnection studies by their respective balancing area authority or transmission owner, have the lowest alignment priority. Analysis of the CAISO, non-CAISO, and Cluster 15 interconnection queues for commercial interest is in the Commercial Interest Analysis of Interconnection Queue workbook (Appendix K), while summaries of commercial interest from the CAISO queue and the other queues are included in the Initial Mapping Dashboard (Appendix B).

While mapping efforts seek to align with higher-confidence commercial interest, departures will occur as the Working Group seeks to balance alignment with the other mapping criteria. Multiple locations with large amounts of higher-confidence commercial interest have poor alignment with other mapping criteria, discouraging mapping of resources to those areas. Additionally, the amount of higher-confidence commercial interest for battery storage is greater than the amount of battery storage included in the portfolio. Generally, mapping results attempt to not select locations without any commercial interest, for solar and storage in particular, if avoidable. The total amount of commercial interest in battery storage in just the CAISO queue (80 GW) exceeds the 2041 portfolio amount (25 GW) by over 3x, and staff will seek to relocate those resources if it does not significantly decrease alignment with the other criteria. Table 40 and Table 41 summarize the updated mapping results for both model years compared to identified commercial development interest by CAISO study area. Table 40Table 41 shows the mapped generic resources in the four PG&E study areas

compared to the amount of commercial interest by confidence category. Table 41 shows the same comparison for the six study areas in the southern part of CAISO. Overall, in 2041, there is a significant amount of higher-confidence storage, particularly storage with TPD, in all study areas, given the amount of storage in the interconnection queue. With respect to solar, the amounts mapped to southern study areas are generally less than the amount of higher-confidence commercial interest, while the amount of solar mapped to the four PG&E study areas is generally equal to or exceeds the amount of higher-confidence solar. With respect to the non-solar or battery resources, mapped results are generally more than the amount of higher-confidence commercial interest. The table values are derived from the various interconnection queues with resource amounts already online, in the modeling baseline, or identified as in-development resources, excluded. These adjustments limit the risks of double counting commercial interest when assessing the mapping of the generic resources in the portfolio.

Table 40: Comparison of updated mapping results (2036 and 2041 model years) to identified commercial interest by CAISO study area and resource type for the PG&E study areas.

	Mapped Portfolio		Commercial Queue Interest				Mapped Portfolio		Commercial Queue Interest		
PG&E North of Greater Bay	**Generic (2036)**	**Generic (2041)**	**TPD**	**Higher Confidence**	**All Queue Interest**	**PG&E Greater Bay**	**Generic (2036)**	**Generic (2041)**	**TPD**	**Higher Confidence**	**All Queue Interest**
Geothermal (MW)	3,175	3,175	28	37	3,405	Geothermal (MW)	-	-	-	-	-
Biomass (MW)	-	-	-	-	-	Biomass (MW)	-	-	-	-	-
OnshoreWind (MW)	873	1,753	200	368	368	OnshoreWind (MW)	-	-	161	2,200	2,200
OOS Wind (MW)	-	-	-	-	258	OOS Wind (MW)	-	4,000	-	-	2,515
Offshore Wind (MW)	-	1,607	-	-	-	Offshore Wind (MW)	-	-	-	-	-
Distrib. Solar (MW)	-	-	-	-	-	Distrib. Solar (MW)	-	-	-	0	0
Solar (MW)	1,003	1,003	25	918	1,844	Solar (MW)	1,685	1,915	-	1,059	1,454
Battery (MW)	-	-	270	4,605	4,881	Battery (MW)	96	96	6,836	10,848	13,713
LDES (MW)	-	-	-	-	415	LDES (MW)	310	310	-	-	-
Total (MW)	**5,050**	**7,537**	**522**	**5,929**	**11,172**	**Total (MW)**	**2,091**	**6,321**	**6,997**	**14,107**	**19,882**

	Mapped Portfolio		Commercial Queue Interest				Mapped Portfolio		Commercial Queue Interest		
PG&E Fresno	**Generic (2036)**	**Generic (2041)**	**TPD**	**Higher Confidence**	**All Queue Interest**	**PG&E Kern**	**Generic (2036)**	**Generic (2041)**	**TPD**	**Higher Confidence**	**All Queue Interest**
Geothermal (MW)	170	170	-	-	-	Geothermal (MW)	-	-	-	-	-
Biomass (MW)	-	-	-	-	-	Biomass (MW)	-	-	-	-	-
OnshoreWind (MW)	-	-	-	-	-	OnshoreWind (MW)	-	-	2,488	2,547	2,657
OOS Wind (MW)	-	-	-	-	6,409	OOS Wind (MW)	-	-	-	-	-
Offshore Wind (MW)	-	-	-	-	-	Offshore Wind (MW)	2,924	2,924	-	-	-
Distrib. Solar (MW)	-	-	-	-	-	Distrib. Solar (MW)	-	-	-	-	-
Solar (MW)	6,378	9,038	3	6,506	10,497	Solar (MW)	8,035	8,035	263	4,395	6,630
Battery (MW)	2,432	2,432	5,513	7,786	14,324	Battery (MW)	355	355	3,010	5,466	7,620
LDES (MW)	140	140	-	-	-	LDES (MW)	1,122	1,122	-	-	-
Total (MW)	**9,120**	**11,780**	**5,517**	**14,291**	**31,230**	**Total (MW)**	**12,436**	**12,436**	**5,760**	**12,409**	**16,907**

Table 41: Comparison of updated mapping results (2036 and 2041 model years) to identified commercial interest by CAISO study area and resource type for the CAISO southern area study areas.

	Mapped Portfolio		Commercial Queue Interest				Mapped Portfolio		Commercial Queue Interest		
SCE Northern Area	Generic (2036)	Generic (2041)	TPD	Higher Confidence	All Queue Interest	SCE Metro	Generic (2036)	Generic (2041)	TPD	Higher Confidence	All Queue Interest
Geothermal (MW)	-	-	-	-	-	Geothermal (MW)	-	-	-	-	-
Biomass (MW)	-	-	-	-	-	Biomass (MW)	-	-	-	-	-
OnshoreWind (MW)	-	-	100	100	124	OnshoreWind (MW)	-	-	-	-	-
OOS Wind (MW)	-	-	-	-	3,310	OOS Wind (MW)	-	3,000	-	-	9,208
Offshore Wind (MW)	-	-	-	-	-	Offshore Wind (MW)	-	-	-	-	-
Distrib. Solar (MW)	-	-	-	33	64	Distrib. Solar (MW)	-	-	-	3	3
Solar (MW)	4,980	5,906	808	4,755	6,306	Solar (MW)	486	886	-	1,823	1,933
Battery (MW)	757	757	6,736	10,828	15,449	Battery (MW)	6,455	6,455	5,631	7,269	18,352
LDES (MW)	1,680	1,680	300	312	1,312	LDES (MW)	-	-	-	-	517
Total (MW)	**7,417**	**8,343**	**7,945**	**16,027**	**26,564**	**Total (MW)**	**6,941**	**10,341**	**5,631**	**9,094**	**30,013**

	Mapped Portfolio		Commercial Queue Interest				Mapped Portfolio		Commercial Queue Interest		
SCE North of Lugo	Generic (2036)	Generic (2041)	TPD	Higher Confidence	All Queue Interest	East of Pisgah	Generic (2036)	Generic (2041)	TPD	Higher Confidence	All Queue Interest
Geothermal (MW)	-	-	-	-	5	Geothermal (MW)	870	870	-	-	-
Biomass (MW)	-	-	-	-	-	Biomass (MW)	-	-	-	-	-
OnshoreWind (MW)	-	-	-	212	692	OnshoreWind (MW)	321	321	66	310	310
OOS Wind (MW)	-	-	-	-	768	OOS Wind (MW)	4,100	5,600	-	-	1,177
Offshore Wind (MW)	-	-	-	-	-	Offshore Wind (MW)	-	-	-	-	-
Distrib. Solar (MW)	-	-	-	11	51	Distrib. Solar (MW)	-	-	-	-	-
Solar (MW)	606	606	44	1,156	2,627	Solar (MW)	5,303	5,803	417	4,871	7,451
Battery (MW)	148	148	1,587	2,293	2,827	Battery (MW)	607	607	2,525	5,332	6,509
LDES (MW)	286	286	-	-	-	LDES (MW)	960	960	-	-	-
Total (MW)	**1,040**	**1,040**	**1,631**	**3,671**	**6,970**	**Total (MW)**	**12,160**	**14,160**	**3,008**	**10,514**	**15,447**

	Mapped Portfolio		Commercial Queue Interest				Mapped Portfolio		Commercial Queue Interest		
SCE Eastern	Generic (2036)	Generic (2041)	TPD	Higher Confidence	All Queue Interest	SDG&E	Generic (2036)	Generic (2041)	TPD	Higher Confidence	All Queue Interest
Geothermal (MW)	70	70	-	-	-	Geothermal (MW)	505	505	-	-	-
Biomass (MW)	-	-	-	-	-	Biomass (MW)	-	-	-	-	-
OnshoreWind (MW)	323	323	-	301	808	OnshoreWind (MW)	990	2,290	300	1,923	1,925
OOS Wind (MW)	2,651	4,151	-	-	1,451	OOS Wind (MW)	-	-	-	-	431
Offshore Wind (MW)	-	-	-	-	-	Offshore Wind (MW)	-	-	-	-	-
Distrib. Solar (MW)	-	-	-	7	21	Distrib. Solar (MW)	-	-	-	-	16
Solar (MW)	3,750	5,080	500	9,051	15,599	Solar (MW)	7,374	7,604	238	3,703	7,772
Battery (MW)	-	-	4,923	15,471	20,664	Battery (MW)	307	307	2,376	8,811	9,242
LDES (MW)	950	950	500	1,917	1,917	LDES (MW)	500	500	-	-	500
Total (MW)	**7,744**	**10,574**	**5,923**	**26,748**	**40,460**	**Total (MW)**	**9,676**	**11,206**	**2,914**	**14,437**	**19,886**

Table 42, Table 43, and Table 44 summarize the substations with non-alignment flags. The tables show both the number of substations where the amount mapped exceeds the various categories of commercial interest and the number of substations where the commercial interest exceeds the amount mapped. Table 42 has the analysis for the final utility-scale solar and battery storage; Table 43 has it for onshore, in-CAISO wind and geothermal; and Table 44 has it for biomass and community-scale distributed solar.

Geothermal and biomass mapping results have a relatively small number of flags for mapped amounts exceeding the total commercial interest. For geothermal, interconnection availability was a primary driver of non-alignment scores. There was no commercial interest identified for biomass and there was no biomass selected in the TPP portfolio, so there are no non-alignment flags for biomass.

For solar and battery storage, there are relatively high instances of the resources mapped exceeding the total amount of commercial interest, particularly in northern study areas, as seen in Table 42. The drivers of these non-alignment instances include seeking to improve reliability modeling results, improving environmental and land-use criteria, a rebalancing a general imbalance of northern and southern solar projects in the interconnection queues, and aligning with the previous TPP. There are

also a significant number of substations for batteries where the higher-confidence commercial interest exceeds the amount mapped. For battery storage, the key factor driving the number of flags for more commercial interest is that there are significantly more battery projects in the queue than in the optimized portfolio. Furthermore, while a substation may have higher-confidence commercial interest, it may also have poor alignment with the other mapping criteria. Additionally, in locations where the storage commercial interest was co-located with solar interest, the Working Group factored in the solar mapping alignment as well.

For onshore wind, the results have 13 substations where the amount mapped exceeds total commercial interest including several substations with no commercial interest. Compared to solar and storage there is significantly less wind in the identified queues. The mapping results in two substations (Humboldt 115 kV and Moss Landing 500 kV) with a non-alignment flag for having more higher-confidence commercial interest than mapped resources and five substations with higher total commercial interest than mapped resources. Additional onshore wind was not mapped to Humboldt or Moss Landing due to limited resource potential, some environmental impact implications, and transmission system capability limitations if more wind is mapped. The five substations with the 1+ flags for wind, Cabrillo 115 kV, Devers 500 kV, Los Coches 138 kV, Lugo 230 kV, Windhub 230 kV, all have identified commercial interest from the Cluster 15 application list but generally higher potential environmental impacts.

Table 42: Summary of substations with non-alignment flags for the commercial interest criteria by CAISO study area for the updated 2041 portfolio mapping results of solar and battery storage resources.

2041 Mapping Results	Solar					Battery Storage				
Number of Substations by Area	Exceeds Total CI (Flag: 4- or 5-)	Exceeds Higher Confidence CI (Flag:	More Executed IA or TPD CI (3+ or	More higher confidence CI (2+)	More total CI (1+)	Exceeds Total CI (Flag: 4- or 5-)	Exceeds Higher Confidence CI (Flag:	More Executed IA or TPD CI (3+ or	More higher confidence CI (2+)	More total CI (1+)
PG&E North of Greater Bay Study Area	2	1	13	12	10	0	0	12	11	2
PG&E Greater Bay Study Area	12	0	24	25	8	1	0	32	5	10
PG&E Fresno Study Area	25	2	17	8	5	3	1	20	6	4
PG&E Kern Study Area	14	3	15	10	1	0	0	18	4	2
SCE Northern Area	6	0	5	2	0	0	0	15	0	3
SCE Metro Study Area	2	0	2	10	1	0	3	6	0	8
SCE North of Lugo Study Area	2	0	7	1	1	0	0	9	0	2
East of Pisgah Study Area	3	1	2	0	3	0	0	9	0	2
SCE Eastern Study Area	2	0	3	4	2	0	0	11	3	3
SDG&E Study Area	6	3	1	0	0	1	0	13	12	1
Total	74	10	89	72	31	5	4	145	41	37

Table 43: Summary of substations with non-alignment flags for the commercial interest criteria by CAISO study area for the updated 2041 portfolio mapping results of onshore wind and geothermal resources.

2041 Mapping Results	Geothermal					Onshore Wind				
Number of Substations by Area	Exceeds Total CI (Flag: 4- or 5-)	Exceeds Higher Confidence CI (Flag:	More Executed IA or TPD CI (3+ or	More higher confidence CI (2+)	More total CI (1+)	Exceeds Total CI (Flag: 4- or 5-)	Exceeds Higher Confidence CI (Flag:	More Executed IA or TPD CI (3+ or	More higher confidence CI (2+)	More total CI (1+)
PG&E North of Greater Bay Study Area	11	1	1	0	0	6	0	1	1	0
PG&E Greater Bay Study Area	0	0	0	0	0	0	0	3	1	0
PG&E Fresno Study Area	4	0	0	0	0	0	0	0	0	0
PG&E Kern Study Area	0	0	0	0	0	0	0	1	0	1
SCE Northern Area	0	0	0	0	0	0	0	2	0	1
SCE Metro Study Area	0	0	0	0	0	0	0	0	0	0
SCE North of Lugo Study Area	0	0	0	0	1	0	0	1	0	1
East of Pisgah Study Area	3	0	0	0	0	2	0	1	0	0
SCE Eastern Study Area	1	0	0	0	0	1	0	0	0	1
SDG&E Study Area	1	0	0	0	0	4	0	1	0	1
Total	20	1	1	0	1	13	0	10	2	5

Table 44: Summary of substations with non-alignment flags for the commercial interest criteria by CAISO study area for the updated 2041 portfolio mapping results of biomass and distributed solar resources.

