CPUC Staff Report: Modeling Assumptions for the 2020-2021 Transmission Planning Process Release 2 (TPP Sensitivity Portfolios)

CPUC Energy Division
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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 2019 busbar mapping process performed by the CPUC, CAISO and California Energy Commission (CEC), for input into TPP, providing transparency and opportunity for IRP and TPP stakeholder engagement.

Further, the CPUC has traditionally provided a document describing planning and modeling assumptions to accompany the portfolios transmitted for study in the TPP annually. It was originally called the "Long-Term Procurement Plan Assumptions and Scenarios" and later the "Unified Inputs and Assumptions". This Report includes the key guidance for TPP studies that was conveyed in the earlier documents, thus superseding earlier guidance and documents.

2. Scope

This release of the Report (Release 2) addresses the busbar mapping and other modeling assumptions for TPP Policy-driven Sensitivity portfolios as outlined in Table 1 below. It also provides an update on assumptions that should be used for the generic battery storage resources made available as potential mitigation solutions during TPP study. Refer Release 1[1] for all other modeling assumptions for the Reliability Base Portfolio, Policy-driven Base Portfolio, and Economic Assessments.

Table 1 Modeling assumptions reported in this document (Release 2)

IRP Portfolio	2020-21 TPP Portfolio Use Case/s	Assumptions Updated or New Since Release 1	Key Report Sections
• 2017-2018 Preferred System Portfolio, with updated baseline (Updated 2018 PSP)	• Reliability Base Portfolio • Policy-driven Base Portfolio • Economic assessments	• Cost assumption for generic battery storage resources that are made available as potential mitigation solutions during TPP study	• Section 9
• 2019-2020 Reference System Portfolio (to be adopted) ("2019 RSP")	• Policy-driven Sensitivity Portfolio 1	• Busbar allocations of generation resources	• Section 5 • Section **Error! Reference**

[1] ftp://ftp.cpuc.ca.gov/energy/modeling/Modeling_Assumptions_2020_2021_TPP-Report-Release1.pdf

• 2019 30 MMT by 2030 with Expanded Energy Only Transmission Capacity Sensitivity Portfolio ("2019 30 MMT EO Portfolio")	• Policy-driven Sensitivity Portfolio 2	• Busbar allocations of battery storage resources • Thermal retirement assumptions • Demand response assumptions	**source not found.** • Section 6 • Section 7 • Section 8 • Section 9

3. Report Summary

The CPUC's Proposed Decision "2019-2020 Electric Resource Portfolios to Inform Integrated Resource Plans and Transmission Planning" adopted on March 26, 2020 recommends transmitting the 2018 Preferred System Portfolio as the TPP Base Cases, and the 2019 RSP and 2019 30 MMT EO Portfolio as the TPP Policy-driven Sensitivity Cases. This Report release provides busbar mapping results and other assumptions for the TPP Policy-driven Sensitivity Cases.

Section 5 states the objectives of studying each portfolio and details the inputs CPUC staff provided to the mapping process.

Section **Error! Reference source not found.** describes the methodology used by CPUC, CAISO and CEC staff to conduct busbar mapping.

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

Section 7 summarizes the results of the mapping process.

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

Section 9 draws conclusions regarding mapping the TPP Policy-driven Sensitivity Cases and identifies next steps: CPUC staff will provide details about the workplan for busbar mapping for 2021-22 TPP later this year.

4. Inputs

In order the complete the steps in the methodology described below, the following input is needed: Portfolio of selected resources for 2030, by transmission zone, with Fully Deliverable (FD) and Energy-Only (EO) megawatt (MW) amounts specified.

4.1. 2019 RSP

The objective of studying this portfolio in 2020-21 TPP is to understand the transmission implications of resource investments driven by the state policies and goals considered in the IRP process. RESOLVE did not identify the need for any major transmission upgrades as part of the 2019 RSP. However, RESOLVE, as a system-level capacity expansion model, cannot evaluate transmission investments to the degree that CAISO assessments can. Furthermore, RESOLVE's transmission capability limit and upgrade cost information is limited to the inputs provided to the IRP process by the CAISO. If a transmission zone has not been previously studied by the CAISO, there may be no information available about the transmission limits or potential costs of upgrading within that zone. By studying this portfolio as a policy-driven sensitivity the CAISO will produce results including what transmission upgrades would be required for this resource portfolio. These results can be used to inform future quantitative or qualitative analysis within the IRP process.

The inputs for this portfolio are summarized in Table 2 and Table 3 below. Further details of the inputs to the mapping process are available in Appendix D.

Table 2. Generation resources selected in the 2019 RSP (2030 cumulative)

Pre Round 1 - RESOLVE selections	**Selected Resources**
Resource	**Total MW (2019 RSP)**
Greater_Imperial_Geothermal	-
Carrizo_Wind	287
Central_Valley_North_Los_Banos_Wind	173
Greater_Imperial_Solar	548
Humboldt_Wind	34
Inyokern_North_Kramer_Solar	97
Kern_Greater_Carrizo_Solar	242
Kern_Greater_Carrizo_Wind	60
Mountain_Pass_El_Dorado_Solar	248
North_Victor_Solar	300
Northern_California_Ex_Wind	866
Riverside_Palm_Springs_Solar	-
Riverside_Palm_Springs_Wind	NA
SCADSNV_Solar	330
Solano_Wind	542
Southern_California_Desert_Ex_Solar	862
Southern_Nevada_Solar	-
Tehachapi_Solar	4,202
Tehachapi_Wind	275
Westlands_Ex_Solar	1,779
Westlands_Solar	58
Arizona_Solar	2,352
Baja_California_Wind	600
New_Mexico_Wind	606
Sub Total - Renewables	**14,460**
Pumped Storage Hydro	973
Total	**15,433**

The 2019 RSP includes the following amounts of new battery storage (i.e., incremental to the baseline):

Table 3. Battery resources selected in the 2019 RSP

Year	2020	2021	2022	2023	2024	2026	2030
New Battery Storage (Cumulative MW)	152	2,453	2,453	2,453	3,299	6,127	8,873

4.2. 2019 30 MMT EO Portfolio

The objective of the 2019 30 MMT Portfolio is for the CAISO to study how transmission upgrades can alleviate renewable curtailment, improving available information on the costs and benefits of building new transmission and how these compare to potential storage alternatives.

To achieve this objective, the portfolio was tailored to test transmission zones with high potential to contain cost-effective transmission or storage solutions to alleviating congestion and curtailment. The 30 MMT target alone resulted in an increase of renewable and storage resources selected by RESOLVE. Additional renewable resources were selected when EO transmission limits were expanded in specific transmission zones for the purpose of measuring the ability of transmission and non-wire solutions to reducing congestion and curtailment. The resource selection within these transmission zones is summarized in the table below.

Of the transmission zones in which EO limits were expanded, the following transmission zones[2] have EO resource selections exceeding 80% of their expanded EO limits: Southern PG&E, Kern Greater Carrizo, Central Valley North Los Banos, SCADSNV, GLW-VEA, and Riverside Palm Springs. The resource amount selected in Tehachapi was also significant. CPUC staff expect that these selections are sufficient to meet the TPP study objectives for this portfolio.

[2] As defined in *Inputs & Assumptions: 2019-2020 Integrated Resource Planning*, p.54, available at: ftp://ftp.cpuc.ca.gov/energy/modeling/Inputs%20%20Assumptions%202019-2020%20CPUC%20IRP%202020-02-27.pdf

Transmission Zone	Estimated FD Capability (MW)	Estimated EO Capability (New EO Values - level II)	Max Resource Selection (EO minus FD)	EO Resource Selection (2030)	Utilization of Expanded EO Transmission Capability
Southern PG&E	1,100	5,180	4,080	4,080	100%
Westlands	-	3,200	3,200	-	N/A
Kern and Greater Carrizo	1,000	4,180	3,180	2,880	91%
Carrizo	400	1,100	700	700	100%
Central Valley North & Los Banos	1,000	1,000	-	500	N/A
Tehachapi	4,300	6,100	1,800	1,399	78%
Southern CA Desert and Southern NV	3,000	13,260	10,260	9,272	90%
El Dorado and Mountain Pass 230 kV	250	4,040	3,790	1,500	40%
Southern NV (GLW-VEA)	700	2,170	1,470	1,470	100%
Greater Imperial	1,200	3,100	1,900	1,264	67%
Riverside East & Palm Springs	2,950	6,050	3,100	3,068	99%

The inputs for this portfolio are summarized in Table 4 and Table 5 below. Further details of the inputs to the mapping process are available in Appendix E.

