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Draft Methodology for Resource-to-Busbar Mapping ~~& Assumptions~~ for ~~The~~the Annual TPP

CPUC Energy Division
~~January~~July 2023

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1. Document Purpose

Resource-to-busbar mapping ("busbar mapping") is the process of refining the geographically coarse 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 methodology document is to memorialize and communicate the steps the CPUC, CAISO and California Energy Commission (CEC) will take to implement the process and provide transparency and opportunity for stakeholder comment.

The busbar mapping methodology outlined in this document is focused on achieving effective and timely busbar mapping of the utility-scale resources in IRP portfolios, which need to be adopted via a CPUC decision to be able to inform the CAISO's annual TPP.

2. Document Version History

The table below outlines the evolution of this document, listing and linking previous versions of the busbar mapping methodology. Key updates added in the current version are outlined in Section 4 below.

Version	Revision Notes
October 18, 2019[1]	Staff Proposal for the 2020-2021 TPP
February 21, 2020[2]	Improvements informed by stakeholder feedback on the Staff Proposal, and staff experience during implementation of the process for the 2020-2021 TPP
March 30, 2020[3]	Addition of methodology for battery resources for the 2020-2021 TPP
October 23, 2020[4]	Staff Proposal for the 2021-2022 TPP
January 7, 2021[5]	Final Methodology for the 2021-2022 TPP
August 1, 2021[6]	Staff Proposed Methodology & Assumptions

[1] https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/2018/IRP_Busbar_Mapping-Methodology-2019-10-18.pdf
[2] ftp://ftp.cpuc.ca.gov/energy/modeling/Busbar_Mapping-Methodology-2020-02-21.pdf
[3] ftp://ftp.cpuc.ca.gov/energy/modeling/Busbar_Mapping-Methodology-2020-03-30.pdf
[4] https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M348/K816/348816247.PDF
[5] ftp://ftp.cpuc.ca.gov/energy/modeling/Busbar%20Mapping%20Methodology%20for%202021-2022%20TPP_V.2021-01-07.pdf
[6] 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/ruling_proposed-psp.pdf

December 21, 2021[7]	Methodology for Resource-to-Busbar Mapping & Assumptions for the Annual TPP
October 5, 2022	Updates to the Methodology for the 2023-2024 TPP Ruling
January 9, 2023	Updates to the Methodology for the 2023-2024 TPP Proposed Decision[8]
July 17, 2023	Proposed Updates to the methodology to be implemented for the 2024-25 TPP

3. IRP & TPP Context

Through the IRP process, the CPUC generates portfolios of electrical generation, distributed energy resources, storage, and transmission resources designed to meet the state's greenhouse gas emission reduction targets for the electric sector while minimizing cost and ensuring reliability. In order to ensure alignment between the planning and development of generation, storage, and transmission resources, where the ability to serve the grid is often interdependent, the CPUC's IRP process coordinates closely with the CAISO's TPP. The IRP process develops a resource portfolio(s) annually as a key input to the TPP base case studies, which includes a reliability base case portfolio and a policy-driven base case portfolio. The CPUC may also transmit additional resource portfolios as inputs for sensitivity studies that test the implications of various policy futures. These are collectively referred to as "IRP portfolios."

The IRP cycle can involve developing these portfolios with different approaches. RESOLVE,[9] ~~a~~an electric sector capacity expansion model, is used to develop portfolios for the Reference System Plan, whereas Load Serving Entities' (LSEs') IRP plans are used to develop a Preferred System Plan portfolio, and a hybrid approach may be used to supplement specific portfolio development. Upon formal CPUC adoption of the IRP portfolios, they are transmitted to the CAISO to be used as inputs to the TPP. The adopted IRP portfolios include a mix of existing resources, resources under development and scheduled to come online (or retire) in the near term, as well as generic future candidate resources. However, the locational specificity of the selected generic candidate resources is limited because of the geographically coarse planning zones used in IRP modeling.

In order to more accurately study the performance of the IRP portfolios at the high voltage system level, the CAISO needs to model the selected generic resources in representative sizes at specific transmission substation locations within each renewable planning zone identified in the IRP portfolios. Consequently, the selected generic resources need to be remapped outside of RESOLVE

[7] "Methodology for Resource-to-Busbar Mapping & Assumptions for the TPP" (2021). CPUC. https://files.cpuc.ca.gov/energy/modeling/Busbar%20Mapping%20Methodology%20for%20the%20TPP_V2021_12_21.pdf

[8] "Methodology for Resource-to-Busbar Mapping & Assumptions for the 23-24 TPP" (2023). CPUC. 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

[9] Further information on RESOLVE is available here: https://www.cpuc.ca.gov/irp/

or LSEs' plans to specific busbars[10] in the transmission system before the portfolios can be transmitted to the CAISO and be considered as inputs to the TPP.

To disaggregate the selected zonal resource capacities and allocate to specific busbars, CPUC staff and CEC staff translate the tabular format of the portfolios into geographic map format and consider higher resolution information about transmission infrastructure and land use. This methodology identifies the guiding principles, busbar mapping steps, and the associated criteria for conducting this process.