2041 Mapping Results	Biomass					Distributed Solar				
Number of Substations by Area	Exceeds Total CI (Flag: 4- or 5-)	Exceeds Higher Confidence CI (Flag:	More Executed IA or TPD CI (3+ or	More higher confidence CI (2+)	More total CI (1+)	Exceeds Total CI (Flag: 4- or 5-)	Exceeds Higher Confidence CI (Flag:	More Executed IA or TPD CI (3+ or	More higher confidence CI (2+)	More total CI (1+)
PG&E North of Greater Bay Study Area	0	0	0	0	0	0	0	0	0	0
PG&E Greater Bay Study Area	0	0	0	0	0	0	0	1	0	0
PG&E Fresno Study Area	0	0	0	0	0	0	0	0	0	0
PG&E Kern Study Area	0	0	0	0	0	0	0	0	0	0
SCE Northern Area	0	0	0	0	0	0	0	5	0	1
SCE Metro Study Area	0	0	0	0	0	0	0	3	0	1
SCE North of Lugo Study Area	0	0	0	0	0	0	0	5	0	2
East of Pisgah Study Area	0	0	0	0	0	0	0	0	0	0
SCE Eastern Study Area	0	0	0	0	0	0	0	3	0	0
SDG&E Study Area	0	0	0	0	0	0	0	0	0	5
Total	0	0	0	0	0	0	0	17	0	9

6.8 Prior TPP Base Case Criteria Alignment

The methodology guiding principles state that busbar allocations for equivalent TPP cases should be relatively consistent year to year: for example, Base Cases from one year to the next; and Policy-driven Sensitivity Cases exploring the same issue from one year to the next. Where large changes are necessary, the reasons for these should be clear. Staff should consider whether changes are occurring due to exogenous factors (e.g., demand or resource cost shifts) or due to modeling margin of error.

The updated mapping results for both 2036 and 2041 are compared to the previous base case portfolio for the 25-26 TPP and summarized by resource type in Table 45. Overall, the 26-27 TPP has significantly more resources overall than the 25-26 TPP in both the 10- and 15-year timeframe. The largest difference between the 2036/2035 portfolios is the amount of solar, which is roughly 27 GW higher in 26-27 TPP. Wind builds decreased across all categories between the 2036/2035 portfolios, while geothermal resources increased by roughly 3.5 GW. Storage builds shifted from 4-hr to 8-hr between the 2036/2035 portfolios and LDES builds increased by 4.7 GW. By 2041/2040, the 26-27 TPP has roughly 6.3 GW more OOS wind than the 25-26 TPP, reversing the earlier trend. Offshore wind builds are aligned in the later modeling years. The difference in solar builds decreases to roughly 8.8 GW by 2041/2040 and 8-hr storage builds reconverge with 25-26 TPP totals.

Table 45: Comparison of updated mapping portfolio to the 25-26 TPP base case (2035 and 2040 model years) by resource type.

Resource Type	Total Res (2036)	Total Res (2041)	25-26 TPP (2035)	25-26 TPP (2040)
Units	MW	MW	MW	MW
Geothermal	5,104	5,104	1,639	1,639
Biomass	-	-	171	171
Onshore Wind	2,576	4,756	7,895	7,895
OOS Wind	7,036	17,036	9,000	10,707
Offshore Wind	2,924	4,531	4,531	4,531
Solar	47,461	53,737	19,833	44,892
Battery-4hr	9,478	9,478	16,189	16,189
Battery-8hr	11,860	11,860	2,593	11,770
LDES	5,948	5,948	1,264	1,264
Zone Total	**92,387**	**112,450**	**63,115**	**99,059**

Figure 10 and Figure 11 compare the updated mapping results for 2036 and 2041 model years to the 25-26 TPP base case portfolio's 2035 and 2040 model years respectively, summarizing the number of resources mapped to each CAISO study area. Table 46 shows the comparison between the updated mapping results and 25-26 TPP base case by CAISO study area in table form.

With the exception of SCE North of Lugo, the total amount of resources mapped to each study area in 2036/2035 from the 26-27 TPP exceeds that from the 25-26 TPP. The reduction at SCE North of Lugo is primarily due to the removal of onshore wind previously mapped to the study area, as

well as a slight reduction in the amount of solar. In the 2041/2040 model years, this trend remains mostly the same apart from PG&E Fresno, which has slightly fewer resources mapped overall compared to the 25-26 TPP. This is mostly driven by a reduction in solar that was previously mapped to the study area for the first time in the 25-26 TPP. These resources were remapped from southern study areas post-ruling. Other noticeable changes include the addition of geothermal in PG&E North of Greater Bay, the replacement of some offshore wind and battery storage in favor of additional solar and out-of-state wind in PG&E Greater Bay, and significantly more 8-hr batteries mapped to SCE Metro. Other changes are mostly attributable to incremental changes in the amount of solar, wind, or batteries.

Generally, the PG&E Fresno area has a significant amount of solar development interest, particularly compared to other study areas north of Path 26, when the Working Group was assessing where to map the additional solar relocated from south of Path 26. Additionally, the buses in this study area had favorable land-use and environmental criteria alignment, particularly compared to a few key substations in southern California where less solar has been mapped this cycle. Finally, the PG&E Fresno area had some available transmission capability created by previously approved upgrades (e.g. at the new Manning substation) and additional upgrades are likely to be triggered by mapping of other longer lead-time resource (i.e., wind and non-battery LDES) so additional solar and storage were mapped to further utilize these upgrades.

Figure 10: Comparison of the updated 2036 mapped portfolio (left) to the 2035 model year from the previous 25-26 TPP (right) by CAISO study area.

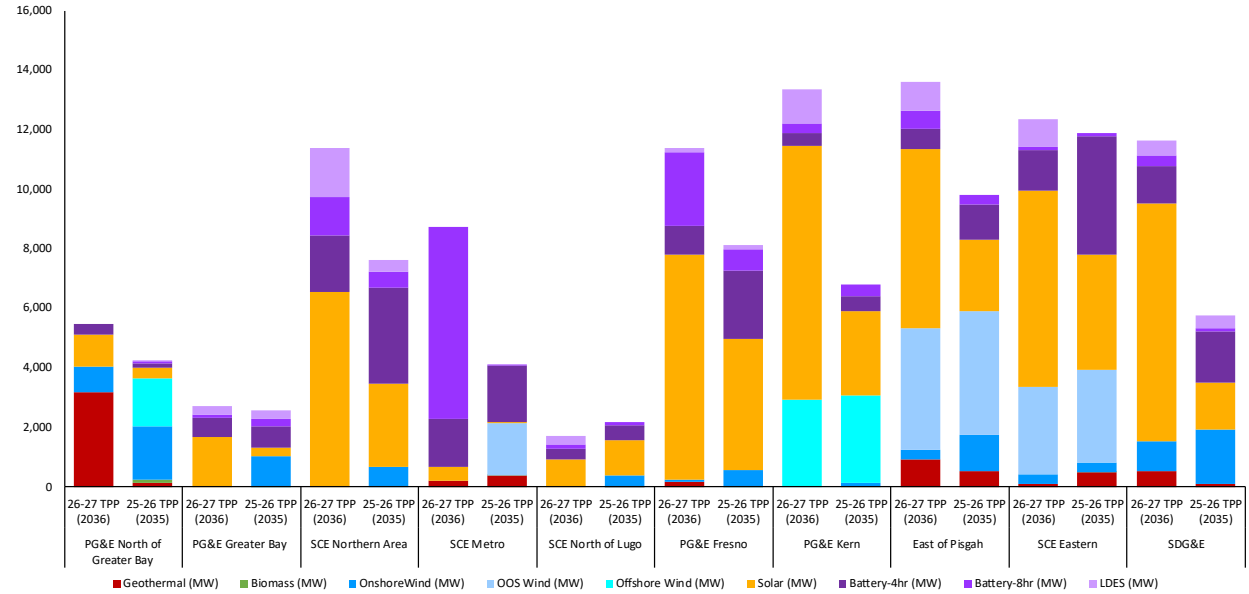


Figure 11: Comparison of the updated 2041 mapped portfolio (left) to the 2040 model year from the previous 25-26 TPP (right) by CAISO study area.

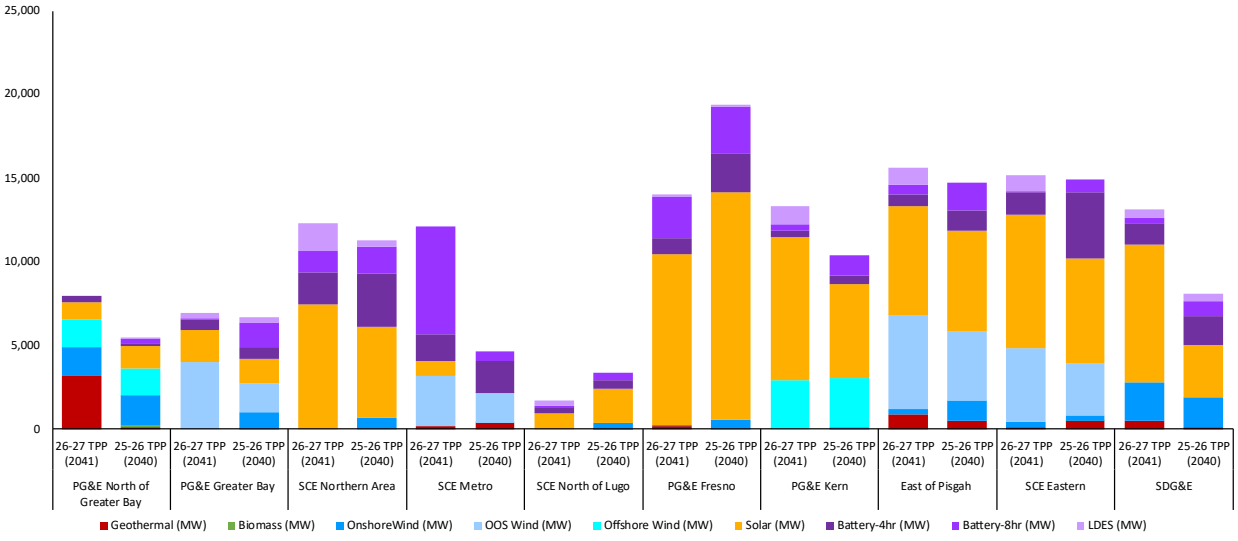


Table 46: Comparison of updated mapping results for the 2036 and 2041 model years to the 2035 and 2040 portfolios from the 25-26 TPP by CAISO study area and resource type.

Mapping Results Compared to 25-26 TPP Base Case by CAISO Study Area											
CAISO Study Area	Resource Type	Total Res (2036)	Total Res (2041)	25-26 TPP (2035)	25-26 TPP (2040)	CAISO Study Area	Resource Type	Total Res (2036)	Total Res (2041)	25-26 TPP (2035)	25-26 TPP (2040)
PG&E North of Greater Bay	Geothermal (MW)	3,186.2	3,186.2	123.0	123.0	PG&E Fresno	Geothermal (MW)	170.0	170.0	-	-
	Biomass (MW)	-	-	108.8	108.8		Biomass (MW)	-	-	9.5	9.5
	OnshoreWind (MW)	872.5	1,752.5	1,802.7	1,802.7		OnshoreWind (MW)	69.3	69.3	560.5	560.5
	OOS Wind (MW)	-	-	-	-		OOS Wind (MW)	-	-	-	-
	Offshore Wind (MW)	-	1,607.0	1,607.0	1,607.0		Offshore Wind (MW)	-	-	-	-
	Solar (MW)	1,045.2	1,045.2	378.0	1,333.0		Solar (MW)	7,565.6	10,225.6	4,402.1	13,612.1
	Battery-4hr (MW)	362.7	362.7	125.0	125.0		Battery-4hr (MW)	979.6	979.6	2,307.8	2,307.8
	Battery-8hr (MW)	-	-	95.0	305.0		Battery-8hr (MW)	2,467.0	2,467.0	700.0	2,765.0
	LDES (MW)	-	-	5.0	5.0		LDES (MW)	140.0	140.0	140.0	140.0
	Zone Total (MW)	**5,467**	**7,954**	**4,244**	**5,409**		**Zone Total (MW)**	**11,391**	**14,051**	**8,120**	**19,395**
PG&E Greater Bay	Geothermal (MW)	-	-	-	-	PG&E Kern	Geothermal (MW)	-	-	-	-
	Biomass (MW)	-	-	11.9	11.9		Biomass (MW)	-	-	23.3	23.3
	OnshoreWind (MW)	-	-	1,013.6	1,013.6		OnshoreWind (MW)	-	-	113.1	113.1
	OOS Wind (MW)	-	4,000.0	-	1,707.0		OOS Wind (MW)	-	-	-	-
	Offshore Wind (MW)	-	-	-	-		Offshore Wind (MW)	2,924.0	2,924.0	2,924.0	2,924.0
	Solar (MW)	1,695.5	1,925.5	293.8	1,445.8		Solar (MW)	8,553.7	8,553.7	2,852.3	5,647.3
	Battery-4hr (MW)	628.0	628.0	718.8	718.8		Battery-4hr (MW)	398.1	398.1	493.0	493.0
	Battery-8hr (MW)	95.7	95.7	236.1	1,508.3		Battery-8hr (MW)	355.0	355.0	410.0	1,210.0
	LDES (MW)	310.0	310.0	310.0	310.0		LDES (MW)	1,122.0	1,122.0	-	-
	Zone Total (MW)	**2,729**	**6,959**	**2,584**	**6,715**		**Zone Total (MW)**	**13,353**	**13,353**	**6,816**	**10,411**
SCE Northern Area	Geothermal (MW)	-	-	-	-	East of Pisgah	Geothermal (MW)	914.8	914.8	517.3	517.3
	Biomass (MW)	-	-	-	-		Biomass (MW)	-	-	-	-
	OnshoreWind (MW)	-	-	674.0	674.0		OnshoreWind (MW)	321.0	321.0	1,228.5	1,228.5
	OOS Wind (MW)	-	-	-	-		OOS Wind (MW)	4,100.0	5,600.0	4,151.0	4,151.0
	Offshore Wind (MW)	-	-	-	-		Offshore Wind (MW)	-	-	-	-
	Solar (MW)	6,561.0	7,487.0	2,809.5	5,419.5		Solar (MW)	6,018.0	6,518.0	2,398.0	5,998.0
	Battery-4hr (MW)	1,884.0	1,884.0	3,224.0	3,224.0		Battery-4hr (MW)	685.0	685.0	1,210.0	1,210.0
	Battery-8hr (MW)	1,280.0	1,280.0	509.0	1,584.0		Battery-8hr (MW)	606.5	606.5	320.0	1,635.0
	LDES (MW)	1,680.0	1,680.0	400.0	400.0		LDES (MW)	960.0	960.0	-	-
	Zone Total (MW)	**11,405**	**12,331**	**7,617**	**11,302**		**Zone Total (MW)**	**13,605**	**15,605**	**9,825**	**14,740**
SCE Metro	Geothermal (MW)	203.0	203.0	389.0	389.0	SCE Eastern	Geothermal (MW)	100.0	100.0	500.0	500.0
	Biomass (MW)	-	-	5.6	5.6		Biomass (MW)	-	-	7.9	7.9
	OnshoreWind (MW)	-	-	-	-		OnshoreWind (MW)	323.0	323.0	324.5	324.5
	OOS Wind (MW)	-	3,000.0	1,750.0	1,750.0		OOS Wind (MW)	2,936.0	4,436.0	3,099.0	3,099.0
	Offshore Wind (MW)	-	-	-	-		Offshore Wind (MW)	-	-	-	-
	Solar (MW)	490.6	890.6	32.9	32.9		Solar (MW)	6,610.0	7,940.0	3,873.5	6,253.5
	Battery-4hr (MW)	1,589.0	1,589.0	1,890.5	1,890.5		Battery-4hr (MW)	1,341.5	1,341.5	3,985.4	3,985.4
	Battery-8hr (MW)	6,464.5	6,464.5	10.0	610.0		Battery-8hr (MW)	100.0	100.0	100.0	780.0
	LDES (MW)	-	-	-	-		LDES (MW)	950.0	950.0	-	-
	Zone Total (MW)	**8,747**	**12,147**	**4,078**	**4,678**		**Zone Total (MW)**	**12,361**	**15,191**	**11,890**	**14,950**
SCE North of Lugo	Geothermal (MW)	-	-	9.7	9.7	SDG&E	Geothermal (MW)	530.0	530.0	100.0	100.0
	Biomass (MW)	-	-	4.2	4.2		Biomass (MW)	-	-	-	-
	OnshoreWind (MW)	-	-	362.2	362.2		OnshoreWind (MW)	990.0	2,290.0	1,815.8	1,815.8
	OOS Wind (MW)	-	-	-	-		OOS Wind (MW)	-	-	-	-
	Offshore Wind (MW)	-	-	-	-		Offshore Wind (MW)	-	-	-	-
	Solar (MW)	921.8	921.8	1,198.1	2,017.1		Solar (MW)	7,999.9	8,229.9	1,595.3	3,133.3
	Battery-4hr (MW)	358.5	358.5	507.2	507.2		Battery-4hr (MW)	1,251.2	1,251.2	1,727.2	1,727.2
	Battery-8hr (MW)	134.4	134.4	113.0	463.0		Battery-8hr (MW)	357.0	357.0	100.0	910.0
	LDES (MW)	286.0	286.0	-	-		LDES (MW)	500.0	500.0	409.2	409.2
	Zone Total (MW)	**1,701**	**1,701**	**2,194**	**3,363**		**Zone Total (MW)**	**11,628**	**13,158**	**5,748**	**8,096**