Table 4. Generation resources selected in the 2019 30 MMT EO Portfolio (2030 cumulative)

Pre Round 1 - RESOLVE selections	**Selected Resources**
Resource	**Total MW (2019 EO P'folio)**
Greater_Imperial_Geothermal	716
Solano_Geothermal	135
Carrizo_Solar	600
Carrizo_Wind	287
Central_Valley_North_Los_Banos_Wind	173
Greater_Imperial_Solar	867
Humboldt_Wind	34
Inyokern_North_Kramer_Solar	97
Kern_Greater_Carrizo_Solar	3,001
Kern_Greater_Carrizo_Wind	60
Mountain_Pass_El_Dorado_Solar	248
North_Victor_Solar	300
Northern_California_Ex_Wind	866
NW_Ext_Tx_Wind	1,500
Riverside_Palm_Springs_Solar	-
Riverside_Palm_Springs_Wind	NA
SCADSNV_Solar	1,970
Solano_Wind	542
Southern_California_Desert_Ex_Solar	862
Southern_Nevada_Solar	1,470
Southern_Nevada_Wind	442
SW_Ext_Tx_Wind	500
Tehachapi_Solar	4,801
Tehachapi_Wind	275
Westlands_Ex_Solar	1,779
Westlands_Solar	634
Arizona_Solar	2,141
Baja_California_Wind	600
Wyoming_Wind	1,500
New_Mexico_Wind	1,500
Sub Total - Renewables	**27,900**
Pumped Storage Hydro	2,798
Total	**30,698**

The 2019 30 MMT EO Portfolio includes the following amounts of new battery storage (i.e., incremental to the baseline):

Table 5. Battery resources selected in the 2019 30 MMT EO Portfolio

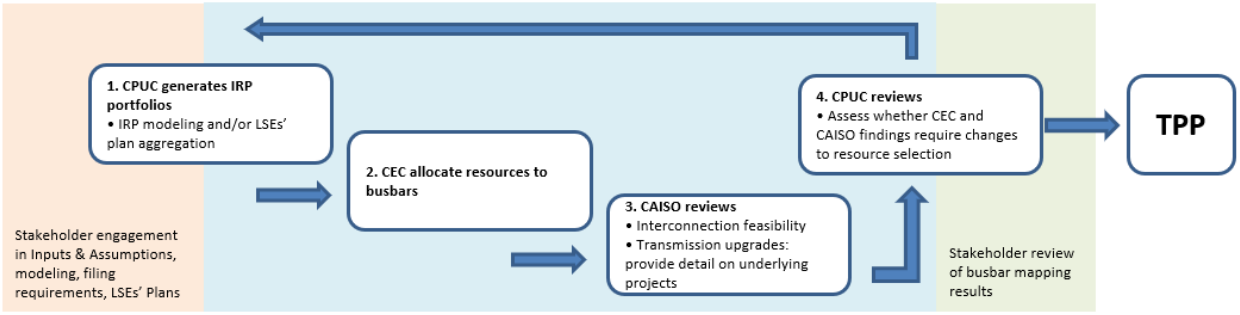
Year	2020	2021	2022	2023	2024	2026	2030
New Battery Storage (Cumulative MW)	152	2,587	2,587	2,587	2,709	5,036	12,657

As part of this evaluation CAISO has the flexibility to move the battery storage to accommodate the objective of the 2019 30 MMT EO Portfolio study, but will have to abide by certain guidelines outlined under Section 9.2.

5. Methodology

Staff from the two agencies and the CAISO completed the steps described in the "CPUC Staff Proposal: Methodology for 2019 IRP Resource-to-Busbar Mapping, October 18, 2019" (Staff Proposal), except where improvements were identified, as summarized here. The full, updated Methodology is available as a separate document (see Appendix A).

Figure 1. Flowchart of the 2019 busbar mapping process



Improvements to the Staff Proposal were informed by stakeholder feedback and staff's experience during implementation of the process, as summarized below. The methodology for generation resources in this Report is unchanged from that used for generation resources in Release 1, whereas for battery storage the mapping methodology is new to this Release 2.

5.1. Generation Resources

- "Commercial interest" was added as an additional busbar mapping criterion. This extends one of the guiding principles in the Methodology to explicitly consider the development activity observed in interconnection queues and load-serving entities' (LSE) plans, as applicable. Allocation should generally align with commercial interest.
- "Consistency with prior year" was also added as a criterion. Allocation for the TPP Base Cases should generally align with busbar mapping allocations submitted to CAISO in prior TPP portfolios. Where significant changes are proposed they should be explicitly justified.

- When a further round of mapping is required (due to non-compliance with the criteria) staff may re-allocate resources between transmission zones provided the expected cost, reliability and emissions performance of the portfolio is not materially altered.
    - To support such re-allocation CPUC staff conducted solar cost sensitivity modeling. This is described in Section 6 and the working file is available (see Appendix H).
- Observation of other Californian interconnection queues, in addition to CAISO's, to assess commercial interest
- Out-of-state resources were examined by staff, particularly resources to be delivered to the Riverside East Palm Springs and Greater Imperial transmission zones. Staff examined these resources with respect to commercial interest and consistency with treatment in prior portfolios and confirmed the reasonableness of the delivery point assumptions (Palo Verde and Willow Beach). This was in response to SWPG comments.
- CPUC and CEC staff reviewed comments from stakeholders related to using or adding additional environmental and land use datasets to the Methodology. Suggested additional datasets included:
    - USFWS Critical Habitat for Endangered Species
    - Desert Tortoise Connectivity
    - Core Recovery areas from Species Recovery Plans
    - California-equivalent environmental and land use data sets for out-of-state energy resource areas

  CPUC and CEC staff examined these datasets further and agree that the agencies should work with stakeholders to evaluate use of additional datasets. In the current busbar mapping exercise, some of these data elements are built into maps used for screening of energy resource locations[3]. Specifically, the USFWS critical habitat mapping and desert tortoise important areas, including habitat connectivity, are represented in the mapping and application of exclusion areas applied in the RESOLVE model.

5.2. Battery Storage Resources

Baseline Resources

Existing battery storage units and contracted battery storage projects shall be mapped to busbars to the extent possible during TPP by CAISO staff and the participating transmission owners (PTOs). Contracted battery storage projects were identified by ruling[4] in the IRP proceeding's Procurement Track. The ruling identified project names which should enable the CAISO to work with the PTOs to identify locations for each project. These projects make specific a large portion of the generic battery storage that has been/is included in the portfolios the CPUC transmits to the CAISO TPP for study.

Generic Resources

For TPP Base Cases, staff is not mapping remaining generic battery storage to any specific locations, but is instead allowing CAISO to retain the flexibility necessary to apply the storage where it provides value that can be clearly identified through TPP. This approach will reduce the

[3] Available on DataBasin: https://caenergy.databasin.org/galleries/eab0ce3a5be447ce928a310e80c65c8d#expand=208851

[4] http://docs.cpuc.ca.gov/SearchRes.aspx?docformat=ALL&docid=323767159

risk of any mapping of storage to busbars potentially masking important transmission reliability risk during TPP assessments.

For TPP Sensitivity Cases, staff is mapping generic battery storage to specific busbars for transmission planning in the CAISO for the first time. This approach is described in the updated version of the Methodology document.

Types of battery storage considered in-scope:

1. Both hybrid or co-located, and standalone
2. Both inside and outside Local Capacity Requirements (LCR) areas

Refer to Section 9 below regarding next steps to further improve the Methodology for busbar mapping in 2020 and beyond.

6. Analysis

This section details the analysis performed to reach the final results in Section 7.

6.1. Implementation of Criteria for Mapping Generation 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. This informs whether changes to the allocation may be required. Each of the criteria are described in the Methodology (see Appendix A). An assessment using the criteria was implemented and reported in the dashboards as follows below. "Level 1" refers to strong compliance; "Level 2" to possible or moderate breach of a criterion; and "Level 3" to a likely or material breach, indicating that a further round of mapping is required to improve compliance. Blank cells are shown in the dashboards where there is insufficient data to assess compliance.

