Modeling Assumptions for the 2023-2024 Transmission Planning Process

CPUC Staff Report

February 2023

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 Plan (IRP) proceeding, into plausible network modeling locations 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 methodology and results of the busbar mapping process performed by the CPUC, CAISO and California Energy Commission (CEC), for input into the 2023-2024 TPP, providing transparency and opportunity for IRP and TPP stakeholder engagement.

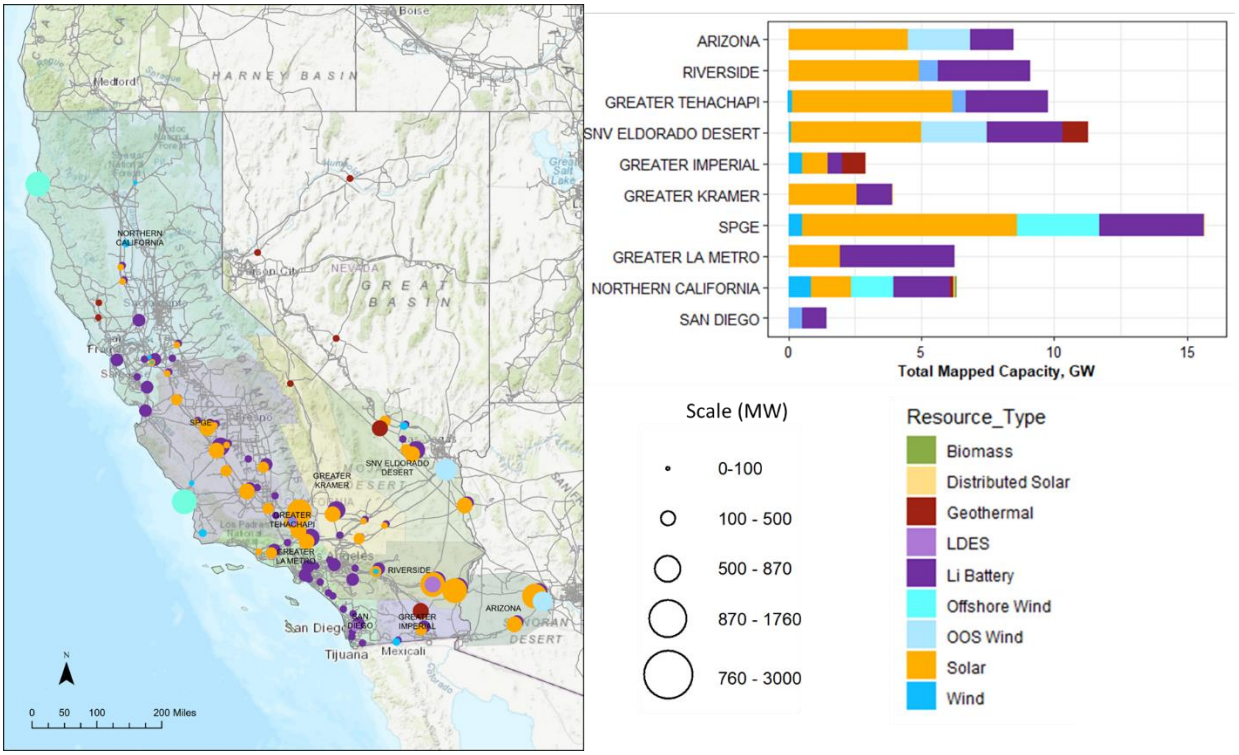
Similar to preparation for previous two TPPs, this Report includes the key guidance for TPP studies that in past years was conveyed in the "Long-Term Procurement Plan Assumptions and Scenarios" and later the "Unified Inputs and Assumptions", thus superseding earlier guidance and documents.

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:

1. Methodology for Resource-to-Busbar Mapping & Assumption for the TPP
2. Busbar Mapping Dashboard workbooks for base case portfolio's 2033 and 2035 model year mappings
3. Busbar Mapping Dashboard workbook for the offshore wind sensitivity portfolio's 2035 model year mapping
4. 2022 IRP Baseline Reconciliation for online and in-development resources
5. Retirement List of Thermal Generation Units

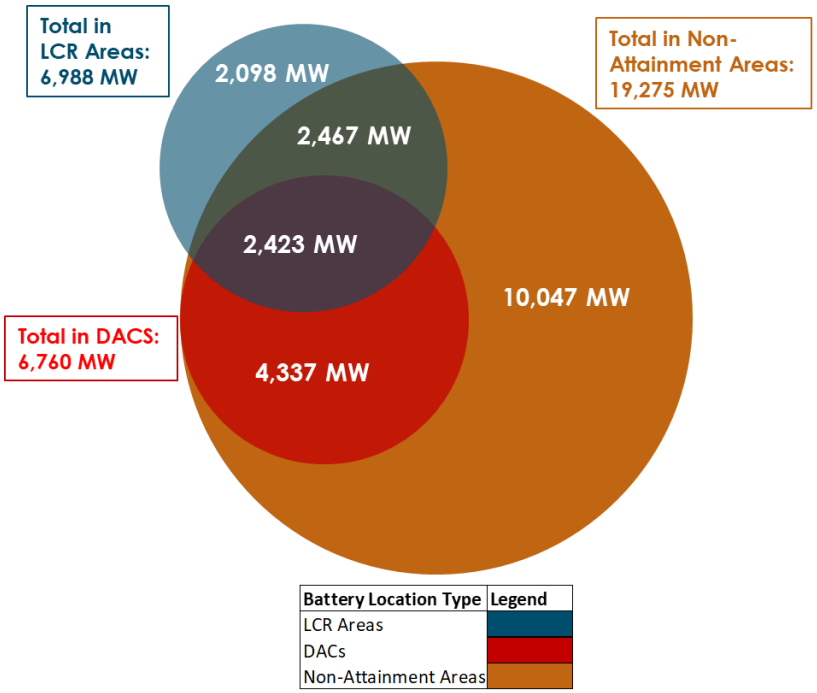
Figure 1 below includes a table and a graph which provide an overview of the composition of the mapped results for base case portfolio's 2035 model year as well as a visual map-based representation that conveys the mapped resources, one of the primary inputs being transmitted by the CPUC to the CAISO for the 2023-2024 TPP, in an easily digestible manner. The map provides an overview of the results of the implementation of the busbar mapping process. These results, as well as the inputs, methodology, and analysis are described in detail in the following sections of this Report.

Figure 1: Final busbar mapping results of the base case portfolio for 2035. (Left) Map of the final busbar mapping results show the location and amount of resources mapped by resource type. (Right) Plot show the total mapped capacity broken down by region.



With 21,740 MW of battery storage capacity mapped to busbars in 2033 and 28,370 MW mapped in 2035 for the 2023-2024 TPP base case portfolio, battery storage will continue to play an important role in California's ability to meet policy goals, and in CAISO's transmission planning process. The battery storage capacity was mapped using the established methodology which takes into consideration policy goals as one of multiple factors. Figure 2 below shows a subset of the total storage resources mapped for the 2035 portfolio and depicts the degree to which staff was able to map the storage to various prioritized locations including local capacity requirement (LCR) areas, Disadvantaged Communities (DACs), and air-quality non-attainment areas.

Figure 2 Locationally mapped battery storage alignment for three of the battery mapping policy objectives[1].



The Figure 3 below includes a corresponding table and graph which provide an overview of the composition of the mapped results offshore wind sensitivity portfolio as well as a visual map-based representation that conveys the mapped resources, one of the primary inputs being transmitted by the CPUC to the CAISO for the 2023-2024 TPP, in an easily digestible manner. The sensitivity includes a total of 13,400 MW of offshore wind with 8,000 MW of North Coast offshore wind for study by the CAISO as a policy driven sensitivity portfolio.

Figure 3: Final busbar mapping results of the offshore wind sensitivity portfolio. (Left) Map of the final busbar mapping results show the location and amount of resources mapped by resource type. (Right) Plot show the total mapped capacity broken down by region.

[1] As defined in the Busbar Mapping Methodology. See Appendix A.

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 2023-2024 TPP, as outlined in Table 1 below. This report contains only the mapping results for the 30 MMT base case portfolio using the 2021 IEPR Additional Transportation Electrification (ATE) load scenario. CPUC staff will release a supplemental report in February 2023 for the offshore wind sensitivity Portfolio.

Table 1: Modeling assumptions reported in this document.

IRP Portfolio	**2023-2024 TPP Portfolio Use Case(s)**	**Modeling Assumptions**
30 MMT base case portfolio using the 2021 IEPR[2] Additional Transportation Electrification (ATE) load scenario (30 MMT with ATE portfolio)	• Reliability base case • Policy-driven base case assessment • Economic assessments	• Busbar allocations of non-battery resources and battery resources for 2033 and 2035 model years • New baseline resources identified since the February 2020 baseline transmitted for the 2020-2021 TPP. • Demand response assumptions • Thermal generation RESOLVE input assumptions
30 MMT offshore wind sensitivity portfolio using the 2021 IEPR ATE with 13.4 GW of offshore wind in 2035 (Offshore wind sensitivity portfolio)	• Policy-driven sensitivity assessment	• Busbar allocations of non-battery resources and battery resources for the 2035 model year • New baseline resources. • Demand response assumptions • Thermal generation RESOLVE input assumptions

[2] Referring to the Integrated Energy Policy Report (IEPR) prepared by the California Energy Commission.

3. Report Summary

The October 7, 2022, Ruling Seeking Comments on Portfolios to be used in the 2023-2024 TPP[3] proposed the 30 MMT portfolio with the 2021 IEPR Additional Transportation Electrification (ATE) load scenario as the reliability and policy-driven base case portfolio for the 2023-2024 TPP. The ruling proposed mapping and transmitting two study years: 2033 and 2035 for this base case portfolio. The ruling also proposed transmitting two policy-driven sensitivity portfolios: an offshore wind portfolio centered on the development of 13.4 GW of offshore wind by 2035 and a limited offshore and out-of-state (OOS) wind development portfolio designed to study an alternative resource mix more reliant on solar, storage, and geothermal. Based on party comments, the decision was made to not include the second, limited offshore and OOS wind sensitivity portfolio.

The busbar mapping work was conducted by staff taking into consideration parties' comments on the busbar mapping methodology. This Report describes the base case portfolio, its mapping to specific busbars, as well as additional inputs and assumptions for the CAISO's 2023-2024 TPP. This report also summarizes the key mapping results for the offshore wind sensitivity portfolio.

This Report is structured as follows:

Section 4 states the objectives of studying the base case and offshore wind sensitivity portfolios and details the inputs CPUC staff provided to the mapping process.

Section 5 summarizes the updates made to the proposed methodology[4] used by CPUC, CAISO and CEC staff to conduct busbar mapping and produce other inputs and assumptions for the 2023-2024 TPP.

Section 6 details the analysis and steps taken by staff to improve the mapping allocations in order to meet the criteria.

Section 7 summarizes the final results of the mapping process.

Section 8 presents other information about the portfolio that is required for TPP.

Section 9 draws conclusions regarding mapping the portfolios for the 2023-2024 TPP and provides guidance to the CAISO.

[3] https://docs.cpuc.ca.gov/SearchRes.aspx?docformat=ALL&docid=497509406

[4] Referring to the version attached to the 10/07/22 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/2022-irp-cycle-events-and-materials/2023-2024-tpp-portfolios-and-modeling-assumptions/busbar-mapping-methodology-for-the-tppv20221005.pdf

4. Inputs

In order to the complete the steps in the methodology described below, the following input is needed: Portfolios of selected resources for 2033 and 2035 by RESOLVE resource area, with Fully Deliverable (FD) and Energy-Only (EO) megawatt (MW) amounts specified.

The base case portfolio described in Section 4.2 was developed using similar modeling assumptions as the 2022-2023 TPP 30 MMT High Electrification Sensitivity Portfolio. The following additional updates were made since the 2022-2023 TPP base case portfolio transmitted to the CAISO in February 2022:[5]

- Updated the resource costs to the NREL 2021 ATB and Lazard LCOS 7.0
- Updated the load forecast to the CEC 2021 IEPR
    - The Base and Sensitivity portfolios all use the 2021 IEPR Additional Transportation Electrification load scenario.
- Updated the existing and planned resources to reflect updates to capacity and retirements of existing plants, "in-development" resources that have newly come online, and new "in-development" resources, improving alignment with LSE Resource Data Templates as of August 2022.
- Updated transmission deliverability-resource mappings, existing transmission deliverability capacity, and transmission upgrade costs using the CAISO 2021-2022 TPP results.
- Updated the secondary system need (SSN) transmission utilization for battery storage resources to be in line with latest CAISO assumptions:
    - 50% transmission capacity utilization in on-peak SSN timeframe.

4.1 Reconciling New Baseline Resources

Since the previous busbar mapping cycles, new resources have been added to the baseline, the master array of resources online, under-construction, or contracted and assumed to be operational in the years modeled. These new resources need to be reconciled to ensure they are properly accounted for in busbar mapping and the transmission planning process. The previous RESOLVE baseline for TPP was set in February 2020 and was included as part of the 2020-2021 TPP portfolio transmittal to the CAISO. The CAISO utilized this baseline set to develop the updated transmission capacities in the CAISO's White Paper – 2021 Transmission Capability Estimates for use in the CPUC's Resource Planning Process (CAISO's 2021 White Paper),[6] which the CPUC utilized in both the RESOLVE model used to develop the portfolio and in the busbar mapping process. The new baseline resources need to be accounted for in both the portfolio creation and the transmission deliverability information.

Since the development of the February 2020 baseline, Load Serving Entities (LSEs) have submitted two sets of integrated resource plans and procurement compliance filings to the CPUC pursuant to D.19-11-016, D.20-12-044, and D.21-06-035 that identified new resources coming online or being

[5] Details on the 2022-2023 TPP base case portfolio and the RESOLVE model version used to develop it can be found at the CPUC webpage: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2019-20-irp-events-and-materials

[6] Revised White Paper – 2021 Transmission Capability Estimates for use in the CPUC's Resource Planning Process (10/28/2021).

developed, which LSEs have procured but are not in the 2020-2021 TPP baseline. CPUC staff fully incorporated new resources contracted by LSEs identified from the September 2020 integrated resource plans and procurement compliance filings submitted through September 2022. Staff also partially utilized the recently submitted November 2022 integrated resource plans to verify new resources and identify additional contracted resources. Given the timing of the busbar mapping effort, staff were not able to fully incorporate the plans November 2022 IRP plans. Additionally, CPUC staff reached out to major Participating Transmission Owners (PTOs) within the CAISO's balancing authority area (BAA) to review the identified resources in their regions and to identify any additional under-construction resources that ought to be included for study in the TPP.

These new online, under-construction, and contracted resources need to be accounted for by the CPUC in busbar mapping and by the CAISO in the transmission planning process to ensure their transmission capability utilization is accurately captured in planning. The steps below describe with reference to the 30 MMT with ATE base case portfolio how these new resources were incorporated in the mapping process:

- The new resources identified through the reconciliation process were aggregated into online resources and in-development resources, which are either under-construction as identified by the PTOs or under-contract by LSEs.
- In developing the RESOLVE portfolio, rather than utilizing the updated baseline, staff accounted for these new baseline resources in the portfolio by forcing the RESOLVE model to include as "planned" resources in its portfolio the amount of each resource type. This ensured that RESOLVE reserved the transmission headroom that these new baseline resources require. In previous busbar mapping cycles, baseline resources were subtracted from the selected portfolios because they were not accounted for in the RESOLVE "planned" set of resources.
- In the busbar mapping process, staff then reconcile the new baseline resources by specifically mapping planned resources selected by RESOLVE to match the locations of the new baseline resources. Online resources were only accounted for in the transmission calculations analysis, while the in-development resources were included with the generic resources in all busbar mapping analysis. (NOTE: Additional resources were identified as online or in-development by CPUC staff after the initial RESOLVE portfolios were developed. Rather than rerunning the portfolios with additional "planned" resources, staff shifted RESOLVE identified generic resources to be classified as in-development or online resources in the mapping process. Thus, while the breakdown of "planned" versus generic resources changed, the total MW number of resources does not.)

Reconciled resources identified as solar-storage hybrids were split into individual battery, fully deliverable (FCDS) solar and energy only deliverability status (EODS) solar components based on the max MW output and the known deliverability status of the resource to maintain consistency with the implementation and treatment of co-located solar and storage in the busbar mapping process.

The baseline reconciliation process identified a total of nearly 29,900 MW of newly online, under-construction, or contracted resources not previously included in the 2020-2021 TPP baseline list. Of that amount over 7,800 MW were identified as online as of August 1, 2022, while the remaining 22,000 MW are contracted or under construction resources. Table 2 breaks down those resources by resource type and online or in-development status. A detailed summary

by substation of new online and in-development resources is included in Appendix E. Some resources identified as online or in-development interconnect to lower voltage substations or substations not included in the system level substation list utilized in busbar mapping. As a rough approximation, these resources were mapped to the nearest, transmission connection-wise, substation included in busbar mapping analysis list. For out-of-state resource or out-of-CAISO resources, staff sought to identify and map them to their point of interconnection with the CAISO transmission system.

Table 2: Summary of newly identified online and in-development resources not previously in the 20-21 TPP baseline by resource type and MW amount.

Reconciled Resources (MW)	Battery	Solar	Wind	Geothermal	Biomass	Total
Online	3,494	3,035	1,273	40	6	**7,849**
In-Development	13,389	8,241	178	205	16	**22,030**

4.2 30 MMT with Additional Transportation Electrification Base Case 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 aligns 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 individual LSE planning efforts, staff aggregation of these plans, and IRP capacity expansion modeling. This 30 MMT with 2021 IEPR Additional Transportation Electrification (ATE) portfolio is designed around that 2030 GHG target and is named based on the convention of referring to that target. However, because the resource planning horizon needed specifically for the 2023-2024 TPP extends to 2035, the emissions of the portfolio in 2033 and 2035 are lower than 30 MMT. This is described in more detail under the Description of Portfolio section below. The 2021 IEPR ATE load scenario utilized in the portfolio is designed to reflect a higher electrification future, centered on recent CARB electrification regulations on vehicles, and assess the potential transmission impacts and transmission upgrade needs of new policy drivers pointing to higher electrification loads.

To improve the degree of accuracy of the transmission upgrade information that comes out of the RESOLVE analysis, the CPUC updated the modeling of transmission deliverability using data from the CAISO's 2021 White Paper and supplementing it with data from CAISO's 2021-2022 TPP results. This update further improved the locational information for battery resources modeled in RESOLVE and the ability to select them in the same transmission constraints as solar resources. Ultimately, this resulted in improved information as inputs for the busbar mapping process for assigning co-located solar and battery resources.

However, one of the challenges that persisted with the updated transmission information from the CAISO is a disconnect with the transmission information that was used in developing the LSE plans. To incorporate both the LSE plans and the new transmission deliverability data, some modifications were made to assumptions of resources that could be selected to levels contained in the LSEs' plans. For instance, although offshore wind from the Humboldt area is contained in the

LSE plans, the RESOLVE portfolio was allowed to use offshore wind from Morro Bay as a replacement option. This was done to enable the model to solve, because the amount of available transmission deliverability at Humboldt was less than the amount of resource contained in the LSE plans. In addition, the lack of information on the cost and timing of additional upgrades at Humboldt would make the model unable to solve, without the above adjustment to the assumptions; because it would not be able to meet the constraint even at a higher cost.

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 2023-2024 TPP indicates the need for 4,041 MW of partial or full transmission upgrades by 2033 and 9,531 MW by 2035 to accommodate the full number of resources selected in 2033 and 2035 that could not be accommodated by the existing transmission system.

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 minimize risk of stranded generation assets later being discovered to be undeliverable to load due to a lack of available transmission capability.

To ensure this is a bidirectional minimization of ratepayer costs, 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 Transmission Plan 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 years 2033, the portfolio comprises 21,738 MW of new battery storage, 1,524 MW of long-duration storage in the form of pumped hydro storage, 41,148 MW of new in-state renewable resources (which includes 3,261 MW of offshore wind), and 4,828 MW of new out-of-state (OOS) wind resources on new OOS transmission, among other resources. For the planning years 2035, the portfolio comprises 28,381 MW of new battery storage, 2,000 MW of long-duration

storage in the form of pumped hydro storage, 49,641 MW of new in-state renewable resources (which includes 4,707 MW of offshore wind), and 4,828 MW of new out-of-state (OOS) wind resources on new OOS transmission, among other resources.[7]

Table 3 summarizes the resource build out in 2033 and 2035, the resource planning years needed specifically for the 2023-2024 TPP. The GHG targets modeled in 2033 and 2035 were 27 MMT and 25 MMT respectively.[8]

Table 3. Capacity Additions in 2033 in the 30 MMT with ATE Base Case Portfolio

30 MMT 2021 Additional Transportation Electrification (2033 and 2035 Results)			
	Unit	**2033**	**2035**
Gas	MW	0	128
Biomass	MW	134	134
Geothermal	MW	1,863	1,863
Hydro (Small)	MW	-	-
Wind	MW	3,864	3,864
Wind OOS New Tx	MW	4,828	4,828
Offshore Wind	MW	3,261	4,707
Solar	MW	32,025	39,072
Customer Solar	MW	-	-
Battery Storage	MW	21,738	28,381
Pumped Storage	MW	1,524	2,000
Shed DR	MW	1,111	1,111
Gas Capacity Not Retained	MW	-	-
In-State Renewables	MW	**41,148**	**49,641**
Out-of-State Renewables	MW	**4,828**	**4,828**

This portfolio meets the RESOLVE 22.5% Planning Reserve Margin (PRM) constraint which includes the adjustments made to incorporate the mid-term reliability decision (D.21-06-035) requirements. The loss of load expectation (LOLE) study results include a 0.001 LOLE in 2026, a 0.002 LOLE in 2033, and a 0.022 LOLE in 2035, indicating that this is a reliable portfolio. The resource inputs to the mapping process for this portfolio are summarized in Table 4 below.

[7] Full RESOLVE results can be found on the CPUC's Portfolios and Modeling Assumptions for the 2023-2024 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-2023-2024-transmission-planning-process

[8] This represents the CAISO contribution extrapolated from a 38 MMT by 2030 target using the same assumptions that were used for incorporating post-2030 years into select modeling runs to reflect achievement of the Senate Bill (SB) 100 (DeLeón, 2018) 2045 goals in the development of the 2021-2022 TPP.

Table 4: All resources selected in the 30 MMT with ATE portfolio (2033 and 2035 cumulative)

Pre Round 1 - RESOLVE selections	2033 Selected Resources			2035 Selected Resources		
Resource	2033 FD MW	2033 EO MW	2033 Total MW	2035 FD MW	2035 EO MW	2035 Total MW
Solano_Geothermal	135	-	135	135	-	135
Northern_California_Geothermal	-	-	-	-	-	-
Inyokern_North_Kramer_Geothermal	24	-	24	24	-	24
Southern_Nevada_Geothermal	320	-	320	320	-	320
Greater_Imperial_Geothermal	640	744	1,384	640	744	1,384
Greater_LA_Solar	-	3,000	3,000	-	3,000	3,000
Northern_California_Solar	-	-	-	-	-	-
Southern_PGAE_Solar	-	4,751	4,751	-	11,279	11,279
Tehachapi_Solar	-	6,289	6,289	-	6,289	6,289
Greater_Kramer_Solar	-	5,360	5,360	-	5,360	5,360
Southern_NV_Eldorado_Solar	-	7,644	7,644	-	8,163	8,163
Riverside_Solar	-	4,003	4,003	-	4,003	4,003
Arizona_Solar	-	160	160	-	160	160
Imperial_Solar	-	693	693	-	693	693
Northern_California_Wind	-	866	866	-	866	866
Solano_Wind	-	560	560	-	560	560
Humboldt_Wind	-	34	34	-	34	34
NW_Ext_Tx_Wind	-	67	67	-	67	67
Kern_Greater_Carrizo_Wind	60	-	60	60	-	60
Carrizo_Wind	-	287	287	-	287	287
Central_Valley_North_Los_Banos_Wind	173	-	173	173	-	173
Tehachapi_Wind	-	275	275	-	275	275
Southern_Nevada_Wind	-	442	442	-	442	442
Wyoming_Wind	2,328	-	2,328	2,328	-	2,328
Riverside_Palm_Springs_Wind	-	-	-	-	-	-
New_Mexico_Wind	2,500	-	2,500	2,500	-	2,500
SW_Ext_Tx_Wind	-	500	500	-	500	500
Baja_California_Wind	600	-	600	600	-	600
Diablo_Canyon_Offshore_Wind	-	-	-	-	-	-
Morro_Bay_Offshore_Wind	3,100	-	3,100	3,100	-	3,100
Humboldt_Bay_Offshore_Wind	161	-	161	1,607	-	1,607
Cape_Mendocino_Offshore_Wind	-	-	-	-	-	-
Sub Total - Renewables	**10,042**	**35,675**	**45,717**	**11,487**	**42,722**	**54,210**
Greater_LA_Li_Battery	5,347	-	5,347	6,741	-	6,741
Northern_California_Li_Battery	319	-	319	319	-	319
Southern_PGAE_Li_Battery	5,690	-	5,690	7,730	-	7,730
Tehachapi_Li_Battery	3,530	-	3,530	6,240	-	6,240
Greater_Kramer_Li_Battery	2,532	-	2,532	2,532	-	2,532
Southern_NV_Eldorado_Li_Battery	3,040	-	3,040	3,440	-	3,440
Riverside_Li_Battery	617	-	617	617	-	617
Arizona_Li_Battery	0	-	0	0	-	0
Imperial_Li_Battery	-	-	-	-	-	-
San_Diego_Li_Battery	655	-	655	754	-	754
Riverside_West_Pumped_Storage	413	-	413	500	-	500
Tehachapi_Pumped_Storage	500	-	500	500	-	500
Riverside_East_Pumped_Storage	500	-	500	500	-	500
San_Diego_Pumped_Storage	111	-	111	500	-	500
CAISO_New_BTM_Li_Battery	8	-	8	8	-	8
Sub Total - Energy Storage	**23,262**	**-**	**23,262**	**30,381**	**-**	**30,381**

In addition to the resource selection information from RESOLVE, transmission upgrade results are also used to inform the mapping analysis. Table 5 summarizes the selected upgrades triggered in RESOLVE, showing that there are few upgrades selected through 2035. This is partly due to the construction times associated with the upgrades as provided in the CAISO's 2021 White Paper. Most upgrades have longer completion times and cannot come online or be selected by RESOLVE until the late 2020s period. By 2035 a total of 9,531 MW of partial and full transmission upgrades are selected by the portfolio.