Table 47: Number of substations in each CAISO study area with non-alignment flags for the consistency with previous base case criteria for the updated mapping results (2041 model year) compared to the 2040 model year from the 25-26 TPP by resource type.

2041 Portfolio Mapping – Number of Substations by CAISO Study Area with Fewer Resources Mapped											
Resource Type	Level of Decrease at Sub	PG&E North of Greater Bay	PG&E Greater Bay	PG&E Fresno	PG&E Kern	SCE Northern Area	SCE Metro	SCE North of Lugo	East of Pisgah	SCE Eastern	SDG&E
Geothermal	Slight*	0	0	0	0	0	0	0	0	0	0
	Significant**	3	0	0	0	0	1	1	0	1	0
Biomass	Slight	0	0	0	0	0	0	0	0	0	0
	Significant	16	6	5	6	0	1	2	0	2	0
Wind, Onshore	Slight	0	0	0	0	0	0	0	0	1	1
	Significant	5	7	3	1	3	0	2	3	0	0
OOS Wind	Slight	0	0	0	0	0	0	0	0	0	0
	Significant	0	0	0	0	0	0	0	1	0	0
Offshore Wind	Slight	0	0	0	0	0	0	0	0	0	0
	Significant	0	0	0	0	0	0	0	0	0	0
Distributed _Solar	Slight	0	0	1	0	1	1	0	0	0	0
	Significant	7	10	9	8	1	4	4	0	0	3
Solar	Slight	0	1	1	2	2	0	0	2	0	0
	Significant	5	5	15	6	4	1	6	3	2	2
Total Battery	Slight	0	0	0	0	4	0	1	0	1	1
	Significant	8	15	20	8	6	3	5	8	10	18
LDES	Slight	0	0	0	0	1	0	0	0	0	0
	Significant	1	0	0	0	0	0	0	0	0	0

*100 MW or 10% less (level-3 alignment)

**500 MW or 33% less (level-4 or -5 alignment)

Table 48 shows the number of substations by CAISO study area and resource type in 2041 that have non-alignment flags as a result of fewer resources being mapped to them than the updated results for the TPP base case in the 2040 model year. The change in number of substations with non-alignment flags between the initial and updated mappings results is summarized by resource type in Table 48.

Table 48: Net change in number of substations with a non-alignment flag between the initial and updated mapping results for the 2041 portfolio by resource type.

Net Change in Substations with Alignment Flags Between Initial and Updated Mapping (2041)		
Resource Type	Level of Decrease at Sub	Total Number of Flags Changed
Geothermal	Slight*	0
	Significant**	0
Biomass	Slight	0
	Significant	14
Wind, Onshore	Slight	1
	Significant	6
OOS Wind	Slight	0
	Significant	1
Offshore Wind	Slight	0
	Significant	0
Distributed_Solar	Slight	3
	Significant	22
Solar	Slight	3
	Significant	17
Total Battery	Slight	7
	Significant	55
LDES	Slight	1
	Significant	-1

*100 MW or 10% less (level-3 alignment)

**500 MW or 33% less (level-4 or -5 alignment)

Overall, solar and battery storage mapping results in the most non-alignment flags. The battery flags are primarily driven by the large amount of in-development battery resources and mapping to those locations limiting the Working Group's ability to map to other buses that were previously mapped to. As part of the remapping update, the number of alignment flags increased reflects the remapping that was needed to align with the additional in-development battery resources identified. For solar, the alignment flags are driven by a need to align with in-development resources as well, a reduction in solar mapped to certain buses with higher environmental impact flags, and the remapping effort to shift solar from the southern study areas to north of Path 26.

Biomass and distributed solar, again, have numerous non-alignment flags in the PG&E study areas due to the percentage change factors as the mapped amount differences are relatively small, 1-5 MWs, but result in a significant percentage change.

7. Results

Sections 7.1-7.6 summarize the updated mapping results by CAISO study area for the base case portfolio following the adjustments and busbar mapping analysis outlined previously. The summaries include the resources mapped in both 2036 and 2041 and key transmission implications of the mapping. Table 49 shows the total mapped resources by CAISO study area for the 2036 portfolio and Table 50 shows the results for the 2041 portfolio. Results are shown by CAISO study area for easier comparison and integration with the CAISO's TPP and other transmission analysis and interconnection processes. The Updated Dashboard for the Proposed Decision Mapping of the 26-27 TPP Base Case (Appendix C) contains full details of the mapping results and the busbar mapping criteria analysis.

Table 49: Updated mapping results of the base case portfolio (2036 model year) summarized by CAISO study area and resource type.

2036 - Mapped Total Resources (In-Dev & Generic), MW										
CAISO Study Area	**Geothermal**	**Biomass**	**Onshore Wind**	**OOS Wind**	**Offshore Wind**	**Distributed Solar**	**Solar**	**Battery**	**LDES**	**Total 2036 Resources**
PG&E North of Greater Bay	3,186	-	873	-	-	18	1,028	363	-	**5,467**
PG&E Greater Bay	-	-	-	-	-	10	1,685	724	310	**2,729**
PG&E Fresno	170	-	69	-	-	34	7,532	3,447	140	**11,391**
PG&E Kern	-	-	-	-	2,924	19	8,535	753	1,122	**13,353**
SCE Northern	-	-	-	-	-	21	6,540	3,164	1,680	**11,405**
SCE Metro	203	-	-	-	-	5	486	8,054	-	**8,747**
SCE North of Lugo	-	-	-	-	-	10	912	493	286	**1,701**
East of Pisgah	915	-	321	4,100	-	-	6,018	1,292	960	**13,605**
SCE Eastern	100	-	323	2,936	-	-	6,610	1,442	950	**12,361**
SDG&E	530	-	990	-	-	-	8,000	1,608	500	**11,628**
Total 2036 Resources:	**5,104**	**-**	**2,576**	**7,036**	**2,924**	**116**	**47,345**	**21,338**	**5,948**	**92,387**

Table 50: Updated mapping results of the base case portfolio (2041 model year) summarized by CAISO study area and resource type.

2041 - Mapped Total Resources (In-Dev & Generic), MW										
CAISO Study Area	**Geothermal**	**Biomass**	**Onshore Wind**	**OOS Wind**	**Offshore Wind**	**Distributed Solar**	**Solar**	**Battery**	**LDES**	**Total 2041 Resources**
PG&E North of Greater Bay	3,186	-	1,753	-	1,607	18	1,028	363	-	**7,954**
PG&E Greater Bay	-	-	-	4,000	-	10	1,915	724	310	**6,959**
PG&E Fresno	170	-	69	-	-	34	10,192	3,447	140	**14,051**
PG&E Kern	-	-	-	-	2,924	19	8,535	753	1,122	**13,353**
SCE Northern	-	-	-	-	-	21	7,466	3,164	1,680	**12,331**
SCE Metro	203	-	-	3,000	-	5	886	8,054	-	**12,147**
SCE North of Lugo	-	-	-	-	-	10	912	493	286	**1,701**
East of Pisgah	915	-	321	5,600	-	-	6,518	1,292	960	**15,605**
SCE Eastern	100	-	323	4,436	-	-	7,940	1,442	950	**15,191**
SDG&E	530	-	2,290	-	-	-	8,230	1,608	500	**13,158**
Total 2041 Resources:	**5,104**	**-**	**4,756**	**17,036**	**4,531**	**116**	**53,621**	**21,338**	**5,948**	**112,450**

As discussed in Section 6.3, the 2036 and 2041 mapped portfolio results in a number of 2024 White Paper exceedances that will likely require upgrades, several of which are large upgrades providing gigawatts of additional transmission capability and costing billions of dollars. Additionally, the mapped portfolio includes resources like out-of-state wind and geothermal that will require major new transmission lines across multiple states and balancing areas. The mapped 26-27 TPP base case portfolio results in a comparable number of transmission constraint exceedance in the CAISO system and potential transmission upgrades as the busbar mapping effort identified for the portfolio

transmitted to the CAISO for the 25-26 TPP base case, which is still under study and full transmission needs have not been identified. The busbar mapping results for the 25-26 TPP had 12 constraint exceedances in 2035 and 22 constraint exceedances in 2040, while this year's 26-27 TPP mapping has 10 constraint exceedances in 2036 and 16 constraint exceedances in 2041.

The 26-27 TPP portfolio has a greater amount of out-of-CAISO and out-of-state resources needing new transmission than the 25-26 TPP portfolio. A key update in these potential transmission needs in this year's busbar mapping is updated out-of-state wind resources and expanded out-of-state geothermal and EGS resources with transmission solutions and cost information provided by CAISO's 20-year Transmission Outlook (2023-2024). An extended discussion of out-of-state transmission needs is included in Section 9.

7.1 Transmission Exceedances in Busbar Mapping and RESOLVE Modeling

The RESOLVE modeling for the portfolio development incorporates CAISO White Paper transmission constraint and upgrade information. It optimizes not only the resource build inclusive of transmission costs but also identifies which upgrades should be triggered. RESOLVE also has cost assumptions for the new transmission needed for the various out-of-CAISO resources. As a capacity expansion model, RESOLVE has several limitations when it comes to resource and transmission assessment including an unrealistic ability to build partial transmission upgrades. Additionally, RESOLVE cannot fully incorporate all the additional data, criteria analysis, and nuances utilized in busbar mapping. Thus, historically, there has been often significant difference in the transmission upgrades RESOLVE identifies as likely being needed and the ones identified through busbar mapping with busbar mapping in the past several TPP cycles identifying significantly more transmission exceedances and potential upgrades needed than RESOLVE. The divergence has been reduced for the 26-27 TPP base case. RESOLVE selected only 4 and 8 upgrades respectively in 2036 and 2041 whereas the mapped 26-27 TPP portfolio triggered 10 and 16 upgrades in the same years. CPUC staff have continued to implement improvements to RESOLVE to better capture mapping implications. This cycle, CPUC staff implemented further improvements including capturing the Path 26 constraints between Northern and Southern California.

7.2 PG&E Northern: PG&E North of Greater Bay Area and Greater Bay Area

Mapped Resources Summary

Table 51 and Table 52 summarize the resources mapped to the PG&E North of Greater Bay and Greater Bay study areas, respectively. The tables summarize the identified in-development resources and mapped generic resources for the 2036 and 2041 portfolios by resource type and modeled deliverability status. In addition to resources mapped to substations in Northern California and the Bay area, the mapped resources in these two areas include Humboldt offshore wind in 2041, Wyoming Wind interconnecting to the Tesla area in 2041, geothermal mapped in 2036 and 2041 to balancing authorities in Oregon and Nevada that would likely require upgrades to out-of-CAISO transmission or new transmission to interconnect to the CAISO system, and onshore wind mapped in 2036 and 2041 to the Nevada Energy (NVE) balancing area of northeastern California, which would require likely upgrades to out-of-CAISO transmission or new transmission to interconnect to the CAISO system.

Table 51: Updated mapping results (2036 & 2041) for the PG&E North of Greater Bay study area by resource type.