1. Distance to transmission
    - Level 3 non-compliance threshold (i.e., exceedance of this threshold results in Level 3 assessment):
        - Resources for which the busbar allocation results in gen-tie lengths exceeding 50 miles
    - Level 2 non-compliance threshold:
        - Resources for which the busbar allocation results in gen-tie lengths exceeding 15 miles
2. Transmission capability limits
    - Busbar allocation in given area should abide by the estimated transmission capability in each zone and sub-zone, triggering only those upgrades which are determined to be cost-effective during the formation of the IRP portfolios
    - Level 3 non-compliance threshold:
        - Selected resource exceeds transmission capability (FD or EO)

3. a) Available land area
    - Allocation in each area should not exceed available land area to accommodate the resources, based on environmental information
    - Level 2 non-compliance threshold:
        - Resources for which the busbar allocation results in exceedance of 20% of the land area estimated to be available to accommodate a resource

3. b) Environmental constraints
    - Allocation in each area should not exceed available low-impact land area to accommodate the resources, based on environmental information
    - Level 2 non-compliance threshold:
        - Resources for which the busbar allocation results in exceedance of 20% of the low-environmental-implication land area estimated to be available to accommodate a resource

4. Commercial interest
    - Allocation should generally align with commercial interest per the interconnection queues[5] and/or LSEs' plans as applicable
    - Quantitative thresholds should be considered but may not be able to take into account how significant selected resource amounts are relative to the size of the whole portfolio, nor temporal aspects (for example, interconnection queues may be less relevant signals of commercial interest for long-dated planning years as compared to the near term)
    - Level 3 non-compliance threshold:
        - Selected resource amount of 300 MW or more in transmission zone without any commercial interest; or
        - Commercial interest in transmission zone is evident, yet selected resource amount is higher or lower by more than 3,000 MW
    - Level 2 non-compliance threshold:
        - Commercial interest in transmission zone is evident, yet selected resource amount is higher or lower by more than 2,000 MW

5. Consistency with prior year's mapping
    - Allocation for the TPP Sensitivity Cases should generally align with busbar mapping allocations submitted to CAISO in prior comparable TPP portfolios. Based on the objectives of studying the 2019 RSP and 2019 30 MMT EO Portfolio as Policy-driven Sensitivities, staff determined that comparison to the February 2020 busbar

[5] The CAISO generator interconnection queue is available at: http://www.caiso.com/planning/Pages/GeneratorInterconnection/Default.aspx
The Imperial Irrigation District generator interconnection queue is available at: http://www.oasis.oati.com/iid/index.html

allocations of the Updated 2018 PSP, described in Report Release 1[6], is most relevant.

- Where significant changes to prior mappings are proposed they should be explicitly justified.
- Level 3 non-compliance threshold:
  - 1,000 MW or greater difference from prior year (to identify material absolute changes from prior year's mapping)
- Level 2 non-compliance threshold:
  - 60% or greater difference from prior year (to identify changes that may be smaller in absolute terms yet are still significant in percentage terms)

6.2. 2019 RSP – Generation Resources

Starting with the RESOLVE-selected resources identified in Section 4.1 **Error! Reference source not found.** above, CPUC staff made manual reallocations between resources to improve compliance with the criteria, including:

- Riverside Palm Springs Solar: reallocated 1,000 MW FD from Tehachapi Solar (subsequently this reallocation was reversed)
- Southern California Desert Ex Solar: reallocated 862 MW FD to Southern Nevada Solar to reduce allocations in "Ex" zones (described further below)
- Westlands Ex Solar: reallocated 1,041 MW and 737 MW FD to Westlands Solar and Kern Greater Carrizo Solar; reallocation to Central Valley North Los Banos Solar was also considered however it has much lower commercial interest evident
- Mountain Pass El Dorado Solar: reallocated from FD to EO; staff identified that this resource had erroneously not been assigned a transmission zone in RESOLVE and sought to avoid a potential over-selection of capacity having unintended consequences (subsequently reversed)

Such manual reallocations of solar resources can improve compliance with busbar mapping criteria without materially impacting the expected cost, reliability or emissions of a portfolio. This is supported by the solar cost sensitivity modeling staff performed (see Appendix H).

"Ex" transmission zones have available transmission capacity, indicated by active capacity in CAISO's interconnection queue, but are outside of CAISO's defined transmission zones. Many resources in the supply curve in RESOLVE are outside of CAISO's assigned zones and so were assigned during 2019 IRP Inputs and Assumptions development to Ex zones due to their location[7]. In the mapping process staff generally sought to reallocate RESOLVE-selected solar resources from Ex zones to CAISO's defined zones, if overall compliance with the criteria is improved, due to less certainty in the transmission assumptions for Ex zones.

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[6] ftp://ftp.cpuc.ca.gov/energy/modeling/Modeling_Assumptions_2020_2021_TPP-Report-Release1.pdf

[7] *Inputs & Assumptions: 2019-2020 Integrated Resource Planning*, p.54-56, available at: ftp://ftp.cpuc.ca.gov/energy/modeling/Inputs%20%20Assumptions%202019-2020%20CPUC%20IRP%202020-02-27.pdf

These reallocations resulted in the following level of compliance with the criteria. Note compliance with criterion 5 was assessed with reference to the February 2020 busbar allocations of the Updated 2018 PSP described in Report Release 1[8].

Table 6. Dashboard showing compliance of busbar allocations for the 2019 RSP, prior to Round 1 mapping, with the criteria

Pre Round 1 - Adjusted with inter-resource Reallocations	Selecte Resour	Selecte Resour	Adjuste Resour	Compliance with Criteria [1=Yes, 2=Possible/Moderate, 3=Materially in Breach]					
Resource	Total MW (2018 PSP)	Total MW (2019 RSP)	Total MW (2019 RSP adj)	1. Distance to Trans.	2. Trans. Capability	3a. Available Land Area	3b. High Env. Impl.	4. Comm. Interest	5. Consistency with Prior Year's Mappi
Greater_Imperial_Geothermal	1,256	-	-		1			1	3
Carrizo_Wind	160	287	287		1			1	2
Central_Valley_North_Los_Banos_Wind	146	173	173		1			1	1
Greater_Imperial_Solar	-	548	548		1			2	2
Humboldt_Wind	-	34	34		1				2
Inyokern_North_Kramer_Solar	554	97	97		1			1	2
Kern_Greater_Carrizo_Solar	-	242	979		3			1	2
Kern_Greater_Carrizo_Wind	-	60	60		1			1	2
Mountain_Pass_El_Dorado_Solar	-	248	248		3			1	2
North_Victor_Solar	-	300	300		1			1	2
Northern_California_Ex_Wind	-	866	866		1			1	2
Riverside_Palm_Springs_Solar	1,622	-	1,000		3			1	1
Riverside_Palm_Springs_Wind	42	NA	NA		1			1	
SCADSNV_Solar	-	330	330		1			1	2
Solano_Wind	644	542	542		1			1	1
Southern_California_Desert_Ex_Solar	-	862	-		1			1	1
Southern_Nevada_Solar	3,006	-	862		3			1	3
Tehachapi_Solar	1,153	4,202	3,202		1			1	3
Tehachapi_Wind	-	275	275		1			1	2
Westlands_Ex_Solar	-	1,779	(0)		1			1	1
Westlands_Solar	-	58	1,099		3			3	3
Arizona_Solar	428	2,352	2,352		1			1	3
Baja_California_Wind	-	600	600		1			1	2
New_Mexico_Wind	-	606	606		1			1	2
Sub Total - Renewables	**9,011**	**14,460**	**14,459**						

CEC staff allocated these adjusted MW to substations in accordance with the Methodology, and demonstrated strong compliance with criteria 1 (distance to transmission), 3a (available land area) and 3b (high environmental impacts), as shown in Table 7 below.

Substation allocations of note:

- Southern Nevada Solar was allocated within SCADSNV-GLW_VEA with the following approach:
    - Priority on allocating FD MW to substations in GLW-VEA due to their proximity to the resource in the RESOLVE supply curve
    - Remaining FD MW to El Dorado 230kV, and then EO MW allocated to El Dorado 230kV, El Dorado 500kV, and Mohave 500kV in order to simultaneously achieve compliance with criteria 2 and 3a. This requires the assumption that solar resources are available outside the specific Southern

[8] ftp://ftp.cpuc.ca.gov/energy/modeling/Modeling_Assumptions_2020_2021_TPP-Report-Release1.pdf

Nevada resource areas in the RESOLVE supply curve, in proximity to these substations. This assumption is supported by observing the significant relevant capacity currently in the CAISO interconnection queue.