Table 5: Summary of RESOLVE triggered transmission expansion; amounts are in MWs.

Cumulative Transmission Upgrades (MW)									
Transmission Constraint	**2023**	**2024**	**2025**	**2026**	**2028**	**2030**	**2032**	**2033**	**2035**
Colorado_River_500_230_group	-	-	-	-	-	-	-	-	-
Contra_Costa_Delta_Switchyard_230_group	-	-	-	-	-	-	-	-	-
Delevan_Cortina_230_group	-	-	-	-	-	-	-	-	-
Devers_Red_Bluff_group	-	-	-	-	-	-	-	-	-
East_of_Miguel_group	-	-	-	-	-	-	-	-	-
Eldorado_500_230_group	-	-	-	-	-	-	-	-	400
Encina_San_Luis_Rey_group	-	-	-	-	-	-	-	-	456
GLW_VEA_group	-	-	-	-	-	-	-	-	-
Gates_500_230_Transformer_group	-	-	-	-	-	-	-	-	-
Gates_Arco_Midway_230_group	-	-	-	-	-	-	-	-	-
Gates_Panoche_230_group	-	-	-	-	-	-	-	-	-
Greater_LA_group	-	-	-	-	-	-	-	-	-
Humboldt_Offshore_Line_group	-	-	-	-	-	-	161	161	1,607
Humboldt_Trinity_115_group	-	-	-	-	-	-	-	-	-
Imperial_Valley_group	-	-	-	-	-	-	-	-	-
Internal_San_Diego_group	-	-	-	-	-	-	-	-	488
Los_Banos_500_230_Transformer_group	-	-	-	-	-	-	-	-	-
Los_Banos_Gates_500_OPDS_group	-	-	-	-	-	-	-	-	-
Lugo_Transformer_group	-	-	-	-	-	-	980	980	980
Mohave_Eldorado_500_group	-	-	-	-	-	-	-	-	-
Morro_Bay_Offshore_500_group	-	-	-	-	-	2,900	2,900	2,900	2,900
Morro_Bay_Templeton_230_group	-	-	-	-	-	-	-	-	-
Moss_Landing_Los_Banos_230_OPDS_group	-	-	-	-	-	-	-	-	-
San_Luis_Rey_San_Onofre_group	-	-	-	-	-	-	-	-	-
Serrano_Alberhill_group	-	-	-	-	-	-	-	-	-
Silvergate_Bay_Boulevard_group	-	-	-	-	-	-	-	-	-
South_Kramer_Victor_Lugo_group	-	-	-	-	-	-	-	-	-
South_Kramer_Victor_group	-	-	-	-	-	-	-	-	-
Tehachapi_Antelope_group	-	-	-	-	-	-	-	-	2,700
Tesla_Westley_230_group	-	-	-	-	-	-	-	-	-

4.3 Offshore Wind Sensitivity Portfolio

Objective and Rationale

The objective of transmitting the offshore wind sensitivity portfolio to the CAISO for the 2023-2024 TPP as a policy-driven sensitivity is to refine and update transmission assumptions relevant to offshore wind resource buildouts in line with recent policy and resource potential changes. This portfolio seeks to build on the results of the 2021-2022 TPP offshore wind sensitivity and the CAISO's 20-year transmission outlook by reexamining the transmission needs of potential offshore-wind resources in further detail. The portfolio also seeks to assess the transmission implications of policy changes that have occurred since the previous studies, including:

- Increased load assumptions associated with higher transportation electrification goals and corresponding increased resource need,
- New offshore wind development goals in line with Assembly Bill (AB) 525,

- Potentially higher resource potential assumptions from the National Renewable Energy Laboratory (NREL) based on various mooring technology and placement assumptions for the Morro Bay and Humboldt call areas[9], and
- The removal of the Diablo Canyon offshore wind call area from current development consideration by BOEM.

This portfolio, thus, utilizes the same 30 MMT GHG target by 2030 and 2021 IEPR ATE load scenario as the base case and like the base case extends out to 2035. The portfolio includes 13,400 MW of offshore wind in 2035, with over 8,000 MW centered on the North Coast. In comparison, the 2021-2022 TPP offshore wind sensitivity portfolio had 8,300 MW of offshore wind and only 1, 600 MW on the North Coast. The focus on North Coast transmission study aligns with the removal of the Diablo Canyon call area and the ongoing AB 525 work being led by the California Energy Commission (CEC). The aim is that the outputs of this sensitivity will produce transmission information necessary for the future development of offshore wind in line with AB 525 policy goals.

Description of Portfolio

For the planning years 2033, the portfolio comprises 20,072 MW of new battery storage, 1,000 MW of long-duration storage in the form of pumped hydro storage, 38,674 MW of new in-state renewable resources (which includes 7,656 MW of offshore wind), and 4,828 MW of new out-of-state (OOS) wind resources on new OOS transmission, among other resources. For the planning years 2035, the portfolio comprises 23,553 MW of new battery storage, 1,000 MW of long-duration storage in the form of pumped hydro storage, 44,419 MW of new in-state renewable resources (which includes 13,400 MW of offshore wind), and 4,828 MW of new out-of-state (OOS) wind resources on new OOS transmission, among other resources.[10]

Table 6 summarizes the resource build out in 2033 and 2035, the resource planning years needed specifically for the 2023-2024 TPP. The GHG targets modeled in 2033 and 2035 were 27 MMT and 25 MMT respectively.[11]

9 Cooperman, Aubryn, et al. (2022). "Assessment of Offshore Wind Energy Leasing Areas for Humboldt and Morro Bay Wind Energy Areas, California" National Renewable Energy Laboratory. NREL/TP-5000-82341. https://www.nrel.gov/docs/fy22osti/82341.pdf.

10 Full RESOLVE results can be found on the CPUC's Portfolios and Modeling Assumptions for the 2023-2024 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-2023-2024-transmission-planning-process

11 This represents the CAISO contribution extrapolated from a 38 MMT by 2030 target using the same assumptions that were used for incorporating post-2030 years into select modeling runs to reflect achievement of the Senate Bill (SB) 100 (DeLeón, 2018) 2045 goals in the development of the 2021-2022 TPP.

Table 6. Capacity Additions in 2033 in the 30 MMT with ATE High Offshore Wind Sensitivity Portfolio

30 MMT 2021 Additional Transportation Electrification High Offshore Wind Sensitivity (2033 and 2035 Results)			
	Unit	**2033**	**2035**
Gas	MW	-	-
Biomass	MW	134	134
Geothermal	MW	1,149	1,149
Hydro (Small)	MW	-	-
Wind	MW	3,864	3,864
Wind OOS New Tx	MW	4,828	4,828
Offshore Wind	MW	7,656	13,400
Solar	MW	25,871	25,871
Customer Solar	MW	-	-
Battery Storage	MW	20,072	23,553
Pumped Storage	MW	1,000	1,000
Shed DR	MW	977	977
Gas Capacity Not Retained	MW	-	-
In-State Renewables	MW	**38,674**	**44,419**
Out-of-State Renewables	MW	**4,828**	**4,828**

This portfolio also meets the RESOLVE 22.5% Planning Reserve Margin (PRM) constraint which includes the adjustments made to incorporate the mid-term reliability decision (D.21-06-035) requirements.-The resource inputs to the mapping process for this portfolio are summarized in Table 7 below.

Table 7. All resources selected in the 30 MMT with ATE High Offshore Wind sensitivity portfolio (2033 and 2035 cumulative)

Pre Round 1 - RESOLVE selections	2033 Selected Resources			2035 Selected Resources		
Resource	2033 FD MW	2033 EO MW	2033 Total MW	2035 FD MW	2035 EO MW	2035 Total MW
Solano_Geothermal	135	-	135	135	-	135
Northern_California_Geothermal	-	-	-	-	-	-
Inyokern_North_Kramer_Geothermal	-	-	-	-	-	-
Southern_Nevada_Geothermal	320	-	320	320	-	320
Greater_Imperial_Geothermal	662	32	694	662	32	694
Greater_LA_Solar	-	2,953	2,953	-	2,953	2,953
Northern_California_Solar	-	-	-	-	-	-
Southern_PGAE_Solar	-	1,238	1,238	-	1,238	1,238
Tehachapi_Solar	-	4,878	4,878	-	4,878	4,878
Greater_Kramer_Solar	-	4,149	4,149	-	4,149	4,149
Southern_NV_Eldorado_Solar	-	7,644	7,644	-	7,644	7,644
Riverside_Solar	-	4,006	4,006	-	4,006	4,006
Arizona_Solar	-	171	171	-	171	171
Imperial_Solar	-	708	708	-	708	708
Northern_California_Wind	-	866	866	-	866	866
Solano_Wind	-	560	560	-	560	560
Humboldt_Wind	-	34	34	-	34	34
NW_Ext_Tx_Wind	-	67	67	-	67	67
Kern_Greater_Carrizo_Wind	60	-	60	60	-	60
Carrizo_Wind	-	287	287	-	287	287
Central_Valley_North_Los_Banos_Wind	173	-	173	173	-	173
Tehachapi_Wind	113	162	275	113	162	275
Southern_Nevada_Wind	-	442	442	-	442	442
Wyoming_Wind	2,328	-	2,328	2,328	-	2,328
Riverside_Palm_Springs_Wind	-	-	-	-	-	-
New_Mexico_Wind	2,500	-	2,500	2,500	-	2,500
SW_Ext_Tx_Wind	-	500	500	-	500	500
Baja_California_Wind	600	-	600	600	-	600
Diablo_Canyon_Offshore_Wind	-	-	-	-	-	-
Morro_Bay_Offshore_Wind	5,355	-	5,355	5,355	-	5,355
Humboldt_Bay_Offshore_Wind	2,301	-	2,301	3,045	-	3,045
Cape_Mendocino_Offshore_Wind	-	-	-	5,000	-	5,000
Sub Total - Renewables	**14,547**	**28,696**	**43,243**	**20,292**	**28,696**	**48,987**
Greater_LA_Li_Battery	5,608	-	5,608	7,241	-	7,241
Northern_California_Li_Battery	319	-	319	319	-	319
Southern_PGAE_Li_Battery	4,718	-	4,718	5,475	-	5,475
Tehachapi_Li_Battery	3,420	-	3,420	4,511	-	4,511
Greater_Kramer_Li_Battery	1,576	-	1,576	1,576	-	1,576
Southern_NV_Eldorado_Li_Battery	3,040	-	3,040	3,040	-	3,040
Riverside_Li_Battery	617	-	617	617	-	617
Arizona_Li_Battery	-	-	-	-	-	-
Imperial_Li_Battery	-	-	-	-	-	-
San_Diego_Li_Battery	766	-	766	766	-	766
Riverside_West_Pumped_Storage	-	-	-	-	-	-
Tehachapi_Pumped_Storage	500	-	500	500	-	500
Riverside_East_Pumped_Storage	500	-	500	500	-	500
San_Diego_Pumped_Storage	0	-	0	0	-	0
CAISO_New_BTM_Li_Battery	8	-	8	8	-	8
Sub Total - Energy Storage	**21,072**	**-**	**21,072**	**24,553**	**-**	**24,553**

In addition to the resource selection information from RESOLVE, transmission upgrade results are also used to inform the mapping analysis. Table 8 summarizes the selected upgrades triggered in RESOLVE, showing that there are more upgrades selected through 2035 than the Base Portfolio, due to the additional offshore wind resource. By 2035 a total of 14,246 MW of partial and full transmission upgrades are selected by the portfolio.

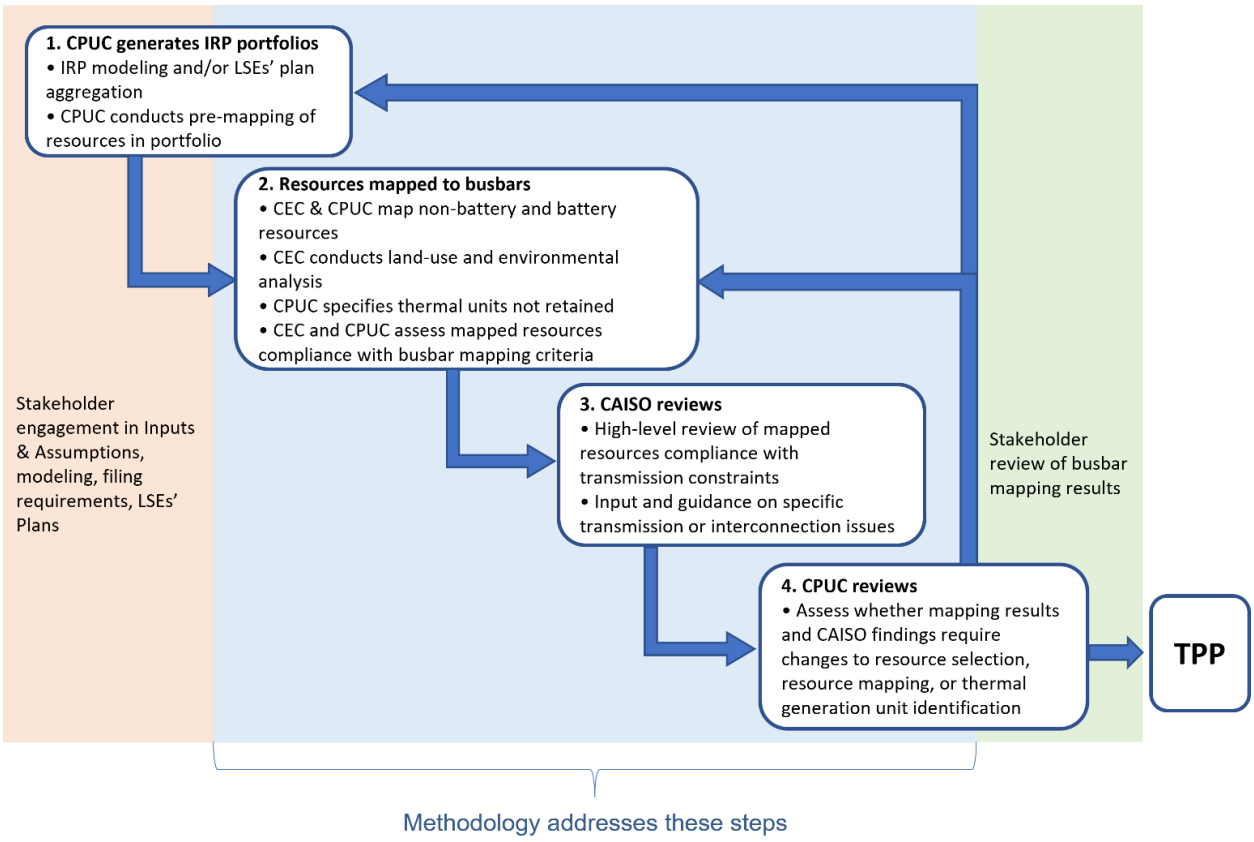
Table 8. Summary of RESOLVE triggered transmission expansion; amounts are in MWs.

Cumulative Transmission Upgrades (MW)									
Transmission Constraint	**2023**	**2024**	**2025**	**2026**	**2028**	**2030**	**2032**	**2033**	**2035**
Cape_Mendocino_Offshore_Line_group	-	-	-	-	-	-	-	-	5,000
Colorado_River_500_230_group	-	-	-	-	-	-	-	-	-
Contra_Costa_Delta_Switchyard_230_group	-	-	-	-	-	-	-	-	-
Delevan_Cortina_230_group	-	-	-	-	-	-	-	-	-
Devers_Red_Bluff_group	-	-	-	-	-	-	-	-	-
East_of_Miguel_group	-	-	-	-	-	-	-	-	-
Eldorado_500_230_group	-	-	-	-	-	-	-	-	-
Encina_San_Luis_Rey_group	-	-	-	-	-	-	-	-	-
GLW_VEA_group	-	-	-	-	-	-	-	-	-
Gates_500_230_Transformer_group	-	-	-	-	-	-	-	-	-
Gates_Arco_Midway_230_group	-	-	-	-	-	-	-	-	-
Gates_Panoche_230_group	-	-	-	-	-	-	-	-	-
Greater_LA_group	-	-	-	-	-	-	-	-	-
Humboldt_Offshore_Line_group	-	-	-	-	-	-	-	2,301	3,045
Humboldt_Trinity_115_group	-	-	-	-	-	-	-	-	-
Imperial_Valley_group	-	-	-	-	-	-	-	-	-
Internal_San_Diego_group	-	-	-	-	-	-	-	-	-
Los_Banos_500_230_Transformer_group	-	-	-	-	-	-	-	-	-
Los_Banos_Gates_500_OPDS_group	-	-	-	-	-	-	-	-	-
Lugo_Transformer_group	-	-	-	-	-	-	-	-	-
Mohave_Eldorado_500_group	-	-	-	-	-	-	-	-	-
Morro_Bay_Offshore_500_group	-	-	-	-	-	3,249	5,155	5,155	5,155
Morro_Bay_Templeton_230_group	-	-	-	-	-	-	-	-	-
Moss_Landing_Los_Banos_230_OPDS_group	-	-	-	-	-	-	-	-	-
San_Luis_Rey_San_Onofre_group	-	-	-	-	-	-	-	-	-
Serrano_Alberhill_group	-	-	-	-	-	-	-	-	-
Silvergate_Bay_Boulevard_group	-	-	-	-	-	-	-	-	-
South_Kramer_Victor_Lugo_group	-	-	-	-	-	-	-	-	-
South_Kramer_Victor_group	-	-	-	-	-	-	-	-	-
Tehachapi_Antelope_group	-	-	-	-	-	-	-	-	1,046
Tesla_Westley_230_group	-	-	-	-	-	-	-	-	-

5. Busbar Mapping Methodology Improvements

Staff from the two agencies and the CAISO completed the steps described in the CPUC Staff Proposal: Methodology for Resource-to-Busbar Mapping & Assumptions for the Annual TPP, except where minor improvements were identified, as summarized here. The full, updated Methodology is available as a separate document (see Appendix A).

Figure 4: Flowchart of the busbar mapping process for the TPP



Improvements to the Staff Proposal were informed by stakeholder feedback, recommendations from the CEC and CAISO, and staff's experience during implementation of the busbar mapping process, as summarized below.

Busbar Mapping Steps

- Clarifying how commercial interest at substations not included as candidate substations in busbar mapping analysis are approximated at the nearest substation already in the candidate substation set.

Busbar Mapping Criteria

- Updating the commercial interest criteria to add further ranking details to the prioritizing of commercial interest based on development status with an additional rank for commercial interest in Phase II of CAISO queue interconnection studies. The mapping criteria prioritization of alignment with commercial interests is thus:

- "High confidence" commercial interest — projects in-development, with allocated transmission plan deliverability (TPD), or that have executed interconnection agreements.
- Projects in Phase II of CAISO's interconnection studies
- Projects in Phase I and other projects in interconnection queues.

6. Analysis

This section outlines the mapping process and notes mapping adjustments made after the initial mapping released with the October 2022 ruling.6 For the non-battery resources staff use a "dashboard" to identify whether busbar allocations of a particular round of mapping of a portfolio comply with the five key criteria described in the Methodology (see Appendix A.). This informs whether changes to the allocation may be required. For the battery resources CPUC staff apply the methodology and analyze it through the lens of achievement of policy objectives, interaction with the non-battery resources, and transmission implications. Both the battery and the non-battery mapping build on the locational information reported in the resource selection results Section 4.2 from the RESOLVE optimization.

Section 6.1 summarizes the results of the initial mapping effort the busbar Working Group staff performed to map all resources to substations for the October 2022 ruling. Full results for both the 2033 and 2035 mapped years at a substation level and the mapped resources compliance with the busbar mapping criteria are detailed in the respective Mapping Dashboards for each portfolio year released with the October ruling. These dashboards are included as Appendix H for 2033 and Appendix I for 2035.

Section 6.2 presents the adjustments made to the mapping post-ruling for the proposed decision. Working Group staff made these adjustments to improve compliance with the busbar mapping criteria, to account for updated information on transmission, commercial interest, and in-development resources, and to incorporate feedback stakeholders provided through ruling comments and replies. These mapping adjustments are summarized by resource area in this section.

Section 6.3 summarizes the mapping adjustments made following the release of the January 13, 2023, Proposed Decision.[12] These few adjustments are centered around aligning the mapping with updated in-development resource information provided by the PTOs.

A full accounting of the adjustments by resource type and substation is in the final Mapping Dashboards released with this report as Appendix B for 2033 mapping results and Appendix C for 2035 mapping results.

6.1 Initial Mapping Results for October Proposed 23-24 TPP Portfolios Ruling

This section summarizes the results of the initial rounds of mapping that the busbar Working Group comprised of CPUC, CEC, and CAISO staff carried out following the flow chart in Figure 4. To map the resources identified in the 30 MMT with ATE base case portfolio included in the October ruling, staff relied heavily on mapped results of the 22-23 TPP high electrification sensitivity portfolio[13] transmitted to the CAISO on July 1, 2022[14]. The two portfolios are nearly the same and the Working Group only made minor changes to the busbar mapping methodology since

[12] January 13, 2023, Proposed Decision Ordering Supplemental Mid-Term Reliability Procurement (2026-2027) and Transmitting Electric Resource Portfolios to CAISO for the 2023-2024 TPP: https://docs.cpuc.ca.gov/SearchRes.aspx?docformat=ALL&docid=501102663

[13] Dashboard of 2035 mapping results for the 22-23 TPP high electrification sensitivity: https://files.cpuc.ca.gov/energy/modeling/BusbarMapping_30MMT_HESens_Dashboard_08_22_22_TPD_v2.xlsx

[14] July 1, 2022, Joint CPUC and CEC commissioners letter to the CAISO transmitting the 2022-23 TPP High Electrification Portfolio: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2019-2020-irp-events-and-materials/tpp-portfolio-transmittal-letter.pdf

conducting the mapping for the 22-23 TPP sensitivity. The proposed 23-24 TPP base case portfolio utilizes the same load scenario as the previous sensitivity and CPUC staff only made minor updates to the RESOLVE model. Thus, the two portfolios are similar with the only significant difference being the proposed 23-24 TPP base case portfolio having ~1,600 MW less solar selected by 2035.

The initial rounds of mapping by the working group resulted in significant shifts to where the resources in the 23-24 TPP base case portfolio were mapped when compared to the mapped results of the 22-23 TPP sensitivity portfolio, particularly for solar and storage resources. These changes were driven by the methodology changes prioritizing mapping to commercial interest that has been allocated transmission planning deliverability (TPD) and the need to align with newly identified in-development resources.

Table 9 below shows a summary by region and resource type of the mapped base case portfolio in 2033 included with the October ruling compared with the 22-23 TPP base case portfolio. Table 10 below compares the October ruling mapping of the base case portfolio in 2035 with the 22-23 TPP sensitivity portfolio. Full mapping results for the base case portfolio included in the October ruling are, again, in Appendix H and Appendix I for modeling years 2033 and 2035 respectively.

Table 9: Summary of October 2022 Ruling mapping results for the 2033 base case portfolio by resource area and type.