PG&E North of Greater Bay	In-Development		Mapped Generic (2036)		Total (2036)	Mapped Generic (2041)		Total (2041)
Res. Type (MW)	FCDS	EODS	FCDS	EODS	Total	FCDS	EODS	Total
Geothermal	11	-	3,175	-	3,186	3,175	-	**3,186**
Biomass	-	-	-	-	-	-	-	**-**
Onshore Wind	-	-	173	700	873	953	800	**1,753**
OOS Wind	-	-	-	-	-	-	-	**-**
Offshore Wind	-	-	-	-	-	1,607	-	**1,607**
Distributed Solar	-	18	-	-	18	-	-	**18**
Solar	-	25	-	1,003	1,028	-	1,003	**1,028**
Battery (4-hr)	363	-	-	-	363	-	-	**363**
Battery (8-hr)	-	-	-	-	-	-	-	**-**
LDES	-	-	-	-	-	-	-	**-**
Total by Status	**374**	**43**	**3,348**	**1,703**	**5,467**	**5,735**	**1,803**	**7,954**

Table 52: Updated mapping results (2036 & 2041) for the PG&E Greater Bay study area by resource type.

PG&E Greater Bay	In-Development		Mapped Generic (2036)		Total (2036)	Mapped Generic (2041)		Total (2041)
Res. Type (MW)	FCDS	EODS	FCDS	EODS	Total	FCDS	EODS	Total
Geothermal	-	-	-	-	-	-	-	**-**
Biomass	-	-	-	-	-	-	-	**-**
Onshore Wind	-	-	-	-	-	-	-	**-**
OOS Wind	-	-	-	-	-	4,000	-	**4,000**
Offshore Wind	-	-	-	-	-	-	-	**-**
Distributed Solar	-	10	-	-	10	-	-	**10**
Solar	-	-	755	930	1,685	985	930	**1,915**
Battery (4-hr)	628	-	-	-	628	-	-	**628**
Battery (8-hr)	-	-	96	-	96	96	-	**96**
LDES	-	-	310	-	310	310	-	**310**
Total by Status	**628**	**10**	**1,161**	**930**	**2,729**	**5,391**	**930**	**6,959**

Transmission Implications

Table 53 highlights the CAISO's 2024 White Paper transmission constraints with exceedances for the mapped 2036 and 2041 portfolios in the PG&E North of Greater Bay and Greater Bay study areas based on the busbar mapping transmission calculations. The table shows the resources mapped within each constraint, the calculated exceedance level, the identified 2024 White Paper upgrade, and the CPUC staff estimated likelihood of the upgrade being triggered.

In the 2036 portfolio, resource mapping results in one transmission constraint exceedance in the North of Greater Bay study area as seen in Table 53. It is likely to be triggered as noted in Section 6.3, but full TPP analysis will be needed to confirm. There are two upgrades triggered by the mapping in the Greater Bay study area in 2036.

In the 2041 portfolio, resource mapping results in three additional constraint exceedances, two in North of Greater Bay study area and one additional in the Greater Bay study area, as seen in Table 53. The increased exceedance in the Bellota-Weber 230 kV Line constraints makes the need for an

upgrade more likely and CPUC staff view the cost of the identified 2024 White Paper upgrade, costing an estimated $400 million, as effective given the amount of resources behind the constraint including LDES and onshore wind resources. The upgrade for the Woodland-Davis 115kV line is unlikely to be triggered due to the low exceedance, but more study is needed.

In the Greater Bay study area for the 2041 mapping, as noted in Section 6.3, the upgrade for the Birds Landing-Contra Costa 230kV Line is likely to be triggered although further study is needed. This exceedance has occurred in model years in previous cycles; however, in those cases, CAISO staff had noted that an exceedance was not likely. In 2036, the exceedance in Windmaster-Delta pumps 230 kV Line is unlikely to need the identified White Paper upgrade per CAISO staff although further study is needed, but the likelihood is high in 2041. CPUC staff consider this an effective solution however that would provide an estimated increase in capability of 6,034 MW and cost $417 million. For the Tesla-Bellota 230 kV Line constraint exceedance, the White Paper upgrade is not estimated to provide sufficient capacity to alleviate the exceedance, so an alternative option may be necessary and will be assessed in the TPP study.

The Wyoming wind mapped as interconnecting on new transmission to the Tesla 500 kV bus in 2041 is a key driver of these exceedances. Given the uncertainty around the actual location of any new transmission for the identified Wyoming wind resource, CPUC staff encourage additional analysis of any potential upgrades needed based on exceedances where the mapped Wyoming wind is a key driver. The 1,607 MW of offshore wind mapped to a new Humboldt 500 kV substation is included in both the 2036 and 2041 portfolios. This is a key driver of the Collinsville-Tesla 500 kV Line constraint.

NGBA contains significant amounts of mapped geothermal, which include out-of-state (OOS) resources. OOS geothermal was mapped largely to the Malin 500 kV substation although Northeast CA resources in NVE's balancing area were mapped to Hilltop and a new substation near Leavitt to their maximum resource potential amounts. An alternative is to tie all out of state resources into Malin. However, stakeholders voiced concerns about the amount of geothermal mapped to Malin in initial mappings, so CPUC staff chose to map several tie-in points for OOS geothermal.

It should be noted that while project-specific transmission costs have been included in the characterization for the Wyoming wind resource in the RESOLVE model, based on the TransWest Express line and other options, the specific cost assumptions for delivery at Tesla have not been characterized. The transmission cost assumptions in RESOLVE for Wyoming wind in the 2041 mapped portfolio are taken from the recent 2023-2024 20-year Transmission Outlook. Given the uncertainties around such transmission, CPUC staff is in the process of conducting further modeling and analysis to assess the cost and benefits of interconnecting Wyoming wind on new transmission to Northern California and understands CAISO is similarly conducting additional analysis on potential transmission solutions before recommending any upgrades driven by the Wyoming wind for approval.

As noted above, any upgrades identified as needed exclusively due to Northeastern California and Wyoming wind resources will have a high degree of uncertainty and warrant further study. In total for the 2036 portfolio, excluding those resources, mapped resources in the Greater Bay and North of Greater Bay study areas could need transmission upgrades costing between $4.0 – 4.4 billion based on CPUC staff analysis. For the 2041 mapped portfolio, including potential new transmission

for both the Northeastern California and Wyoming wind, potential transmission solutions needed could cost between $16.1– 16.5 billion.[20]

[20] The costs of the 4 GW of transmission that would be needed to deliver Wyoming wind to Tesla are estimated at $10.6 billion. The costs of the transmission that would be needed to bring OOS geothermal to Malin and several subs in Northeastern California are estimated at $1.5 billion.

Table 53: Summary of CAISO 2024 White Paper constraint exceedances in the PG&E North of Greater Bay and Greater Bay study areas caused by the updated mapping results for the 2036 and 2041 base case mapped portfolios.

Base Case (2036) Tx Constraint Exceedances		Existing Capability		FCDS Resources Mapped (In-Dev & Generic)**				EODS Resources Mapped**		Calculated Largest On-peak Exceedance	Calculated Off-peak Exceedance	FCDS Upgrade Info		CPUC staff estimated likelihood of being triggered
CAISO Zone	Constraint Name	On-Peak Capability (MW)	Off-Peak Capability (MW)	Onshore & Offshore Wind (MW)	Solar (MW)	Storage (MW)	Biomass & Geothermal (MW)	Onshore Wind (MW)	Solar (MW)			Capability Increase (MW)	Estimated Cost (millions)	
PG&E North of Greater Bay	Collinsville-Tesla 500 kV Line	3,379	7,706	402	755	729	3,197	700	1,543	**(862)**	**None**	8,645	$ 2,852	High
PG&E Greater Bay Area	Windmaster-Delta pumps 230 kV line	546	3,673	230	510	614	88	-	235	**(347)**	**None**	6,034	$ 417	Low
	Birds Landing-Contra Costa 230kV Line	656	1,176	230	-	398	441	-	22	**(298)**	**None**	1,766	$ 700	High

Base Case (2041) Tx Constraint Exceedances		Existing Capability		FCDS Resources Mapped (In-Dev & Generic)**				EODS Resources Mapped**		Calculated Largest On-peak Exceedance	Calculated Off-peak Exceedance	FCDS Upgrade Info		CPUC staff estimated likelihood of being triggered
CAISO Zone	Constraint Name	On-Peak Capability (MW)	Off-Peak Capability (MW)	Onshore & Offshore Wind (MW)	Solar (MW)	Storage (MW)	Biomass & Geothermal (MW)	Onshore Wind (MW)	Solar (MW)			Capability Increase (MW)	Estimated Cost (millions)	
PG&E North of Greater Bay Area	Collinsville-Tesla 500 kV Line	3,379	7,706	2,789	985	729	3,197	800	1,543	**(2,652)**	**None**	8,645	$ 2,852	High
	Woodland- Davis 115kV line	90	81	220	-	-	9	-	12	**(29)**	**(75)**	109	$ 9	Low
	Bellota-Weber 230kV line	1,661	2,539	220	1,996	1,553	30	-	1,769	**(604)**	**None**	460	$ 400	Medium
PG&E Greater Bay Area	Windmaster-Delta pumps 230 kV line	546	3,673	300	510	614	88	-	235	**(382)**	**None**	6,034	$ 417	High
	Tesla-Bellota 230 kV line	3,154	4,254	4,450	6	779	69	-	801	**(600)**	**None**	300	$ -	Medium
	Birds Landing-Contra Costa 230kV Line	656	1,176	300	-	398	441	-	22	**(333)**	**None**	1,766	$ 700	High

** Includes amounts from IRP baseline resources not in the White Paper baseline based on COD

7.3 Southern PG&E: PG&E Fresno and Kern Study Areas

Mapped Resources Summary

Table 54 and Table 55 summarize the resources mapped to the PG&E Fresno and Kern study areas. The tables summarize the identified in-development resources and mapped generic resources for the 2036 and 2041 portfolios by resource type and modeled deliverability status. These two study areas encompass resources mapped to substations in the San Joaquin Valley and the Central Coast including Morro Bay offshore wind resources.

Table 54: Updated mapping results (2036 & 2041) for the PG&E Fresno study area by resource type.

PG&E Fresno	In-Development		Mapped Generic (2036)		Total (2036)	Mapped Generic (2041)		Total (2041)
Res. Type (MW)	**FCDS**	**EODS**	**FCDS**	**EODS**	**Total**	**FCDS**	**EODS**	**Total**
Geothermal	-	-	170	-	170	170	-	**170**
Biomass	-	-	-	-	-	-	-	**-**
Onshore Wind	-	69	-	-	69	-	-	**69**
OOS Wind	-	-	-	-	-	-	-	**-**
Offshore Wind	-	-	-	-	-	-	-	**-**
Distributed Solar	-	34	-	-	34	-	-	**34**
Solar	166	988	3,688	2,690	7,532	6,348	2,690	**10,192**
Battery (4-hr)	980	-	-	-	980	-	-	**980**
Battery (8-hr)	35	-	2,432	-	2,467	2,432	-	**2,467**
LDES	-	-	140	-	140	140	-	**140**
Total by Status	**1,181**	**1,091**	**6,430**	**2,690**	**11,391**	**9,090**	**2,690**	**14,051**

Table 55: Updated mapping results (2035 & 2040) for the PG&E Kern study area by resource type

PG&E Kern	In-Development		Mapped Generic (2036)		Total (2036)	Mapped Generic (2041)		Total (2041)
Res. Type (MW)	**FCDS**	**EODS**	**FCDS**	**EODS**	**Total**	**FCDS**	**EODS**	**Total**
Geothermal	-	-	-	-	-	-	-	**-**
Biomass	-	-	-	-	-	-	-	**-**
Onshore Wind	-	-	-	-	-	-	-	**-**
OOS Wind	-	-	-	-	-	-	-	**-**
Offshore Wind	-	-	2,924	-	2,924	2,924	-	**2,924**
Distributed Solar	-	19	-	-	19	-	-	**19**
Solar	60	440	4,945	3,090	8,535	4,945	3,090	**8,535**
Battery (4-hr)	398	-	-	-	398	-	-	**398**
Battery (8-hr)	-	-	355	-	355	355	-	**355**
LDES	-	-	1,122	-	1,122	1,122	-	**1,122**
Total by Status	**458**	**459**	**9,346**	**3,090**	**13,353**	**9,346**	**3,090**	**13,353**

Transmission Implications

Table 56 highlights the CAISO's 2024 White Paper transmission constraints with exceedances for the mapped 2036 and 2041 portfolios in the PG&E Fresno and Kern study areas based on the busbar mapping transmission calculations. The table is split into the identified on-peak exceedances and off-peak exceedances for 2036 and 2041. The table shows the resources mapped within each constraint, the calculated exceedance level, the identified 2024 White Paper upgrade, and the Working Group estimated likelihood of the upgrade being triggered. In the 2036 and 2041portfolios, resource mapping results in no exceedances in the PG&E Kern study area. The PG&E Fresno area has five exceedances in both model years, as seen in Table 56.

In PG&E Fresno, the five exceedances will likely require transmission upgrades, particularly the Chowchilla-Le grand 115kV Line constraint as it has no available on-peak deliverability. CPUC staff view the identified 2024 White Paper upgrade for the Chowchilla-Le grand 115kV Line constraint, which costs an estimated $550 million and provides 1,211 MW of capability, as a cost-effective solution given the amount and type of resources mapped. CPUC staff note that the identified upgrade has an estimated time to construct that would make it not available in the 2036 timeframe; however, if the constraint were to become binding in a TPP policy study, the CAISO would seek to identify a potentially different solution with the shorter timeline needed. CPUC staff view the Borden-Storey #1 230kV line constraint's identified White Paper upgrade, estimated at $50 million, which would provide over 1,200 MW of additional deliverability, as cost-effective.

PG&E Fresno mapping results in five exceedances in both model years:

- Gates 500/230kV TB #11 constraint, which has a 2024 White Paper upgrade estimated to cost $35 million and to provide 10,038 MW of capability
- Gates 500/230kV TB #12 constraint, which has the same upgrade as the Gates 500/230kV TB #11 constraint
- Chowchilla-Le grand 115kV Line constraint, which has an upgrade estimated to cost $550 million and to provide 1,211 MW of capability
- Borden-Storey #1 230kV line constraint, which has an upgrade estimated to cost $50 million and to provide MW 1,247 MW of capability
- Mustang-Henrietta 230 kV line constraint, which has an upgrade estimated to cost $830 million and to provide 2,479 MW of capability

In both the 2036 and 2041 mapped portfolios, 2.9 GW of offshore wind mapped to the Morro Bay wind area is modeled as interconnecting to the existing Diablo Canyon 500 kV substation, based on past feedback from the Working Group staff that the existing Diablo Canyon 500 kV substation is likely able to accommodate the amount of offshore resources included in the portfolio at Morro Bay lease area. However, CPUC staff note that interconnection studies suggest the Diablo Canyon 500 kV substation may have difficulty accommodating additional gen-ties for offshore wind. CPUC staff request that CAISO also assess the potential to interconnect Morro Bay offshore wind at a new Morro Bay 500 kV substation, first identified in the 21-22 TPP offshore wind sensitivity with a then estimated cost of $110 million, if it is more cost-effective.