- Arizona Solar was allocated across three substations, pro-rated according to capacity in the CAISO interconnection queue

Table 7. Dashboard showing compliance of busbar allocations for the 2019 RSP, after Round 1 mapping, with the criteria

Post Round 1	Selected Resources	Selected Resources	Adjusted Resources	Compliance with Criteria [1=Yes, 2=Possible/Moderate, 3=Materially in Breach]					
Resource	Total MW (2018 PSP)	Total MW (2019 RSP)	Total MW (2019 RSP adj)	1. Distance to Trans.	2. Trans. Capability	3a. Available Land Area	3b. High Env. Impl.	4. Comm. Interest	5. Consistency with Prior Year's
Greater_Imperial_Geothermal	1,256	-	-	1	1	1	1	1	3
Carrizo_Wind	160	287	287	1	1	2	2	1	2
Central_Valley_North_Los_Banos_Wind	146	173	173	2	1	2	2	1	1
Greater_Imperial_Solar	-	548	548	1	1	1	1	2	2
Humboldt_Wind	-	34	34	1	1	2	2		2
Inyokern_North_Kramer_Solar	554	97	97	1	1	1	1	1	2
Kern_Greater_Carrizo_Solar	-	242	979	1	3	1	1	1	2
Kern_Greater_Carrizo_Wind	-	60	60	2	1	1	1	1	2
Mountain_Pass_El_Dorado_Solar	-	248	248	1	3	1	1	1	2
North_Victor_Solar	-	300	300	1	1	1	1	1	2
Northern_California_Ex_Wind	-	866	866	1	1	2	1	1	2
Riverside_Palm_Springs_Solar	1,622	-	1,000	1	3	1	1	1	1
Riverside_Palm_Springs_Wind	42	#N/A	#N/A						
SCADSNV_Solar	-	330	330	1	1	1	1	1	2
Solano_Wind	644	542	542	1	1	2	2	1	1
Southern_California_Desert_Ex_Solar	-	862	-	1	1	1	1	1	1
Southern_Nevada_Solar	3,006	-	862	1	3	1	1	1	3
Tehachapi_Solar	1,153	4,202	3,202	1	1	1	1	1	3
Tehachapi_Wind	-	275	275	1	1	2	1	1	2
Westlands_Ex_Solar	-	1,779	(0)	1	1	1	1	1	1
Westlands_Solar	-	58	1,099	1	3	1	1	3	3
Arizona_Solar	428	2,352	2,352		1			1	3
Baja_California_Wind	-	600	600		1			1	2
New_Mexico_Wind	-	606	606		1				2
Sub Total - Renewables	**9,011**	**14,460**	**14,459**						

Staff observed the material non-compliances with criterion 2 (transmission capability) and determined that further changes were necessary to resolve these; these steps reversed some of the original reallocations that had been made prior to Round 1 of mapping. These, as well as some unrelated improvements, were made by staff:

- Southern PG&E transmission zone: prior reallocations complied with subzone limits, but were found to breach this outermost zone limit; accordingly:
  - Kern Greater Carrizo Solar: 737 MW FD was reallocated to Westlands Solar
  - Westlands Solar: 1,353 MW FD of this resource was allocated to the Gates-Diablo 500kV system based on CAISO staff's guidance that this system appears geographically in the Southern PG&E outermost transmission zone, but is electrically outside the zone.
- Southern California Desert and Southern Nevada transmission zone: prior reallocations complied with subzone limits, but were found to breach this outermost zone limit; accordingly:
  - Riverside Palm Springs Solar: 1,000 MW FD was reallocated to Tehachapi Solar
  - Pumped storage hydro: the impacts of the 487 MW FD at each of the proposed Lee Lake substation 500kV and Sycamore Canyon substation 500kV were

checked; CAISO staff guidance was that these fall outside of the nearby transmission zones and accordingly are not expected to utilize the most recent transmission capability estimates available at the time of this Report

- Kern Greater Carrizo Wind: 60 MW reallocated to the Cholame substation to reduce distance to transmission
- Central Valley North Los Banos Wind: 173 MW allocated to a substation in Westlands subzone to reduce distance to transmission
- Mountain Pass El Dorado Solar: reallocated from EO back to FD; staff clarified that the error described above had not resulted in over-selection of capacity by RESOLVE

The outcome of these changes is discussed in Section 7.1 below.

6.3. 2019 30 MMT EO Portfolio - Generation Resources

Starting with the RESOLVE-selected resources identified in Section 4.2 above, CPUC staff made manual reallocations between resources to improve compliance with the criteria:

- Riverside Palm Springs Solar: reallocated 1,000 MW FD from Tehachapi Solar (subsequently this reallocation was reversed)
- Southern California Desert Ex Solar: reallocated 862 MW FD to Southern Nevada Solar, Greater Imperial Solar, and Riverside Palm Springs Solar
- Westlands Ex Solar: reallocated 1,779 MW FD to Westlands Solar, Kern Greater Carrizo Solar, and Riverside Palm Springs Solar; reallocation to Central Valley North Los Banos Solar was also considered however it has much lower commercial interest evident
- Mountain Pass El Dorado Solar: reallocated from FD to EO (subsequently reversed)

The rationale for these reallocations was consistent with that described for the 2019 RSP in Section 6.2 above.

These resulted in the following level of compliance with the criteria. As for the 2019 RSP, compliance with criterion 5 was assessed with reference to the February 2020 busbar allocations of the Updated 2018 PSP described in Report Release 1[9]:

[9] ftp://ftp.cpuc.ca.gov/energy/modeling/Modeling_Assumptions_2020_2021_TPP-Report-Release1.pdf

Table 8 Dashboard showing compliance of busbar allocations for the 2019 30 MMT EO Portfolio, prior to Round 1 mapping, with the criteria

Pre Round 1 - Adjusted with inter-resource Reallocations	Selecte Resour	Selected Resour	Adjusted Resour	Compliance with Criteria [1=Yes, 2=Possible/Moderate, 3=Materially in Breach]					
Resource	Total MW (2018 PSP)	Total MW (2019 EO P'fol	Total MW (2019 EO P'fol adj	1. Distance to Trans.	2. Trans. Capability	3a. Available Land Area	3b. High Env. Impl.	4. Comm. Interest	5. Consistency with Prior Year's Mappi
Greater_Imperial_Geothermal	1,256	716	716		1			1	1
Solano_Geothermal	-	135	135		1			1	2
Carrizo_Solar	-	600	600		1			3	2
Carrizo_Wind	160	287	287		1			1	2
ar	-	-	-		1			1	1
Central_Valley_North_Los_Banos_Win	146	173	173		1			1	1
Greater_Imperial_Solar	-	867	1,147		1			1	3
Humboldt_Wind	-	34	34		1			1	2
Inyokern_North_Kramer_Solar	554	97	97		1			1	2
Kern_Greater_Carrizo_Solar	-	3,001	3,632		3			1	3
Kern_Greater_Carrizo_Wind	-	60	60		1			1	2
Mountain_Pass_El_Dorado_Solar	-	248	248		3			1	2
North_Victor_Solar	-	300	300		1			1	2
Northern_California_Ex_Wind	-	866	866		1			1	2
NW_Ext_Tx_Wind	-	1,500	1,500		1				3
Riverside_Palm_Springs_Solar	1,622	-	1,780		3			1	1
Riverside_Palm_Springs_Wind	42	NA	NA		1			1	
SCADSNV_Solar	-	1,970	1,970		1			1	3
Solano_Wind	644	542	542		1			1	1
Southern_California_Desert_Ex_Solar	-	862	-		1			1	1
Southern_Nevada_Solar	3,006	1,470	1,727		3			3	3
Southern_Nevada_Wind	-	442	442		1			3	2
SW_Ext_Tx_Wind	-	500	500		1			3	2
Tehachapi_Solar	1,153	4,801	3,801		1			1	3
Tehachapi_Wind	-	275	275		1			1	2
Westlands_Ex_Solar	-	1,779	(0)		1			1	1
Westlands_Solar	-	634	1,327		3			1	3
Arizona_Solar	428	2,141	2,141		1			1	3
Baja_California_Wind	-	600	600		1			1	2
Wyoming_Wind	-	1,500	1,500		1				3
New_Mexico_Wind	-	1,500	1,500		1				3
Sub Total - Renewables	**9,011**	**27,900**	**27,900**						

CEC staff allocated these adjusted MW to substations in accordance with the Methodology, and demonstrated strong compliance with criteria 1 (distance to transmission), 3a (available land area) and 3b (high environmental impacts), as shown in Table 9 below.