RESOLVE Resource Name	Resource Type	RESOLVE Selected (2033)			October Ruling Mapping (2033)			22-23 TPP Base Case (2032)		
		FCDS	EODS	TOTAL	FCDS	EODS	TOTAL	FCDS	EODS	TOTAL
InState Biomass	Biomass/Biogas	134	-	**134**	134	-	**134**	134	-	**134**
Solano_Geothermal	Geothermal	135	-	**135**	89		**89**	79	-	**79**
Northern_California_Geothermal	Geothermal	-	-	**-**	-		**-**	-	-	**-**
Inyokern_North_Kramer_Geothermal	Geothermal	24	-	**24**	53		**53**	40	-	**40**
Southern_Nevada_Geothermal	Geothermal	320	-	**320**	500		**500**	440	-	**440**
Northern_Nevada_Geothermal	Geothermal	-	-	**-**	221		**221**	-	-	**-**
Riverside_Palm_Springs_Geothermal	Geothermal	32	-	**32**	-		**-**	-	-	**-**
Greater_Imperial_Geothermal	Geothermal	640	712	**1,352**	1,000		**1,000**	600	-	**600**
Distributed Solar	Solar	125	-	**125**	125	-	**125**	125	-	**125**
Greater_LA_Solar	Solar	-	3,000	**3,000**	-	1,603	**1,603**	-	1,503	**1,503**
Northern_California_Solar	Solar	-	-	**-**	625	13	**638**	-	-	**-**
Southern_PGAE_Solar	Solar	-	4,751	**4,751**	3,479	4,009	**7,488**	1,022	1,781	**2,803**
Tehachapi_Solar	Solar	-	6,289	**6,289**	3,660	2,703	**6,363**	1,751	3,002	**4,753**
Greater_Kramer_Solar	Solar	-	5,360	**5,360**	1,371	761	**2,132**	385	1,071	**1,456**
Southern_NV_Eldorado_Solar	Solar	-	7,644	**7,644**	1,432	2,421	**3,853**	770	1,946	**2,716**
Riverside_Solar	Solar	-	4,003	**4,003**	2,025	3,552	**5,577**	862	1,106	**1,968**
Arizona_Solar	Solar	-	160	**160**	900	2,597	**3,497**	600	1,281	**1,881**
Imperial_Solar	Solar	-	693	**693**	120	630	**750**	100	200	**300**
Northern_California_Wind	Wind	-	866	**866**	230	109	**339**	305	351	**656**
Solano_Wind	Wind	-	560	**560**	737	93	**830**	272	148	**420**
Humboldt_Wind	Wind	-	34	**34**	-	-	**-**	-	-	**-**
Kern_Greater_Carrizo_Wind	Wind	60	-	**60**	60	-	**60**	60	-	**60**
Carrizo_Wind	Wind	-	287	**287**	258	-	**258**	287	-	**287**
Central_Valley_North_Los_Banos_Wind	Wind	173	-	**173**	186	-	**186**	186	-	**186**
North_Victor_Wind	Wind	-	-	**-**	-	-	**-**	-	-	**-**
Tehachapi_Wind	Wind	-	275	**275**	284	-	**284**	275	-	**275**
Southern_Nevada_Wind	Wind	-	442	**442**	321	82	**403**	442	-	**442**
Riverside_Palm_Springs_Wind	Wind	-	-	**-**	116	-	**116**	106	-	**106**
Baja_California_Wind	Wind	600	-	**600**	240	360	**600**	600	-	**600**
Wyoming_Wind	OOS Wind	2,328	-	**2,328**	1,500	-	**1,500**	1,062	-	**1,062**
Idaho_Wind	OOS Wind	-	-	**-**	1,000	-	**1,000**	-	-	**-**
New_Mexico_Wind	OOS Wind	2,500	-	**2,500**	2,328	-	**2,328**	438	-	**438**
SW_Ext_Tx_Wind	OOS Wind	-	500	**500**	690	100	**790**	610	-	**610**
NW_Ext_Tx_Wind	OOS Wind	-	67	**67**	-	-	**-**	-	-	**-**
Humboldt_Bay_Offshore_Wind	Offshore Wind	161	-	**161**	41	120	**161**	-	120	**120**
Morro_Bay_Offshore_Wind	Offshore Wind	3,100	-	**3,100**	3,100	-	**3,100**	1,588	-	**1,588**
Diablo_Canyon_Offshore_Wind	Offshore Wind	-	-	**-**	-	-	**-**	-	-	**-**
Renewable Resource Total		**10,332**	**35,643**	**45,976**	**26,823**	**19,152**	**45,975**	**13,139**	**12,509**	**25,647**
Greater_LA_Li_Battery	Li_Battery	5,347	-	**5,347**	2,654	-	**2,654**	2,861	-	**2,861**
Northern_California_Li_Battery	Li_Battery	319	-	**319**	1,226	-	**1,226**	607	-	**607**
Southern_PGAE_Li_Battery	Li_Battery	5,690	-	**5,690**	2,801	-	**2,801**	1,624	-	**1,624**
Tehachapi_Li_Battery	Li_Battery	3,530	-	**3,530**	2,846	-	**2,846**	3,051	-	**3,051**
Greater_Kramer_Li_Battery	Li_Battery	2,532	-	**2,532**	1,260	-	**1,260**	869	-	**869**
Southern_NV_Eldorado_Li_Battery	Li_Battery	3,040	-	**3,040**	3,034	-	**3,034**	1,236	-	**1,236**
Riverside_Li_Battery	Li_Battery	617	-	**617**	4,569	-	**4,569**	1,608	-	**1,608**
Arizona_Li_Battery	Li_Battery	0	-	**0**	1,805	-	**1,805**	759	-	**759**
Imperial_Li_Battery	Li_Battery	-	-	**-**	473	-	**473**	50	-	**50**
San_Diego_Li_Battery	Li_Battery	655	-	**655**	1,064	-	**1,064**	899	-	**899**
LI_Battery Total		**21,730**		**21,730**	**21,730**	**-**	**21,730**	**13,564**	**-**	**13,564**
SPGE_LDES	LDES	-	-	**-**	-	-	**-**	-	-	**-**
Tehachapi_LDES	LDES	500	-	**500**	500	-	**500**	500	-	**500**
Riverside_East_Pumped_Storage	LDES	500	-	**500**	524	-	**524**	-	-	**-**
Riverside_West_Pumped_Storage	LDES	413	-	**413**				-	-	**-**
San_Diego_Pumped_Storage	LDES	111	-	**111**	500	-	**500**	500	-	**500**
LDES Total		**1,524**		**1,524**	**1,524**	**-**	**1,524**	**1,000**	**-**	**1,000**
Storage Total		**23,254**		**23,254**	**23,254**	**-**	**23,254**	**14,564**		**14,564**
Total Storage+Resources		**33,586**	**35,643**	**69,230**	**50,078**	**19,152**	**69,230**	**27,702**	**12,509**	**40,211**

Table 10: Summary of October 2022 Ruling mapping results for the 2035 base case portfolio by resource area and type.

RESOLVE Resource Name	Resource Type	RESOLVE Selected (2035)			October Ruling Mapping (2035)			22-23 TPP Sens. (2035)		
		FCDS	EODS	TOTAL	FCDS	EODS	TOTAL	FCDS	EODS	TOTAL
InState Biomass	Biomass/Biogas	134	-	**134**	134	-	**134**	134	-	**134**
Solano_Geothermal	Geothermal	135	-	**135**	89		**89**	79		**79**
Northern_California_Geothermal	Geothermal	-	-	**-**	-		**-**	-		**-**
Inyokern_North_Kramer_Geothermal	Geothermal	24	-	**24**	53		**53**	48		**48**
Southern_Nevada_Geothermal	Geothermal	320	-	**320**	500		**500**	440		**440**
Northern_Nevada_Geothermal	Geothermal	174	-	**174**	395		**395**	327		**327**
Riverside_Palm_Springs_Geothermal	Geothermal	32	-	**32**	-		**-**	-		**-**
Greater_Imperial_Geothermal	Geothermal	640	712	**1,352**	1,000		**1,000**	900		**900**
Distributed Solar	Solar	125	-	**125**	125	-	**125**	125	-	**125**
Greater_LA_Solar	Solar	-	3,000	**3,000**	125	1,928	**2,053**	125	1,928	**2,053**
Northern_California_Solar	Solar	-	-	**-**	675	795	**1,470**	344	1,512	**1,856**
Southern_PGAE_Solar	Solar	-	11,279	**11,279**	3,744	5,462	**9,206**	3,535	7,439	**10,974**
Tehachapi_Solar	Solar	-	6,289	**6,289**	3,960	3,853	**7,813**	3,031	4,952	**7,983**
Greater_Kramer_Solar	Solar	-	5,360	**5,360**	1,371	1,295	**2,666**	900	2,281	**3,181**
Southern_NV_Eldorado_Solar	Solar	-	8,163	**8,163**	1,312	3,106	**4,418**	1,320	4,196	**5,516**
Riverside_Solar	Solar	-	4,003	**4,003**	2,040	4,222	**6,262**	1,817	3,495	**5,312**
Arizona_Solar	Solar	-	160	**160**	900	3,197	**4,097**	634	2,592	**3,226**
Imperial_Solar	Solar	-	693	**693**	120	843	**963**	100	553	**653**
Northern_California_Wind	Wind	-	866	**866**	230	109	**339**	305	351	**656**
Solano_Wind	Wind	-	560	**560**	737	93	**830**	321	196	**517**
Humboldt_Wind	Wind	-	34	**34**	-	-	**-**	-	-	**-**
Kern_Greater_Carrizo_Wind	Wind	60	-	**60**	60	-	**60**	60	-	**60**
Carrizo_Wind	Wind	-	287	**287**	258	-	**258**	287	-	**287**
Central_Valley_North_Los_Banos_Wind	Wind	173	-	**173**	186	-	**186**	186	-	**186**
North_Victor_Wind	Wind	-	-	**-**	-	-	**-**	100	-	**100**
Tehachapi_Wind	Wind	-	275	**275**	284	-	**284**	281	-	**281**
Southern_Nevada_Wind	Wind	-	442	**442**	321	82	**403**	442	-	**442**
Riverside_Palm_Springs_Wind	Wind	-	-	**-**	116	-	**116**	116	-	**116**
Baja_California_Wind	Wind	600	-	**600**	240	360	**600**	600	-	**600**
Wyoming_Wind	OOS Wind	2,328	-	**2,328**	1,500	-	**1,500**	1,500	-	**1,500**
Idaho_Wind	OOS Wind	-	-	**-**	1,000	-	**1,000**	1,000	-	**1,000**
New_Mexico_Wind	OOS Wind	2,500	-	**2,500**	2,328	-	**2,328**	2,328	-	**2,328**
SW_Ext_Tx_Wind	OOS Wind	-	500	**500**	690	100	**790**	610	-	**610**
NW_Ext_Tx_Wind	OOS Wind	-	67	**67**	-	-	**-**	-	-	**-**
Humboldt_Bay_Offshore_Wind	Offshore Wind	1,607	-	**1,607**	1,487	120	**1,607**	1,487	120	**1,607**
Morro_Bay_Offshore_Wind	Offshore Wind	3,100	-	**3,100**	3,100	-	**3,100**	3,100	-	**3,100**
Diablo_Canyon_Offshore_Wind	Offshore Wind	-	-	**-**	-	-	**-**	-	-	**-**
Renewable Resource Total		**11,952**	**42,690**	**54,642**	**29,078**	**25,564**	**54,642**	**26,581**	**29,614**	**56,196**
Greater_LA_Li_Battery	Li_Battery	6,741	-	**6,741**	4,003	-	**4,003**	4,055	-	**4,055**
Northern_California_Li_Battery	Li_Battery	319	-	**319**	2,608	-	**2,608**	2,198	-	**2,198**
Southern_PGAE_Li_Battery	Li_Battery	7,730	-	**7,730**	4,976	-	**4,976**	6,074	-	**6,074**
Tehachapi_Li_Battery	Li_Battery	6,240	-	**6,240**	4,126	-	**4,126**	3,884	-	**3,884**
Greater_Kramer_Li_Battery	Li_Battery	2,532	-	**2,532**	1,264	-	**1,264**	1,904	-	**1,904**
Southern_NV_Eldorado_Li_Battery	Li_Battery	3,440	-	**3,440**	3,113	-	**3,113**	2,711	-	**2,711**
Riverside_Li_Battery	Li_Battery	617	-	**617**	4,828	-	**4,828**	4,110	-	**4,110**
Arizona_Li_Battery	Li_Battery	0	-	**0**	1,805	-	**1,805**	1,798	-	**1,798**
Imperial_Li_Battery	Li_Battery	-	-	**-**	473	-	**473**	415	-	**415**
San_Diego_Li_Battery	Li_Battery	754	-	**754**	1,179	-	**1,179**	1,254	-	**1,254**
LI_Battery Total		**28,373**		**28,373**	**28,373**	**-**	**28,373**	**28,402**		**28,402**
SPGE_LDES	LDES	-	-	**-**	300	-	**300**	300	-	**300**
Tehachapi_LDES	LDES	500	-	**500**	500	-	**500**	500	-	**500**
Riverside_East_Pumped_Storage	LDES	500	-	**500**	700	-	**700**	700	-	**700**
Riverside_West_Pumped_Storage	LDES	500	-	**500**	-	-	**-**	-	-	**-**
San_Diego_Pumped_Storage	LDES	500	-	**500**	500	-	**500**	500	-	**500**
LDES Total		**2,000**		**2,000**	**2,000**	**-**	**2,000**	**2,000**		**2,000**
Storage Total		**30,373**		**30,373**	**30,373**	**-**	**30,373**	**30,402**		**30,402**
Total Storage+Resources		**42,325**	**42,690**	**85,015**	**59,451**	**25,564**	**85,015**	**56,983**	**29,614**	**86,598**

6.2 Post Ruling Mapping Adjustments

Following the October 7, 2022, ruling, busbar Working Group staff conducted additional rounds of mapping on the base case portfolio resources to improve compliance with the busbar mapping criteria, to incorporate updated datasets and feedback by stakeholders, and to include the methodology changes adopted as noted in Section 5. Key updates and feedback that guided mapping adjustments include:

- Updated online and in-development resources, including feedback from major participating transmission owners (PTOs).
- Updated CAISO interconnection queue (12/02/2022 version) and changed MW amount calculations to cap the MW resource potential of a resource type at the max net MWs to grid listed in the queue. Appendix G shows CPUC staff analysis of CAISO's interconnection queue.
- Methodology update based on stakeholder ruling feedback to consider Cluster 2 projects in the CAISO queue as higher confidence potential projects than non-Cluster 2 projects.
- Guidance on potential transmission upgrades and substation interconnection issues information from the CAISO 22-23 TPP preliminary results stakeholder call on November 17, 2022.[15]
- Stakeholder ruling feedback to better balance mapping criteria of aligning resources with TPD allocation, consistency with similar portfolios from previous TPPs, and prioritization of mapping storage resources to local areas and DACs to better enable gas retirement.
- Additional stakeholder feedback on mapping concerns for specific resources and at specific locations including:
    - Geothermal resources and potential development interest in Northern California and Nevada, and
    - Potential environmental impacts in the North of Lugo area.

The overall shifts in mapped resources in 2033 and 2035 are summarized in Table 11 and Table 12 respectively by resource type and RESOLVE resource area. The previous 22-23 TPP base case portfolio (model year 2032) and the sensitivity portfolio (model year 2035) summaries are again provided for comparison.

Table 13 shows the impact of mapping adjustments for battery storage in 2035 on alignment with the battery-specific mapping criteria. As noted, the mapping adjustments result in over a gigawatt more storage mapped to substations in DACs and nearly two gigawatts more storage mapped in ozone and NO_x air quality non-attainment zones.

[15] CAISO 2022-2023 TPP including the November 17, 2022, 2022-2023 TPP Preliminary Results: https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/2022-2023-Transmission-planning-process

Table 11: Summary of updated mapping results for the 2033 base case portfolio by resource area and type.

RESOLVE Resource Name	Resource Type	Total Resources (2033)			Change from Ruling (2033)			22-23 TPP Base Case (2032)		
		FCDS	EODS	TOTAL	FCDS	EODS	TOTAL	FCDS	EODS	TOTAL
InState Biomass	Biomass/Biogas	134	-	**134**	-	-	**-**	134	-	**134**
Solano_Geothermal	Geothermal	139		**139**	50	-	**50**	79	-	**79**
Northern_California_Geothermal	Geothermal	-		**-**	-	-	**-**	-	-	**-**
Inyokern_North_Kramer_Geothermal	Geothermal	53		**53**	-	-	**-**	40	-	**40**
Southern_Nevada_Geothermal	Geothermal	500		**500**	-	-	**-**	440	-	**440**
Northern_Nevada_Geothermal	Geothermal	371		**371**	150	-	**150**	-	-	**-**
Riverside_Palm_Springs_Geothermal	Geothermal	-		**-**	-	-	**-**	-	-	**-**
Greater_Imperial_Geothermal	Geothermal	800		**800**	(200)	-	**(200)**	600	-	**600**
Distributed Solar	Solar	125	-	**125**	(0)	-	**(0)**	125	-	**125**
Greater_LA_Solar	Solar	-	1,351	**1,351**	-	(252)	**(252)**	-	1,503	**1,503**
Northern_California_Solar	Solar	505	625	**1,130**	(120)	612	**492**	-	-	**-**
Southern_PGAE_Solar	Solar	3,778	2,336	**6,114**	299	(1,673)	**(1,374)**	1,022	1,781	**2,803**
Tehachapi_Solar	Solar	4,146	2,533	**6,678**	486	(171)	**315**	1,751	3,002	**4,753**
Greater_Kramer_Solar	Solar	1,310	1,000	**2,310**	(61)	239	**178**	385	1,071	**1,456**
Southern_NV_Eldorado_Solar	Solar	1,943	2,031	**3,974**	511	(390)	**121**	770	1,946	**2,716**
Riverside_Solar	Solar	1,958	4,235	**6,193**	(67)	683	**616**	862	1,106	**1,968**
Arizona_Solar	Solar	1,550	1,907	**3,457**	650	(690)	**(40)**	600	1,281	**1,881**
Imperial_Solar	Solar	120	573	**693**	-	(57)	**(57)**	100	200	**300**
Northern_California_Wind	Wind	230	109	**339**	-	-	**-**	305	351	**656**
Solano_Wind	Wind	682	75	**757**	(55)	(18)	**(73)**	272	148	**420**
Humboldt_Wind	Wind	-	-	**-**	-	-	**-**	-	-	**-**
Kern_Greater_Carrizo_Wind	Wind	180	-	**180**	120	-	**120**	60	-	**60**
Carrizo_Wind	Wind	174	-	**174**	(84)	-	**(84)**	287	-	**287**
Central_Valley_North_Los_Banos_Wind	Wind	150	-	**150**	(36)	-	**(36)**	186	-	**186**
North_Victor_Wind	Wind	-	-	**-**	-	-	**-**	-	-	**-**
Tehachapi_Wind	Wind	345	-	**345**	61	-	**61**	275	-	**275**
Southern_Nevada_Wind	Wind	403	-	**403**	82	(82)	**-**	442	-	**442**
Riverside_Palm_Springs_Wind	Wind	107	20	**127**	(9)	20	**12**	106	-	**106**
Baja_California_Wind	Wind	240	360	**600**	-	-	**-**	600	-	**600**
Wyoming_Wind	OOS Wind	1,500	-	**1,500**	-	-	**-**	1,062	-	**1,062**
Idaho_Wind	OOS Wind	1,000	-	**1,000**	-	-	**-**	-	-	**-**
New_Mexico_Wind	OOS Wind	2,328	-	**2,328**	-	-	**-**	438	-	**438**
SW_Ext_Tx_Wind	OOS Wind	690	100	**790**	-	-	**-**	610	-	**610**
NW_Ext_Tx_Wind	OOS Wind	-	-	**-**	-	-	**-**	-	-	**-**
Humboldt_Bay_Offshore_Wind	Offshore Wind	-	161	**161**	(41)	41	**-**	-	120	**120**
Morro_Bay_Offshore_Wind	Offshore Wind	3,100	-	**3,100**	-	-	**-**	1,588	-	**1,588**
Diablo_Canyon_Offshore_Wind	Offshore Wind	-	-	**-**	-	-	**-**	-	-	**-**
Renewable Resource Total		**28,560**	**17,415**	**45,975**	**1,736**	**(1,737)**	**(0)**	**13,139**	**12,509**	**25,647**
Greater_LA_Li_Battery	Li_Battery	3,315	-	**3,315**	661	-	**661**	2,861	-	**2,861**
Northern_California_Li_Battery	Li_Battery	1,778	-	**1,778**	553	-	**553**	607	-	**607**
Southern_PGAE_Li_Battery	Li_Battery	3,116	-	**3,116**	315	-	**315**	1,624	-	**1,624**
Tehachapi_Li_Battery	Li_Battery	2,846	-	**2,846**	-	-	**-**	3,051	-	**3,051**
Greater_Kramer_Li_Battery	Li_Battery	1,165	-	**1,165**	(95)	-	**(95)**	869	-	**869**
Southern_NV_Eldorado_Li_Battery	Li_Battery	1,850	-	**1,850**	(1,184)	-	**(1,184)**	1,236	-	**1,236**
Riverside_Li_Battery	Li_Battery	4,763	-	**4,763**	193	-	**193**	1,608	-	**1,608**
Arizona_Li_Battery	Li_Battery	1,212	-	**1,212**	(593)	-	**(593)**	759	-	**759**
Imperial_Li_Battery	Li_Battery	462	-	**462**	(11)	-	**(11)**	50	-	**50**
San_Diego_Li_Battery	Li_Battery	1,224	-	**1,224**	160	-	**160**	899	-	**899**
LI_Battery Total		**21,730**	**-**	**21,730**	**(1)**	**-**	**(1)**	**13,564**	**-**	**13,564**
SPGE_LDES	LDES	-	-	**-**	-	-	**-**	-	-	**-**
Tehachapi_LDES	LDES	500	-	**500**	-	-	**-**	500	-	**500**
Riverside_East_Pumped_Storage	LDES	524	-	**524**	-	-	**-**	-	-	**-**
Riverside_West_Pumped_Storage	LDES	-	-	**-**	-	-	**-**	-	-	**-**
San_Diego_Pumped_Storage	LDES	500	-	**500**	-	-	**-**	500	-	**500**
LDES Total		**1,524**	**-**	**1,524**	**-**	**-**	**-**	**1,000**	**-**	**1,000**
Storage Total		**23,254**	**-**	**23,254**	**(1)**	**-**	**(1)**	**14,564**		**14,564**
Total Storage+Resources		**51,813**	**17,415**	**69,228**	**1,736**	**(1,737)**	**(1)**	**27,702**	**12,509**	**40,211**

Table 12: Summary of updated mapping results for the 2035 base case portfolio by resource area and type

RESOLVE Resource Name	Resource Type	Total Resources (2035)			Change From Ruling (2035)			22-23 TPP Sens. (2035)		
		FCDS	EODS	TOTAL	FCDS	EODS	TOTAL	FCDS	EODS	TOTAL
InState Biomass	Biomass/Biogas	134	-	**134**				134	-	**134**
Solano_Geothermal	Geothermal	139		**139**	50	-	**50**	79		**79**
Northern_California_Geothermal	Geothermal	-		**-**	-	-	**-**	-		**-**
Inyokern_North_Kramer_Geothermal	Geothermal	53		**53**	-	-	**-**	48		**48**
Southern_Nevada_Geothermal	Geothermal	500		**500**	-	-	**-**	440		**440**
Northern_Nevada_Geothermal	Geothermal	445		**445**	50	-	**50**	327		**327**
Riverside_Palm_Springs_Geothermal	Geothermal	-		**-**	-	-	**-**	-		**-**
Greater_Imperial_Geothermal	Geothermal	900		**900**	(100)	-	**(100)**	900		**900**
Distributed Solar	Solar	125	-	**125**	(0)	-	**(0)**	125	-	**125**
Greater_LA_Solar	Solar	125	1,776	**1,901**	-	(152)	**(152)**	125	1,928	**2,053**
Northern_California_Solar	Solar	685	1,061	**1,746**	10	266	**276**	344	1,512	**1,856**
Southern_PGAE_Solar	Solar	4,123	4,738	**8,861**	379	(724)	**(345)**	3,535	7,439	**10,974**
Tehachapi_Solar	Solar	4,146	2,738	**6,883**	186	(1,116)	**(930)**	3,031	4,952	**7,983**
Greater_Kramer_Solar	Solar	1,310	1,350	**2,660**	(61)	55	**(6)**	900	2,281	**3,181**
Southern_NV_Eldorado_Solar	Solar	2,157	2,786	**4,943**	845	(320)	**525**	1,320	4,196	**5,516**
Riverside_Solar	Solar	1,958	4,535	**6,493**	(82)	313	**231**	1,817	3,495	**5,312**
Arizona_Solar	Solar	1,550	2,947	**4,497**	650	(250)	**400**	634	2,592	**3,226**
Imperial_Solar	Solar	120	843	**963**	-	-	**-**	100	553	**653**
Northern_California_Wind	Wind	230	109	**339**	-	-	**-**	305	351	**656**
Solano_Wind	Wind	682	75	**757**	(55)	(18)	**(73)**	321	196	**517**
Humboldt_Wind	Wind	-	-	**-**	-	-	**-**	-	-	**-**
Kern_Greater_Carrizo_Wind	Wind	180	-	**180**	120	-	**120**	60	-	**60**
Carrizo_Wind	Wind	174	-	**174**	(84)	-	**(84)**	287	-	**287**
Central_Valley_North_Los_Banos_Wind	Wind	150	-	**150**	(36)	-	**(36)**	186	-	**186**
North_Victor_Wind	Wind	-	-	**-**	-	-	**-**	100	-	**100**
Tehachapi_Wind	Wind	345	-	**345**	61	-	**61**	281	-	**281**
Southern_Nevada_Wind	Wind	403	-	**403**	82	(82)	**-**	442	-	**442**
Riverside_Palm_Springs_Wind	Wind	107	20	**127**	(9)	20	**12**	116	-	**116**
Baja_California_Wind	Wind	240	360	**600**	-	-	**-**	600	-	**600**
Wyoming_Wind	OOS Wind	1,500	-	**1,500**	-	-	**-**	1,500	-	**1,500**
Idaho_Wind	OOS Wind	1,000	-	**1,000**	-	-	**-**	1,000	-	**1,000**
New_Mexico_Wind	OOS Wind	2,328	-	**2,328**	-	-	**-**	2,328	-	**2,328**
SW_Ext_Tx_Wind	OOS Wind	690	100	**790**	(0)	-	**(0)**	610	-	**610**
NW_Ext_Tx_Wind	OOS Wind	-	-	**-**	-	-	**-**	-	-	**-**
Humboldt_Bay_Offshore_Wind	Offshore Wind	1,446	161	**1,607**	(41)	41	**-**	1,487	120	**1,607**
Morro_Bay_Offshore_Wind	Offshore Wind	3,100	-	**3,100**	-	-	**-**	3,100	-	**3,100**
Diablo_Canyon_Offshore_Wind	Offshore Wind	-	-	**-**	-	-	**-**	-	-	**-**
Renewable Resource Total		**31,043**	**23,598**	**54,642**	**1,965**	**(1,965)**	**(0)**	**26,581**	**29,614**	**56,196**
Greater_LA_Li_Battery	Li_Battery	4,580	-	**4,580**	578	-	**578**	4,055	-	**4,055**
Northern_California_Li_Battery	Li_Battery	2,477	-	**2,477**	(131)	-	**(131)**	2,198	-	**2,198**
Southern_PGAE_Li_Battery	Li_Battery	5,204	-	**5,204**	228	-	**228**	6,074	-	**6,074**
Tehachapi_Li_Battery	Li_Battery	3,668	-	**3,668**	(458)	-	**(458)**	3,884	-	**3,884**
Greater_Kramer_Li_Battery	Li_Battery	1,404	-	**1,404**	140	-	**140**	1,904	-	**1,904**
Southern_NV_Eldorado_Li_Battery	Li_Battery	2,689	-	**2,689**	(424)	-	**(424)**	2,711	-	**2,711**
Riverside_Li_Battery	Li_Battery	4,863	-	**4,863**	35	-	**35**	4,110	-	**4,110**
Arizona_Li_Battery	Li_Battery	1,662	-	**1,662**	(143)	-	**(143)**	1,798	-	**1,798**
Imperial_Li_Battery	Li_Battery	503	-	**503**	30	-	**30**	415	-	**415**
San_Diego_Li_Battery	Li_Battery	1,324	-	**1,324**	145	-	**145**	1,254	-	**1,254**
LI_Battery Total		**28,373**	**-**	**28,373**	**(0)**	**-**	**(0)**	**28,402**		**28,402**
SPGE_LDES	LDES	300	-	**300**	-	-	**-**	300	-	**300**
Tehachapi_LDES	LDES	500	-	**500**	-	-	**-**	500	-	**500**
Riverside_East_Pumped_Storage	LDES	700	-	**700**	-	-	**-**	700	-	**700**
Riverside_West_Pumped_Storage	LDES	-	-	**-**	-	-	**-**	-	-	**-**
San_Diego_Pumped_Storage	LDES	500	-	**500**	-	-	**-**	500	-	**500**
LDES Total		**2,000**	**-**	**2,000**	**-**	**-**	**-**	**2,000**		**2,000**
Storage Total		**30,373**	**-**	**30,373**	**(0)**	**-**	**(0)**	**30,402**		**30,402**
Total Storage+Resources		**61,416**	**23,598**	**85,015**	**1,965**	**(1,965)**	**(0)**	**56,983**	**29,614**	**86,598**

Table 13: Updated battery mapping alignment with the four main storage centric mapping criteria.