Table 56: Summary of CAISO 2024 White Paper constraint exceedances in the PG&E Kern and Fresno study areas caused by the Updated mapping results for the 2036 and 2041 base case mapped portfolios.

Base Case (2036) Tx Constraint Exceedances		Existing Capability		FCDS Resources Mapped (In-Dev & Generic)**				EODS Resources Mapped**		Calculated Largest On-peak Exceedance	Calculated Off-peak Exceedance	FCDS Upgrade Info		CPUC staff estimated likelihood of being triggered
CAISO Zone	Constraint Name	On-Peak Capability (MW)	Off-Peak Capability (MW)	Onshore & Offshore Wind (MW)	Solar (MW)	Storage (MW)	Biomass & Geothermal (MW)	Onshore Wind (MW)	Solar (MW)			Capability Increase (MW)	Estimated Cost (millions)	
PG&E Fresno Area	Gates 500/230kV TB #12	5,406	3,581	-	5,530	4,384	21	69	6,001	**(733)**	**(1,195)**	14,825*	$ 35	High
	Gates 500/230kV TB #11	5,337	5,027	-	5,844	4,192	12	69	5,563	**(920)**	**None**	10,038*	$ -	High
	Chowchilla-Le grand 115kV Line	-	158	-	5	270	3	-	290	**(273)**	**None**	1,211	$ 550	High
	Borden-Storey #1 230kV line	412	780	-	495	1,169	1	-	1,629	**(832)**	**None**	1,247	$ 50	Medium
	Mustang-Henrietta 230 kV line	5,581	5,617	2,924	5,742	2,727	-	-	3,817	**(1,175)**	**(2,132)**	2,479	$ -	High

Base Case (2041) Tx Constraint Exceedances		Existing Capability		FCDS Resources Mapped (In-Dev & Generic)**				EODS Resources Mapped**		Calculated Largest On-peak Exceedance	Calculated Off-peak Exceedance	FCDS Upgrade Info		CPUC staff estimated likelihood of being triggered
CAISO Zone	Constraint Name	On-Peak Capability (MW)	Off-Peak Capability (MW)	Onshore & Offshore Wind (MW)	Solar (MW)	Storage (MW)	Biomass & Geothermal (MW)	Onshore Wind (MW)	Solar (MW)			Capability Increase (MW)	Estimated Cost (millions)	
PG&E Fresno Area	Gates 500/230kV TB #12	5,406	3,581	-	7,120	4,384	21	69	6,001	**(1,862)**	**(2,451)**	14,825*	$ 35	High
	Gates 500/230kV TB #11	5,337	5,027	-	7,874	4,192	12	69	5,563	**(2,362)**	**(1,438)**	10,038*	$ -	High
	Tranquility-Helm 230kV Line	2,921	2,777	-	3,126	2,027	3	-	2,395	**(314)**	**None**	2,274	$ 1,500	Low
	Chowchilla-Le grand 115kV Line	-	158	-	125	270	3	-	290	**(291)**	**None**	1,211	$ 550	High
	Borden-Storey #1 230kV line	412	780	-	1,895	1,169	1	-	1,629	**(1,518)**	**(835)**	1,247	$ 50	Medium
	Mustang-Henrietta 230 kV line	5,581	5,617	2,924	5,742	2,727	-	-	3,817	**(1,175)**	**(2,132)**	2,479	$ -	High

** Includes amounts from IRP baseline resources not in the White Paper baseline based on COD

* Same upgrade addresses both of these exceeded constraints

7.4 Greater Tehachapi and LA Metro: SCE Northern and Metro Study Areas

Mapped Resources Summary

Table 57 and Table 58 summarize the resources mapped to the SCE Northern and Metro Study Areas, respectively. The tables summarize the identified in-development resources and mapped generic resources for the mapped 2036 and 2041 portfolios by resource type and modeled deliverability status. In addition to the Tehachapi region, the SCE Northern area includes portions of the Central Valley interconnecting to the SCE system which extends up to the Big Creek hydroelectric facilities. The SCE Metro study area includes the Lugo 500 kV substation, which is used in busbar mapping to represent imports into the CAISO from out-of-state resources. In 2041, 3,000 MW of New Mexico wind on new transmission is modeled as interconnecting to Lugo, per high level analysis on the costs and capability of new HVDC transmission lines as reported in the CAISO 20-year Transmission Outlook (2023-2024). In past TPPs, it was assumed that in-development Utah geothermal would use existing CAISO import capability on the Intermountain Power Plant (IPP) transmission system to Lugo. For this cycle CPUC staff request CAISO study alternative transmission options and import points due to the expiration of CAISO's transmission rights on the IPP transmission line in 2027[21].

Table 57: Mapping results (2036 & 2041) for the SCE Northern study area by resource type.

SCE Northern	In-Development		Mapped Generic (2036)		Total (2036)	Mapped Generic (2041)		Total (2041)
Res. Type (MW)	FCDS	EODS	FCDS	EODS	Total	FCDS	EODS	Total
Geothermal	-	-	-	-	-	-	-	-
Biomass	-	-	-	-	-	-	-	-
Onshore Wind	-	-	-	-	-	-	-	-
OOS Wind	-	-	-	-	-	-	-	-
Offshore Wind	-	-	-	-	-	-	-	-
Distributed Solar	-	21	-	-	21	-	-	**21**
Solar	197	1,363	4,980	-	6,540	5,906	-	**7,466**
Battery (4-hr)	1,884	-	-	-	1,884	-	-	**1,884**
Battery (8-hr)	523	-	757	-	1,280	757	-	**1,280**
LDES	-	-	1,680	-	1,680	1,680	-	**1,680**
Total by Status	**2,604**	**1,384**	**7,417**	**-**	**11,405**	**8,343**	**-**	**12,331**

[21] https://www.caiso.com/documents/transmissioncontrolagreement.pdf

Table 58: Updated mapping results (2036 & 2041) for the SCE Metro study area by resource type.

SCE Metro	In-Development		Mapped Generic (2036)		Total (2036)	Mapped Generic (2041)		Total (2041)
Res. Type (MW)	FCDS	EODS	FCDS	EODS	Total	FCDS	EODS	Total
Geothermal	203	-	-	-	203	-	-	**203**
Biomass	-	-	-	-	-	-	-	**-**
Onshore Wind	-	-	-	-	-	-	-	**-**
OOS Wind	-	-	-	-	-	3,000	-	**3,000**
Offshore Wind	-	-	-	-	-	-	-	**-**
Distributed Solar	-	5	-	-	5	-	-	**5**
Solar	-	-	486	-	486	886	-	**886**
Battery (4-hr)	1,589	-	-	-	1,589	-	-	**1,589**
Battery (8-hr)	10	-	6,455	-	6,465	6,455	-	**6,465**
LDES	-	-	-	-	-	-	-	**-**
Total by Status	**1,802**	**5**	**6,941**	**-**	**8,747**	**10,341**	**-**	**12,147**

Transmission Implications

Between the two study areas, no exceedances in the 2024 White Paper constraints occur based on the busbar mapping transmission calculations.

The 2041 mapped portfolio included 3,000 MW of New Mexico wind on new transmission. This amount of New Mexico wind is in addition to the almost 3,000 MW mapped as interconnecting at Palo Verde and utilizing the SunZia HVDC transmission line in 2036. CPUC mapped the New Mexico wind in line with the high-level results from the 20-year Transmission Outlook (2023-2024) which identified a new HVDC transmission line into the Lugo area as a potential transmission solution with an estimated cost of $3.5 – 4.9 billion. CPUC staff note that this solution is not driven by any specific transmission project being planned and is not a mandate to assume this specific intertie if alternative, more effective solutions are available. The 20-year Transmission Outlook also identified an alternative new transmission to Palo Verde. An example currently under development is the RioSol transmission line, a proposed AC-line paralleling the SunZia HVDC line. As with the Wyoming wind mapped to the Tesla area in Northern California, the 2023-2024 20-year Transmission Outlook cost estimate represents a higher cost than assumed in RESOLVE modeling for New Mexico wind. Given the uncertainty around the potential transmission solutions, complexity of any transmission line crossing multiple balancing areas, and lack of a clear existing planned transmission line, CPUC staff is in the process of conducting further modeling and analysis to assess the cost and benefits of interconnecting additional New Mexico wind on new transmission. Even though the resources are in the 2036 mapped portfolio, CPUC staff recommend CAISO continue to conduct analysis on potential transmission solutions and alternatives, as well as potential co-benefits for other balancing areas, rather than recommending a specific transmission upgrade for approval this TPP cycle.

The 2041 mapped portfolio included 3,000 MW of New Mexico wind on new transmission. This amount of New Mexico wind is in addition to the almost 3,000 MW mapped as interconnecting at Palo Verde and utilizing the SunZia HVDC transmission line in 2036. CPUC mapped the New Mexico wind in line with the high-level results from the 20-year Transmission Outlook (2023-2024) which identified a new HVDC transmission line into the Lugo area as a potential transmission solution with an estimated cost of $3.5 – 4.9 billion. CPUC staff note that this solution is not driven

by any specific transmission project being planned and is not a mandate to assume this specific intertie if alternative, more effective solutions are available. The 20-year Transmission Outlook also identified an alternative new transmission to Palo Verde. An example currently under development is the RioSol transmission line, a proposed AC-line paralleling the SunZia HVDC line. As with the Wyoming wind mapped to the Tesla area in Northern California, the 2023-2024 20-year Transmission Outlook cost estimate represents the cost assumed in RESOLVE modeling for New Mexico wind. Given the uncertainty around the potential transmission solutions, complexity of any transmission line crossing multiple balancing areas, and lack of a clear existing planned transmission line, CPUC staff is in the process of conducting further modeling and analysis to assess the cost and benefits of interconnecting additional New Mexico wind on new transmission. Even though the resources are in the 2036 mapped portfolio, CPUC staff recommend CAISO continue to conduct analysis on potential transmission solutions and alternatives, as well as potential co-benefits for other balancing areas, rather than recommending a specific transmission upgrade for approval this TPP cycle.

7.5 Greater Kramer and Southern Nevada: SCE North of Lugo Study Area and East of Pisgah Study Area

Mapped Resources Summary

Table 59 and Table 60summarize the resources mapped to the SCE North of Lugo Study Area and the East of Pisgah Study Area respectively. The tables summarize the identified in-development resources and mapped generic resources for the mapped 2036 and 2041 portfolios by resource type and modeled deliverability status. The SCE North of Lugo Study area contains the Greater Kramer area and the SCE system up to the Control substation, which includes the Silver Peak CAISO import intertie. The East of Pisgah Study Area contains the resources mapped to in-CAISO areas of Southern Nevada (resources mapped to substations in the GLW, VEA, and SCE systems in the area) and out-of-CAISO resources mapped as interconnecting to intertie points within the study area. These OOS out-of-CAISO resources include Wyoming and Idaho Wind, as well as Northern Nevada geothermal, all modeled as interconnecting at the existing CAISO system's Harry Allen and Eldorado interties.

Table 59: Updated mapping results (2036 & 2041) for the SCE North of Lugo study area by resource type.

SCE North of Lugo	In-Development		Mapped Generic (2036)		Total (2036)	Mapped Generic (2041)		Total (2041)
Res. Type (MW)	FCDS	EODS	FCDS	EODS	Total	FCDS	EODS	Total
Geothermal	-	-	-	-	-	-	-	-
Biomass	-	-	-	-	-	-	-	-
Onshore Wind	-	-	-	-	-	-	-	-
OOS Wind	-	-	-	-	-	-	-	-
Offshore Wind	-	-	-	-	-	-	-	-
Distributed Solar	-	10	-	-	10	-	-	10
Solar	70	236	556	50	912	556	50	912
Battery (4-hr)	339	-	20	-	359	20	-	359
Battery (8-hr)	6	-	128	-	134	128	-	134
LDES	-	-	286	-	286	286	-	286
Total by Status	**415**	**246**	**990**	**50**	**1,701**	**990**	**50**	**1,701**

Table 60: Updated mapping results (2036 & 2041) for the East of Pisgah study area by resource type.

East of Pisgah	In-Development		Mapped Generic (2036)		Total (2036)	Mapped Generic (2041)		Total (2041)
Res. Type (MW)	FCDS	EODS	FCDS	EODS	Total	FCDS	EODS	Total
Geothermal	45	-	870	-	915	870	-	**915**
Biomass	-	-	-	-	-	-	-	**-**
Onshore Wind	-	-	321	-	321	321	-	**321**
OOS Wind	-	-	4,100	-	4,100	5,600	-	**5,600**
Offshore Wind	-	-	-	-	-	-	-	**-**
Distributed Solar	-	-	-	-	-	-	-	**-**
Solar	65	650	3,850	1,453	6,018	4,350	1,453	**6,518**
Battery (4-hr)	685	-	-	-	685	-	-	**685**
Battery (8-hr)	-	-	607	-	607	607	-	**607**
LDES	-	-	960	-	960	960	-	**960**
Total by Status	**795**	**650**	**10,707**	**1,453**	**13,605**	**12,707**	**1,453**	**15,605**

Transmission Implications

Busbar mapping results in one transmission constraint exceedance in the 2036 portfolio SCE East of Pisgah study area based on the transmission calculations, as seen in Table 61. The table shows the resources mapped within each constraint, the calculated exceedance level, the identified 2024 White Paper upgrade, and the CPUC staff estimated likelihood of the upgrade being triggered.

In the East of Pisgah study area, the 2036 mapping results in a large exceedance in the Lugo-Victorville Area constraint, that increases significantly in the 2041 mapping. This level of exceedance will likely trigger the identified upgrade. This level of exceedance will almost certainly trigger the identified upgrade. CPUC staff note the amount of resources mapped is much greater than what is mapped in the 2035 portfolio in the 25-26 TPP base case. A key factor to any transmission need is the mapped out-of-state Wyoming and New Mexico Wind with planned interties in this constraint as the Eldorado, Harry Allen, and Palo Verde interties are included. Like the 25-26 TPP portfolio mapping, the portfolio includes roughly 400 MW of Central Nevada geothermal mapped as in-CAISO resources and interconnecting to the Beatty substation within the GLW-VEA system. These resources will likely require a long gen-tie (50+ miles) from potential geothermal areas in Central Nevada to the Beatty interconnection point with potential costs of $200-700 million dollars, per CPUC staff high-level estimates.