Substation allocations of note were:

- Southern Nevada Solar was allocated within SCADSNV-GLW_VEA with the same approach as for the 2019 RSP described in Section 6.2 above
- Arizona Solar was allocated across three substations, pro-rated according to capacity in the CAISO interconnection queue

Table 9. Dashboard showing compliance of busbar allocations for the 2019 30 MMT EO Portfolio, after Round 1 mapping, with the criteria

Post Round 1	Selected Resources	Selected Resources	Adjusted Resources	Compliance with Criteria [1=Yes, 2=Possible/Moderate, 3=Materially in Breach]					
Resource	Total MW (2018 PSP)	Total MW (2019 EO P'folio)	Total MW (2019 EO P'folio adj)	1. Distance to Trans.	2. Trans. Capability	3a. Available Land Area	3b. High Env. Impl.	4. Comm. Interest	5. Consistency with Prior Year's Mapping
Greater_Imperial_Geothermal	1,256	716	716	1	1			1	1
Solano_Geothermal	-	135	135	1	1			1	2
Carrizo_Solar	-	600	600	1	1	1	1	3	2
Carrizo_Wind	160	287	287	1	1	2	2	1	2
Central_Valley_North_Los_Banos_Wind	146	173	173	2	3	2	2	1	1
Greater_Imperial_Solar	-	867	1,147	1	1	1	1	1	3
Humboldt_Wind	-	34	34	1	1	2	2	1	2
Inyokern_North_Kramer_Solar	554	97	97	1	1	1	1	1	2
Kern_Greater_Carrizo_Solar	-	3,001	3,001	1	1	1	1	1	3
Kern_Greater_Carrizo_Wind	-	60	60	2	1	2	2	1	2
Mountain_Pass_El_Dorado_Solar	-	248	248	1	1	1	1	1	2
North_Victor_Solar	-	300	300	1	1	1	1	1	2
Northern_California_Ex_Wind	-	866	866	1	1	2	1	1	2
NW_Ext_Tx_Wind	-	1,500	1,500		1				3
Riverside_Palm_Springs_Solar	1,622	-	29	1	1	1	1	1	1
Riverside_Palm_Springs_Wind	42	NA	NA						
SCADSNV_Solar	-	1,970	2,721	1	1	2	1	1	3
Solano_Wind	644	542	542	1	1	2	2	1	1
Southern_California_Desert_Ex_Solar	-	862	-	1	1	1	1	1	1
Southern_Nevada_Solar	3,006	1,470	1,727	1	1	1	1	3	3
Southern_Nevada_Wind	-	442	442	1	1			3	2
SW_Ext_Tx_Wind	-	500	500		1			3	2
Tehachapi_Solar	1,153	4,801	4,801	1	1	1	1	1	3
Tehachapi_Wind	-	275	275	1	1	2	1	1	2
Westlands_Ex_Solar	-	1,779	(0)	1	1	1	1	1	1
Westlands_Solar	-	634	1,958	1	3	1	1	1	3
Arizona_Solar	428	2,141	2,141		1			1	3
Baja_California_Wind	-	600	600		1			1	2
Wyoming_Wind	-	1,500	1,500		1				3
New_Mexico_Wind	-	1,500	1,500		1				3
Sub Total - Renewables	**9,439**	**27,900**	**27,900**						

Staff observed the material non-compliances with criterion 2 (transmission capability) and determined that further changes were necessary to resolve these; these steps reversed some of the original reallocations that had been made prior to Round 1 of mapping. These, as well as some unrelated improvements, were made by staff:

- Southern PG&E transmission zone: prior reallocations complied with subzone limits, but were found to breach this outermost zone limit; accordingly:
    - Kern Greater Carrizo Solar: 631 MW FD was reallocated to Westlands Solar
    - Westlands Solar: 900 MW FD of this resource was allocated to the Gates-Diablo 500kV system based on CAISO staff's guidance that this system appears geographically in the Southern PG&E outermost transmission zone, but is electrically outside the zone.
- Southern California Desert and Southern Nevada (SCADSNV) transmission zone: prior reallocations complied with subzone limits, but were found to breach this outermost zone limit; accordingly:
    - Riverside Palm Springs Solar: 1,000 MW FD was reallocated to Tehachapi Solar and 751 MW to Southern California Desert and Southern Nevada Solar, with this latter amount allocated to the Mohave and El Dorado 500kV substations to avoid utilizing capability of the subzones within the SCADSNV outermost transmission zone
    - Pumped storage hydro: Staff assumed that 1,582 MW FD is allocated at the Red Bluff substation within the Riverside Palm Springs subzone. This required solar

in that subzone to be re-allocated to Mohave and El Dorado 500kV substations to avoid exceeding estimates of the transmission capability limit. Further, the impacts of the 608 MW FD allocated to each of the proposed Lee Lake substation 500kV and Sycamore Canyon substation 500kV were checked; CAISO staff guidance was that these fall outside of the nearby transmission zones and accordingly are not expected to utilize the transmission capability estimates.

- Kern Greater Carrizo Wind, Central Valley North Los Banos Wind, and Mountain Pass El Dorado Solar: same as the changes made for the 2019 RSP described in Section 6.2 above

The outcome of these changes is discussed in Section 7.2 below.

6.4. Battery Storage Resources

Staff analysis grouped the commercial interest into three categories: High Confidence, Moderate Confidence, and LCR Area Solutions, using the criteria listed below.

a. High Confidence (3,192 MW of battery storage commercial interest estimated by staff)
   i. Executed Generator Interconnection Agreement **AND** outside of LCR Area; **OR**
   ii. Material modification assessments (MMA) addition at an existing generating facility[10]
b. Moderate Confidence (5,428 MW)
   i. Phase II GIDAP study complete; **AND**
   ii. Not located in an LCR; **AND**
   iii. Not an MMA project[11] since Phase II facilities study status not known.
c. LCR Solutions (5,830 MW)
   i. Located in an LCR area; **AND**
   ii. Phase II GIDAP study complete **OR** MMA addition to an existing generating facility.

It can be seen from the above and from the interconnection queue and publicly available MMA data that the total commercial interest (approx. 46,000 MW)[12] exceeds the RESOLVE-selected battery volumes of 8,873 MW for the 2019 RSP, and 12,657 MW for the 2019 30 MMT EO Portfolio.

This section describes the steps to using commercial interest to guide the busbar mapping of battery storage for the 2019 30 MMT EO Portfolio. The 2019 30 MMT EO Portfolio is used here because it has the larger amount of storage. For the 2019 RSP, CPUC Staff recommend that the CAISO

[10] All MMA additions will have to go through the interconnection process and do not yet hold a Generator Interconnection Agreement.
[11] The publicly available MMA list does not include project specific details. Therefore, it is impossible for CPUC Staff to discern which of the projects included in the list are additions to Queue projects that have completed Phase II of the GIDAP study, per criteria b.i.
[12] http://www.caiso.com/planning/Pages/GeneratorInterconnection/Default.aspx
http://www.caiso.com/Documents/OpportunitiesAddingStorageExisting-NewGenerationSitesCall101019.html

should reduce the amount to reflect the lower amount of storage in this portfolio. Reductions should be made in the moderate confidence and LCR categories first, retaining the high confidence category intact to the extent possible.

In summary, CPUC staff mapped the full amount of high confidence commercial interest, plus only a portion of moderate confidence commercial interest, plus only a portion of LCR area commercial interest, up to the amount needed to form a complete portfolio.

Commercial Interest Category Summary

Battery Storage Type	Standalone	Hybrid (co-located with generation facility)	MMA
High Confidence (MMA)	Not available	Not Available	1,215
High Confidence (non-MMA)	512	1,465	
Moderate Confidence	1,046	4,382	-
LCR Area solutions	3,797	1,804	230
Total	5,354	7,651	1,445

The following section describes the allocations to substations following the breakdown by category as described above.

<u>High confidence category</u>
The first amount to be allocated to substations is the commercial interest occurring as MMA projects proposed as additions to existing facilities, and occurring outside of LCR Areas. This category is allocated to the substations where these MMA requests occur. The point of interconnection identified in the MMA project list is used as the busbar assignment.

For example, with reference to the Gates substation: 160 MW of MMA addition-to-existing-site projects occur at this substation. This is 13% of the MMA high-confidence total (the total MMA-proposed additions to existing sites outside of LCR Areas is 1,215 MW). Since CPUC Staff are utilizing the full 1215 MW for substation allocations, all 160 MW are allocated to Gates.