Battery Adjustments Criteria Summary (2035)			
Battery Category	**Ruling Capacity (MW)**	**Adjustments**	**Updated Capacity (MW)**
Co-Located in LCR Areas	2,560	313	2,873
Stand-Alone in LCR Areas	3,719	362	4,081
Total in LCR Areas	**6,279**	**675**	**6,954**
Co-Located in DACs	3,146	563	3,709
Stand-Alone in DACs	1,984	816	2,800
Total in DACs	**5,130**	**1,378**	**6,509**
Co-Located in Non-Attainment Zones	12,735	90	12,826
Stand-Alone in Non-Attainment Zones	4,714	1,842	6,556
Total in Non-Attainment Zones	**17,449**	**1,932**	**19,381**
Co-Located in High-Curtailment Zones	12,962	(347)	12,614
Stand-Alone in High-Curtailment Zones	475	468	943
Total in High-Curtailment Zones	**13,437**	**120**	**13,557**

In the following sections, the summary of mapping adjustments made by busbar Working Group staff are broken down by areas: Northern California, Southern PG&E, Greater Tehachapi (which includes the Northern SCE transmission up to Big Creek Hydro facilities), Greater LA Metro (which includes most of Orange County and the Simi and Santa Clara Valleys), Greater Kramer (which includes up to the Control substation and over to the Pisgah and Calcite substations), Southern Nevada (which includes GLW and the El Dorado and Mohave substations), Riverside, Arizona, San Diego, and Imperial. Full substation level mapping adjustments are in the final Mapping Dashboards included as Appendix B for 2033 and Appendix C for 2035.

6.2.A Northern California

The Northern California area includes the Greater Bay Area, the Tesla substation area, and all the state to the north and east of those areas. Table 14 shows the initial ruling mapping totals for Northern California and the net mapping adjustments made post-ruling.

Table 14: October 2022 Ruling mapping summary and post-ruling mapping adjustments for the Northern California area by resource type and status

October Ruling Resources in Northern California

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	3	-	8	-	73	-	-	-	84	-	**84**
Geothermal	-	-	-	-	89	-	-	-	89	-	**89**
Geothermal OOS	-	-	40	-	-	-	-	-	40	-	**40**
Distributed Solar	-	-	8	-	37	-	-	-	45	-	**45**
Utility-Scale Solar	-	3	120	-	505	10	50	782	675	795	**1,470**
Wind	56	-	-	-	911	201	-	-	967	201	**1,168**
Offshore Wind	-	-	-	-	-	161	1,446	-	1,446	161	**1,607**
Li_Battery	208	-	782	-	236	-	1,383	-	2,608	-	**2,608**

Resource Mapping Adjustments

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	1	-	(4)	-	22	-	-	-	19	-	**19**
Geothermal	-	-	-	-	50	-	-	-	50	-	**50**
Geothermal OOS	-	-	-	-	-	-	-	-	-	-	**-**
Distributed Solar	10	-	12	-	(28)	-	-	-	(5)	-	**(5)**
Utility-Scale Solar	-	-	(120)	132	-	480	130	(346)	10	266	**276**
Wind	(1)	-	-	-	(54)	(18)	-	-	(55)	(18)	**(73)**
Offshore Wind	-	-	-	-	-	-	-	-	-	-	**-**
Li_Battery	-	-	197	-	356	-	(684)	-	(131)	-	**(131)**

Key mapping adjustments for the area are:

- Added geothermal resources to the Solano (Geysers) geothermal area from the Imperial area to address the full commercial interest in the area and stakeholder feedback on development potential.
- Relocated wind mapped to the Cortina substation because updated commercial interest information showed that the development interest had withdrawn from the CAISO queue. Shifted those wind resources to other substations in Northern CA, Southern PG&E, and Riverside with commercial interest.
- Relocated generic batteries resources from multiple substations to substations with newly identified in-development resources in Northern CA and in other regions.

6.2.B Southern PG&E

The Southern PG&E area includes most of the San Joaquin valley and the Central Coast area, including Moss Landing, serviced by the PG&E transmission system. Table 15 shows the initial ruling mapping totals for Southern PG&E and the net mapping adjustments made post-ruling.

Table 15: October 2022 Ruling mapping summary and post-ruling mapping adjustments for the Southern PG&E area by resource type and status.

October Ruling Resources in Southern PG&E

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	4	-	4	-	-	-	8	-	**8**
Geothermal	-	-	-	-	-	-	-	-	-	-	**-**
Distributed Solar	-	-	29	-	18	-	-	-	47	-	**47**
Utility-Scale Solar	740	-	862	108	1,878	3,901	265	1,453	3,744	5,462	**9,206**
Wind	-	-	167	-	337	-	-	-	504	-	**504**
Offshore Wind	-	-	-	-	3,100	-	-	-	3,100	-	**3,100**
Li_Battery	747	-	749	-	1,304	-	2,175	-	4,976	-	**4,976**
LDES	-	-	-	-	-	-	300	-	300	-	**300**

Resource Mapping Adjustments

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	1	-	3	-	-	-	4	-	**4**
Geothermal	-	-	-	-	-	-	-	-	-	-	**-**
Distributed Solar	-	-	2	-	3	-	-	-	5	-	**5**
Utility-Scale Solar	(179)	87	330	282	148	(2,042)	80	949	379	(724)	**(345)**
Wind	-	-	9	-	(8)	-	-	-	0	-	**0**
Offshore Wind	-	-	-	-	-	-	-	-	-	-	**-**
Li_Battery	183	-	868	-	(735)	-	(87)	-	228	-	**228**
LDES	-	-	-	-	-	-	-	-	-	-	**-**

Key mapping adjustments for the Southern PG&E area are:

- Shifted wind mapped to the Cholame 70 kV bus and portions of wind mapped to Los Banos and Templeton to the Caliente substation to better align with commercial interest and avoid potential transmission issues that could be caused by Cholame's low voltage.
- Reduced solar resources mapped to Mustang, Tranquility, and Helm to better align with updated commercial interest.
- Shifted solar resources amongst Midway's 500 kV, 230 kV, 115 kV buses to better align with commercial interest.
- Reduced battery resources mapped to Midway 230 kV, Tranquility 230 kV, Moss Landing 500 kV, and Caliente 230 kV to better align with high confidence commercial interest and in-development resources at Moss Landing 230 kV and Gates 230 kV and to align with previously mapped storage at Mesa 115 kV and Lamont 115 kV that the 21-22 TPP identified as alternatives to transmission solutions.
- Mapped solar and storage to Gregg and Solar SS substations and solar to Borden and Lamont substations to better align with mapped resources in the 22-23 TPP sensitivity portfolio.

6.2.C Greater Tehachapi

The Greater Tehachapi area comprises the Tehachapi renewable area centered around Antelope, Whirlwind, and Windhub substations plus the SCE Northern Area transmission system up to the Big Creek hydroelectric facilities. Table 16 shows the initial ruling mapping totals for Greater Tehachapi and the net mapping adjustments made post-ruling.

Table 16: October 2022 Ruling mapping summary and post-ruling mapping adjustments for the Greater Tehachapi area by resource type and status.

October Ruling Resources in Greater Tehachapi

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	-	-	9	-	-	-	9	-	**9**
Distributed Solar	-	-	6	-	-	-	-	-	6	-	**6**
Utility-Scale Solar	746	-	1,031	600	1,883	2,103	300	1,150	3,960	3,853	**7,813**
Wind	169	-	3	-	112	-	-	-	284	-	**284**
Li_Battery	400	-	1,939	-	507	-	1,280	-	4,126	-	**4,126**
LDES	-	-	-	-	500	-	-	-	500	-	**500**

Resource Mapping Adjustments

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	-	-	-	-	-	-	-	-	**-**
Distributed Solar	-	-	-	-	-	-	-	-	-	-	**-**
Utility-Scale Solar	(28)	10	14	-	500	(181)	(300)	(945)	186	(1,116)	**(930)**
Wind	49	-	-	-	12	-	-	-	61	-	**61**
Li_Battery	172	-	(238)	-	66	-	(458)	-	(458)	-	**(458)**
LDES	-	-	-	-	-	-	-	-	-	-	**-**

Key mapping adjustments for the Tehachapi area are:

- Reduced the amount of battery storage mapped at Windhub 230 kV and 500 kV buses and slightly reduced batteries mapped to Whirlwind 230 kV and Vestal 230 kV despite large commercial interest. Batteries were mapped to other substations that had higher battery criteria alignment and to better align with newly identified in-development battery resources.
- Reduced, significantly, the amount of solar mapped to Whirlwind 230 kV and Windhub 500 kV substations and mapped the resources to other areas to improve prior mapping alignment and limit potential overcrowding of interconnections in the Tehachapi area. Both buses have large amounts of solar still mapped to them and with the area already well developed, CPUC staff agreed with stakeholders concerns that new resources may have difficulty siting and interconnecting without potential additional costs.
- Increased solar resources mapped to Springville and Rector substations to better align with previous mapping in the 22-23 TPP sensitivity and with commercial interest in the San Joaquin valley.

6.2.D Greater LA Metro

The Greater LA Metro area also include Orange County to the south and the Simi and Santa Clara Valleys out to the Goleta substation in Ventura and Santa Barbara Counties to the north. Table 17 shows the initial ruling mapping totals for Greater LA Metro and the net mapping adjustments made post-ruling. The key mapping adjustment for the LA Metro area is:

- Shifted 200 MW of battery storage from the Vincent substation and nearly 600 MW of battery storage from other areas to substations in the Metro area to align with newly identified in-development and soon to be in-construction resources at substations within DACs or near existing thermal plants.

Table 17: Greater LA Metro area's October 2022 Ruling mapping summary and post-ruling adjustments by resource type and status.

October Ruling Resources in Greater LA Metro											
Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	5	-	1	-	-	-	6	-	**6**
Distributed Solar	-	-	-	-	20	-	-	-	20	-	**20**
Utility-Scale Solar	-	-	-	1	-	1,602	125	325	125	1,928	**2,053**
Li_Battery	246	-	646	-	1,762	-	1,349	-	4,003	-	**4,003**
Resource Mapping Adjustments											
Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	2	-	(2)	-	-	-	-	-	-	-	**-**
Distributed Solar	-	-	20	-	(20)	-	-	-	-	-	**-**
Utility-Scale Solar	-	-	-	-	-	(252)	-	100	-	(152)	**(152)**
Li_Battery	20	-	1,135	-	(493)	-	(84)	-	578	-	**578**

6.2.E Greater Kramer

The Greater Kramer area includes, in addition to the region around the Victor and Kramer substations, the areas east out to the Pisgah substation, south to the Lucerne valley, and north up to SCE's Control substation. Table 18 shows the initial ruling mapping totals for the Greater Kramer area and the net mapping adjustments made post-ruling. The area only had a small series of adjustments with the key few being:

- Reduced solar resources mapped to Kramer substation given the potential higher environmental impacts in the area, although there is a significant amount already in development.
- Solar from Kramer was mapped to Pisgah along with battery storage from Southern Nevada to improve consistency with mapping in the 22-23 TPP sensitivity.
- Small adjustments to resources mapped at other substations in the area to align with updated in-development and commercial interest information.

Table 18: October 2022 Ruling mapping summary and post-ruling adjustments for the Greater Kramer area by resource type and status.

October Ruling Resources in Greater Kramer

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	22	-	3	-	-	-	25	-	**25**
Geothermal	40	-	-	-	-	-	-	-	40	-	**40**
Geothermal OOS	-	-	13	-	-	-	-	-	13	-	**13**
Distributed Solar	-	-	5	-	2	-	-	-	7	-	**7**
Utility-Scale Solar	100	-	620	510	651	251	0	534	1,371	1,295	**2,666**
Li_Battery	50	-	700	-	510	-	4	-	1,264	-	**1,264**

Resource Mapping Adjustments

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	(20)	-	(3)	-	-	-	(22)	-	**(22)**
Geothermal	-	-	-	-	-	-	-	-	-	-	**-**
Geothermal OOS	-	-	-	-	-	-	-	-	-	-	**-**
Distributed Solar	-	-	-	-	-	-	-	-	-	-	**-**
Utility-Scale Solar	-	-	5	40	(66)	199	(0)	(184)	(61)	55	**(6)**
Li_Battery	-	-	-	-	(95)	-	235	-	140	-	**140**

6.2.F Southern Nevada

Southern Nevada includes the GLW area, resources at the El Dorado, Ivanpah, and Mohave substations, and imports of out of BAA areas interconnecting at CAISO interties in the Nevada area. Table 19 shows the initial ruling mapping totals for the Southern Nevada and El Dorado area and the net mapping adjustments made post-ruling.

Table 19: Southern Nevada and Eldorado area's October 2022 Ruling mapping summary and post-ruling adjustments by resource type and status.

October Ruling Resources in Southern Nevada

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Geothermal	-	-	-	-	500	-	-	-	500	-	**500**
Geothermal OOS*	-	-	76	-	105	-	174	-	355	-	**355**
Utility-Scale Solar	-	-	260	249	1,172	2,172	-	565	1,432	2,986	**4,418**
Wind	-	-	-	-	321	82	-	-	321	82	**403**
OOS Wind, New Tx	-	-	-	-	2,500	-	-	-	2,500	-	**2,500**
OOS Wind, Ext Tx	571	100	-	-	-	-	-	-	571	100	**671**
Li_Battery	-	-	440	-	2,594	-	79	-	3,113	-	**3,113**

Resource Mapping Adjustments

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Geothermal	-	-	-	-	-	-	-	-	-	-	**-**
Geothermal OOS*	-	-	-	-	150	-	(100)	-	50	-	**50**
Utility-Scale Solar	-	-	-	(9)	511	(381)	214	190	725	(200)	**525**
Wind	-	-	-	-	82	(82)	-	-	82	(82)	**-**
OOS Wind, New Tx	-	-	-	-	-	-	-	-	-	-	**-**
OOS Wind, Ext Tx	-	-	-	-	-	-	-	-	-	-	**-**
Li_Battery	-	-	(12)	-	(1,172)	-	760	-	(424)	-	**(424)**

*OOS in this case denotes out-of-state and outside of CAISO BAA

Key mapping adjustments for the Southern Nevada, Eldorado and Mohave areas are:

- Relocated the 200 MW of storage mapped to Ivanpah 230 kV and 800 MW of storage mapped to Mohave 500 kV. Shifted 600 MW of the battery storage to other Southern Nevada substations and 400 MW to the Kramer and LA Metro areas.
- Shifted 300 MW of solar from Mohave 500 kV and added an additional 900 MW of solar from other areas to southern Nevada substations.
- Shifted 50 MW of geothermal from Imperial area to Northern Nevada geothermal.

The large solar and storage mapping adjustments are centered around Working Group staff's efforts to strike a balance between alignment with TPD allocations, consistency with similar portfolios in previous TPPs, and environmental impact potentials. Prior portfolio mappings had more resources mapped to GLW substations, while the Mohave substation has significantly more TPD allocated but less resources previously mapped to it in past portfolios. Additionally, staff have noted in previous TPP reports that large amounts of solar mapped to Mohave could have higher potential environmental impacts. The relocation of storage resources to the Kramer and LA metro areas were to align with previous mappings in the Kramer area and to account for the newly identified in-development resources in the LA Metro area at substations with high alignment with the battery-specific mapping criteria.

6.2.G Riverside & Arizona

The Riverside and Arizona areas includes Arizona substations within CAISO's BAA and out-of-BAA resources being imported at the Palo Verde intertie. Table 20 shows the initial ruling mapping totals for the Riverside and Arizona areas combined and the net mapping adjustments made post-ruling.

Table 20: October 2022 Ruling mapping summary and post-ruling adjustments for Riverside and Arizona areas by resource type and status.

October Ruling Resources in Riverside & Arizona

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	3	-	-	-	-	-	3	-	**3**
Utility-Scale Solar	1,092	237	1,262	1,359	571	4,553	15	1,270	2,940	7,419	**10,359**
Wind	106	-	9	-	1	-	-	-	116	-	**116**
OOS Wind, Ext Tx	119	-	-	-	-	-	-	-	119	-	**119**
OOS Wind, New Tx	-	-	-	-	2,328	-	-	-	2,328	-	**2,328**
Li_Battery	658	-	2,382	-	3,335	-	258	-	6,633	-	**6,633**
LDES	-	-	-	-	524	-	176	-	700	-	**700**

Resource Mapping Adjustments

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	-	-	-	-	-	-	-	-	**-**
Utility-Scale Solar	(305)	559	(539)	104	1,427	(670)	(15)	70	568	63	**631**
Wind	0	-	(9)	-	-	20	-	-	(9)	20	**12**
OOS Wind, Ext Tx	-	-	-	-	-	-	-	-	-	-	**-**
OOS Wind, New Tx	-	-	-	-	-	-	-	-	-	-	**-**
Li_Battery	534	-	1,094	-	(2,027)	-	292	-	(108)	-	**(108)**
LDES	-	-	-	-	-	-	-	-	-	-	**-**

Key mapping adjustments for the Riverside and Arizona areas are:

- Large shifts of storage and solar resource between generic, in-development, and online to account for updated and newly identified online and in-development resources.
- Large shifts of storage and solar from Colorado River 500 kV to Colorado River 230 kV to account for updates to in-development resources and commercial interest.
- Reduced solar resources mapped to Redbluff 230 and 500 kV substations to better align with updated commercial interest and reduce potential environmental implications.
- Increased solar resources mapped to Delaney and Devers substations to align with CI and consistency with 22-23 TPP sensitivity portfolio, respectively.

The net reduction of resources mapped to Redbluff 230 kV and 500 kV substations was 225 MW of solar and 27 MW of battery storage, leaving 1,972 MW of in-development and generic solar and 1,430 MW of in-development and generic storage mapped to the two buses. The amount remaining still slightly exceeds the total amount of Cluster 2 or higher solar commercial interest at these two buses; however, the reduction does alleviate the level-2 criteria flag for land use. Before the 225 MW reduction, the amount of solar mapped to Redbluff exceeded the 50% threshold of utilizing available low environmental implications land causing that initial level-2 criteria flag. These resources were shifted to Delaney substation which had additional high confidence solar commercial interest.

6.2.H San Diego & Imperial

Table 21 shows the initial ruling mapping totals for the San Diego and Imperial areas combined, which includes resources mapped to the Imperial Irrigation District's service area, and the net mapping adjustments made post-ruling. In the mapping adjustments, small additions of storage were made at several San Diego area substations to align with newly identified in-development resources. Additionally, staff relocated 100 MW of geothermal from Imperial to Northern California's Geysers area and Northern Nevada geothermal to better align with commercial interest in the various interconnection queues.

Table 21: October 2022 Ruling mapping summary and post-ruling adjustments for San Diego and Imperial areas by resource type and status.

October Ruling Resources in San Diego & Imperial

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Geothermal, IID	-	-	76	-	924	-	-	-	1,000	-	**1,000**
Utility-Scale Solar	-	-	20	190	100	440	-	213	120	843	**963**
Wind	105	-	-	-	135	360	-	-	240	360	**600**
Li_Battery	339	-	981	-	217	-	115	-	1,652	-	**1,652**
LDES	-	-	-	-	500	-	-	-	500	-	**500**

Resource Mapping Adjustments

Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Geothermal, IID	-	-	-	-	(200)	-	100	-	(100)	-	**(100)**
Utility-Scale Solar	20	-	(20)	220	-	(277)	-	57	-	-	**-**
Wind	-	-	-	-	-	-	-	-	-	-	**-**
Li_Battery	60	-	220	-	(131)	-	26	-	175	-	**175**
LDES	-	-	-	-	-	-	-	-	-	-	**-**

6.3 Mapping Adjustments Following Proposed Decision Comments and Replies

Following comments and replies to the January 13, 2023, Proposed Decision[16], busbar Working Group staff only made a few minor mapping adjustments. These adjustments incorporate updated in-development resource information from the PTOs to ensure that mapping results accurately accounted for the most recent contracting and construction information provided. As noted in the mapping methodology, alignment with these resources is a high priority.

Overall adjustments centered mostly on shifted generic resources to in-development to account for the additional in-development resources. The Tehachapi area had the most substations with adjustments, as staff accounted for additional in-development resources and further adjusted generic resources to not exceed the South of Magunden transmission constraints, for which staff assessed the CAISO's 2021 White Paper identified upgrade was not cost effective for the exceedance amount. Table 22 shows the net resource adjustment by RESOLVE area for 2035 mapping results, while Table 23 shows the net resource adjustments by substation for 2035. Appendix Chas a detailed breakdown of these mapping adjustments include the intra substation adjustments between generic and in-development, while Appendix B has the net adjustments impact for the 2033 mapping.

[16] January 13, 2023, Proposed Decision Ordering Supplemental Mid-Term Reliability Procurement (2026-2027) and Transmitting Electric Resource Portfolios to CAISO for the 2023-2024 TPP: https://docs.cpuc.ca.gov/SearchRes.aspx?docformat=ALL&docid=501102663

Table 22: Summary of final mapping results for the 2035 base case portfolio by resource area and type

RESOLVE Resource Name	Resource Type	Total Final Resources (2035)			Change From PD (2035)			22-23 TPP Sens. (2035)		
		FCDS	EODS	TOTAL	FCDS	EODS	TOTAL	FCDS	EODS	TOTAL
InState Biomass	Biomass/Biogas	134	-	**134**	-	-	**-**	134	-	**134**
Solano_Geothermal	Geothermal	139		**139**	-	-	**-**	79		**79**
Northern_California_Geothermal	Geothermal	-		**-**	-	-	**-**	-		**-**
Inyokern_North_Kramer_Geothermal	Geothermal	53		**53**	-	-	**-**	48		**48**
Southern_Nevada_Geothermal	Geothermal	500		**500**	-	-	**-**	440		**440**
Northern_Nevada_Geothermal	Geothermal	445		**445**	-	-	**-**	327		**327**
Riverside_Palm_Springs_Geothermal	Geothermal	-		**-**	-	-	**-**	-		**-**
Greater_Imperial_Geothermal	Geothermal	900		**900**	-	-	**-**	900		**900**
Distributed Solar	Solar	125	-	**125**	-	-	**-**	125	-	**125**
Greater_LA_Solar	Solar	125	1,776	**1,901**	-	-	**-**	125	1,928	**2,053**
Northern_California_Solar	Solar	685	1,061	**1,746**	-	-	**-**	344	1,512	**1,856**
Southern_PGAE_Solar	Solar	4,123	4,738	**8,861**	-	-	**-**	3,535	7,439	**10,974**
Tehachapi_Solar	Solar	3,638	3,246	**6,883**	(508)	508	**-**	3,031	4,952	**7,983**
Greater_Kramer_Solar	Solar	1,310	1,350	**2,660**	-	-	**-**	900	2,281	**3,181**
Southern_NV_Eldorado_Solar	Solar	2,157	2,786	**4,943**	-	-	**-**	1,320	4,196	**5,516**
Riverside_Solar	Solar	1,929	4,564	**6,493**	(29)	29	**-**	1,817	3,495	**5,312**
Arizona_Solar	Solar	1,550	2,947	**4,497**	-	-	**-**	634	2,592	**3,226**
Imperial_Solar	Solar	120	843	**963**	-	-	**-**	100	553	**653**
Northern_California_Wind	Wind	230	109	**339**	-	-	**-**	305	351	**656**
Solano_Wind	Wind	682	75	**757**	-	-	**-**	321	196	**517**
Humboldt_Wind	Wind	-	-	**-**	-	-	**-**	-	-	**-**
Kern_Greater_Carrizo_Wind	Wind	180	-	**180**	-	-	**-**	60	-	**60**
Carrizo_Wind	Wind	174	-	**174**	-	-	**-**	287	-	**287**
Central_Valley_North_Los_Banos_Wind	Wind	150	-	**150**	-	-	**-**	186	-	**186**
North_Victor_Wind	Wind	-	-	**-**	-	-	**-**	100	-	**100**
Tehachapi_Wind	Wind	345	-	**345**	-	-	**-**	281	-	**281**
Southern_Nevada_Wind	Wind	403	-	**403**	-	-	**-**	442	-	**442**
Riverside_Palm_Springs_Wind	Wind	107	20	**127**	-	-	**-**	116	-	**116**
Baja_California_Wind	Wind	240	360	**600**	-	-	**-**	600	-	**600**
Wyoming_Wind	OOS Wind	1,500	-	**1,500**	-	-	**-**	1,500	-	**1,500**
Idaho_Wind	OOS Wind	1,000	-	**1,000**	-	-	**-**	1,000	-	**1,000**
New_Mexico_Wind	OOS Wind	2,328	-	**2,328**	-	-	**-**	2,328	-	**2,328**
SW_Ext_Tx_Wind	OOS Wind	690	100	**790**	-	-	**-**	610	-	**610**
NW_Ext_Tx_Wind	OOS Wind	-	-	**-**	-	-	**-**	-	-	**-**
Humboldt_Bay_Offshore_Wind	Offshore Wind	1,446	161	**1,607**	-	-	**-**	1,487	120	**1,607**
Morro_Bay_Offshore_Wind	Offshore Wind	3,100	-	**3,100**	-	-	**-**	3,100	-	**3,100**
Diablo_Canyon_Offshore_Wind	Offshore Wind	-	-	**-**	-	-	**-**	-	-	**-**
Renewable Resource Total		**30,507**	**24,135**	**54,642**	**(537)**	**537**	**0**	**26,581**	**29,614**	**56,196**
Greater_LA_Li_Battery	Li_Battery	4,429	-	**4,429**	(152)	-	**(152)**	4,055	-	**4,055**
Northern_California_Li_Battery	Li_Battery	2,477	-	**2,477**	0	-	**0**	2,198	-	**2,198**
Southern_PGAE_Li_Battery	Li_Battery	5,204	-	**5,204**	-	-	**-**	6,074	-	**6,074**
Tehachapi_Li_Battery	Li_Battery	3,813	-	**3,813**	145	-	**145**	3,884	-	**3,884**
Greater_Kramer_Li_Battery	Li_Battery	1,404	-	**1,404**	-	-	**-**	1,904	-	**1,904**
Southern_NV_Eldorado_Li_Battery	Li_Battery	2,689	-	**2,689**	-	-	**-**	2,711	-	**2,711**
Riverside_Li_Battery	Li_Battery	4,900	-	**4,900**	37	-	**37**	4,110	-	**4,110**
Arizona_Li_Battery	Li_Battery	1,567	-	**1,567**	(95)	-	**(95)**	1,798	-	**1,798**
Imperial_Li_Battery	Li_Battery	603	-	**603**	100	-	**100**	415	-	**415**
San_Diego_Li_Battery	Li_Battery	1,289	-	**1,289**	(35)	-	**(35)**	1,254	-	**1,254**
LI_Battery Total		**28,374**	**-**	**28,374**	**1**	**-**	**1**	**28,402**		**28,402**
SPGE_LDES	LDES	300	-	**300**	-	-	**-**	300	-	**300**
Tehachapi_LDES	LDES	500	-	**500**	-	-	**-**	500	-	**500**
Riverside_East_Pumped_Storage	LDES	700	-	**700**	-	-	**-**	700	-	**700**
Riverside_West_Pumped_Storage	LDES	-	-	**-**	-	-	**-**	-	-	**-**
San_Diego_Pumped_Storage	LDES	500	-	**500**	-	-	**-**	500	-	**500**
LDES Total		**2,000**	**-**	**2,000**	**-**	**-**	**-**	**2,000**		**2,000**
Storage Total		**30,374**	**-**	**30,374**	**1**	**-**	**1**	**30,402**		**30,402**
Total Storage+Resources		**60,880**	**24,135**	**85,015**	**(536)**	**537**	**1**	**56,983**	**29,614**	**86,598**