In the 2036 and 2041 portfolio mappings, 3,000 MW and 4,500 MW, respectively, of Wyoming wind are modeled interconnecting to the Eldorado intertie; however, only 1,500 MW of this wind can utilize the in-development subscriber PTO TransWest line, which has an estimated cost of $2.1 billion. As a subscriber model, the transmission costs of TransWest would not be included in the transmission access charge (TAC) but incorporated through any power purchase agreements for wind resources; however, the costs still impact ratepayers. Since both the SWIP-North and TransWest transmission projects have been approved, they are not included in the total cost estimates of additional transmission that could be triggered by the mapping results discussed. The additional 1,500 MW of Wyoming wind mapped to Eldorado in 2036 could be scheduled on additional TransWest upgrades estimated to cost $2.3 billion or delivered via a different theoretical line.

Table 61: Summary of CAISO 2024 White Paper constraint exceedances in the SCE North of Lugo and East of Pisgah study areas caused by the Updated mapping results for the 2036 (Top) and 2041 (Bottom) base case portfolios.

Base Case (2036) Tx Constraint Exceedances		Existing Capability		FCDS Resources Mapped (In-Dev & Generic)**				EODS Resources Mapped**		Calculated Largest On-peak Exceedance	Calculated Off-peak Exceedance	FCDS Upgrade Info		CPUC staff estimated likelihood of being triggered
CAISO Zone	Constraint Name	On-Peak Capability (MW)	Off-Peak Capability (MW)	Onshore & Offshore Wind (MW)	Solar (MW)	Storage (MW)	Biomass & Geothermal (MW)	Onshore Wind (MW)	Solar (MW)			Capability Increase (MW)	Estimated Cost (millions)	
East of Pisgah Area	Lugo - Victorville area constraint	10,105	12,605	8,942	7,011	5,282	915	-	7,933	**(2,933)**	**(452)**	6,800	$ 2,165	High

Base Case (2041) Tx Constraint Exceedances		Existing Capability		FCDS Resources Mapped (In-Dev & Generic)**				EODS Resources Mapped**		Calculated Largest On-peak Exceedance	Calculated Off-peak Exceedance	FCDS Upgrade Info		CPUC staff estimated likelihood of being triggered
CAISO Zone	Constraint Name	On-Peak Capability (MW)	Off-Peak Capability (MW)	Onshore & Offshore Wind (MW)	Solar (MW)	Storage (MW)	Biomass & Geothermal (MW)	Onshore Wind (MW)	Solar (MW)			Capability Increase (MW)	Estimated Cost (millions)	
East of Pisgah Area	Lugo - Victorville area constraint	10,105	12,605	11,942	7,511	5,282	915	-	7,933	**(5,008)**	**(2,847)**	6,800	$ 2,165	High

** Includes amounts from IRP baseline resources not in the White Paper baseline based on COD

* Same upgrade addresses both of these exceeded constraints

In addition to the 1,500 MW TransWest HVAC line that will deliver Wyoming wind to Eldorado, additional transmission projects could be studied to secure the remaining 1,500 MW of the TransWest HVDC line from Wyoming to IPP and achieve the 3,000 MW of Wyoming wind mapped at Eldorado in 2036. One option could be to develop a second HVAC line from IPP to Eldorado, which is assumed in the mapping results. However, similarly to the New Mexico wind mapped to Palo Verde in the SCE Eastern study area, CPUC staff do not have a specific potential transmission solution identified nor are aware of any specific transmission project being planned for the additional 1,500 MW of Wyoming Wind in both 2036 and 2041. In 2041, as with the Wyoming wind mapped to the Tesla area in Northern California, the 20-year Transmission Outlook (2023-2024) identified a potential high-level solution costing an estimated $4.1-5.2 billion.

Given the uncertainty around the potential transmission solutions, complexity of any transmission line crossing multiple balancing areas, and lack of a clear existing planned transmission line, CPUC staff continue to conduct further modeling and analysis to assess the cost and benefits of interconnecting additional OOS wind on new transmission. Even though the resources are in the 2036 mapped portfolio, CPUC staff recommend CAISO similarly continue to conduct additional analysis on potential transmission solutions and alternatives, as well as potential co-benefits for other balancing areas, rather than recommending a specific transmission upgrade for approval this TPP cycle.

For the 2036 portfolio, the mapped resources in the two study areas likely need transmission upgrades, potentially costing up to $4.5 billion, including OOS transmission to deliver an additional 1,500 MW of Wyoming wind from the terminus of TransWest at IPP to Eldorado. Since RESOLVE selected the additional 1,500 MW of Wyoming wind in 2036 rather than 2041, the estimated costs for the 2041 portfolio are also $4.5 billion.

7.6 Riverside, Arizona, San Diego, and Imperial: SCE Eastern and San Diego Gas & Electric Study Areas

Mapped Resources Summary

Table 62 and Table 63summarize the resources mapped to the SCE Eastern and SDG&E Study Areas. The tables summarize the identified in-development resources and mapped generic resources for the 2036 and 2041 portfolios by resource type and modeled deliverability status. The SCE Eastern study area includes out-of-CAISO resources with OOS New Mexico wind modeled as interconnecting to the Palo Verde intertie and resources (geothermal and some in-development storage) in the Imperial Irrigation District (IID) modeled as interconnecting to the Mirage-Devers intertie. The SDG&E area also includes IID geothermal resources interconnecting to the CAISO through the Imperial Valley intertie. Finally, the SDG&E area includes onshore wind mapped to Baja California, Mexico, but interconnecting directly to the CAISO at the East County buses.

Table 62: Updated mapping results (2036 & 2041) for the SCE Eastern study area by resource type.

SCE Eastern	In-Development		Mapped Generic (2036)		Total (2036)	Mapped Generic (2041)		Total (2041)
Res. Type (MW)	FCDS	EODS	FCDS	EODS	Total	FCDS	EODS	Total
Geothermal	30	-	70	-	100	70	-	**100**
Biomass	-	-	-	-	-	-	-	**-**
Onshore Wind	-	-	263	60	323	263	60	**323**
OOS Wind	285	-	2,651	-	2,936	4,151	-	**4,436**
Offshore Wind	-	-	-	-	-	-	-	**-**
Distributed Solar	-	-	-	-	-	-	-	**-**
Solar	175	2,685	1,220	2,530	6,610	1,820	3,260	**7,940**
Battery (4-hr)	1,342	-	-	-	1,342	-	-	**1,342**
Battery (8-hr)	100	-	-	-	100	-	-	**100**
LDES	-	-	950	-	950	950	-	**950**
Total by Status	**1,932**	**2,685**	**5,154**	**2,590**	**12,361**	**7,254**	**3,320**	**15,191**

Table 63: Updated mapping results (2036 & 2041) for the SDG&E study area by resource type.

SDG&E	In-Development		Mapped Generic (2036)		Total (2036)	Mapped Generic (2041)		Total (2041)
Res. Type (MW)	FCDS	EODS	FCDS	EODS	Total	FCDS	EODS	Total
Geothermal	25	-	505	-	530	505	-	**530**
Biomass	-	-	-	-	-	-	-	**-**
Onshore Wind	-	-	990	-	990	2,290	-	**2,290**
OOS Wind	-	-	-	-	-	-	-	**-**
Offshore Wind	-	-	-	-	-	-	-	**-**
Distributed Solar	-	-	-	-	-	-	-	**-**
Solar	238	388	3,703	3,671	8,000	3,703	3,901	**8,230**
Battery (4-hr)	1,251	-	-	-	1,251	-	-	**1,251**
Battery (8-hr)	50	-	307	-	357	307	-	**357**
LDES	-	-	500	-	500	500	-	**500**
Total by Status	**1,564**	**388**	**6,005**	**3,671**	**11,628**	**7,305**	**3,901**	**13,158**

Transmission Implications

Table 64 highlights the CAISO's 2024 White Paper transmission constraints with exceedances for the 2036 portfolio (Top table) and 2041 portfolio (Bottom table) in the SCE Eastern and SDG&E study areas based on the busbar mapping transmission calculations. The tables show the resources mapped within each constraint, the calculated exceedance level, the identified 2024 White Paper upgrade, and the CPUC staff estimated likelihood of the upgrade being triggered.

The SDG&E study area has no exceedances in both the 2036 and 2041 portfolio mappings. The exceedance of the Chicarita 138 kV constraint observed in the 25-26 TPP has gone away after the removal of 300 MW of batteries that were previously in the modeling baseline.

The SCE Eastern study area has a single constraint exceedance in both 2035 and 2040 portfolio mappings. The exceedance is in the Eagle Mountain constraint which has a 2024 White Paper identified 600 MW capability upgrade costing an estimated $1.2 billion. Study by CAISO during the 25-26 TPP revealed that 145 MW of imports modeled at Blythe are driving this constraint and that the appropriate upgrade to accommodate those imports may be different from the identified White Paper upgrade.

The 2036 mapped portfolio includes 2,936 MW of New Mexico wind on new transmission mapped as interconnecting to the Palo Verde intertie point. 1,500 MW of this wind has been scheduled on the in-development subscriber-based SunZia line, though approximately another 1,500 MW may require additional new transmission to reach Palo Verde from SunZia's endpoint at Pinal Central in Arizona.[22] While not a CAISO TAC upgrade, the SunZia project has an estimated cost of $1.9 billion but since it has already been approved by the CAISO, it is not included in the total cost estimates of new transmission potentially triggered by this portfolio. The assumed new transmission needed to deliver the additional 1,500 MW of New Mexico wind to Palo Verde by 2036) has a cost estimate of $2.5 billion. There is also an additional 3,000 MW of New Mexico wind mapped to Palo Verde in 2041.

In total, the 2036 and 2041 mapped portfolio could require in-CAISO upgrades up to $1.2 billion plus additional transmission costs to bring out-of-CAISO resource in Imperial and New Mexico to the CAISO border. In 2036, OOS transmission costs for New Mexico wind are estimated at $2.5 billion. In 2041, OOS transmission costs for the additional 3 GW of New Mexico wind mapped to Palo Verde are estimated at $5.5 billion.

[22] This additional capacity could either be scheduled on the SunZia RioSol project or on other new transmission.

Table 64. Summary of CAISO 2024 White Paper constraint exceedances in the SCE Eastern and SDG&E study areas caused by the Updated mapping results for the 2036 (Top) and 2041 (Bottom) base case portfolios.

Base Case (2036) Tx Constraint Exceedances		Existing Capability		FCDS Resources Mapped (In-Dev & Generic)**				EODS Resources Mapped**		Calculated Largest On-peak Exceedance	Calculated Off-peak Exceedance	FCDS Upgrade Info		CPUC staff estimated likelihood of being triggered
CAISO Zone	Constraint Name	On-Peak Capability (MW)	Off-Peak Capability (MW)	Onshore & Offshore Wind (MW)	Solar (MW)	Storage (MW)	Biomass & Geothermal (MW)	Onshore Wind (MW)	Solar (MW)			Capability Increase (MW)	Estimated Cost (millions)	
SCE Eastern Area	Eagle Mountain Constraint	-	392	-	300	460	100	60	292	(599)	None	600	$ 1,182	High

Base Case (2041) Tx Constraint Exceedances		Existing Capability		FCDS Resources Mapped (In-Dev & Generic)**				EODS Resources Mapped**		Calculated Largest On-peak Exceedance	Calculated Off-peak Exceedance	FCDS Upgrade Info		CPUC staff estimated likelihood of being triggered
CAISO Zone	Constraint Name	On-Peak Capability (MW)	Off-Peak Capability (MW)	Onshore & Offshore Wind (MW)	Solar (MW)	Storage (MW)	Biomass & Geothermal (MW)	Onshore Wind (MW)	Solar (MW)			Capability Increase (MW)	Estimated Cost (millions)	
SCE Eastern Area	Devers-Red Bluff Constraint	6,133	7,328	6,021	2,648	2,320	-	-	5,909	(33)	(443)	532	N/A	Low
	Eagle Mountain Constraint	-	392	-	300	460	100	60	292	(599)	None	600	$ 1,182	High
	Serrano-Alberhill-Valley Constraint	6,651	10,182	6,341	1,095	4,388	100	60	5,650	(645)	None	1,522	N/A	Low

** Includes amounts from IRP baseline resources not in the White Paper baseline based on COD

8. Other Assumptions for TPP

Guidance previously provided to CAISO as part of the annual CPUC portfolio transmittal was included in a document historically called the "Unified Inputs & Assumptions". CPUC and CAISO staff agree that any necessary content be included in this Report. This section describes the additional modeling assumptions the CPUC provides to the CAISO's TPP, besides the portfolio and busbar mapping assumptions described in the rest of this Report.

8.1 Gas Capacity Not Retained

The RESOLVE model aggregates the amount of gas generation not retained (due to economic optimization) by resource category. Unit-specific information is not modeled. Resource portfolios may also include forced-in gas retirements (e.g., as part of portfolios focused on specific policy questions or IRP plans). As an input into RESOLVE, they are specifically not included in the RESOLVE resource category of gas generation not retained; however, for busbar mapping for the TPP, these resources also need to be accounted for and mapped.

Because the TPP studies require modeling of specific units and locations, CPUC staff shares the specific list of units for CAISO to model as offline, which can be seen in Appendix F. The list is for use in the TPP studies only and should not be interpreted as the CPUC directing retirement of specific gas generators, nor the CPUC attempting to assert authority to retire specific units, nor an expectation of which units are likely nearing retirement. The Busbar Mapping Methodology (Appendix A) outlines criteria for selecting which specific units to model as not retained.

In the 26-27 TPP, RESOLVE determined that non-retention of some gas capacity was economically optimal: in the Base Case, 1,674 MW of gas capacity was not retained, while 1,214 MW was not retained in the Sensitivity portfolio. After scoring the existing gas units based on the Busbar Mapping Methodology (Appendix A), units were identified for non-retention to align with the zonal and technology-level decisions made by RESOLVE. Production cost modeling in SERVM then identified whether the unit selections and zonal flow constraints between Northern and Southern California would increase the loss of load expectation (LOLE) above the reliability standard of 0.1 events per year. The list of non-retained units released with the November 2025 Ruling resulted in heightened LOLE in Northern California; therefore staff have since modified the list to retain more units in PG&E. When making non-retention decisions, large units that would result in significant exceedances to the non-retention MW quantities were skipped, resulting in the selection of lower-scoring units for non-retention instead.