The next amount to be allocated to substations is the commercial interest consisting of projects with executed interconnection agreements occurring outside of LCR areas (non-MMA). This category is allocated to the substations where these interconnection applications occur. The point of interconnection identified in the interconnection queue will be used as the busbar assignment.

After all high-confidence commercial interest has been mapped, the remaining amount of battery storage is mapped in proportion to the amount of commercial interest occurring in the moderate confidence and LCR categories.

<u>Moderate confidence category</u>
The next amount to be allocated to substations is the moderate confidence category. Between the moderate confidence and LCR solutions categories, the total commercial interest is 5,428 + 5,830 =

11,258 MW (48% moderate confidence, and 52% LCR solutions). The sum of commercial interest in these two categories is greater than the remaining 2030 portfolio amount to be mapped. The remaining portfolio to be mapped is 12,657 – 1,215 – 1,977 = 9,465 MW. Therefore, the remaining 9,465 MW is allocated to substations proportionally to these two categories; 48% moderate confidence, and 52% LCR area solutions. The amount mapped to moderate confidence substations is 48% x 9,465 = 4,564 MW. This will be spread across the busbars in the moderate confidence category, spread proportionally across the moderate confidence projects.

For example, the 505 MW of battery storage occurring at the Red Bluff substation constitutes 9% of the 5428 MW of commercial interest identified under the moderate confidence category criteria. Therefore, of the required 4,564 MW of moderate confidence 2019 30 MMT EO Portfolio battery storage, 9% is allocated to the Red Bluff substation. Resulting in 425 MW at the Red Bluff substation, rather than the full 505 MW. This formula is applied to all substations in the moderate confidence category, to result in substation allocations for all 2019 30 MMT EO Portfolio moderate confidence storage.

LCR category

The final category to be allocated is the amount in LCR areas. Using the "LCR Solutions" criteria, 5,830 MW of commercial interest is identified in the LCR category. There is 4,902 MW of battery storage remaining to be mapped. The allocations to substations follow the same logic as for prior categories. Because 7% of the LCR commercial interest occurs at the Devers substation, it follows that 7% x 4,902 = 341 MW are allocated to the Devers substation.

7. Results

This section summarizes the results of mapping each portfolio.

7.1. 2019 RSP – Generation Resources

Two rounds of mapping were required to arrive at the allocations for the 2019 RSP (see Appendix B for final CEC Busbar Mapping Results). A summary of the final results is provided in the dashboard at Table 10 below.

Table 10. Dashboard showing compliance of busbar allocations for the 2019 RSP, following Round 2 mapping, with the criteria

Post Round 2	Selected Resources	Selected Resources	Adjusted Resources	Compliance with Criteria [1=Yes, 2=Possible/Moderate, 3=Materially in Breach]					
Resource	Total MW (2018 PSP)	Total MW (2019 RSP)	Total MW (2019 RSP adj)	1. Distance to Trans.	2. Trans. Capability	3a. Available Land Area	3b. High Env. Impl.	4. Comm. Interest	5. Consistency with Prior Year's Mapping
Greater_Imperial_Geothermal	1,256	-	-	1	1	1	1	1	3
Carrizo_Wind	160	287	287	1	1	2	2	1	2
Central_Valley_North_Los_Banos_Wind	146	173	173	1	1	2	2	1	1
Greater_Imperial_Solar	-	548	548	1	1	1	1	2	2
Humboldt_Wind	-	34	34	1	1	2	2		2
Inyokern_North_Kramer_Solar	554	97	97	1	1	1	1	1	2
Kern_Greater_Carrizo_Solar	-	242	242	1	1	1	1	1	2
Kern_Greater_Carrizo_Wind	-	60	60	1	1	1	1	1	2
Mountain_Pass_El_Dorado_Solar	-	248	248	1	1	1	1	1	2
North_Victor_Solar	-	300	300	1	1	1	1	1	2
Northern_California_Ex_Wind	-	866	866	1	1	2	1	1	2
Riverside_Palm_Springs_Solar	1,622	-	-	1	1	1	1	2	3
Riverside_Palm_Springs_Wind	42	#N/A	#N/A						
SCADSNV_Solar	-	330	330	1	1	1	1	1	2
Solano_Wind	644	542	542	1	1	2	2	1	1
Southern_California_Desert_Ex_Solar	-	862	-	1	1	1	1	1	1
Southern_Nevada_Solar	3,006	-	862	1	1	1	1	1	3
Tehachapi_Solar	1,153	4,202	4,202	1	1	1	1	1	3
Tehachapi_Wind	-	275	275	1	1	2	1	1	2
Westlands_Ex_Solar	-	1,779	(0)	1	1	1	1	1	1
Westlands_Solar	-	58	1,836	1	3	1	1	3	3
Arizona_Solar	428	2,352	2,352		1			1	3
Baja_California_Wind	-	600	600		1			1	2
New_Mexico_Wind	-	606	606		1				2
Sub Total - Renewables	**9,011**	**14,460**	**14,459**						
Pumped Storage Hydro	-	973	974	1	1			1	2
Total	**9,011**	**15,433**	**15,433**						

As required by the Methodology, staff explain the material non-compliances that remain with these substation allocations as follows:

- Greater Imperial Geothermal: geothermal was not selected in the 2019 RSP
- Riverside Palm Springs Solar: reallocation to this resource to improve alignment with mapping of the Updated 2018 PSP is not possible due to the current FD capability of the associated outermost transmission zone, Southern CA Desert and Southern NV, being fully utilized
- Southern Nevada Solar: the dashboard shows assessment at the resource level, whereas for relevant substations in the GLW_VEA subzone, there is consistency with mapping of the Updated 2018 PSP
- Significant growth in selection of solar in the 2019 RSP as compared to the Updated 2018 PSP has resulted in some specific solar resources increasing by more than 1,000 MW: Tehachapi Solar, Westlands Solar, and Arizona Solar
- Westlands Solar: despite manual reallocation to this resource, it remains lower than the commercial interest (criterion 4) indicated in interconnection queue by more than 3,000 MW due to the current FD capability of the associated outermost transmission zone, Southern PG&E, being fully utilized. The apparent exceedance of transmission capability (criterion 2) is alleviated when allocating this resource at the substation level. Excess capacity is allocated to the Gates-Diablo 500 kV system. CAISO staff's guidance is that this system appears geographically in the Southern PG&E outermost transmission zone, but is electrically outside the boundary of the constraint that limits the transmission capability estimate for this zone.

7.2. 2019 30 MMT EO Portfolio – Generation Resources

Two rounds of mapping was required to arrive at the allocations for the 2019 30 MMT EO Portfolio (see Appendix B for final CEC Busbar Mapping Results). A summary of the final results is provided in the dashboard at Table 11 below.

Table 11 Dashboard showing compliance of busbar allocations for the 2019 30 MMT EO Portfolio, following Round 2 mapping, with the criteria

Post Round 2	Selected Resources	Selected Resources	Adjusted Resources	Compliance with Criteria [1=Yes, 2=Possible/Moderate, 3=Materially in Breach]					
Resource	Total MW (2018 PSP)	Total MW (2019 EO P'folio)	Total MW (2019 EO P'folio adj)	1. Distance to Trans.	2. Trans. Capability	3a. Available Land Area	3b. High Env. Impl.	4. Comm. Interest	5. Consistency with Prior Year's Mapping
Greater_Imperial_Geothermal	1,256	716	716	1	1	1	1	1	1
Solano_Geothermal	-	135	135	1	1	1	1	1	2
Carrizo_Solar	-	600	600	1	1	1	1	3	2
Carrizo_Wind	160	287	287	1	1	2	2	1	2
Central_Valley_North_Los_Banos_Wind	146	173	173	1	3	2	2	1	1
Greater_Imperial_Solar	-	867	356	1	1	1	1	2	2
Humboldt_Wind	-	34	34	1	1	2	2	1	2
Inyokern_North_Kramer_Solar	554	97	97	1	1	1	1	1	2
Kern_Greater_Carrizo_Solar	-	3,001	3,001	1	1	1	1	1	3
Kern_Greater_Carrizo_Wind	-	60	60	1	1	2	2	1	2
Mountain_Pass_El_Dorado_Solar	-	248	248	1	1	2	1	1	2
North_Victor_Solar	-	300	300	1	1	1	1	1	2
Northern_California_Ex_Wind	-	866	866	1	1	2	1	1	2
NW_Ext_Tx_Wind	-	1,500	1,500		1			3	3
Riverside_Palm_Springs_Solar	1,622	-	29	1	1	1	1	2	3
Riverside_Palm_Springs_Wind	42	#N/A	#N/A						
SCADSNV_Solar	-	1,970	4,303	1	1	2	1	2	3
Solano_Wind	644	542	542	1	1	2	2	1	1
Southern_California_Desert_Ex_Solar	-	862	-	1	1	1	1	1	1
Southern_Nevada_Solar	3,006	1,470	1,727	1	1	1	1	3	3
Southern_Nevada_Wind	-	442	442	1	1			3	2
SW_Ext_Tx_Wind	-	500	500		1			3	2
Tehachapi_Solar	1,153	4,801	4,801	1	1	1	1	1	3
Tehachapi_Wind	-	275	275	1	1	2	1	1	2
Westlands_Ex_Solar	-	1,779	(0)	1	1	1	1	1	1
Westlands_Solar	-	634	1,958	1	3	1	1	1	3
Arizona_Solar	428	2,141	1,350		1			1	2
Baja_California_Wind	-	600	600		1			1	2
Wyoming_Wind	-	1,500	1,500		1				3
New_Mexico_Wind	-	1,500	1,500		1				3
Sub Total - Renewables	**9,011**	**27,900**	**27,900**						
Pumped Storage Hydro	-	2,798	2,798					1	3
Total	**9,011**	**30,698**	**30,698**						