Table 23: Final net mapping adjustments for the 2035 base case portfolio by resource type and substation

Net Change in resource at substations (MW)		Biomass	Distributed Solar	Solar	Solar	Li_ Battery
Substation	Voltage	FCDS	FCDS	FCDS	EODS	FCDS
Antelope	230	-	-	-	-	-
Arco	230	-	0.3	-	-	-
Barre	230	-	-	-	-	(48.7)
Bellota	115	-	-	-	(11.6)	(3.0)
Bellevue	115	-	(0.0)	-	-	-
Big Creek Hydro	230	(2.0)	-	-	-	-
Chino	230	-	-	-	-	(10.0)
Colorado River	230	-	-	(28.9)	28.9	(42.7)
Delaney	500	-	-	-	-	(65.0)
Escondido	230	-	-	-	-	(35.0)
Gates	230	-	-	-	-	-
Goleta	230	-	-	-	-	-
Hoodoo Wash	500	-	-	-	-	(30.0)
Imperial Valley	230	-	-	-	-	100.0
Lakeville	230	-	-	-	11.6	11.7
Lighthipe	230	-	-	-	-	75.0
Los Banos	230	-	(0.3)	-	-	-
Metcalf	230	-	-	-	-	(8.7)
Moorpark	230	-	-	-	-	(53.0)
Mustang	230	-	-	-	-	-
Pastoria	230	-	-	-	-	(20.0)
Penasquitos	230	-	-	-	-	(30.0)
Penasquitos	138	-	-	-	-	30.0
Rector	230	-	-	(23.0)	23.0	-
Sanger	115	3.0	-	-	-	-
Springville	230	(1.0)	-	(150.0)	150.0	225.0
Valley	500	-	-	-	-	80.0
Vestal	230	-	-	(243.8)	188.0	-
Vincent	230	-	-	-	-	(115.0)
Whirlwind	230	-	-	(91.2)	147.0	-
Windhub	500	-	-	-	-	(60.0)
Windhub	230	-	-	-	-	-

7. Results

Sections 7.1 - 7.8 summarize by region the final mapping results following the mapping adjustments outlined previously and highlight the mapped resources compliance with the criteria outlined in the Methodology (Appendix A). Each section below summarizes the resources mapped to the region, the 2035 mapped resources compliance with the busbar mapping criteria, and key transmission implications of the mapping. The Final Mapping Dashboards (Appendix B for 2033 and Appendix C for 2035) contain the full details of these updated mappings and the full busbar mapping criteria analysis. Table 24 shows the final mapped resources by resource type and RESOLVE resource area for 2035, while Table 25 the final battery storage mapping alignment with the battery-specific mapping criteria.

Table 24: Summary of final mapping results for the 2035 base case portfolio by RESOLVE resource area.

RESOLVE Resource Name	Total Res. Summary (2035)			Online Resources			In-Development Res.			Generic Resources (2033)			Additional Generic Res (2035)		
	FCDS	EODS	TOTAL	FCDS	EODS	Total	FCDS	EODS	Total	FCDS	EODS	Total	FCDS	EODS	Total
InState Biomass	134	-	**134**	6	-	**6**	16	-	**16**	112	-	**112**	-	-	**-**
Solano_Geothermal	139		**139**	-	-	**-**	-	-	**-**	139	-	**139**	-	-	**-**
Inyokern_North_Kramer_Geothermal	53		**53**	40	-	**40**	13	-	**13**	-	-	**-**	-	-	**-**
Southern_Nevada_Geothermal	500		**500**	-	-	**-**	-	-	**-**	500	-	**500**	-	-	**-**
Northern_Nevada_Geothermal	445		**445**	-	-	**-**	116	-	**116**	255	-	**255**	74	-	**74**
Greater_Imperial_Geothermal	900		**900**	-	-	**-**	76	-	**76**	724	-	**724**	100	-	**100**
Distributed Solar	125	-	**125**	11	-	**11**	81	-	**81**	33	-	**33**	-	-	**-**
Greater_LA_Solar	125	1,776	**1,901**	-	-	**-**	-	-	**-**	-	1,351	**1,351**	125	425	**550**
Northern_California_Solar	685	1,061	**1,746**	-	3	**3**	-	144	**144**	505	478	**983**	180	436	**616**
Southern_PGAE_Solar	4,123	4,738	**8,861**	560	87	**647**	1,192	390	**1,582**	2,026	1,859	**3,885**	345	2,402	**2,747**
Tehachapi_Solar	3,638	3,246	**6,883**	662	10	**672**	803	1,360	**2,163**	2,173	1,670	**3,843**	-	205	**205**
Greater_Kramer_Solar	1,310	1,350	**2,660**	100	-	**100**	625	550	**1,175**	585	450	**1,035**	-	350	**350**
Southern_NV_Eldorado_Solar	2,157	2,786	**4,943**	-	-	**-**	260	240	**500**	1,683	1,791	**3,474**	214	755	**969**
Riverside_Solar	1,929	4,564	**6,493**	758	824	**1,582**	374	1,463	**1,837**	798	1,976	**2,774**	-	300	**300**
Arizona_Solar	1,550	2,947	**4,497**	-	-	**-**	350	-	**350**	1,200	1,907	**3,107**	-	1,040	**1,040**
Imperial_Solar	120	843	**963**	20	-	**20**	-	410	**410**	100	163	**263**	-	270	**270**
Northern_California_Wind	230	109	**339**	-	-	**-**	-	-	**-**	230	109	**339**	-	-	**-**
Solano_Wind	682	75	**757**	55	-	**55**	-	-	**-**	627	75	**702**	-	-	**-**
Kern_Greater_Carrizo_Wind	180	-	**180**	-	-	**-**	-	-	**-**	180	-	**180**	-	-	**-**
Carrizo_Wind	174	-	**174**	-	-	**-**	99	-	**99**	75	-	**75**	-	-	**-**
Central_Valley_Los_Banos_Wind	150	-	**150**	-	-	**-**	76	-	**76**	74	-	**74**	-	-	**-**
Tehachapi_Wind	345	-	**345**	218	-	**218**	3	-	**3**	124	-	**124**	-	-	**-**
Southern_Nevada_Wind	403	-	**403**	-	-	**-**	-	-	**-**	403	-	**403**	-	-	**-**
Riverside_Palm_Springs_Wind	107	20	**127**	106	-	**106**	-	-	**-**	1	20	**21**	-	-	**-**
Baja_California_Wind	240	360	**600**	105	-	**105**	-	-	**-**	135	360	**495**	-	-	**-**
Wyoming_Wind	1,500	-	**1,500**	-	-	**-**	-	-	**-**	1,500	-	**1,500**	-	-	**-**
Idaho_Wind	1,000	-	**1,000**	-	-	**-**	-	-	**-**	1,000	-	**1,000**	-	-	**-**
New_Mexico_Wind	2,328	-	**2,328**	-	-	**-**	-	-	**-**	2,328	-	**2,328**	-	-	**-**
SW_Ext_Tx_Wind	690	100	**790**	690	100	**790**	-	-	**-**	0	-	**0**	(0)	-	**(0)**
NW_Ext_Tx_Wind	-	-	**-**	-	-	**-**	-	-	**-**	-	-	**-**	-	-	**-**
Humboldt_Bay_Offshore_Wind	1,446	161	**1,607**	-	-	**-**	-	-	**-**	-	161	**161**	1,446	-	**1,446**
Morro_Bay_Offshore_Wind	3,100	-	**3,100**	-	-	**-**	-	-	**-**	3,100	-	**3,100**	-	-	**-**
Renewable Resource Total	**30,507**	**24,135**	**54,642**	**3,330**	**1,025**	**4,355**	**4,084**	**4,557**	**8,641**	**20,609**	**12,370**	**32,979**	**2,484**	**6,183**	**8,667**
Greater_LA_Li_Battery	4,429	-	**4,429**	197	-	**197**	2,166	-	**2,166**	739	-	**739**	1,327	-	**1,327**
Northern_California_Li_Battery	2,477	-	**2,477**	208	-	**208**	990	-	**990**	580	-	**580**	699	-	**699**
Southern_PGAE_Li_Battery	5,204	-	**5,204**	930	-	**930**	1,617	-	**1,617**	569	-	**569**	2,088	-	**2,088**
Tehachapi_Li_Battery	3,813	-	**3,813**	572	-	**572**	2,589	-	**2,589**	66	-	**66**	586	-	**586**
Greater_Kramer_Li_Battery	1,404	-	**1,404**	50	-	**50**	700	-	**700**	415	-	**415**	239	-	**239**
Southern_NV_Eldorado_Li_Battery	2,689	-	**2,689**	-	-	**-**	428	-	**428**	1,322	-	**1,322**	939	-	**939**
Riverside_Li_Battery	4,900	-	**4,900**	1,138	-	**1,138**	3,567	-	**3,567**	94	-	**94**	100	-	**100**
Arizona_Li_Battery	1,567	-	**1,567**	-	-	**-**	-	-	**-**	1,012	-	**1,012**	555	-	**555**
Imperial_Li_Battery	603	-	**603**	40	-	**40**	552	-	**552**	0	-	**0**	10	-	**10**
San_Diego_Li_Battery	1,289	-	**1,289**	359	-	**359**	780	-	**780**	50	-	**50**	100	-	**100**
LI_Battery Total	**28,374**	**-**	**28,374**	**3,494**	**-**	**3,494**	**13,389**	**-**	**13,389**	**4,847**	**-**	**4,847**	**6,644**	**-**	**6,644**
SPGE_LDES	300	-	**300**	-	-	**-**	-	-	**-**	-	-	**-**	300	-	**300**
Tehachapi_LDES	500	-	**500**	-	-	**-**	-	-	**-**	500	-	**500**	-	-	**-**
Riverside_East_Pumped_Storage	700	-	**700**	-	-	**-**	-	-	**-**	524	-	**524**	176	-	**176**
San_Diego_Pumped_Storage	500	-	**500**	-	-	**-**	-	-	**-**	500	-	**500**	-	-	**-**
LDES Total	**2,000**	**-**	**2,000**	**-**	**-**	**-**	**-**	**-**	**-**	**1,524**	**-**	**1,524**	**476**	**-**	**476**
Storage Total	**30,374**	**-**	**30,374**	**3,494**	**-**	**3,494**	**13,389**	**-**	**13,389**	**6,371**	**-**	**6,371**	**7,120**	**-**	**7,120**
Total Storage+Resources	**60,880**	**24,135**	**85,015**	**6,824**	**1,025**	**7,849**	**17,473**	**4,557**	**22,030**	**26,980**	**12,370**	**39,350**	**9,603**	**6,183**	**15,787**

Table 25: Final battery mapping alignment with the four main storage centric mapping criteria.

Battery Criteria Summary (2035 Mapping)	
Battery Category	**Capacity (MW)**
Co-Located in LCR Areas	2,706
Stand-Alone in LCR Areas	4,282
Total in LCR Areas	**6,988**
Co-Located in DACs	3,950
Stand-Alone in DACs	2,810
Total in DACs	**6,760**
Co-Located in Non-Attainment Zones	11,326
Stand-Alone in Non-Attainment Zones	7,948
Total in Non-Attainment Zones	**19,275**
Co-Located in High-Curtailment Zones	10,164
Stand-Alone in High-Curtailment Zones	3,110
Total in High-Curtailment Zones	**13,274**

Finally, Section 7.9 highlights key results for the mapping of the offshore wind sensitivity portfolio, particularly the locations of the offshore wind resources. The full mapping results of the offshore wind sensitivity portfolio are in Appendix D.

7.1 Northern California Mapping Results

Mapped Resources Summary

Table 26 summarizes the final mapped resources in the Northern California area after all mapping adjustments.

Table 26: Summary of mapped resources in the Northern California area

Updated Resources in Northern California												
Resource Type	**Online Resources (by 8/1/2022)**		**In-Development Resources**		**2033 Generic Resources**		**2035 Additional Resources**		**Total Resources (2035)**		
	FCDS	**EODS**	**FCDS**	**EODS**	**FCDS**	**EODS**	**FCDS**	**EODS**	**FCDS**	**EODS**	**TOTAL**
Biomass/gas	4	-	4	-	95	-	-	-	102	-	**102**
Geothermal	-	-	-	-	139	-	-	-	139	-	**139**
Geothermal OOS	-	-	40	-	-	-	-	-	40	-	**40**
Distributed Solar	11	-	19	-	10	-	-	-	40	-	**40**
Utility-Scale Solar	-	3	-	144	505	478	180	436	685	1,061	**1,746**
Wind	55	-	-	-	857	184	-	-	912	184	**1,095**
Offshore Wind	-	-	-	-	-	161	1,446	-	1,446	161	**1,607**
Li_Battery	208	-	990	-	580	-	699	-	2,477	-	**2,477**

Busbar Mapping Criteria Compliance

Table 27 and Table 28 depict the final busbar mapping criteria alignment for non-storage and storage resources in 2035, respectively, following post-ruling mapping adjustments. Details on the

remaining non-compliance flags are in the 2035 Dashboard and details on the 2033 mapped resources are in the 2033 Dashboard.

Table 27: Summary of the 2035 mapped renewable resources in the Northern California area by substation and the compliance of these allocations with the busbar mapping criteria.

2035 Mapping: In-Development and Generic Resources						Busbar Mapping Criteria Compliance						
Substation	Voltage	Resource Type	FCDS (MW)	EODS (MW)	Total (MW)	1. Dist. to Tx of Approp. Voltage	2. Tx Capability Limit	3a. Available Land Area	3b. Env. Impacts	4. Commercial Interest	5. Prior Base Case	Co-located w/ mapped storage
Bellota	230	Solar	100	-	100	1	1*	1	1	2	1	
Bellota	115	Solar	-	238	238	1	1	1	1	2	1	Yes
Birds Landing	230	In-State Wind	90	45	135	2	1*	1	1	1+	1	
Cayetano	230	Solar	-	100	100	1	1	1	2	1	1	Yes
Cortina	115	Solar	-	230	230	1	2	1	1	1	1	Yes
Cottonwood	230	Solar	75	-	75	1	1*	1	1	2	1	
Delevan	230	Solar	75	385	460	1	1*	1	1	1+	1	Partial
Delevan	230	In-State Wind	-	-	-	1	1*	1	1	1	3	
Delta Switching Yard	230	In-State Wind	80	-	80	1	1*	1	1	1	1	
Fulton	230	Geothermal	56	-	56	2	1*	1	2	2	1	
Geysers	230	Geothermal	83	-	83	1	1*	1	2	2	1	
Glenn	230	In-State Wind	30	98	128	1	1*	1	1	3	2	
Humboldt	115	Offshore Wind	-	161	161	N/A	2	N/A	N/A	1	1	
Humboldt (Proposed)	500	Offshore Wind	1,446	-	1,446	N/A	1*	N/A	N/A	2	1	
Lakeville	230	Solar	12	-	12	1	1*	1	1	1	1	Yes
Kelso	230	In-State Wind	47	5	52	1	1*	1	1	1	1	
Rio Oso	230	Solar	30	11	41	1	1*	1	1	2	1	
Round Mountain	230	In-State Wind	200	11	211	1	1*	2	3	1	2	
Summit	115	Geothermal	40	-	40	N/A	2	N/A	N/A	1	1	
Tesla	500	Solar	400	10	410	1*	1*	1	1	1	1	
Tesla	230	In-State Wind	80	5	85	1	1*	1	1	1	3	
Tesla	500	In-State Wind	330	20	350	1*	1*	1	1	2+	1	
Thermalito	230	In-State Wind	-	-	-	1	1*	1	1	1	3	
Vaca Dixon	115	Solar	5	20	25	1	1*	1	1	1	1	Yes
Woodland	115	Solar	-	52	52	1	1	1	1	1	1	Yes

Table 28: Summary of the 2035 mapped storage resources in the Northern California area by substation and the compliance of these allocations with the busbar mapping criteria.

2035 Mapping: In-Development and Generic Resources				Busbar Mapping Criteria Compliance			Additional Battery Mapping Criteria				
Substation	Voltage	Resource Type	Total (MW)	2. Tx Capability Limit	4. Commercial Interest	5. Prior Base Case	Co-located w/ mapped solar	LCR	DAC	O3 or PM2.5 non-attainment zone	High curtailment zone
Bellota	115	Li_Battery	157	1*	1	1	Yes	0	0	1	0
Birds Landing	230	Li_Battery	-	1*	1+	1		1	0	1	0
Cayetano	230	Li_Battery	100	1*	1	1	Yes	1	0	1	0
Cortina	115	Li_Battery	150	3	2+	1	Yes	0	0	0	0
Curtis	115	Li_Battery	10	1*	1	1		0	0	1	0
Delevan	230	Li_Battery	80	1*	1+	1	Yes	0	0	0	0
Fulton	230	Li_Battery	25	1*	1+	1		1	0	1	0
Geysers	230	Li_Battery	-	1*	2+	1		0	0	0	0
Gold Hill	115	Li_Battery	50	1*	1	1		1	0	1	0
Humboldt	115	Li_Battery	5	3	3	3		0	0	0	0
Lakeville	230	Li_Battery	45	1*	1	1	Partial	0	0	1	0
Los Esteros	115	Li_Battery	200	1*	1+	1		1	1	1	0
Martin (San Francisco	115	Li_Battery	255	1*	1	1		1	0	1	0
Martinez	115	Li_Battery	20	1*	1	1		0	1	1	0
Mendocino	115	Li_Battery	-	3	1	3		No Data	No Data	No Data	No Data
Metcalf	230	Li_Battery	307	1*	2+	1		0	0	1	0
Richmond	115	Li_Battery	55	1*	1	1		No Data	No Data	No Data	No Data
Ripon	115	Li_Battery	100	1*	1	1		1	0	1	0
Round Mountain	230	Li_Battery	-	1*	1+	1		0	0	0	0
Tesla	230	Li_Battery	400	1*	2+	1		0	0	1	0
Tesla	500	Li_Battery	-	1*	1+	1		0	0	1	0
Vaca Dixon	115	Li_Battery	275	1*	2+	1	Partial	0	0	1	0
Woodland	115	Li_Battery	36	1*	1	1	Yes	1	0	1	0

Transmission Implications

The mapped resources shown above result in transmission exceedances in three Northern California area CAISO's 2021 White Paper transmission constraints: Contra Costa-Delta Switchyard 230kV Line, Cortina -Vaca-Dixon 230kV Line, and Humboldt-Trinity 115 kV Line. These are exceeded in both the 2033 and 2035 mappings. Additionally, for the 2035 mapping results, the offshore wind mapped to Humboldt would require new transmission development.

The Cortina -Vaca-Dixon 230kV Line and Contra Costa-Delta Switchyard 230kV Line constraint exceedances could be alleviated with the identified upgrades costing an estimated $3,530 million and $505 million and providing an estimated 2,840 MW and 1,480 MW of additional capacity respectively. CPUC staff views these two upgrades as potentially cost-effective given the amount and diversity of resources mapped to the Northern California area in the 2035 mapping results. However, the previously approved 21-22 TPP upgrades and several small upgrades may sufficiently accommodate these mapped resources without needing these major upgrades identified in the CAISO's 2021 White Paper. The preliminary 22-23 TPP results indicate that the sensitivity portfolio, which has a comparable number of resources in similar locations to the 2033 mapping results, only likely needs several smaller upgrades rather than these two major ones. The details and estimated costs of these upgrades are not yet available. The 2035 mapping results exceedance of the two constraints is larger, increasing the likelihood that the major upgrades identified in the CAISO's

2021 White Paper will be needed. Thus, the resources mapped to substations impacted by these exceedances are noted as in-compliance with the transmission criteria in Table 27 and Table 28 above.

The third constraint, Humboldt-Trinity 115 kV Line, exceedance cannot be fully alleviated by the CAISO's 2021 White Paper upgrade, so the resources mapped to substations impacted by this constraint in Table 28 remain at level-3 non-compliance. The 22-23 TPP preliminary results indicate the potential need for a minor upgrade for a similar set of mapped resources.

Finally, the RESOLVE selected Humboldt offshore wind mapped to a proposed new 500 kV Humboldt substation would require a major new transmission upgrade. In the 21-22 TPP offshore wind sensitivity, the CAISO identified three potential transmission solutions and is again studying potential solutions for the Humboldt offshore wind included in the 22-23 TPP sensitivity portfolio. Although the $2.3 billion overland AC transmission upgrade was used as the upgrade option in the RESOLVE model, it was selected as a placeholder upgrade and not intended to indicate a CPUC preferred upgrade option. Additional CPUC staff modeling results with RESOLVE suggest that any of the three options identified in the 21-22 TPP sensitivity study would likely be cost-effective based on the cost estimates of each upgrade.

7.2 Southern PG&E Mapping Results

Mapped Resources Summary

Table 29 summarizes the final mapped resources in the Southern PG&E area after all mapping adjustments.

Table 29: Summary of mapped resources in the Southern PG&E area.

Upated Resources in Southern PG&E												
Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	4	-	10	-	-	-	14	-	**14**
Geothermal	-	-	-	-	-	-	-	-	-	-	**-**
Distributed Solar	-	-	31	-	21	-	-	-	52	-	**52**
Utility-Scale Solar	560	87	1,192	390	2,025	1,859	345	2,402	4,123	4,738	**8,861**
Wind	-	-	175	-	328	-	-	-	504	-	**504**
Offshore Wind	-	-	-	-	3,100	-	-	-	3,100	-	**3,100**
Li_Battery	930	-	1,617	-	569	-	2,088	-	5,204	-	**5,204**
LDES	-	-	-	-	-	-	300	-	300	-	**300**

Busbar Mapping Criteria Compliance

Table 30 and Table 31 depict the final busbar mapping criteria alignment for non-storage and storage resources in 2035, respectively, following post-ruling mapping adjustments. Details on the remaining non-compliance flags are in the 2035 Dashboard and details on the 2033 mapped resources are in the 2033 Dashboard.

Table 30: Summary of the 2035 mapped renewable resources in Southern PG&E by substation and the compliance of these allocations with the busbar mapping criteria.