Some of the economically non-retained gas capacity is sited within local areas. Staff maps battery storage resources into the local areas as a one-for-one replacement for non-retained gas capacity in order to meet local reliability, up to the limits reported in the CAISO 2026 Local Capacity Technical Report.[23]

The 26-27 TPP portfolios also reflect the assumed retirements of gas resources within the modeling baseline, which are not reflected in the portfolio summaries and mapping results. Those baseline retirements include all the gas-fired once-through cooling plants (~3.7 GW) and assumed linear phaseout of in front of the meter combined heat and power plants (CHP) from 2031-2040, with all CHPs (1,964 MW) assumed retired in 2040. These baseline assumptions are the same used for the 25-26 TPP portfolio. CPUC staff recommend utilizing the gas plant list developed for the 24-25

[23] https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/Local-capacity-requirements-process-2026

TPP for the locations of the CHP plants captured in the IRP baseline.[24] CPUC staff recommend assuming the same CHP plants identified for the 25-26 TPP 10-year portfolios are also retired in the 26-27 TPP 10-year portfolio and the full CHP list is retired for the 2041 portfolios.

8.2 Demand Response

This subsection provides guidance on modeling treatment of demand response (DR) programs in network reliability studies including allocating capacity from those programs to transmission substations. The CPUC's Resource Adequacy (RA) proceeding (currently R.23-10-011 or its successor) determines what resources can provide system and local resource adequacy capacity. Current RA accounting rules indicate that all existing DR programs count to the extent those program impacts are located within the relevant geographic areas being studied for system and local reliability. For its TPP studies, the CAISO utilizes data from Supply-Side Resource Demand Response, which is registered in the CAISO market as either dispatchable, Emergency DR (RDRR) or Economic DR (PDR).

By nature, impacts from DR programs are distributed across large geographies. In order for these impacts to be applied in network reliability studies, DR program capacity must be allocated to transmission substations.

The 26-27 TPP portfolios do not include any model-driven DR resource; however, individual LSEs may have procured DR not captured in the IRP modeling effort. To this end, CPUC staff requests the Investor-Owned Utilities (IOUs), in their capacity as Participating Transmission Owners (PTOs), to submit this information through the CAISO's annual TPP Study Plan stakeholder process. To the extent possible, this data should also allocate impacts of DR programs administered by CCAs or procured from third parties. Because the data requirements specified in both filings contain confidential information, the CPUC expects the CAISO and the IOUs to exchange data using their own non-disclosure agreements.

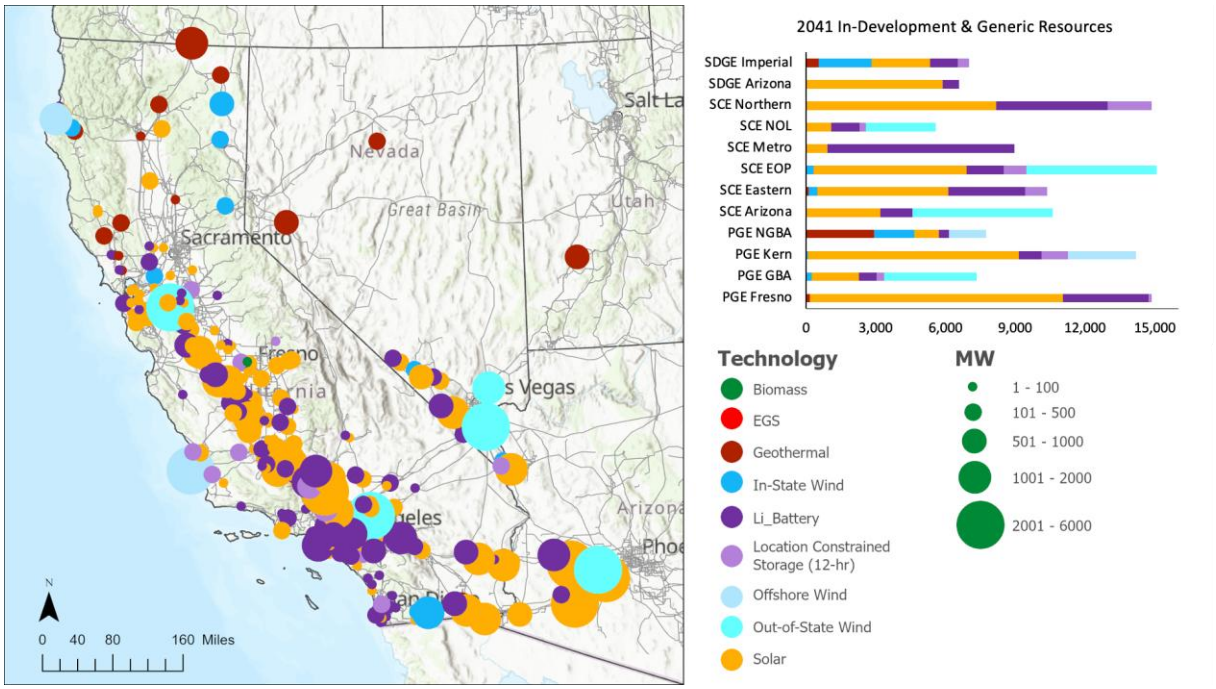
[24] Gas Capacity Not Retained Assumption List for the 24-25 TPP Base Case and Sensitivity Portfolios, 02/15/2024, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2023-irp-cycle-events-and-materials/assumptions-for-the-2024-2025-tpp/gasnotretained_mappingresults.xlsx

9. Conclusion and Next Steps

The CPUC's policy and reliability base case portfolio and the Limited Wind sensitivity portfolio have been mapped to busbars in reasonable accordance with the criteria as described in the Methodology (see Appendix A) and with consideration of state policy objectives and stakeholder feedback. Staff mapped two model years for both portfolios, 2036 and 2041.

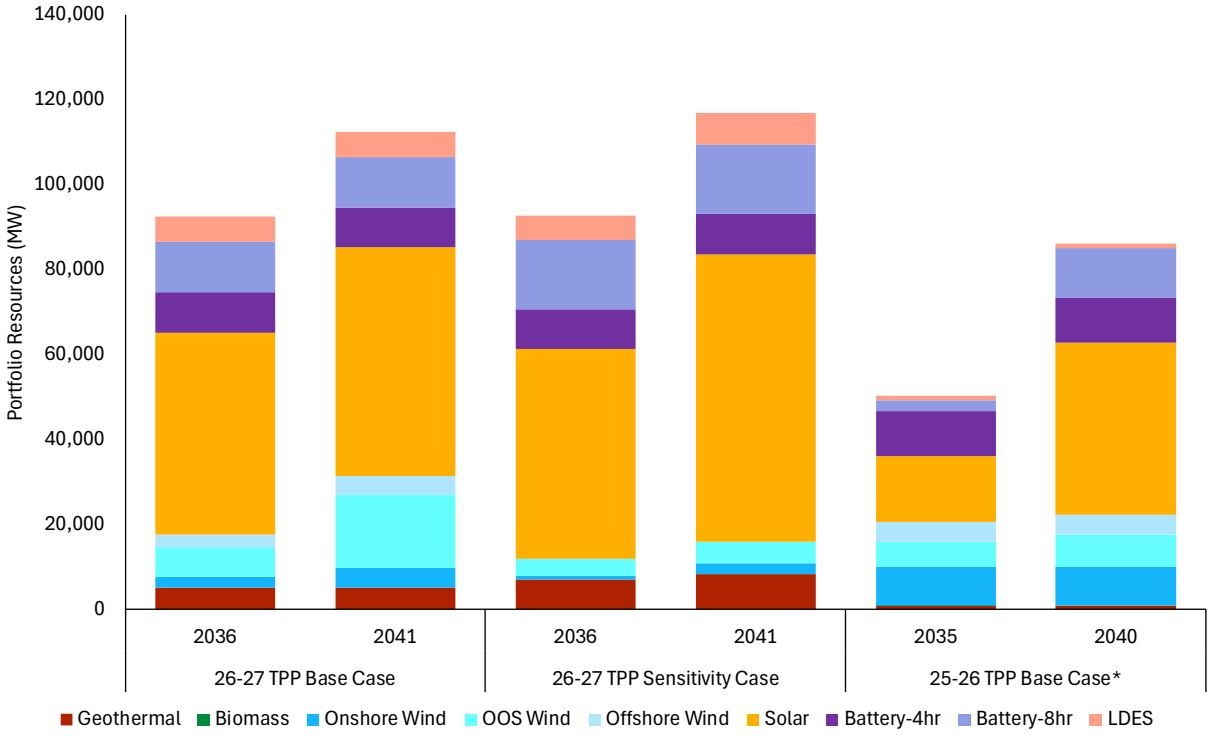
In total for the base case portfolio, Working Group staff mapped over 85,100 MW of renewables, including 13,000 MW of out-of-state wind on new out-of-state transmission and 4,500 MW of offshore wind, and 27,200 MW of storage, including 5,900 MW of long duration storage, in the 2041 portfolio to substations. Figure 12 depicts a visual map-based representation conveying the approximate locations and amounts of resources mapped for the 2041 base case portfolio.

Figure 12: Map of the updated busbar mapping results for the 26-27 TPP base case portfolio (2041) shown by mapped interconnection location and resource type.



The updated mapping results of the 2036 and 2041 mapped portfolios will be transmitted to the CAISO for use in the reliability and policy-driven base case in the 2026-2027 TPP. Figure 13 compares the resources mapped in the 2026-2027 TPP base case portfolio for the two study years, 2036 and 2041, as well as the Limited Wind sensitivity portfolio, with the base case portfolio for the current 2025-2026 TPP and for the previously approved 24-25 Transmission Plan.

Figure 13: Final resource comparison of the 2026-2027 TPP Base Case portfolio and Limited Wind Sensitivity portfolio in the 2036 and 2041 model years with the 25-26 TPP Base Case, adjusted for updated baseline.



** 25-26 TPP portfolio has been adjusted to account for updated baseline used in 26-27 TPP portfolios*

In busbar mapping, the Working Group mapped specific resource types to individual substations using an array of data and analysis that are a part of the busbar mapping criteria detailed in the Busbar Mapping Methodology (Appendix A). Several portions of this analysis rely on data attributable to specific projects (e.g., interconnection queue status or permitting status for commercial development interest criteria or probable water source at potential PSH locations). However, the Working Group neither rejects nor endorses specific projects in its mapping decisions. Rather, the Working Group seeks to maximize the alignment of the entire portfolio with busbar mapping criteria. These criteria help ensure that the California energy planning process selects portfolios that not only meet state climate policy, but that are cost-effective, compatible with conservation priorities, and socially equitable as well.

As was the case for recent past TPP base case portfolio mapping results, the large number of resources mapped due to a higher load scenario, more stringent greenhouse gas emissions targets, and longer modeling timeframes results in a significant number of transmission constraint exceedances being identified that likely will require significant transmission upgrades. Based on preliminary CPUC staff estimates derived from the busbar mapping analysis, the 2036 portfolio mapping of the 26-27 TPP base case may need transmission upgrades that cost between $21.2 billion and $21.7 billion, including the full costs of likely out-of-CAISO transmission needed for

OOS wind and out-of-CAISO resources. For the 2041 portfolio, that estimated total cost projection of upgrades potentially needed increases to between $43.1 - 45.5 billion.[25]

For comparison, the Modeling Assumptions Report for the still ongoing 2025-2026 TPP identified the potential need for upgrades costing between $10 - $20.4 billion in 2035 and $19.7 – 30.6 billion in 2040. The 26-27 TPP Base Case mapped portfolios identify fewer in-CAISO upgrades than the 25-26 TPP Base Case mapped portfolios: 16 upgrades in 2041 in the 26-27 TPP vs. 22 upgrades in 2040 in the 25-26 TPP. However, the 26-27 TPP base case portfolio identifies the need for more OOS transmission than the 25-26 TPP portfolio. More discussion on OOS transmission is included below.

These are only rough estimates by CPUC staff of what could be needed for the base case portfolio, and an exceedance identified in busbar mapping does not determine if transmission upgrades are needed. Actual transmission needs and their costs may differ significantly once the portfolio is fully studied by the CAISO through the 26-27 TPP. Additionally, these numbers do not reflect what upgrades may be recommended for approval in the upcoming CAISO 25-26 Transmission Plan. The 25-26 TPP could result in approval of upgrades that have been identified as potentially needed for the 26-27 TPP base case and it could also identify areas where upgrades are not actually required. Furthermore, CAISO's TPP is not required to recommend approval of upgrades that address transmission needs only relevant in 2041 or for which construction can be started in future years and still be finished in time to meet the need.

The final busbar mapping of resources results in numerous transmission exceedances, which are described in more detail in Section 7 above. The transmission constraint analysis conducted in busbar mapping is centered on only the CAISO's Balancing Area Authority (BAA). The transmission capability and potential upgrades needed in other BAAs are not fully known. For example, the geothermal resources mapped within the Imperial Irrigation District's (IID's) BAA have been assessed within the CAISO transmission system at the interties where the resources would be imported from the IID's system. As discussed in Section 7.6, the amount of geothermal mapped will likely require new transmission in the IID system for those resources to reach the CAISO intertie. Similarly, resources mapped to Nevada Energy (NVE) substations may require upgrades in NVE's area to reach their identified CAISO interties. Additionally, resources mapped in the CAISO may require transmission upgrades or expansion not included in the analysis based on the 2024 White Paper. As noted in Sections 7.2 and 7.5, both Northern California wind mapped to areas in Lassen and Modoc counties and Central Nevada geothermal are modeled as interconnecting to CAISO but will likely require significant new gen-ties or transmission expansion to interconnect. The CAISO Tariff allows for the approval of new transmission to assure all import resources identified in the base case portfolio are deliverable, and the TPP systematically assesses the need for new import-driven transmission.[26]

The grid is ever evolving and for this reason the CPUC transmits portfolios to the CAISO annually for transmission planning. A key criterion for busbar mapping is consistency with prior portfolios, particularly base cases, as reasonable. The goal is to capture the most current available information while also ensuring continuity from year to year. Thus, the Working Group strives for the mapping

[25] OOS costs do not include portions of projects that have already been approved and scheduled including SWIP North, 546 MW of SunZia 1, and 1,500 MW of TransWest Express Desert Link.
[26] See the approved 24-25 Transmission Plan, section 6.1.2 for more detail.

of resources to remain consistent with previous portfolios and to utilize the transmission upgrades already identified in previous TPPs. This consistency also helps indicate which transmission exceedances created by the mapping results for the 2026-2027 TPP portfolio could be alleviated by upgrades being studied in current ongoing 2025-2026 TPP, thereby enhancing transmission planning. While the Working Group strove for consistency with past mappings in this TPP cycle, the increased load seen in the 2024 IEPR, which lead to nearly 50% more resources identified in the 2036 26-27 TPP base case portfolio relative to the 2035 25-26 TPP base case, made it difficult to align with the previous TPP portfolio's mappings and lead to a larger number of flags within this criterion than in previous years.