As required by the Methodology, staff explain the material non-compliances that remain with these substation allocations as follows:

- Carrizo Solar: Although this triggers a level 3 non-compliance with criterion 4 (commercial interest) due to no commercial interest evident in the interconnection queue currently, it is a moderate resource selection relative to the overall amount of solar in the portfolio, has a higher capacity factor than non-selected solar, and helps provide locational diversity.
- Central Valley North Los Banos Wind: The dashboard shows apparent exceedance of criterion 2 (transmission capability) but this is acceptable because This resource has been reallocated to a substation in Westlands subzone to improve criterion 1 (distance to transmission).
- Riverside Palm Springs Solar: Reallocation to this resource to improve alignment with mapping of the Updated 2018 PSP not possible due to the current FD capability of the

associated outermost transmission zone, Southern CA Desert and Southern NV, being fully utilized

- Southern Nevada Solar: The dashboard shows assessment at the resource level, whereas for relevant substations in the GLW_VEA subzone, there is consistency with mapping of the Updated 2018 PSP
- Significant growth in selection of solar in the 2019 30 MMT EO Portfolio as compared to the Updated 2018 PSP has resulted in some specific solar resources increasing by more than 1,000 MW: Kern Greater Carrizo Solar, Tehachapi Solar, and Westlands Solar
- SCADSNV Solar: non-compliance with criterion 5 (consistency with prior year) is flagged in the dashboard but is not substantive, beyond the general growth in selection of solar described above. The refinement in implementing transmission zone definitions into IRP modeling since the 2017-2018 IRP cycle includes the introduction of SCADSNV as a new zone. A large portion of the solar supply curve in this zone has been selected by RESOLVE, and then added to by the reallocations from Riverside Palm Springs Solar, Arizona Solar and Greater Imperial Solar.
- Westlands Solar: the non-compliances flagged in the dashboard are acceptable for the same reasons as described for the 2019 RSP in Section 7.1 above
- Allocations to Wyoming and New Mexico Wind are based on an assumption difference with the Updated 2018 PSP: allowing out-of-state resources on new transmission to be selected as part of the model optimization
- Pumped Storage Hydro was not selected in the Updated 2018 PSP

Further, staff checked the mapping results to ensure that the transmission zones allocated EO resources exceeding 80% of their expanded EO limits remain the same zones identified at the start of the process, listed in Section 4.2 above.

7.3. Battery Storage Resources

The battery storage mapping resulted in allocations that are detailed in Appendix C and summarized as follows:

Battery Storage Type	RESOLVE Portfolio	Method	% Standalone	% Hybrid (co-located)
High Confidence (MMA)	1,215	Full amount of commercial interest	Not available	Not available
High Confidence (non-MMA)	1,977	Full amount of commercial interest	26%	74%
Moderate Confidence	4,564	Percentage of the portfolio total	19%	81%
LCR Area solutions	4,902	Percentage of the portfolio total	68%	32%
Total	**12,657**			

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 Retirement Assumptions

For the TPP reliability and policy-driven base case, the CPUC understands that the CAISO will assume retirement of thermal resources aged 40 years or more. Resources meeting this criterion will be modeled offline unless they have an existing contract that runs beyond their assumed retirement age. If reliability concerns are identified during studies, units assumed retired may be turned online as potential mitigation solutions. The 40-year age-based retirement assumption is consistent with the CPUC's Updated 2018 PSP which is the 2020-21 TPP's reliability and policy-driven base case.

For the TPP's policy-driven sensitivity studies, the CPUC recommends that the CAISO assess the impact of the economic thermal generation retention levels included with the two portfolios created by the RESOLVE model that the CPUC is providing. RESOLVE includes assumptions about the cost and value of maintaining existing thermal generation that allow for modeling of economic retention. Generation not retained may be assumed to likely retire and the CPUC seeks information from the TPP results on how these amounts of assumed retirements affect the objective of the policy-driven sensitivities: to improve information on the cost and benefits of upgrading transmission.

RESOLVE reports the aggregate amount of generation not retained by resource category. Unit-specific information was not modeled. Because the TPP studies require modeling of specific units and locations, further guidance on how to use RESOLVE's aggregate data is required.

CPUC provides two portfolios to study as policy-driven sensitivities. Portfolio #1 is the 2019 RSP in the CPUC's IRP proceeding (with a 46 MMT by 2030 GHG reduction target). For this portfolio, RESOLVE retained nearly all existing thermal generation through 2030. Therefore, CPUC recommends that the CAISO assume zero thermal retirements through 2030 for policy-driven sensitivity #1.

Portfolio #2 is a case with a 30 MMT by 2030 GHG reduction target and expanded EO resource potential. For this portfolio, RESOLVE did not retain about 6.4 GW in aggregate in 2030, with breakdown by resource category shown in the table below. Prior to 2030 all thermal generation is economically retained. In order to model individual units offline, the CPUC recommends the following process:

1. Rank all existing thermal generation units by age in the categories of: combined cycle (CCGT), combustion turbine (Peaker), and reciprocating engine. Combined heat and power units are excluded from this list since RESOLVE assumes they remain online through 2030.
2. Model offline the oldest units up to but not exceeding the amounts in each category as shown in the table below.

3. If known local area requirements are not met then add battery storage to meet the local area requirement up to known battery storage charging limits. Refer to Section 9.2 for related guidance.
4. If known local area requirements are still not met then local thermal generation will be restored in reverse order in steps 1 and 2.
5. If specific local units are turned back on in step 4 then an equal amount of additional system generation capacity will be modeled off-line following steps 1 and 2.

Existing thermal generation economically not retained by RESOLVE in 2030	
TPP policy-driven sensitivity: Portfolio 2	
RESOLVE case: 30 MMT Expanded Energy-Only Potential	
Resource Category	MW
CCGT	2,260
Peaker	4,125
Reciprocating Engine	71

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.17-09-020 or its successor) determines what resources can provide system and local resource adequacy capacity. Current RA accounting rules indicate that all existing DR programs count to the extent those programs impacts are located within the relevant geographic areas being studied for system and local reliability.

By nature, impacts from DR programs are distributed across large geographies. To be applied in network reliability studies, capacity from DR programs must be allocated to transmission substations in order to facilitate power flow analysis.[13] CPUC staff request the investor-owned utilities (IOUs) to allocate their existing DR programs[14] to substations, with the expectation that the IOUs would submit that information to CAISO through the CAISO's annual TPP Study Plan stakeholder process that solicits input on DR assumptions.[15] The data contains confidential information so the CPUC expects the CAISO and the IOUs in their capacity as PTOs to exchange the data using their own non-disclosure agreements.

[13] The CAISO noted that DR eligible for inclusion in the TPP must be allocated to CAISO-controlled substations and must be a CAISO integrated resource, meaning that resource is mapped to specific "PNodes"
[14] Based on the April 2019 annual Load Impact Reports, using the August portfolio-adjusted 1-in-2 weather year condition ex-ante forecast of load impact coincident with CAISO system peak
[15] http://www.caiso.com/Documents/StakeholderInput-2020-2021UnifiedPlanningAssumptions.html

9. Conclusion and Next Steps

9.1. TPP Base Cases

The Updated 2018 PSP's generation resources have been mapped to busbars in accordance with the criteria. The results (available at Appendix B of Report Release 1) can be transmitted to the CAISO for use in the Reliability and Policy-driven Base Cases in 2020-21 TPP. The list of non-battery baseline resources is available at Appendix F.