2035 Mapping: In-Development and Generic Resources						Busbar Mapping Criteria Compliance						
Substation	Voltage	Resource Type	FCDS (MW)	EODS (MW)	Total (MW)	1. Dist. to Tx of Approp. Voltage	2. Tx Capability Limit	3a. Available Land Area	3b. Env. Impacts	4. Commercial Interest	5. Prior Base Case	Co-located w/ mapped storage
Alpaugh	115	Solar	20	125	145	1	2	1	1	2	1	Yes
Arco	230	Solar	130	521	651	1	3	1	1	1	1	Yes
Borden	230	Solar	100	100	200	1	3	1	1	2	1	
Cabrillo	115	In-State Wind	99	-	99	1	2	1	2	1	1	
Caliente	230	Solar	100	-	100	1	3	1	1	1	1	
Caliente	230	In-State Wind	180	-	180	3	3	2	1	1	1	
Cholame	70	In-State Wind	-	-	-	2	3	1	1	1	3	
Diablo	500	Offshore Wind	3,100	-	3,100	N/A	1	N/A	N/A	2	1	
Gates	230	Solar	1,050	650	1,700	1	3	1	1	2+	1	Yes
Gregg	230	Solar	50	105	155	1	2	1	1	2	1	Yes
Helm	230	Solar	120	95	215	1	2	1	1	2	1	Yes
Henrietta	115	Solar	25	95	120	1	2	1	1	2	1	Yes
Lamont	115	Solar	50	100	150	1	3	1	1	1	1	
Le Grand	115	Solar	60	59	119	1	2	1	1	2	1	
Los Banos	230	Solar	300	200	500	1	3	1	1	1	1	Yes
Los Banos	230	In-State Wind	150	-	150	1	3	1	1	1	2	
McCall	230	Solar	-	-	-	1	2*	1	1	1	3	
Midway	230	Solar	50	200	250	1	3	1	2	1	1	Yes
Midway	500	Solar	50	750	800	1*	2*	1	2	1	1	Yes
Midway	115	Solar	200	-	200	1	3	1	2	1+	1	
Morro Bay (Propo	500	Offshore Wind	-	-	-	N/A	1	N/A	N/A	2+	1*	
Mustang	230	Solar	100	200	300	1	3	1	1	1	1	Yes
Olive	115	Solar	40	-	40	1	3	1	1	1	1	Yes
Panoche	230	Solar	50	317	367	1	3	1	1	3	1	Yes
Rio Bravo	115	Solar	-	56	56	1	2	1	1	1	1	Yes
Solar SS	230	Solar	130	-	130	1	2	1	1	2	1	Yes
Templeton	230	In-State Wind	75	-	75	2	3	1	2	3	3	
Tranquility	230	Solar	400	700	1,100	1	3	1	1	1	1	Yes
Westley	230	Solar	227	23	250	1	3	1	1	1	1	Yes
Wheeler Ridge	115	Solar	100	75	175	1	2	1	1	1	1	Yes
Wheeler Ridge	230	Solar	210	280	490	1	3	1	1	2	1	Yes

Legend for Criteria Flags						
	General	Level-3 Non-compliance	3	Level-2 Non-compliance	2	Level-1 Compliance 1
		Greyed out substation rows indicated locations that have no mapped resources but non-compliance with criteria 4 or 5				
		Substation	MW Total	Criteria 4		
		Sample Sub	-	2		
		*Asterik after substation name indicates import into CAISO system				
	Criteria Specific Flags	Criteria 2:	1*	2*		Reflect the final Tx non-compliace after White Paper upgrades are applied
		Criteria 4:	1+	2+	3+	Indicate non-compliance when commercial interest exceeds mapped results. 1+: Significantly more low confidence CI, more Cluster 2 CI, or more high-confidence solar EODS; 2+: Significantly more Cluster 2 CI or more high-confidence CI; 3+: Significantly more FCDS TPD allocated
		Criteria 5:	1*	2*		Adjusted compliance from staff review of impacts of deviation from previous base case

Table 31: Summary of the 2035 mapped storage resources in Southern PG&E by substation and the compliance of these allocations with the busbar mapping criteria.

2035 Mapping: In-Development and Generic Resources				Busbar Mapping Criteria Compliance			Additional Battery Mapping Criteria				
Substation	Voltage	Resource Type	Total (MW)	2. Tx Capability Limit	4. Commercial Interest	5. Prior Base Case	Co-located w/ mapped solar	LCR	DAC	O3 or PM2.5 non-attainment zone	High curtailment zone
Alpaugh	115	Li_Battery	70	2	2	1	Yes	0	1	1	0
Arco	230	Li_Battery	219	3	1+	1	Yes	0	1	1	0.25
Avenal	115	Li_Battery	10	2	1	1		0	1	1	0
Coburn	230	Li_Battery	6	2	1	1		0	0	0	0
Gates	500	Li_Battery	300	3	1	1		0	0	1	0
Gates	230	Li_Battery	420	3	2+	1	Yes	0	0	1	0
Gregg	230	Li_Battery	55	2	2	1	Yes	0	1	1	0
Helm	230	Li_Battery	95	2	2	1	Yes	0	1	1	0
Henrietta	115	Li_Battery	68	2	1	1	Yes	1	1	1	0
Kettleman	70	Li_Battery	10	3	1*	1		0	0	1	0
Lamont	115	Li_Battery	95	3	1	1		0	1	1	0
Los Banos	230	Li_Battery	100	3	1+	1	Yes	0	1	1	0
Los Banos	500	Li_Battery	-	1	1+	1		0	1	1	0
McCall	230	Li_Battery	-	2*	1	3		0	1	1	0
Mesa	115	Li_Battery	50	3	3	1		0	0	0	0
Mesa	230	Li_Battery	100	3	1+	1		0	0	0	0
Midway	230	Li_Battery	92	3	1	1	Yes	0	0	1	0.25
Midway	500	Li_Battery	650	2*	2+	1	Yes	0	0	1	0.25
Midway	115	Li_Battery	-	3	1+	2*		0	0	1	0.25
Morro Bay	230	Li_Battery	-	3	1+	1		0	0	0	0.25
Morro Bay	230	LDES	300	3	1	1					
Moss Landing	500	Li_Battery	350	1	3+	1		1	0	0	0.25
Moss Landing	230	Li_Battery	10	2	1	1		1	0	0	0.25
Mustang	230	Li_Battery	170	3	1+	1	Yes	1	1	1	0
Olive	115	Li_Battery	20	3	1	1	Yes	0	1	1	0
Panoche	230	Li_Battery	170	3	3	1	Yes	1	1	1	0
Rio Bravo	115	Li_Battery	55	3	1	1	Yes	0	1	1	0
Sisquoc	115	Li_Battery	10	3	1	1		0	0	0	0
Solar SS	230	Li_Battery	50	2	2	1	Yes	0	0	1	0
Taft	115	Li_Battery	3	3	1	1		0	0	1	0
Tranquility	230	Li_Battery	700	3	2+	1	Yes	0	1	1	0
Westley	230	Li_Battery	170	3	1	1	Yes	0	1	1	0
Wheeler Ridge	115	Li_Battery	157	2	1	1	Yes	0	1	1	0.25
Wheeler Ridge	230	Li_Battery	70	3	2	1	Yes	0	1	1	0.25

Legend for Criteria Flags						
	General	Level-3 Non-compliance	3	Level-2 Non-compliance	2	Level-1 Compliance 1
		Greyed out substation rows indicated locations that have no mapped resources but non-compliance with criteria 4 or 5		Substation: Sample Sub	MW Total: -	Criteria 4: 2
						*Asterik after substation name indicates import into CAISO system
	Criteria Specific Flags	Criteria 2:	1*	2*		Reflect the final Tx non-compliace after White Paper upgrades are applied
		Criteria 4:	1+	2+	3+	Indicate non-compliance when commercial interest exceeds mapped results. 1+: Significantly more low confidence CI, more Cluster 2 CI, or more high-confidence solar EODS; 2+: Significantly more Cluster 2 CI or more high-confidence CI; 3+: Significantly more FCDS TPD allocated
		Criteria 5:	1*	2*		Adjusted compliance from staff review of impacts of deviation from previous base case

Transmission Implications

The mapped resources in Table 30 and Table 31 have numerous level-2 and level-3 non-compliance for transmission criteria at substations in the Southern PG&E area. In total, five actual on-peak constraints and one actual off-peak constraints from CAISO's 2021 White Paper are exceeded while six on-peak default constraints are exceeded with the 2035 mapping results. The 2033 mapping results have two fewer on-peak actual constraint exceedances but an additional off-peak actual constraint exceedance, which is alleviated by the mapping of more storage in 2035. The default constraints do not have any transmission upgrades identified in the CAISO's 2021 White Paper and may or may not require transmission upgrades to alleviate resulting in level-2 non-compliances for resources impacted by these constraints.

Two of the actual on-peak exceedances and the actual off-peak exceedance can be alleviated by the transmission upgrade identified in the CAISO's 2021 White Paper. Staff assessed these three upgrades: Midway – Gates 230kV Line $142 million upgrade for 3,140 MW of additional capacity, Gates 500/230kV Bank #13 Constraint $40 million upgrade for 4,450 MW of additional capacity, and the Moss Landing-Las Aguilas 230kV off-peak constraint $48 million upgrade for 1,300 MW of additional off-peak capacity, as cost effective. The remaining three on-peak actual constraint exceedances are still in non-compliance because the exceedance remains after accounting for the additional capacity from the three identified upgrades. Those three upgrades are the Wilson-Storey-Borden #1 & #2 230 kV Lines upgrade costing $232 million for 96 MW of capacity, the Tesla-Westley 230kV Line upgrade costing $90 million for 114 MW of capacity, and the Morro Bay-Templeton 230kV Line upgrade costing $1,250 million for 738 MW of capacity. These exceedances are kept at level-3 non-compliance because they may require additional transmission upgrades. Full analysis in the TPP studies could also show the identified upgrades to be sufficient. In contrast to these White Paper exceedances, the 22-23 TPP preliminary results for the sensitivity portfolio, which has a comparable number of resources in similar locations, indicate that several smaller upgrades and reconductoring on top of the upgrades approved in the 21-22 TPP would likely alleviate transmission exceedances throughout this area. The details and estimated costs of these upgrades identified in the preliminary 22-23 TPP results are not yet available.

Following internal busbar Working Group discussions, the 3,100 MW of Morro Bay wind was mapped as interconnecting to the Diablo Canyon 500 kV substation, but the resources could also interconnect to the proposed new 500 kV Morro Bay substation (costing ~$110 million). As was done for the 22-23 TPP, CPUC staff ask that the CAISO also consider a new Morro Bay substation as an alternative interconnection for some or all the Morro Bay offshore wind. Staff, also, did not relocate the LDES resources mapped to the Morro Bay 230 kV substation in 2035 although stakeholders raised concerns about such resources conflicting with the transmission needs of the offshore wind. Since staff mapped the offshore wind resources to the 500 kV system, CAISO staff noted that the 230 kV system would likely not be impacted by resources mapped to the 500 kV system in the area and vice versa.

Overall, the Southern PG&E area has the most discrepancy between transmission utilization and upgrades identified in RESOLVE, in the busbar mapping, and in the TPP studies themselves. CPUC staff is working with CAISO staff to update transmission constraint and upgrade information using the most recent Cluster 14 studies and information on approved upgrades from recent TPP studies for use in future mapping and modeling efforts to reduce these large discrepancies between the steps of the transmission planning process.

7.3 Greater Tehachapi Mapping Results

Mapped Resources Summary

Table 32 summarizes the total resources mapped to the Greater Tehachapi area after all mapping adjustments.

Table 32: Summary of mapped resources in the Greater Tehachapi area.

Updated Resources in Greater Tehachapi												
Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	-	-	6	-	-	-	6	-	**6**
Distributed Solar	-	-	6	-	-	-	-	-	6	-	**6**
Utility-Scale Solar	662	10	803	1,360	2,173	1,670	0	205	3,638	3,246	**6,883**
Wind	218	-	3	-	124	-	-	-	345	-	**345**
Li_Battery	572	-	2,589	-	66	-	586	-	3,813	-	**3,813**
LDES	-	-	-	-	500	-	-	-	500	-	**500**

Busbar Mapping Criteria Compliance

Table 33 depicts the final busbar mapping criteria alignment for resources in 2035 mapped to the Tehachapi area, following post-ruling mapping adjustments. Details on the remaining non-compliance flags are in the 2035 Dashboard and details on the 2033 mapped resources are in the 2033 Dashboard. As noted in Section 6.3, post-PD mapping adjustments in this area were primarily to account for additional in-development storage being mapped to Springville substation. These batteries were partially relocated from Windhub 500 kV (60 MW) and Pastoria (20 MW), resulting in commercial interest non-compliance increasing at both substation due to higher amounts of high confidence commercial interest and an increase in level-2 non complaince with previous base case mapping at Pastoria.

Transmission Implications

The final mapping results for 2033, post ruling mapping adjustments, resulted in no exceedance of the CAISO's 2021 White Paper transmission constraints in the Greater Tehachapi area; but 2035 mapping results identified transmission exceedance, which can be alleviated by the CAISO's 2021 White Paper upgrade. Working group staff identified this $15 million upgrade, which expands capacity on the Antelope – Vincent Constraint by an estimated 2,700 MW, as cost-effective given the amount of resources mapped and exceedance size. Thus, the resources mapped to substations impacted by the exceedance are noted as in-compliance with the transmission criteria in the table above. The South of Magunden Constraint was initially exceeded following initial post-PD mapping adjustments; however, working group staff ascertained that the White Paper identified upgrade was not cost effective for the amount of exceedance and reduced the exceedance by switching solar in at the Northern SCE area substations from FCDS to EODS and reducing the battery resources mapped to Pastoria, even though this increased non-compliance with commercial interests and prior base case alignment at Pastoria.

Table 33: Summary of the 2035 mapped resources (storage and non-storage) in the Greater Tehachapi area by substation and the compliance of these allocations with the busbar mapping criteria.

2035 Mapping: In-Development and Generic Resources						Busbar Mapping Criteria Compliance						Additional Battery Mapping Criteria				
Substation	Voltage	Resource Type	FCDS (MW)	EODS (MW)	Total (MW)	1. Dist. to Tx of Approp. Voltage	2. Tx Capability Limit	3a. Available Land Area	3b. Env. Impacts	4. Commercial Interest	5. Prior Base Case	LCR	DAC	O3 non-attainment zone	PM2.5 non-attainment zone	High curtailment zone
Antelope	230	Li_Battery	197	-	197	N/A	1*	N/A	N/A	1	2	1	1	1	1	0.25
Antelope	230	Solar	770	402	1,172	1	1*	1	1	2	1	1	1	1	1	0.25
Antelope	230	In-State Wind	3	-	3	2	1*	1	3	1	1	1	1	1	1	0.25
Pastoria	230	Li_Battery	60	-	60	N/A	1*	N/A	N/A	2+	2	0	0	1	1	0
Pastoria	230	Solar	40	67	107	1	1*	1	1	1	1	0	0	1	1	0
Rector	230	Solar	77	123	200	1	1*	1	1	2	1	1	0	1	1	0
Springville	230	Li_Battery	225	-	225	N/A	1*	N/A	N/A	1	1	0	1	1	1	0
Springville	230	Solar	50	150	200	1	1*	1	1	2	1	0	1	1	1	0
Vestal	230	Li_Battery	350	-	350	N/A	1*	N/A	N/A	1+	1	1	1	1	1	0
Vestal	230	Solar	50	699	749	1	1*	1	1	1	1	1	1	1	1	0
Whirlwind	230	Li_Battery	959	-	959	N/A	1*	N/A	N/A	1	1*	0	0	1	0	0.25
Whirlwind	230	Solar	655	726	1,381	1	1*	1	2	2	1	0	0	1	0	0.25
Whirlwind	230	In-State Wind	101	-	101	1	1*	1	2	1	1	0	0	1	0	0.25
Whirlwind	230	LDES	500	-	500	N/A	1*	N/A	N/A	1	1	0	0	1	0	0.25
Windhub	500	Li_Battery	412	-	412	N/A	1*	N/A	N/A	3+	1	0	0	1	0	0.25
Windhub	500	Solar	780	-	780	1*	1*	1	1	1	1	0	0	1	0	0.25
Windhub	230	Li_Battery	1,039	-	1,039	N/A	1*	N/A	N/A	3+	1	0	0	1	0	0.25
Windhub	230	Solar	553	1,068	1,621	1	1*	1	1	1	1	0	0	1	0	0.25
Windhub	230	In-State Wind	23	-	23	2	1*	1	1	1	2	0	0	1	0	0.25

Legend for Criteria Flags

General

Level-3 Non-compliance: 3 | Level-2 Non-compliance: 2 | Level-1 Compliance: 1

Greyed out substation rows indicated locations that have no mapped resources but non-compliance with criteria 4 or 5

Substation	MW Total	Criteria 4
Sample Sub	-	2

*Asterik after substation name indicates import into CAISO system

Criteria Specific Flags

Criteria 2:	1*	2*	Reflect the final Tx non-compliace after White Paper upgrades are applied
Criteria 4:	1+	2+	3+ Indicate non-compliance when commercial interest exceeds mapped results. 1+: Significantly more low confidence CI, more Cluster 2 CI, or more high-confidence solar EODS; 2+: Significantly more Cluster 2 CI or more high-confidence CI; 3+: Significantly more FCDS TPD allocated
Criteria 5:	1*	2*	Adjusted compliance from staff review of impacts of deviation from previous base case

7.4 Greater LA Metro Mapping Results

Mapped Resources Summary

Table 34 summarizes the final mapped resources in the Greater LA area, which includes most of Orange County and southern portions of Ventura and Santa Barbara Counties, after all mapping adjustments.

Table 34: Summary of mapped resources in the Greater LA Metro area.

Updated Resources in Greater LA Metro												
Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	2	-	3	-	1	-	-	-	6	-	**6**
Distributed Solar	-	-	20	-	-	-	-	-	20	-	**20**
Utility-Scale Solar	-	-	-	-	-	1,351	125	425	125	1,776	**1,901**
Li_Battery	197	-	2,166	-	739	-	1,327	-	4,429	-	**4,429**

Busbar Mapping Criteria Compliance

Table 35 depicts the final busbar mapping criteria alignment for resources in 2035 mapped to the Greater LA area, following post-ruling mapping adjustments. Details on the remaining non-compliance flags are in the 2035 Dashboard and details on the resources mapped in 2033 are in the 2033 Dashboard. Post-PD mapping adjustments summarized in Section 6.3, slightly reduced (53 MW) the amount of storage mapped to Moorpark substation causing level-2 non-compliance flags in commercial interest and alignment with previous base case mapping. This decrease, however, was deemed necessary to enable battery mapping alignment with additional in-development resources at Lightipe substation.

Transmission Implications

The final mapped results did not trigger any transmission exceedances in the constraints incorporated from the CAISO's 2021 White Paper in either 2033 or 2035. The 22-23 TPP sensitivity portfolio preliminary results, however, indicate the potential need for several upgrades with a total estimated cost of $800 – 900 million. This base case portfolio has roughly 500 MW more resources in the Greater LA Metro area in 2035 than the 22-23 TPP sensitivity indicating that further upgrades may be necessary.

Table 35: Summary of the 2035 mapped resources (storage and non-storage) in the Greater LA Metro area by substation and the compliance of these allocations with the busbar mapping criteria.

2035 Mapping: In-Development and Generic Resources						Busbar Mapping Criteria Compliance						Additional Battery Mapping Criteria				
Substation	Voltage	Resource Type	FCDS (MW)	EODS (MW)	Total (MW)	1. Dist. to Tx of Approp. Voltage	2. Tx Capability Limit	3a. Available Land Area	3b. Env. Impacts	4. Commercial Interest	5. Prior Base Case	LCR	DAC	O3 non-attainment zone	PM2.5 non-attainment zone	High curtailment zone
Alamitos	230	Li_Battery	82	-	82	N/A	1	N/A	N/A	1	1	0	0	1	1	0
Barre	230	Li_Battery	20	-	20	N/A	1	N/A	N/A	1	1	1	1	1	1	0
Capistrano	138	Li_Battery	250	-	250	N/A	1	N/A	N/A	1	1	1	0	1	1	0
Chino	230	Li_Battery	20	-	20	N/A	1	N/A	N/A	1	1	1	0	1	1	0
Etiwanda	230	Li_Battery	200	-	200	N/A	1	N/A	N/A	1	1	1	1	1	1	0
Goleta	230	Li_Battery	70	-	70	N/A	1	N/A	N/A	1	1	0	0	0	0	0
Hinson	230	Li_Battery	300	-	300	N/A	1	N/A	N/A	2	1	0	1	1	1	0
Johanna	230	Li_Battery	80	-	80	N/A	1	N/A	N/A	1	1	1	1	1	1	0
Laguna Bell	230	Li_Battery	500	-	500	N/A	1	N/A	N/A	1	1	0	1	1	1	0
Lighthipe	230	Li_Battery	175	-	175	N/A	1	N/A	N/A	1	1	0	1	1	1	0
Mandalay	230	Li_Battery	-	-	-	N/A	1	N/A	N/A	1+	1	0	1	1	0	0
Mira Loma	230	Li_Battery	300	-	300	N/A	1	N/A	N/A	1+	1	0	1	1	1	0
Moorpark	230	Li_Battery	447	-	447	N/A	1	N/A	N/A	2+	2	1	0	1	0	0
Moorpark	230	Solar	-	500	500	1	1	1	1	1	1	1	0	1	0	0
Padua	230	Li_Battery	124	-	124	N/A	1	N/A	N/A	1	1	0	0	1	1	0
Pardee	230	Li_Battery	95	-	95	N/A	1	N/A	N/A	1	1	0	0	1	1	0
Rio Hondo	230	Li_Battery	50	-	50	N/A	1	N/A	N/A	2	1	0	0	1	1	0
Santa Clara	230	Li_Battery	30	-	30	N/A	1	N/A	N/A	1	1	0	0	1	0	0
Santa Clara	230	Solar	125	125	250	1	1	1	1	3	1	0	0	1	0	0
Talega	230	Li_Battery	100	-	100	N/A	1	N/A	N/A	1	1	0	0	1	0	0
Vincent	230	Li_Battery	1,139	-	1,139	N/A	1	N/A	N/A	3+	1	0	0	1	0	0.25
Vincent	230	Solar	-	1,151	1,151	1	1	1	1	1	1	0	0	1	0	0.25
Walnut	230	Li_Battery	250	-	250	N/A	1	N/A	N/A	1	2	1	1	1	1	0

The descriptions and implications of the criteria flags are consistent with the legends included with the prior criteria summaries in Table 31and Table 33.

7.5 Greater Kramer Mapping Results

Mapped Resources Summary

Table 36 summarizes the final mapped resources in the Greater Kramer area after all mapping adjustments.

Table 36: Summary of mapped resources in the Greater Kramer area.

Updated Resources in Greater Kramer											
Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	3	-	-	-	-	-	3	-	**3**
Geothermal	40	-	-	-	-	-	-	-	40	-	**40**
Geothermal OOS	-	-	13	-	-	-	-	-	13	-	**13**
Distributed Solar	-	-	5	-	2	-	-	-	7	-	**7**
Utility-Scale Solar	100	-	625	550	585	450	-	350	1,310	1,350	**2,660**
Li_Battery	50	-	700	-	415	-	239	-	1,404	-	**1,404**

Busbar Mapping Criteria Compliance

Table 37 depicts the final busbar mapping criteria alignment for resources in 2035 mapped to the Greater Kramer area, following post-ruling mapping adjustments. Details on the remaining non-compliance flags are in the 2035 Dashboard and details on the resources mapped in 2033 are in the 2033 Dashboard.

Transmission Implications

One CAISO's 2021 White Paper transmission constraints in the Greater Kramer area is exceeded by the resources mapped in 2033, while all three constraints are exceeded in 2035. The Kramer-Victor/Roadway -Victor Constraint exceedance, in both 2033 and 2035, is alleviated by the cost-effective upgrade identified in the white paper, which costs $108 million for an estimated 430 MW on-peak capacity expansion.

The other two identified upgrades, the Victor-Lugo Constraint upgrade costing $226 million for an estimated 430 MW capacity increase and Lugo 500/230 kV Transformer Constraint costing $70 million for an estimated 980 MW capacity increase, would only alleviate small exceedances of the capability limits for the two respective constraints. The working group staff assessed that the small exceedances on their own do not make these upgrades cost effective. However, the North of Lugo area already has a complex Remedial Action Scheme (RAS) and curtailment of existing resources, as noted in the 22-23 TPP preliminary results. Additionally, the region's transmission has interactions with the East of Pisgah transmission systems and the resources mapped to the Southern Nevada & Eldorado area. These factors make the transmission upgrades in this area more cost-effective and so all the resources mapped to the substations within these constraints are marked as in-compliance with the transmission criteria as seen in Table 37. The preliminary 22-23 TPP results also indicate the potential need for additional and alternative transmission upgrades not identified in the CAISO's 2021 White Paper.

Table 37: Summary of the 2035 mapped resources (storage and non-storage) in the Greater Kramer area by substation and the compliance of these allocations with the busbar mapping criteria.

2035 Mapping: In-Development and Generic						Busbar Mapping Criteria Compliance						Additional Battery Mapping Criteria			
Substation	Voltage	Resource Type	FCDS (MW)	EODS (MW)	Total (MW)	1. Dist. to Tx of Approp. Voltage	2. Tx Capability Limit	3a. Available Land Area	3b. Env. Impacts	4. Commercial Interest	5. Prior Base Case	LCR	DAC	O3 non-attainment zone	High curtailment zone
Calcite	230	Li_Battery	200	-	200	N/A	1*	N/A	N/A	1	2	0	0	1	0
Calcite	230	Solar	200	250	450	1	1*	1	1	1	1	0	0	1	0
Control*	115	Geothermal	13	-	13	N/A	1*	N/A	N/A	1	1	0	0	0	0
Coolwater	115	Li_Battery	104	-	104	N/A	1*	N/A	N/A	1+	1	0	1	1	0
Coolwater	115	Solar	150	200	350	1	1*	1	2	1	1	0	1	1	0
Coolwater	115	In-State Wind	-	-	-	1	1*	2	2	1+	1	0	1	1	0
Kramer	230	Li_Battery	700	-	700	N/A	1*	N/A	N/A	1+	1	0	0	1	0
Kramer	115	Li_Battery	75	-	75	N/A	1*	N/A	N/A	1	1	0	0	1	0
Kramer	230	Solar	615	550	1,165	2	1*	1	2	1	1	0	0	1	0
Kramer	115	Solar	95	-	95	1	1*	1	2	1	1	0	0	1	0
Pisgah	230	Li_Battery	125	-	125	N/A	1*	N/A	N/A	2	1	0	1	1	0
Pisgah	230	Solar	100	200	300	2	1*	1	1	2	1	0	1	1	0
Roadway	115	Li_Battery	150	-	150	N/A	1*	N/A	N/A	1	2	0	1	1	0
Roadway	115	Solar	50	150	200	1	1*	1	2	1	2	0	1	1	0
Victor	230	Solar	-	-	-	1	1*	1	2	1	3	0	0	1	0

Legend for Criteria Flags					
General	Level-3 Non-compliance	3	Level-2 Non-compliance	2	Level-1 Compliance 1
	Greyed out substation rows indicated locations that have no mapped resources but non-compliance with criteria 4 or 5		Substation: Sample Sub	MW Total: -	Criteria 4: 2
	*Asterik after substation name indicates import into CAISO system				
Criteria Specific Flags	Criteria 2:	1*	2*		Reflect the final Tx non-compliace after White Paper upgrades are applied
	Criteria 4:	1+	2+	3+	Indicate non-compliance when commercial interest exceeds mapped results. 1+: Significantly more low confidence CI, more Cluster 2 CI, or more high-confidence solar EODS; 2+: Significantly more Cluster 2 CI or more high-confidence CI; 3+: Significantly more FCDS TPD allocated
	Criteria 5:	1*	2*		Adjusted compliance from staff review of impacts of deviation from previous base case

*Resources mapped to this substation are outside of the CAISO's BAA.