9.1 Guidance on the 2026-2027 TPP Base Case Portfolio

The mapped results, as noted above, highlight the likely need for a significant number of transmission upgrades; however, some of the identified exceedances are similar to those observed in the 25-26 TPP base case which is still the subject of ongoing analysis. The mapping also results in a significant need for new transmission beyond the CAISO's BAA to interconnect the OOS and out-of-BAA wind and geothermal resources to CAISO interties.

The 2024 White Paper upgrades identified as likely needed for the 2036 and 2041 mapping results were mostly in the northern study areas, with the already approved transmission upgrades accommodating most of the resources mapped to the southern study areas. CPUC staff estimate that the potential upgrades within the CAISO for the 2036 portfolio, based on the 2024 White Paper assumptions, have a total cost ranging from $8.3 – $8.8 billion. In addition, new transmission needed to interconnect additional out-of-state Wyoming and New Mexico wind and Northen California wind in NVE could cost up to $12.1 billion. In the 2041 portfolio, CPUC staff estimate that the in-CAISO upgrades potentially needed could cost between $10 – $12.4 billion based on 2024 White Paper assumptions and additional analysis, while offshore wind and out-of-state resources would likely need upgrades costing $33 billion. Upgrades that may be approved in the 2025-26 TPP may reduce these amounts as such upgrades would likely alleviate many of the identified exceedances. CPUC staff provide additional guidance on the potential transmission implications in each CAISO study area in Section 7.

The transmission utilization analysis conducted in busbar mapping is limited in scope and designed to highlight areas that may require transmission solutions to accommodate resources mapped. Busbar mapping and RESOLVE modeling are not power flow modeling tools and cannot identify with 100% accuracy where transmission is needed and what upgrades are required – that is the role of the CAISO's full TPP analysis. Therefore, the CAISO's full TPP analysis may identify alternative, less costly upgrades than those assumed in busbar mapping. CPUC staff encourage the CAISO to assess alternative and potentially less costly upgrades particularly for the exceedances discussed in Section 7 where the amount of resources behind the exceedances may not warrant the size and cost of the identified 2024 White Paper upgrades.

If the TPP policy-driven assessment[27] of the base portfolio identifies the need for upgrades, the CAISO would typically recommend those upgrades to the CAISO Board of Governors for approval as policy-driven transmission upgrades. The CAISO retains more flexibility to approve or decline projects in situations where they are 1) identified only in the reliability assessments, 2) identified as

[27] The TPP assesses reliability, policy, and economic driven projects.

needed for only the 2041 mapping results, or 3) if the estimated build time does not necessitate immediate commencement to meet the identified resource need. CPUC staff will continue to coordinate with CAISO staff and will also engage in the CAISO's Transmission Planning Process.

Additional Analysis of Transmission Needs for Out-of-State and In-state Wind on New Out-of-CAISO Transmission and Offshore Wind

The 26-27 TPP portfolio is substantially bigger than the 25-26 TPP portfolio, selecting 90.6 GW of resources in 2036 vs. 63.1 GW in 2035 and 110.6 GW in 2041 vs. 99.1 GW in 2040. 6.3 of the additional 11.5 GW selected between 2040 and 2041 are OOS wind, chiefly because capacity expansion modeling done with RESOLVE identifies OOS wind as the cheapest non-storage resource with high capacity value.[28] Critically, OOS wind is still optimally selected in large amounts by RESOLVE even when the costs of building the new interregional transmission needed to interconnect OOS wind to the California grid are accounted for. Accordingly, much of the transmission cost increase in the 26-27 TPP base case portfolio relative to the 25-26 TPP base case portfolio is driven by OOS transmission. Working Group staff estimate that 10 GW of new interregional transmission lines at an estimated cost of $20 billion will be needed to interconnect the 2041 26-27 TPP base case portfolio's OOS wind.

However, as the 25-26 TPP Modeling Assumptions Report stresses, additional analysis is needed to effectively plan the transmission of such large amounts of OOS wind. For one, the amounts and transmission implications of OOS wind included in the 2041 26-27 TPP base case portfolio have not previously been studied at a detailed level. Additionally, the interconnection points for the OOS resources assumed in the 2041 26-27 TPP base case mapping are based only on high-level studies, and more optimal and cost-effective alternatives may exist.

Due to these the complexity and cost of potential transmission solutions for OOS wind, CPUC staff, as was done in the 25-26 TPP Modeling Assumptions Report, recommend requesting the CAISO to continue to conduct additional analysis on potential transmission solutions for these resources to better understand the options, costs, and potential collaborations with other BAAs. In concert, CPUC staff are in the process of studying potential routes and interconnection points for various OOS wind resources.

In additional recognition of the complexities surrounding OOS wind, the proposed decision would have the CPUC transmitting a limited wind sensitivity portfolio in which only 5.1 GW of OOS wind are added by 2041 and no new OOS transmission is built to interconnect OOS wind to CAISO for study in the 26-27 TPP. Studying this sensitivity positions the Working Group to both better understand the feasibility of the large amounts of OOS wind in the base case and alternative pathways to meet 2041 energy demands should interconnecting large amount of OOS wind to CAISO prove infeasible. Additionally, the sensitivity models the 2036 and 2041 portfolios with no offshore wind, allowing the Working Group to study the transmission and resource implications of offshore wind failing to come online within the next 15 years.

Further, CPUC staff recommend requesting the CAISO defer approving any of these potential transmission lines needed for these resources in the 26-27 TPP and, as it is impacted, in the 25-26

[28] See slides 53-59 in the 9/30/2025 ruling for a discussion of the OOS wind selected in the 26-27 TPP base case relative to the 25-26 TPP base case and the least cost portfolio. Note that slide 58 reveals that the least cost portfolio selects 2 GW more of OOS wind in the 2036 and 2041 portfolios than the 26-27 TPP base case.

TPP. This delay will give time for the CAISO to study potential solutions and CPUC staff to conduct additional analysis.

Specifically, this request would refer to the following resources in the 10-year portfolio, in addition to the OOS wind added in the 15-year portfolio:

- 1,500 MW of Wyoming Wind mapped to Eldorado 500 kV not already scheduled on the TransWest line in both the 2036 and 2041 portfolios, the 2035 base case for the 25-26 TPP, and the 2034 base case for the 24-25 TPP.
- 1,500 MW of New Mexico wind mapped to Palo Verde 500 kV in the 2036 portfolio not already scheduled on the SunZia line. These resources were mapped to Lugo in the 25-26 TPP and an identical request was made to delay approving upgrades for those resources.
- 873 MW of Northern California wind in NVE's territory mapped to new substations near Leavitt and Madeline in both the 2036 and 2041 portfolios and the 2035 and 2041 base case portfolios in the 25-26 TPP.

Additional Transmission Modeling and Busbar Mapping for the 26-27 TPP: Path 26 and Path 15 Expansion

For the proposed 26-27 TPP base case RESOLVE selected $1 billion of upgrades along an interconnected set of high-voltage transmission lines that connect SCE to PG&E. These lines, known as Path 26 and Path 15, were not represented in RESOLVE before this cycle and so could not be selected in past TPPs.[29] Path 26 and 15 expansion was selected in both the base case and sensitivity portfolios, suggesting these upgrades may be beneficial across a range of future scenarios for delivering new renewable resources to load and reducing congestion costs. However, CPUC staff moved resources into both SCE and PG&E as part of their remapping of SDG&E solar, potentially reducing the benefits of Path expansion. Regardless, the full TPP study process will be needed to determine if Path upgrades are necessary, as is the case with any upgrade triggered by busbar mapping.

The new zonal topology functionality that enables RESOLVE to select Path 26 and 15 upgrades was made with CAISO staff's input, and Working Group staff anticipate continuing to model Path constraints in future cycles. However, more work can be done to refine how Path constraints are modeled in RESOLVE to better align with TPP study results. CPUC staff will work with CAISO staff through the 26-27 TPP to more accurately model Path 26 and 15 in future TPP cycles.

Alignment with CAISO Queue Resources with Allocated TPD to Preserve Deliverability for Specified Resources

As was done for the 25-26 TPP, 24-25 TPP, and 23-24 TPP, CPUC staff request that the CAISO continue the necessary studies to inform and enable opportunities to provide Maximum Import Capability (MIC) expansion and the development of incremental transmission capacity to support the OOS/out-of-CAISO and long lead-time (LLT) resources mapped in the policy- and reliability-

[29] Refer to section 6.1 for more detail on the disaggregation of RESOLVE's zonal topology into separate IOU's, which also enabled the selection of Path 15 and 26 upgrades.

driven base case portfolio, while preserving the existing transmission capacity that has been allocated to other projects earlier in the interconnection queue.

"Unaccounted for TPD" refers to TPD that has been awarded by CAISO to specific interconnection requests, but for which there is no corresponding resource in the base case portfolio at the same point of interconnection. This occurs because the busbar mapping process does not include all interconnection requests in the CAISO queue as resources in the base case, only as a factor in determining commercial interest.

For this 26-27 TPP, CPUC staff have sought to identify the resources currently holding unaccounted for TPD that may result in an inability to reserve deliverability for LLTs – namely, OOS wind, in-state geothermal, offshore wind, and location-constrained LDES. CPUC staff have calculated the delta between TPD allocated by the CAISO at each busbar and the mapped portfolio resources. When only non-LLT portfolio resources are included in the calculation, this delta represents the remaining unaccounted for TPD that could be available for the interconnection of LLT resources. When all mapped portfolio resources are included, this delta represents the incremental allocated TPD that is not captured in the mapped portfolio but is otherwise reserved by CAISO. CPUC staff transmit the quantity of unaccounted for TPD at the busbars where LLTs are mapped in the base case portfolio to CAISO to ensure upgrades needed to preserve deliverability of LLTs are factored into the TPP. These transmittal quantities are available in the TPD Allocations by Busbar supplemental dashboard, available in Appendix I.

CPUC staff will continue to engage with CAISO staff to further analyze the unaccounted for TPD that impacts potential LLT TPD. CPUC staff will then continue to engage with CAISO staff throughout the TPP analysis process to ensure LLT TPD is preserved. CPUC staff and CAISO staff will continue to refine the treatment of approach to incorporating unaccounted for TPD in subsequent TPP cycles.

Battery Storage-Specific Transmission Upgrades and Battery Storage as Transmission Upgrade Alternatives

As with past TPP portfolio transmittals, CPUC staff acknowledge that, in some cases, more information is needed to understand the full impacts of the battery mappings, particularly in LCR areas, before new transmission projects are identified by the CAISO as needed. Accordingly, CAISO staff should consult CPUC staff before moving forward with any new policy-driven transmission upgrades associated specifically with storage mapping in this planning cycle. Additionally, to the extent that storage resources are required for mitigation of transmission issues identified in the CAISO's 2025-2026 Transmission Plan, CPUC staff would expect to coordinate with CAISO to enable small adjustments in the CPUC's mapping of storage resources to allow for the inclusion of this storage in the CAISO's analysis of the 2026-2027 TPP portfolio.

9.2 Limited Wind Sensitivity Portfolio

At the time of this report, the Working Group staff have not completed the mapping analysis efforts to include in this report for the limited wind policy driven sensitivity portfolio that the CPUC will transmit to the CAISO for the 2026-2027 TPP. The Dashboard for the limited wind sensitivity is included in Appendix M and staff expect to release the full analysis with the final mapping results in February 2026.

9.3 Busbar Mapping for Future TPP Cycles

Staff appreciate the feedback and suggestions from stakeholders in response to the August and November 2025 webinars and in comments and replies to the September and November 2025 Rulings. Feedback and suggestions not already addressed in the transmittal for the 2026-2027 TPP will be a priority for consideration in the draft workplan and mapping methodology updates for 2027-2028 TPP busbar mapping. The busbar mapping effort for the next cycle will seek to continue to refine the busbar mapping criteria, particularly commercial interest criteria and mapping of EGS resources. CPUC staff will continue to work with both CAISO and CEC staff to improve the data used for busbar mapping and the associated mapping analysis. Furthermore, CPUC staff continue to strive to resolve the process alignment and timing issues that make it challenging to inform resource-to-busbar mapping for an upcoming TPP with the results of the ongoing TPP.

10. Appendices

A. Methodology for Resource-to-Busbar Mapping for the Annual TPP

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 11/3/2025, Link:
https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/mapping_methodology_26-27.pdf

B. Dashboard for Initial Mapping of Proposed 26-27 TPP Base Case

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 9/30/2025, Link:
https://files.cpuc.ca.gov/energy/modeling/LTPP/Full%20Dashboard%20%E2%80%93%20Initial%20Mapping%2026-27%20TPP%20Base%20Case.zip

C. Dashboard for the Proposed Decision Mapping of the 26-27 TPP Base Case

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 01/16/26, Link:
https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/full-dashboard-for-the-pd-26-27-tpp-base-case.xlsx

D. Initial Baseline Reconciliation and In-Development Resources (November Ruling version)

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 11/05/25, Link:
https://files.cpuc.ca.gov/energy/modeling/LTPP/Baseline_Reconciliation_and_In-development_Resources_26-27_TPP_Initial.xlsx

E. Updated Baseline Reconciliation and In-Development Resources (PD version)

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 01/14/26, Link:
https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/updated_baseline_reconciliation_supplemental_workbook.xlsx

F. Initial Gas Capacity Not Retained Supplemental Workbook (November Ruling Version)

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 01/05/26, Link:
https://files.cpuc.ca.gov/energy/modeling/LTPP/Gas_Capacity_Not_Retained_26-27_TPP_Initial.zip

G. Updated Gas Capacity Not Retained Supplemental Workbook (PD version)

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 01/14/26, Link:
https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/updated_gas_capacity_nr_supplemental_workbook.xlsx

H. Updated Gas Capacity Not Retained Supplemental Workbook (PD version)

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 01/16/2026. Link: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/updated_gas_capacity_nr_supplemental_workbook.xlsx

I. TPD Allocations by Busbar (PD Version)

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 01/14/26, Link: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/tpd_allocations_busbar_supplemental-workbook.xlsx

J. Initial Commercial Interest Analysis of CAISO Interconnection Queue (November Ruling version)

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 11/05/25. Link https://files.cpuc.ca.gov/energy/modeling/LTPP/Commercial_Interest_Analysis_26-27_TPP_Initial.xlsx

K. Updated Commercial Interest Analysis of CAISO Interconnection Queue (PD version)

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 01/14/26, Link: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/updated_commercial_interest_supplemental_workbook.xlsx

L. CEC Land-use and Environmental Screens Data Workbook (November Ruling version)

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 12/10/25. Link: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/land-use_and_environmental_screens_data_26-27_tpp_updated.xlsx

M. Dashboard for the Mapping of the 26-27 TPP Low Wind Sensitivity Portfolio

Posted to the CPUC's "Assumptions for the 2026-2027 TPP" webpage, 12/10/25. Link: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/full-dashboard-for-the-pd-26-27-tpp-sensitivity.xlsx

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