Existing battery storage units and contracted battery storage projects shall be mapped to busbars to the extent possible during TPP by CAISO staff and the PTOs. Contracted battery storage projects in the IRP Procurement Decision (D.19-11-016) baseline (available at Appendix G) make specific a large portion of the generic battery storage that was part of the original 2018 PSP.

Staff is not mapping remaining generic storage to any specific locations, but instead allowing CAISO to retain the flexibility necessary to apply the storage where it provides value that can be clearly identified through the transmission planning process. Refer to Release 1 for additional details.[16] Release 1 details the amount of battery storage RESOLVE found to be cost-effective to support reliability, GHG reduction, and renewable integration needs. Given these system benefits, the CAISO should not include the full capital cost of storage as an assumption in the assessment of storage as a transmission alternative that can mitigate reliability needs identified. The CAISO should however consider in its assessments the limitations of those storage units in serving system needs and account for those constraints where possible.

9.2. TPP Sensitivity Cases

Generation Resources

The 2019 RSP's and 2019 30 MMT EO Portfolio's resources have been mapped to busbars in accordance with the criteria. The results (available at Appendix B and Appendix C) can be transmitted to the CAISO for use in the Policy-driven Sensitivity Cases in 2020-21 TPP. The list of non-battery baseline resources is available at Appendix F.

Battery Storage Resources

The amount of new battery storage identified in the 2019-2020 IRP cycle is unprecedented. Both the CPUC planning processes and the CAISO's planning processes provide significant and distinct opportunities for identifying valuable information for furthering the state in the co-optimization of generation, transmission, and storage resources when planning. For example, CAISO studies are more locationally granular in nature as compared to IRP system-wide modeling, and have historically involved detailed study of local capacity areas and requirements. For this reason, the direction provided here by the CPUC provides a degree of flexibility to the CAISO, and assumes an iterative process between IRP and TPP processes.

[16] ftp://ftp.cpuc.ca.gov/energy/modeling/Modeling_Assumptions_2020_2021_TPP-Report-Release1.pdf

CPUC staff's battery storage allocations (available at Appendix C) can be transmitted to the CAISO for use in the Policy-driven Sensitivity Cases in 2020-21 TPP. They are summarized as follows:

Battery Storage Type	RESOLVE Portfolio	Method	% Standalone	% Hybrid (co-located)
High Confidence (MMA)	1,215	Full amount of commercial interest	Not available	Not available
High Confidence (non-MMA)	1,977	Full amount of commercial interest	26%	74%
Moderate Confidence	4,564	Percentage of the portfolio total	19%	81%
LCR Area solutions	4,902	Percentage of the portfolio total	68%	32%
Total	**12,657**			

For the 2019 RSP policy-driven sensitivity portfolio CPUC staff recommend the CAISO incorporate battery storage resources in the following order to meet the total 8,873 MW.

First, all base case portfolio battery storage MW utilized by the CAISO to mitigate reliability needs within the reliability assessment (which, as described in Report Release 1, has up to 1,157 MW of 1.3-hour batteries and 1,000 MW of 4-hour batteries available for these purposes).

Next, all high confidence battery storage, which includes both MMA and non-MMA type projects and totals 3,192 MW.

Finally, battery projects included in the moderate confidence category, the LCR category, or a combination of the two. Inclusion of battery storage in LCR areas will depend in part on the results produced by the CAISO in May 2020 as part of the ongoing Local Capacity Technical (LCT) study. See example combination of the two in Appendix C. The example is provided for illustration only, and is not intended to be binding, as final values will be determined pending CAISO analysis.

Battery storage will be handled differently in the 2019 30 MMT EO Portfolio, for which the objective is for the CAISO to study how transmission upgrades can alleviate the curtailment, improving available information on the costs and benefits of building new transmission and how these compare to potential storage alternatives. As part of this evaluation CAISO has the flexibility to move the battery storage to accommodate the objective of the 2019 30 MMT EO Portfolio study, but will abide by the following guidelines:

1. Include all battery storage MW identified for reliability mitigation purposes when conducting the reliability assessment using the base case resource portfolio. Up to 1,157 MW of 1.3-hour batteries and 1,000 MW of 4-hour batteries. The CAISO staff can use discretion about changing duration of these battery storage resources within reasonable bounds if required as part of mitigation evaluation in TPP reliability assessment.
2. Aim to align with the 2019 RSP, prioritizing battery storage at substations in a manner consistent with the high confidence category.
3. Include as much of the total battery storage 12,657 MW selected in the 2019 30 MMT EO Portfolio as possible.

9.3. Busbar Mapping for 2021-22 TPP and Future Cycles

As recognized in the Staff Proposal, there is likely to be the need to further develop the methodology for mapping future IRP portfolios for 2021-22 TPP and beyond, in order to plan for deep decarbonization of the electric sector and the associated need to co-optimize economic, land use, transmission, and interconnection issues. Staff appreciates the initial suggestions from stakeholders in response to the questions posed in the Staff Proposal and identifies the following items as priorities for consideration in the draft workplan for 2021-22 TPP busbar mapping. It may not be possible to implement all of these for busbar mapping later in 2020 but staff acknowledge the need to explore these with stakeholders:

- Continued updates to the land use screens, including to address the resources for which assessment was not conducted due to lack of data, as indicated by blank entries in the dashboards presented in Sections 6 and 7 above. This could also include incorporation of updated geographic information system data protocol (recommended by Public Advocates Office) as well as updates to numeric scoring methodology (recommended by TNC) and updates to land use datasets including for out-of-state resources (recommended by GLW, Defenders, and TNC).
- Interface between LSEs' plans, including for new transmission, and consideration of what substations are available for allocation
- Review of minimization of intra-zonal congestion as a guiding principle, in light of stakeholder comments arguing this biases mapping toward high voltage busbars.
- Observation of permitting status of projects, in addition to their interconnection queue status
- Review of "standard radius" assumption for gen-ties, considering latest industry trends, by resource-type
- Development of a unified resource identification protocol for consistent use across planning and procurement processes
- Continued improvements to storage mapping methods

CPUC staff will notify stakeholders later in 2020 regarding the process for participating in the formation of the workplan for busbar mapping of IRP portfolios that are due to be generated in late-2020.

10. Appendices

A. Methodology for 2019 IRP Resource-to-Busbar Mapping

Will be available at the CPUC's "Modeling Assumptions for the 2020-2021 TPP" webpage: https://www.cpuc.ca.gov/General.aspx?id=6442464144

B. CEC Busbar Mapping Results for Generation Resources – Sensitivity Portfolios

Data Basin link to Excel files:
https://caenergy.databasin.org/galleries/eab0ce3a5be447ce928a310e80c65c8d#expand=208848

C. Busbar Mapping Results for Battery Storage – Sensitivity Portfolios

Workbook will be available at the CPUC's "Modeling Assumptions for the 2020-2021 TPP" webpage: https://www.cpuc.ca.gov/General.aspx?id=6442464144

D. Busbar Mapping Dashboard workbook – 2019 RSP Sensitivity Portfolio

Will be available at the CPUC's "Modeling Assumptions for the 2020-2021 TPP" webpage: https://www.cpuc.ca.gov/General.aspx?id=6442464144

E. Busbar Mapping Dashboard workbook – 2019 30 MMT EO Sensitivity Portfolio

Will be available at the CPUC's "Modeling Assumptions for the 2020-2021 TPP" webpage: https://www.cpuc.ca.gov/General.aspx?id=6442464144

F. 2019 IRP Baseline (for non-battery resources)

Link to Excel file Gen_List_standalone .xlsx:
ftp://ftp.cpuc.ca.gov/energy/modeling/Gen_List_standalone_2020-02-07.xlsx

G. IRP Procurement Decision Baseline (for battery storage resources)

Refer "Baseline list of resources as required by D.19-11-016", Baseline_List_Combined tab, available at: https://www.cpuc.ca.gov/General.aspx?id=6442463413

H. Solar Cost Sensitivity Modeling slides

Link to PDF file:
https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/2019/2020-02-Solar_Cost_Sensitivity_Modeling-slides-V1.0.pdf

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