The Greater Kramer area includes 13 MW Northern Nevada geothermal mapped at the Control 115 kV substation and utilizing the Silver Peak 55 kV intertie into the CAISO. The preliminary 22-23 TPP results indicated that a larger amount geothermal exceed the capacity on that intertie; however, it is currently unclear whether the amount mapped will exceed available transmission capacity. If this small amount of geothermal would require significant upgrades, the more cost-effective option would likely be to shift the resources to a different import intertie.

7.6 Southern Nevada and El Dorado Mapping Results

Mapped Resources Summary

Table 38 summarizes the final mapped resources in the Southern Nevada and El Dorado area, including the Mohave substation, after all mapping adjustments. This area includes out-of-state and out-of-CAISO resources: Northern Nevada Geothermal, Wyoming Wind, and Idaho Wind mapped as entering the CAISO at interties in the Southern Nevada region.

Table 38: Summary of mapped resources in the Southern Nevada and El Dorado area.

Updated Resources in Southern Nevada												
Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Geothermal	-	-	-	-	500	-	-	-	500	-	**500**
Geothermal OOS*	-	-	76	-	255	-	74	-	405	-	**405**
Utility-Scale Solar	-	-	260	240	1,683	1,791	214	755	2,157	2,786	**4,943**
Wind	-	-	-	-	403	-	-	-	403	-	**403**
OOS Wind, New Tx	-	-	-	-	2,500	-	-	-	2,500	-	**2,500**
OOS Wind, Ext Tx	571	100	-	-	-	-	-	-	571	100	**671**
Li_Battery	-	-	428	-	1,322	-	939	-	2,689	-	**2,689**

Busbar Mapping Criteria Compliance

Table 39 depicts the final busbar mapping criteria alignment for resources in 2035 mapped to the Southern Nevada area, following post-ruling mapping adjustments. Details on the remaining non-compliance flags are in the 2035 Dashboard and details on the resources mapped in 2033 are in the 2033 Dashboard.

Transmission Implications

For both 2033 and 2035 mapping results, two of the area's CAISO's 2021 White Paper transmission constraints with default capacity limits, the GLW-VEA Area Constraint and the Mohave/Eldorado 500 kV Constraint, are exceeded by the mapping results, which results in level-2 non-compliances. The CAISO's 2021 White paper identified transmission upgrade for the GLW-VEA Area Constraint was approved in the 21-22 TPP, so there is currently no identified transmission upgrade for that constraint or the Mohave/Eldorado Constraint. The third constraint, Eldorado 500/230 kV Transformer #5 Constraint, is not exceeded so substations within it are marked with the in-compliance flag.

Table 39: Summary of the 2035 mapped resources (storage and non-storage) in the Southern Nevada area by substation and the compliance of these allocations with the busbar mapping criteria.

2035 Mapping: In-Development and Generic Resources						Busbar Mapping Criteria Compliance						Additional Battery Mapping Criteria			
Substation	Voltage	Resource Type	FCDS (MW)	EODS (MW)	Total (MW)	1. Dist. to Tx of Approp. Voltage	2. Tx Capability Limit	3a. Available Land Area	3b. Env. Impacts	4. Commercial Interest	5. Prior Base Case	LCR	DAC	O3 or PM2.5 non-attainment zone	High curtailment zone
Beatty	138	Geothermal	500	-	500	3	2	N/A	N/A	2	1	0	0	0	0
Carpenter Canyon	230	Li_Battery	200	-	200	N/A	2	N/A	N/A	1	1	0	0	0	1
Carpenter Canyon	230	Solar	250	215	465	1	2	1	N/A	2	1	0	0	0	1
Desert View	230	Li_Battery	40	-	40	N/A	2	N/A	N/A	2	1	0	0	1	0.25
Desert View	230	Solar	100	50	150	1	2	1	N/A	2	1	0	0	1	0.25
Eldorado	230	Li_Battery	529	-	529	N/A	1	N/A	N/A	1	1	0	0	0	1
Eldorado	230	Solar	-	300	300	2	1	1	N/A	1	1	0	0	0	1
Eldorado	230	Geothermal, OOS	100	-	100	N/A	1	N/A	N/A	2	1	0	0	0	1
Eldorado	500	Geothermal, OOS	305	-	305	N/A	2	N/A	N/A	2	1	0	0	0	1
Eldorado	500	OOS Wind, New Tx	2,500	-	2,500	N/A	2	N/A	N/A	1	1				
Innovation	230	Li_Battery	150	-	150	N/A	2	N/A	N/A	1	1	0	0	0	0.25
Innovation	230	Solar	237	65	302	1	2	1	N/A	1	2	0	0	0	0.25
Innovation	230	In-State Wind	93	-	93	2	2	1	N/A	3	2	0	0	0	0.25
Ivanpah	230	Li_Battery	-	-	-	N/A	1	N/A	N/A	2+	1	0	1	0	0
Lathrop	138	Li_Battery	200	-	200	N/A	2	N/A	N/A	2	1	0	0	0	0
Lathrop	138	Solar	150	350	500	1	2	1	N/A	2	1	0	0	0	0
Mohave	500	Li_Battery	700	-	700	1*	2	N/A	N/A	3+	1	0	0	0	1
Mohave	500	Solar	520	700	1,220	1*	2	1	N/A	2+	1	0	0	0	1
Sloan Canyon	230	In-State Wind	310	-	310	2	2	2	N/A	1	1	No Data	No Data	No Data	No Data
Trout Canyon	230	Li_Battery	830	-	830	N/A	2	N/A	N/A	2+	1	0	0	0	0.25
Trout Canyon	230	Solar	650	1,106	1,756	2	2	1	N/A	1+	1	0	0	0	0.25
Valley (VEA)	138	Li_Battery	40	-	40	N/A	2	N/A	N/A	1	1	1	0	0	0
Valley (VEA)	138	Solar	50	-	50	1	2	1	N/A	1	1	1	0	0	0
Vista (VEA)	138	Solar	200	-	200	1	2	1	N/A	2	1	0	0	0	0

The descriptions and implications of the criteria flags are consistent with the legends included with the prior criteria summaries in Table 37.

Preliminary results for the 22-23 TPP sensitivity portfolio indicate that the resources mapped to this area and the OOS resources imported into this area will likely need several upgrades including a major transmission upgrade along the Lugo-Victorville-Eldorado 500 kV transmission system. The preliminary 22-23 TPP identified several potential alternatives for upgrades in the GLW-VEA Area Constraint and the major transmission upgrade likely needed for the whole region. The GLW area constraint potential upgrades estimated costs range from $250 - $486 million and the potential major 500 kV transmission upgrade alternatives could cost between $2 - 2.8 billion.

7.7 Riverside & Arizona Mapping Results

Mapped Resources Summary

Table 40 summarizes the final mapped resources in the Riverside area and areas of Arizona linked to the CAISO BAA. This area includes out-of-state and out-of-CAISO New Mexico Wind resource mapped as entering the CAISO at Palo Verde intertie.

Table 40: Summary of mapped resources in the Riverside and Arizona areas.

Updated Resources in Riverside & Arizona											
Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Biomass/gas	-	-	3	-	-	-	-	-	3	-	**3**
Utility-Scale Solar	758	824	724	1,463	1,998	3,883	-	1,340	3,479	7,511	**10,990**
Wind	106	-	-	-	1	20	-	-	107	20	**127**
OOS Wind, Ext Tx	119	-	-	-	-	-	-	-	119	-	**119**
OOS Wind, New Tx	-	-	-	-	2,328	-	-	-	2,328	-	**2,328**
Li_Battery	1,138	-	3,567	-	1,106	-	655	-	6,467	-	**6,467**
LDES	-	-	-	-	524	-	476	-	1,000	-	**1,000**

Busbar Mapping Criteria Compliance

Table 41 depicts the final busbar mapping criteria alignment for resources in 2035 mapped to the Riverside and Arizona areas, following post-ruling mapping adjustments. Details on the remaining non-compliance flags are in the 2035 Dashboard and details on the resources mapped in 2033 are in the 2033 Dashboard.

Table 41: Summary of the 2035 mapped resources (storage and non-storage) in the Riverside and Arizona areas by substation and the compliance of these allocations with the busbar mapping criteria.

2035 Mapping: In-Development and Generic Resources						Busbar Mapping Criteria Compliance						Additional Battery Mapping Criteria			
Substation	Voltage	Resource Type	FCDS (MW)	EODS (MW)	Total (MW)	1. Dist. to Tx of Approp. Voltage	2. Tx Capability Limit	3a. Available Land Area	3b. Env. Impacts	4. Commercial Interest	5. Prior Base Case	LCR	DAC	O3 or PM2.5 non-attainment zone	High curtailment zone
Colorado River	500	Li_Battery	-	-	-	N/A	3	N/A	N/A	1	1*	0	0	0	0.25
Colorado River	230	Li_Battery	751	-	751	N/A	3	N/A	N/A	1+	1	0	0	0	0.25
Colorado River	500	Solar	335	165	500	2	3	1	1	2	2	0	0	0	0.25
Colorado River	230	Solar	569	1,295	1,864	2	3	1	1	1+	1	0	0	0	0.25
Delaney	500	Li_Battery	1,042	-	1,042	1*	3	N/A	N/A	2+	1	0	0	1	0.25
Delaney	500	Solar	1,000	2,000	3,000	1*	3	1	N/A	2+	1	0	0	1	0.25
Devers	230	Li_Battery	445	-	445	N/A	3	N/A	N/A	2+	1	1	0	1	0
Devers	230	Solar	150	425	575	1	3	1	2	1	1	1	0	1	0
Devers	230	In-State Wind	1	20	21	2	3	1	1	2+	1	1	0	1	0
El Casco	230	Li_Battery	165	-	165	N/A	3	N/A	N/A	1	1	0	0	1	0
Hassayampa	500	Li_Battery	20	-	20	1*	3	N/A	N/A	2+	2*	0	0	1	0.25
Hassayampa	500	Solar	300	171	471	1*	3	1	N/A	1+	2	0	0	1	0.25
Hoodoo Wash	500	Li_Battery	535	-	505	1*	3	N/A	N/A	2+	1	0	0	0	0
Hoodoo Wash	500	Solar	250	776	1,026	1*	3	1	N/A	2+	1	0	0	0	0
Lee Lake (Proposed)	500	LDES	-	-	-	N/A	1	N/A	N/A	3+	1				
Palo Verde*	500	OOS Wind, New Tx	2,328	-	2,328	N/A	3	N/A	N/A	1	1				
Redbluff	500	Li_Battery	500	-	500	1*	3	N/A	N/A	1+	1	0	0	0	0.25
Redbluff	230	Li_Battery	930	-	930	N/A	3	N/A	N/A	2+	1	0	0	0	0.25
Redbluff	500	Solar	-	900	900	1*	1	1	1	1	1	0	0	0	0.25
Redbluff	230	Solar	118	954	1,072	1	3	1	1	2	1	0	0	0	0.25
Redbluff	500	LDES	700	-	700	N/A	3	N/A	N/A	2+	1				
Valley	500	Li_Battery	770	-	770	1*	3	N/A	N/A	1+	1	1	0	0	0
Vista	230	Li_Battery	200	-	200	N/A	3	N/A	N/A	1	1	0	1	1	0

The descriptions and implications of the criteria flags are consistent with the legends included with the prior criteria summaries in Table 37.
*Resources mapped to this substation are outside of the CAISO's BAA.

Transmission Implications

All three CAISO's 2021 White Paper constraints impacting mapped resources in the Riverside and Arizona areas are exceeded in the on-peak limits by the final mapping results for both 2033 and 2035. Each constraint has an upgrade identified in the CAISO's 2021 White Paper: the Serrano – Alberhill – Valley 500 kV Constraint upgrade, which costs $ 1.48 billion for an additional 3,648 MW of capacity, the Devers – Red Bluff 500 kV Constraint upgrade, which costs $1.02 billion for an additional 3,100 MW of on-peak capacity, and Colorado River 500/230 kV Transformer Constraint, which costs $74 million for an additional 1,000 MW of capacity. Working Group staff assessed the upgrades for all three constraints as cost-effective; however, level-3 non-compliance flags remain for nearly all the mapped resources in Table 41 because the exceedance of the Serrano – Alberhill – Valley 500 kV Constraint is greater than the capacity of the upgrade identified in the CAISO's 2021 White Paper. The 22-23 TPP preliminary results for the sensitivity portfolio indicated these upgrades combined with an additional series of reconductoring and smaller upgrades costing an estimated $420 million may likely alleviated the exceedances observed in the mapping results.

For most of the resources mapped in the Imperial Irrigation District's (IID's) BAA including Imperial Geothermal, staff selected the IID-SCE intertie at the Mirage 230 kV substation as the import point into the CAISO, and thus are included within these transmission constraints. Additional transmission upgrade implications of these resources are discussed further in Section 7.8 on San Diego and Imperial Mapping Results. The resources mapped to the Arizona area particularly at the Hoodoo Wash substation also impact the San Diego and Imperial area related transmission constraints. These impacts are also discussed in Section 7.8 below.

7.8 San Diego & Imperial Mapping Results

Mapped Resources Summary

Table 42 summarizes the final mapped resources in the San Diego and Imperial areas. The Imperial area includes resources mapped within the Imperial Irrigation District's (IID's) BAA., although a significant portion of these resources are imported into the CAISO system in the Riverside area discussed in the previous section.

Table 42: Summary of mapped resources in the San Diego and Imperial areas.

Updated Resources in San Diego & Imperial												
Resource Type	Online Resources (by 8/1/2022)		In-Development Resources		2033 Generic Resources		2035 Additional Resources		Total Resources (2035)		
	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	FCDS	EODS	TOTAL
Geothermal, IID	-	-	76	-	724	-	100	-	900	-	**900**
Utility-Scale Solar	20	-	-	410	100	163	-	270	120	843	**963**
Wind	105	-	-	-	135	360	-	-	240	360	**600**
Li_Battery	399	-	1,332	-	50	-	110	-	1,892	-	**1,892**
LDES	-	-	-	-	500	-	-	-	500	-	**500**

Busbar Mapping Criteria Compliance

Table 43 depicts the final busbar mapping criteria alignment for resources in 2035 mapped to the San Diego and Imperial areas, following post-ruling mapping adjustments. Details on the remaining

non-compliance flags are in the 2035 Dashboard and details on the resources mapped in 2033 are in the 2033 Dashboard.

Transmission Implications

The post-ruling mappings in both 2033 and 2035 result in three on-peak constraint exceedances in the San Diego and Imperial areas that can be alleviated by the CAISO's 2021 White Paper identified upgrades. Working group staff identified all three upgrades: the Encina-San Luis Rey Constraint upgrade costing $102 million for an estimated 3,700 MW of additional capacity, the San Luis Rey-San Onofre Constraint upgrade costing and estimated $237 million for an estimated 4,260 MW of additional capacity, and the San Diego Internal Constraint upgrade costing $90 million for an estimated 2,000 MW of additional capacity, as cost effective.

The Imperial area has an additional exceedance of the East of Miguel Area constraint in the on-peak limit for 2033 mapping and the on- and off-peak limits for the 2035 mapping, which also impacts some of the resources mapped to Arizona. In 2033 the exceedance is primarily driven by the additional resources mapped to Hoodoo Wash substation in Arizona, but additional solar and storage mapped to other substations in Imperial increases the exceedance in the 2035 results. Furthermore, the mapping assumes only 50 MW of new geothermal being exported from IID's BAA at the SDGE-IID intertie with rest going to the SCE-IID intertie. If additional geothermal were to interconnect at the SDGE-IID intertie rather than the SCE-IID intertie, it would further increase the exceedance.

The resources under the East of Miguel constraint have a level 3 non-compliance flag because the CAISO's 2021 White Paper upgrade, given its estimated capacity and costs assumptions (1,400 MW and $3.68 billion), is not cost-effective considering just the resources on their own. However, the preliminary results for the 22-23 TPP sensitivity portfolio, which has a similar exceedance, indicate potential benefits of a similar upgrade to the Riverside, Arizona, and San Diego areas in addition to just the resources in the Imperial area. The CAISO's 2021 White paper upgrade also has the potential enable more geothermal in the Salton Sea and Imperial areas to interconnect. The preliminary 22-23 TPP results also identified an alternative series of upgrades to mitigate the overloads that may have lower costs than the identified White Paper upgrade, but the estimated costs of those transmission solutions were not yet fully identified in the preliminary results. With that uncertainty, the various overall transmission solutions to alleviate exceedances in the San Diego and Imperial areas could potentially range in cost from more than $1.4 billion to more than $3.9 billion.

Table 43: Summary of the 2035 mapped resources (storage and non-storage) in the San Diego and Imperial areas by substation and the compliance of these allocations with the busbar mapping criteria.

2035 Mapping: In-Development and Generic Resources						Busbar Mapping Criteria Compliance						Battery Mapping Criteria		
Substation	Voltage	Resource Type	FCDS (MW)	EODS (MW)	Total (MW)	1. Dist. to Tx of Approp. Voltage	2. Tx Capability Limit	3a. Available Land Area	3b. Env. Impacts	4. Commercial Interest	5. Prior Base Case	LCR	DAC	O3 or PM2.5 non-attainment zone
ECO	115	Li_Battery	108	-	108	N/A	3	N/A	N/A	1	1	1	0	1
ECO	115	Solar	-	180	180	1	3	2	1	1	1	1	0	1
ECO	230	In-State Wind	-	360	360	2	3	N/A	N/A	2+	2	1	0	1
ECO	115	In-State Wind	135	-	135	1	3	2	1	1+	1	1	0	1
ECO	500	In-State Wind	-	-	-	2	3	N/A	N/A	2+	1	1	0	1
Encina	115	Li_Battery	-	-	-	N/A	1*	N/A	N/A	1+	2*	0	0	1
Escondido	230	Li_Battery	115	-	115	N/A	1*	N/A	N/A	1+	1	1	0	1
IID System*	230	Li_Battery	150	-	150	N/A	3	N/A	N/A	1	1	0	1	1
IID System*	230	Solar	-	100	100	N/A	1	N/A	N/A	2+	1	0	1	1
IID System*	230	Geothermal	850	-	850	1	3	1	2	2	1	0	1	1
IID System*	161	Geothermal	50	-	50	1	3	1	2	1	1	0	1	1
Imperial Valley	230	Li_Battery	305	-	305	N/A	3	N/A	N/A	2+	1	1	0	0
Imperial Valley	230	Solar	100	563	663	1	3	1	1	1+	1	1	0	0
Kearny	115	Li_Battery	10	-	10	N/A	1*	N/A	N/A	1	1	No Data	No Data	No Data
Miguel	230	Li_Battery	10	-	10	N/A	1*	N/A	N/A	1	1	0	0	1
Mission	230	Li_Battery	10	-	10	N/A	1*	N/A	N/A	1	1	0	0	1
Mission	138	Li_Battery	50	-	50	N/A	1*	N/A	N/A	1	1	0	0	1
Ocotillo	500	In-State Wind	-	-	-	2	3	2	1	2+	1	0	0	1
Otay Mesa	230	Li_Battery	75	-	75	N/A	1*	N/A	N/A	1+	1	0	0	1
San Luis Rey	230	Li_Battery	60	-	60	N/A	1*	N/A	N/A	2+	1	0	0	1
Silvergate	230	Li_Battery	200	-	200	N/A	1*	N/A	N/A	1	1	1	1	1
Sycamore	138	Li_Battery	400	-	400	N/A	1*	N/A	N/A	1	1	1	0	1
Sycamore	230	LDES	500	-	500	N/A	1*	N/A	N/A	2	1	1	0	1
Talega	230	Li_Battery	100	-	100	N/A	1	N/A	N/A	1	1	0	0	1

7.9 Offshore Wind Sensitivity

Table 44 shows the final mapped resources for the offshore wind sensitivity portfolio summarized by resource type and resources area while Table 45 summarizes the mapped battery resources by alignment with the battery-centric mapping criteria.

Table 44: Summary of final mapping results for the offshore wind sensitivity

RESOLVE Resource Name	Resource Type	RESOLVE Selected (2035)			Final Mapping Results (2035)		
		FCDS	EODS	TOTAL	FCDS	EODS	TOTAL
InState Biomass	Biomass/Biogas	134	-	**134**	134	-	**134**
Solano_Geothermal	Geothermal	135	-	**135**	95		**95**
Inyokern_North_Kramer_Geothermal	Geothermal	-	-	**-**	53		**53**
Southern_Nevada_Geothermal	Geothermal	320	-	**320**	280		**280**
Northern_Nevada_Geothermal	Geothermal	-	-	**-**	191		**191**
Riverside_Palm_Springs_Geothermal	Geothermal	32	-	**32**	-		**-**
Greater_Imperial_Geothermal	Geothermal	662	-	**662**	530		**530**
Distributed Solar	Solar	125	-	**125**	125	-	**125**
Greater_LA_Solar	Solar	-	2,953	**2,953**	-	1,251	**1,251**
Northern_California_Solar	Solar	-	-	**-**	5	615	**620**
Southern_PGAE_Solar	Solar	-	1,238	**1,238**	2,693	2,037	**4,730**
Tehachapi_Solar	Solar	-	4,878	**4,878**	3,483	2,280	**5,762**
Greater_Kramer_Solar	Solar	-	4,149	**4,149**	1,290	775	**2,065**
Southern_NV_Eldorado_Solar	Solar	-	7,644	**7,644**	1,507	1,931	**3,438**
Riverside_Solar	Solar	-	4,006	**4,006**	1,445	3,298	**4,743**
Arizona_Solar	Solar	-	171	**171**	900	1,707	**2,607**
Imperial_Solar	Solar	-	708	**708**	120	410	**530**
Northern_California_Wind	Wind	-	866	**866**	230	109	**339**
Solano_Wind	Wind	-	560	**560**	682	75	**757**
Humboldt_Wind	Wind	-	34	**34**	-	-	**-**
Kern_Greater_Carrizo_Wind	Wind	60	-	**60**	180	-	**180**
Carrizo_Wind	Wind	-	287	**287**	174	-	**174**
Central_Valley_North_Los_Banos_Wind	Wind	173	-	**173**	150	-	**150**
Tehachapi_Wind	Wind	113	162	**275**	345	-	**345**
Southern_Nevada_Wind	Wind	-	442	**442**	403	-	**403**
Riverside_Palm_Springs_Wind	Wind	-	-	**-**	107	20	**127**
Baja_California_Wind	Wind	600	-	**600**	240	360	**600**
Wyoming_Wind	OOS Wind	2,328	-	**2,328**	1,500	-	**1,500**
Idaho_Wind	OOS Wind	-	-	**-**	1,000	-	**1,000**
New_Mexico_Wind	OOS Wind	2,500	-	**2,500**	2,328	-	**2,328**
SW_Ext_Tx_Wind	OOS Wind	-	500	**500**	690	100	**790**
NW_Ext_Tx_Wind	OOS Wind	-	67	**67**	-	-	**-**
Humboldt_Bay_Offshore_Wind	Offshore Wind	3,045	-	**3,045**	2,439	161	**2,600**
Morro_Bay_Offshore_Wind	Offshore Wind	5,355	-	**5,355**	5,355	-	**5,355**
Diablo_Canyon_Offshore_Wind	Offshore Wind	-	-	**-**	-	-	**-**
Cape_Mendocino_Offshore_Wind	Offshore Wind	5,000	-	**5,000**	2,000	-	**2,000**
Del_Norte_Offshore_Wind	Offshore Wind	-	-	**-**	3,445	-	**3,445**
Renewable Resource Total		**20,582**	**28,664**	**49,247**	**34,117**	**15,129**	**49,246**
Greater_LA_Li_Battery	Li_Battery	7,241	-	**7,241**	3,713	-	**3,713**
Northern_California_Li_Battery	Li_Battery	319	-	**319**	2,368	-	**2,368**
Southern_PGAE_Li_Battery	Li_Battery	5,475	-	**5,475**	3,201	-	**3,201**
Tehachapi_Li_Battery	Li_Battery	4,511	-	**4,511**	3,226	-	**3,226**
Greater_Kramer_Li_Battery	Li_Battery	1,576	-	**1,576**	1,165	-	**1,165**
Southern_NV_Eldorado_Li_Battery	Li_Battery	3,040	-	**3,040**	2,079	-	**2,079**
Riverside_Li_Battery	Li_Battery	617	-	**617**	4,900	-	**4,900**
Arizona_Li_Battery	Li_Battery	0	-	**0**	1,112	-	**1,112**
Imperial_Li_Battery	Li_Battery	-	-	**-**	593	-	**593**
San_Diego_Li_Battery	Li_Battery	766	-	**766**	1,189	-	**1,189**
LI_Battery Total		**23,545**		**23,545**	**23,545**	**-**	**23,545**
Tehachapi_LDES	LDES	500	-	**500**	500	-	**500**
Riverside_East_Pumped_Storage	LDES	500	-	**500**	-	-	**-**
San_Diego_Pumped_Storage	LDES	-	-	**-**	500	-	**500**
LDES Total		**1,000**		**1,000**	**1,000**	**-**	**1,000**
Storage Total		**24,545**		**24,545**	**24,545**	**-**	**24,545**
Total Storage+Resources		**45,127**	**28,664**	**73,792**	**58,663**	**15,129**	**73,791**

Table 45: Final offshore wind sensitivity portfolio battery mapping alignment with the four main storage centric mapping criteria.

Battery Criteria Summary (2035)	
Battery Category	**Capacity (MW)**
Co-Located in LCR Areas	2,720
Stand-Alone in LCR Areas	3,914
Total in LCR Areas	**6,634**
Co-Located in DACs	2,677
Stand-Alone in DACs	2,858
Total in DACs	**5,535**
Co-Located in Non-Attainment Zones	8,994
Stand-Alone in Non-Attainment Zones	6,268
Total in Non-Attainment Zones	**15,261**
Co-Located in High-Curtailment Zones	9,608
Stand-Alone in High-Curtailment Zones	943
Total in High-Curtailment Zones	**10,551**

Full details at the substation level of the mapped resources for the offshore wind sensitivity portfolio are included in the Final Mapping Dashboard for the sensitivity portfolio in Appendix D. The overall goal for mapping the non-offshore wind resources was to align the locations of the resources with those in the base case portfolio. Thus, Working Group staff did not map resources to any new substations in the sensitivity and the resources amount mapped do not exceed what was mapped in the base case portfolio.

With respect to the offshore wind resources in the initial RESOLVE results, CPUC staff did not specify specific locations for the 5,000 MW of the North Coast Offshore Wind. The busbar Working Group staff worked with CAISO and CEC staff to identify what offshore wind potential interest areas to map these resources. From this collaboration, Working Group staff also adjusted the amount of offshore wind mapped to the Humboldt area. This consultation aides in aligning the mapping and the upcoming TPP analysis work on this sensitivity with the ongoing AB 525 offshore wind policy efforts led by the CEC. The final distribution of the 13,400 MW of offshore wind is as follows:

- Morro Bay Call area: 5,355 MW
- Humboldt Call area: 2,600 MW
- Del Norte offshore wind interest area: 3,445 MW
- Cape Mendocino offshore wind interest area: 2,000 MW

The busbar Working Group has not specified transmission upgrades or specific interconnection locations for these offshore wind resources to enable the CAISO in its TPP analysis to study the various transmission options available.

8. Other Assumptions for TPP

Guidance previously provided to CAISO as part of the annual CPUC portfolio transmittal was included in a document 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 Thermal Generator Retirement

RESOLVE reports the aggregate amount of thermal generation not retained by resource category. Unit-specific information is not modeled. Because the TPP studies require modeling of specific units and locations, CPUC staff provide information to the CAISO regarding which units should be assumed as retired for transmission planning purposes. However, the resource portfolio for the 2023-2024 TPP does not include as an output any not retained thermal generation. Instead, the portfolio does include thermal generation retirements as an input prior to resource optimization.[17] The detailed workbook contained in Appendix F lists the specific units assumed as retired. CPUC staff applied the steps described in the methodology (see Appendix A) to develop this list.

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 (R. 19-11-009 or its successor R. 21-10-002) 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. 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.

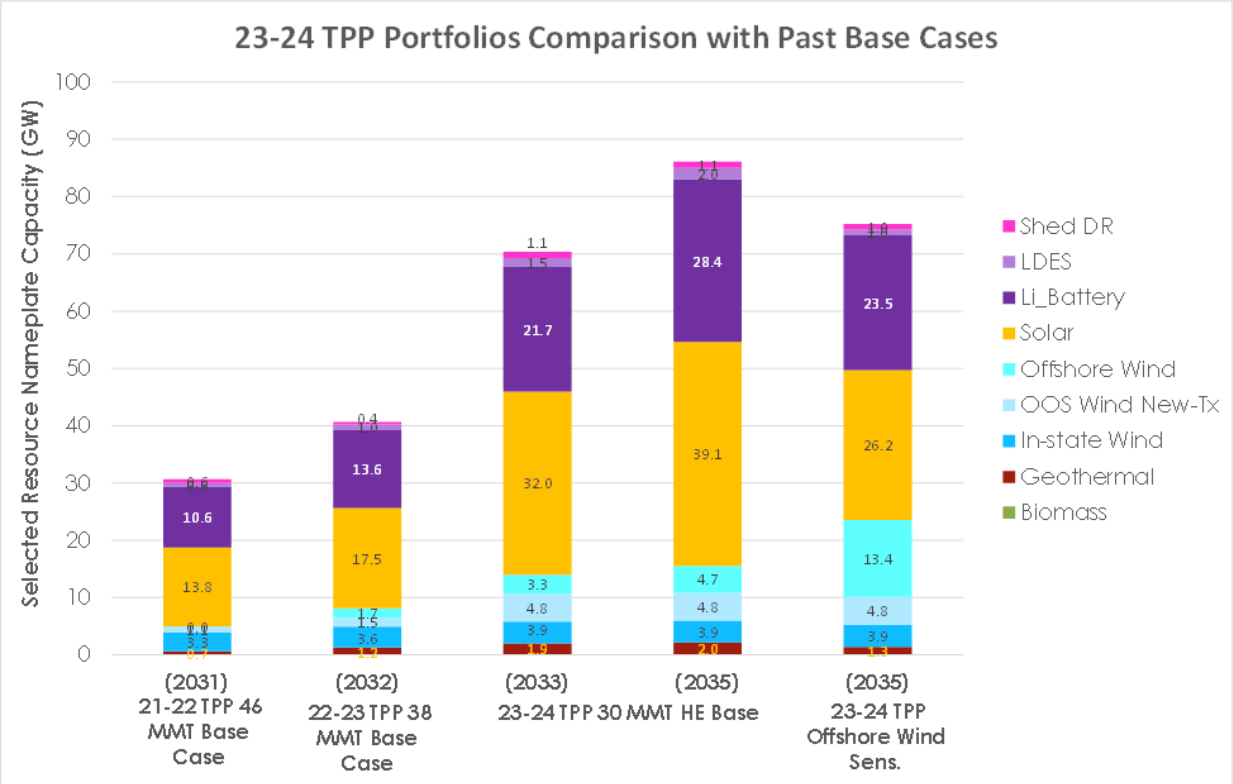
[17] The RESOLVE inputs and assumptions for this 2023-2024 TPP analysis incorporated an implementation of the High-Need Scenario of the Mid-Term Reliability Decision D.21-06-035 which included 40-year age-based retirements for peakers and CHP generators that came online by the end of 1986

9. Conclusion and Next Steps

The CPUC's policy and reliability base case portfolio and the offshore wind sensitivity portfolio have been mapped to busbars in reasonable accordance with the criteria and with consideration of state policy objectives, as described in the Methodology (see Appendix A). Staff mapped an unprecedented number of resources due to the portfolio's higher load scenario, more stringent greenhouse gas emissions target, and longer modeling outlook.

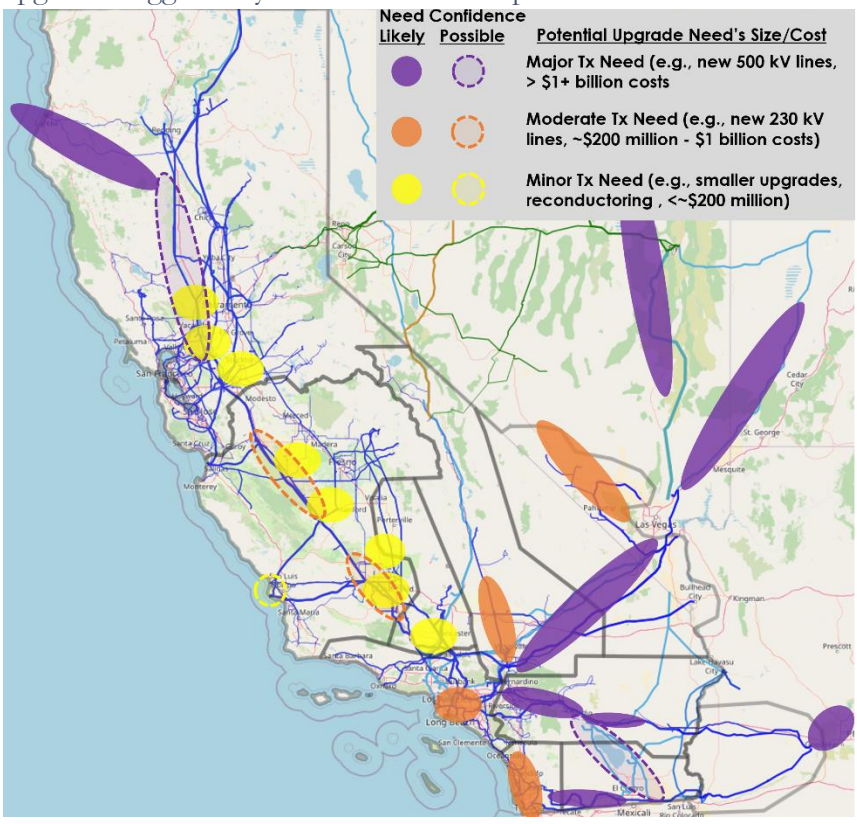
In total for the base case portfolio, the Working Group staff mapped over 54,500 MW of renewables, including 4,800 MW of out-of-state wind on new out-of-state transmission and 4,700 MW of offshore wind, and over 30,000 MW of storage, including 2,000 MW of long duration storage, in the 2035 portfolio to substations this cycle. The results of the 2033 and 2035 mapped portfolios (Appendices B and C) are transmitted to the CAISO for use in the reliability and policy-driven base case in the 2023-2024 TPP. In comparison, staff mapped 25,500 MW of renewables, including 1,500 MW of out-of-state wind and 1,700 MW of offshore wind, and over 14,500 MW of storage in the 2022-2023 TPP base case portfolio. Figure 5 compares the amount of resources mapped in this report for the base case portfolio for the 2023-2024 TPP two study years, 2033 and 2035, and for the offshore wind sensitivity portfolio to the amount of resources mapped in the portfolios adopted by the CPUC as base cases for the 2021-2022 TPP and the 2022-2023 TPP.

Figure 5: Final resource comparison of the 2023-2024 TPP base case portfolio in 2033 and 2035 and offshore wind sensitivity portfolio with the base case portfolios for the 2021-2022 and 2022-2023 TPPs.



The 2021-2022 TPP base case portfolio resulted in the identified need for six policy-driven transmission upgrades potentially costing between $1.1 – 1.5 billion within the CAISO system. The 2022-2023 TPP is still on going with the draft report scheduled for release in March 2023. However, preliminary results indicate the likely need for several major transmission upgrades beyond the $1.5-2 billion in upgrades identified as potentially needed in the 22-23 TPP Busbar Mapping Report.[18] These additional transmission upgrades stem from a significant update to the number of under-construction resources identified by Primary Transmission Owners (PTOs) and a joint CPUC-CEC July 2022 letter to study key OOS resources on top of deliverability already allocated to projects in the CAISO queue. The near doubling of resources in the 2033 base case portfolio and more than doubling in the 2035 portfolio for the 23-24 TPP results in a significant increase in the likely transmission needs of the mapped portfolio and a much greater uncertainty to the upgrades themselves and their costs needed for the mapped results. Due to the portfolio size, the amount of mapped resources exceed known transmission capacity and upgrade information in multiple locations. Therefore, staff inferred potential transmission implications from the preliminary results of the 22-23 TPP. Based on these preliminary CPUC staff estimates, the 2035 mapping of the 23-24 TPP base case portfolio may need between $15 – 27 billion, including transmission needs for offshore wind and the full costs of likely out-of-CAISO transmission needs for OOS wind. Figure 6 depicts the approximate location and magnitude of potential transmission upgrade needs of the base case portfolio as estimated by CPUC busbar working group staff based on the 2035 mapping, the CAISO's 2021 White Paper transmission info, and the preliminary 22-23 TPP results. Actual

Figure 6: Map of CPUC busbar staff estimates of location and magnitude of potential transmission upgrades triggered by the 2035 base case portfolio.



[18] Modeling Assumptions for the 2022-2023 TPP link: https://files.cpuc.ca.gov/energy/modeling/Modeling_Assumptions_2022-2023_TPP_V.2022-2-7.pdf

transmission needs and their costs may differ significantly once the portfolio is fully studied by the CAISO through the 23-24 TPP. Furthermore, CAISO's TPP is not required to recommend for approval upgrades to address transmission needs that are only relevant in 2035 or can be started in future years and still be constructed in time to meet the need. Thus Figure 6 does not reflect what is likely to be included in the CAISO 23-24 TPP, only what CPUC busbar mapping staff estimates as likely to be needed by 2035 for the base case portfolio resources.

Over 6,500 MW of storage was mapped to substations with DACs and over 19,000 MW of storage was mapped to substations within NO_x or ozone non-attainment zones. While RESOLVE is currently not able to model true hybrids as a potential resource, the RESOLVE updates and new transmission constraints and expressions utilized for this portfolio enabled the busbar mapping process to co-locate 22,000 MW of solar with 19,000 MW of batteries represented by mapping EODS solar and batteries to the same substations. The new transmission expressions better model the interplay between FCDS and EODS resources particularly with respect to storage. These updates capture the ability to use solar and storage together over the same transmission. By co-locating EODS solar with FCDS storage, the busbar mapping process is representing the key aspects of hybrid resources in a deconstructed fashion: utilizing the EODS solar for storage charging and preserving the FCDS transmission headroom for storage deliverability.

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 900 MW of geothermal resources mapped within the Imperial Irrigation District's (IID's) BAA have been assessed with CAISO transmission system at the interties where the resources would be imported from the IID's system. The impacts on the IID's system are unknown, as are the type and cost of any upgrades that may be required to successfully interconnect the resources to deliver to the CAISO border.

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. Thus, the Working Group strives for the mapping of resources to remain consistent with previous portfolios and to utilize the transmission upgrades already triggered in previous TPPs. This consistency also helps indicate that transmission exceedances created by the mapping results for the 2023-2024 TPP portfolio could be alleviated by upgrades being studied in current ongoing 2022-2023 TPP, thereby providing an advantage to the transmission planning.

9.1 Guidance on the 30 MMT with 2021 IEPR Additional Transportation Electrification Base Case Resource Portfolio

These mapped results, as noted above, highlight the need for an amount of transmission upgrades significantly larger than identified by analysis of previous base case portfolios. As described in greater detail in Section7, the mapped resources exceed existing transmission limits for many constraints within the CAISO system. Of the 42 constraints from the 2021 CAISO's White Paper utilized in the busbar mapping, the resources mapped in the 2035 results exceed the identified capacity of 27 constraints in either the on-peak, off-peak, or both. The mapping also results in a

significant need for new transmission to interconnect North Coast offshore wind and new transmission beyond the CAISO's BAA to interconnect the OOS and out-of-BAA wind and geothermal resources to CAISO interties. In total, potential upgrades in the White Paper or the preliminary 22-23 TPP results were identified as needed for the 2035 mapping results in every area of California. CPUC staff estimate that the potential upgrades within the CAISO for the 2035 portfolio have costs estimates ranging from $9 – 19 billion. Additional new transmission needed to interconnect the offshore wind mapped could costs between $2.5 – 4.5 billion, while the new transmission beyond CAISO's borders needed for OOS wind ranges between $3 – 4 billion. CPUC staff estimate that these upgrades would provide enough transmission capacity for at least 30 – 40 GW of new resources.

For the potential transmission upgrade needs within the CAISO system, many of the identified transmission capabilities found to be exceeded are default limits within the CAISO's 2021 White Paper, so there are no identified upgrades from the White Paper. Additionally, a few of the upgrades identified do not provide enough estimated additional capacity to fully account for the number of resources mapped to substations in that constraint. Thus, in many of the exceedance situations staff have relied on the still-in-progress upgrade estimates from the 22-23 TPP preliminary results to assess the potential transmission implications of the mapped results. These limitations have led to greater uncertainty in the potential transmission upgrade impacts and costs analysis for busbar mapping. This uncertainty was driven by the large increase in the size of the portfolio mapped, which is due to the higher load assumptions and further into the future modeling year. CPUC staff plan on alleviating much of the uncertainty in the next cycle by working with the CAISO to incorporate the results of the recent Cluster 14 transmission studies and the 22-23 TPP results when completed.

If the TPP policy-driven assessment 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 with approval of projects if they are identified only in the reliability assessments, if they are identified as needed for only the 2035 mapping results, and if the estimated build time does not necessitate immediate commencement to meet the identified resource need. The CPUC will continue to coordinate with the CAISO and will be engaged in the CAISO's Transmission Planning Process by providing comments or additional guidance through the TPP stakeholder process based on results of the analysis for the base portfolio related to transmission upgrade needs that are identified.

Alignment with CAISO Queue Resources with Allocated TPD

As was done in the July 1, 2022 transmittal letter to the CAISO, CPUC staff are proposing to request that the that 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 and long-lead time (LLT) resources mapped in the policy- and reliability-driven base case portfolio, while preserving the existing transmission capacity that has been allocated to other projects earlier in the interconnection queue. Working Group staff sought to align the mapping with resources in the CAISO's interconnection queue that have been assigned transmission plan deliverability (TPD) while still aligning with the various other busbar mapping criteria. To that end, not all the assigned TPD in the transmission areas key to OOS and LLT resources were accounted for by mapped resources, particularly in the 2033 portfolio mapping results. CPUC staff will engage with CAISO staff to identify any TPD not already accounted for by the mapping of the portfolio's resources in these key areas. CPUC staff will compile the MW

amounts and locations of these TPD resources so that the CAISO can include them in addition to the mapped portfolio resources when conducting TPP analysis.

Offshore Wind

CPUC staff recognize the need for a unique approach with offshore wind at both the North Coast and Central Coast locations. In mapping both Humboldt and Morro Bay offshore wind, the CPUC is not making specific interconnection and transmission project upgrade recommendations but is requesting the CAISO through its TPP analysis to identify optimal transmission solutions for interconnecting the offshore wind resources.

The working group mapped the 3,100 MW of Morro Bay offshore wind in both the 2033 and 2035 base case portfolios interconnecting to the existing Diablo Canyon 500 kV substation, following guidance from CAISO staff. CPUC staff request CAISO consider this mapping arrangement and the potential to connect some or all of the Morro Bay offshore wind to a proposed new 500 kV Morro Bay substation as identified in the 21-22 TPP offshore wind sensitivity portfolio results.

The base case portfolio has 161 MW of Humboldt offshore wind in 2033 and 1,607 MW in 2035. In alignment with the commercial interest currently in the CAISO's interconnection queue, the Working Group mapped the 161 MW as interconnecting with off-peak deliverability at the existing 115 kV Humboldt substation. The remaining 1,446 MW are mapped to a proposed new 500 kV Humboldt substation in the 2035 mapping results that requires new transmission to interconnect to the CAISO system. Though the RESOLVE model had to utilize one of the three North Coast upgrades identified in the 21-22 TPP offshore wind sensitivity results in its modeling of offshore, CPUC staff are not recommending that specific transmission option or any transmission option. Not identifying a specific upgrade enables the CAISO to continue to study the various transmission alternatives for interconnecting Humboldt offshore wind and incorporate results from the 22-23 TPP sensitivity, which has a similar amount of offshore wind, and the concurrent 23-24 TPP offshore wind sensitivity portfolio, which has 3,000 MW of Humboldt and 5,000 MW of additional North Coast offshore wind. CAISO staff can consider all base case Humboldt offshore wind resources mapped to a single substation to avoid significant upgrades to the existing 115 kV system solely for the small amount of offshore wind mapped.

Out-of-State Wind on New Out-of-State Transmission

The amount of OOS wind on new transmission is significantly higher (4,828 MW in total) in this base case portfolio than in the 21-22 and 22-23 TPP base cases, which had 1,062 MW and 1,500 MW respectively. In those two previous cases, CPUC staff did not specify the location of that OOS wind or its injection location into the CAISO system. Instead, CPUC staff requested the CAISO study the impacts of the 1,062 MW in the 21-22 TPP at both the El Dorado and Palo Verde injection points with Idaho, Wyoming, and New Mexico wind all being considered. With that effort ongoing, CPUC staff made a similar request for the 22-23 TPP base case's OOS wind. CPUC staff recognize that the CAISO has folded its economic study focused on Idaho Wind, started with the 21-22 TPP request, into the currently ongoing 22-23 TPP effort. For the 4,828 MW of OOS wind in this base case, the Working Group did map the resources to specific injection points and identify specific locations as sources of the OOS wind, with 1,000 MW of Idaho Wind and 1,500 MW of Wyoming wind interconnecting at Harry Allen or El Dorado 500 kV substations and 2,328 MW of New Mexico Wind interconnecting at the Palo Verde substation.

Out-of-CAISO Resources and Maximum Import Capability (MIC)

The 23-24 TPP base case portfolio, in addition to the over 4,800 MW of OOS wind on new transmission, has a significant amount of geothermal mapped to IID and areas in Nevada beyond the CAISO's Balancing Area. As was done for the 2022-2023 TPP portfolio, busbar Working Group staff specified in the Mapping Dashboard the out-of-CAISO transmission and MIC assumptions for these resources including whether the resources should be treated by CAISO in TPP analysis as using existing MIC allocations or require MIC expansion. For all the OOS wind on new transmission and most of the geothermal resources, Working Group staff identified the resources as requiring MIC expansion. Full details of the out-of-CAISO resources can be found on the "OutsideCAISO_Res_Summary" tab of the Mapping Dashboards (see Appendix C for the 2035 results).

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

As with the past two TPP portfolio submittals, the CPUC staff agree 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, the CAISO should consult the CPUC 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 2022-2023 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 these 2023-2024 TPP portfolios.

9.2 Guidance on the Offshore Wind Sensitivity Portfolio

As described in greater detail in Section 7.9, the 13.4 GW of offshore wind have been mapped to one location on the Central Coast (Morro Bay) and three separate locations on the North Coast (Humboldt, Del Norte, and Cape Mendocino) to allow CAISO to identify transmission upgrades and cost information necessary to further advance offshore wind planning in line with the state's offshore wind policy goals. Again, the CPUC is not making specific interconnection and transmission project upgrade recommendations but is requesting the CAISO through its TPP analysis to identify optimal transmission solutions for interconnecting the offshore wind resources included in the sensitivity portfolio. While the busbar Working Group mapped the Morro Bay offshore wind to the Diablo Canyon 500 kV substation and the Humboldt offshore wind to a proposed Humboldt 500 kV substation, as noted in Section 7.9, the Cape Mendocino and Del Norte interest areas offshore wind resources are not mapped to specific substations. Thus, the guidance stated for offshore wind in the base portfolio in Section 9.1 also applies to this sensitivity portfolio: the CAISO should not limit TPP analysis to the specific substations to which the busbar working group mapped the offshore wind resources.

9.3 Busbar Mapping for 2024-25 TPP and Future Cycles

Staff appreciates the feedback and suggestions from stakeholders in response to the questions posed in the October 2022 ruling. Anything not already addressed in the transmittal for the 2023-2024 TPP will be a priority for consideration in the draft workplan for 2024-2025 TPP busbar mapping. The busbar mapping effort for the 24-25 TPP will likely feature three major changes. First, an overhaul

of the environmental and land-use screens datasets utilized by the CEC in the mapping effort. Second, an expansion of time horizon for which the modeling and mapping is conducted. Per SB 887 (2022), CPUC staff will be working in collaboration with CEC staff to provide mapped portfolios out to a fifteen-year planning horizon. Third, CPUC staff will work with CAISO staff to incorporate the recent Cluster 14 GIDAP transmission studies and the future 22-23 TPP study results into an updated white paper for use in CPUC's modeling and mapping efforts. Furthermore, CPUC staff continue to strive to resolve the process alignment and timing issues that make it challenging to inform resource busbar mapping for an upcoming TPP with the results of the ongoing TPP.

10. Appendices

A. Methodology for Resource-to-Busbar Mapping & Assumption for the TPP

Updated for the PD, version 01/13/23: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/2023-2024-tpp-portfolios-and-modeling-assumptions/busbarmethodologyfortppv20230109.pdf

B. Busbar Mapping Dashboard workbook – Base Case Portfolio, 2033

Available at the CPUC's "Portfolios and Modeling Assumptions for the 2023-2024 Transmission Planning Process" webpage: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/busbardashboard2033_30mmt_hebase_vd_02-22-23.xlsx

C. Busbar Mapping Dashboard workbook – Base Case Portfolio, 2035

Available at the CPUC's "Portfolios and Modeling Assumptions for the 2023-2024 Transmission Planning Process" webpage: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/busbardashboard2035_30mmt_hebase_vd_02-22-23.xlsx

D. Busbar Mapping Dashboard workbook – Offshore Wind Sensitivity Portfolio, 2035

Available at the CPUC's "Portfolios and Modeling Assumptions for the 2023-2024 Transmission Planning Process" webpage: 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-2023-2024-transmission-planning-process

E. 2022 Baseline Reconciliation and In-Development Resources

Available at the CPUC's "Portfolios and Modeling Assumptions for the 2023-2024 Transmission Planning Process" webpage: 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-2023-2024-transmission-planning-process

F. Retirement List of Thermal Generation Units

Available at the CPUC's "Portfolios and Modeling Assumptions for the 2023-2024 Transmission Planning Process" webpage: 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-2023-2024-transmission-planning-process

G. CAISO Interconnection Queue Analysis Units

Available at the CPUC's "Portfolios and Modeling Assumptions for the 2023-2024 Transmission Planning Process" webpage: 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-2023-2024-transmission-planning-process

H. October 2022 Ruling Busbar Mapping Dashboard workbook – Base Case Portfolio, 2033
Released with 10/07/2022 Ruling: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/2023-2024-tpp-portfolios-and-modeling-assumptions/2033_busbardashboard_30mmt_base_public_v100722.xlsx

I. October 2022 Ruling Busbar Mapping Dashboard workbook – Base Case Portfolio, 2035
Released with 10/07/2022 Ruling: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/2023-2024-tpp-portfolios-and-modeling-assumptions/2035_busbardashboard_30mmt_base_public_v100722.xlsx

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