4. Scope of Busbar Mapping

Deep decarbonization of the electric sector to meet California's climate goals is likely to require a transformation of the state's electrical infrastructure, i.e., significant investment in solar, wind and storage, including the associated transmission. In turn, the requirements placed on planning processes, including busbar mapping, are likely to be significant due to the need to co-optimize economic, land use, transmission, and interconnection issues associated with the amount of renewables and storage needed to be online in the next decade. This will be critical for California to stay on a trajectory to achieve the state's SB 100 goal[11] of 100 percent clean electricity by 2045, as well as 80 percent below 1990 emissions by 2050.

This busbar mapping methodology ~~may need to be revisited in future years~~is regularly updated to ensure that the co-optimization issues identified above are fully incorporated in the busbar mapping methodology in time to inform annual TPP modeling.

Further, the methodology is focused on resources within CAISO and other Californian Balancing Authority Areas (BAA) selected to serve CPUC IRP jurisdictional LSEs. Selected resources outside CAISO and other Californian BAAs are represented at CAISO boundaries so that their in-CAISO effects can be studied in the TPP.

The methodology outlined in this document builds on the previous methodologies listed in Section ~~2~~2 and takes into consideration stakeholder feedback. This methodology for mapping resources in IRP portfolios will serve as a living document for continued use in the annual TPP~~.~~ and other resource mapping efforts as needed. The document will be updated to incorporate changes or improvements as needed at appropriate junctures of future cycles.

~~Key updates to this methodology between the version developed for the 2021-2022 TPP (released Jan. 7, 2021) and the version included in with the 2022-2023 TPP portfolio development (released Dec. 21, 2021) include:~~

- ~~Utilizing new CAISO transmission deliverability data for available transmission headroom for full capacity deliverability status (FCDS) and energy only deliverability status (EODS).~~

[10] "Busbar" and "substation" are used interchangeably in this document. A busbar, a specific connection point within a substation, is the more accurate term. The mapping process need only identify the applicable substation to connect a resource, so long as the availability of a feasible busbar there has been considered.
[11] Detailed at: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

- ~~Incorporating new transmission constraint divisions based on the new CAISO transmission deliverability data, different from the nested transmission zones and Ex-zones used in the previous cycle.~~
- ~~For non-battery busbar mapping, incorporating busbar-level granularity of commercial interest rather than zonal-level of commercial interest.~~
- ~~For all resources, incorporating expected online dates for commercial interest into the mapping criteria for allocation to busbars.~~
- ~~Updating the battery busbar mapping steps to account for the locational information for battery resources that will be provided by RESOLVE for the first time.~~
- ~~Removing elements no longer necessary with the implementation of the new CAISO transmission deliverability data, including the 90% transmission utilization limit used in mapping battery resources to busbars, and for co-located battery and solar PV resources, removing the transfer of FCDS status from the solar PV resources to the battery resources.~~
- ~~Inclusion of an additional battery ranking value applied to substations in proximity of a fossil-fueled plant that has been identified in the Thermal Generator Retirement list.~~
- ~~Updating the busbar mapping process flow chart and the battery and non-battery mapping steps and workflow between the CPUC, CEC, and CAISO.~~
- ~~Improving the implementation process of the busbar mapping criteria to better capture mapped resources' compliance with the criteria and to incorporate latest stakeholder input and updated data sets.~~

The current version of the methodology improves on the most recent version released with the ~~2022-20233~~2023-2024 TPP portfolios (released ~~Dec. 21, 2021~~January 13, 2023) by including the following ~~minor~~major adjustments:

- ~~Updating the commercial interest criteria to prioritize, under high-confidence commercial interest, projects that have been allocated transmission plan deliverability by the CAISO.~~
- ~~Updating the commercial interest criteria to prioritize Phase II CAISO queue resources over Phase I resources.~~
- ~~Clarifying the work CPUC staff conduct in the pre-mapping of portfolio resources in Step #1 of Detailed Busbar Mapping Steps.~~
- ~~Clarifying in the description of the development of the candidate substation set in Step #2 of Detailed Busbar Mapping Steps that in some situations commercial interest at a non-candidate substation is approximated to the nearest substation already in the candidate set.~~
- ~~Clarifying how CEC and CPUC staff conduct land use screen analysis in Step #2 of Detailed Busbar Mapping Steps.~~
- ~~Providing the sources of~~ Updating the busbar mapping process flow chart and the busbar mapping steps, which describe the workflow between the CPUC, CEC, and CAISO staff, to best reflect recent and proposed changes in the mapping process.
    - Improving descriptions of the roles of CPUC, CEC, and CAISO staff and the descriptions of the effort that occur at each step of the mapping process.
- Unifying the renewable generation and battery mapping criteria for consistency across resource types and applying previously storage-only analysis for disadvantaged communities, air pollutant non-attainment zones, and load pockets to all resources.
- Adding new busbar mapping criteria and updating existing criteria based on new and updated datasets including:

- Updating land-use and environmental criteria to utilize newly developed CEC land-use screens.
- Adding parcelization criteria to incorporate a new dataset developed by the CEC that looks at the ~~CAISO data used for transmission capability and transmission upgrade~~property fragmentation of land and its impact on potential resource development.
- Updating cropland criteria analysis ~~and clarifying how periodic updates of that transmission~~to utilize CEC's new Cropland Index Model and incorporating information ~~is incorporated~~on critically overdrafted groundwater basins.
- Utilizing more detailed interconnection data in collaboration with CAISO staff and the Participating Transmission Owners to better account for interconnection factors.
- Incorporating Inflation Reduction Act Energy Communities.

- Improving the implementation process and analysis of the busbar mapping criteria to better capture mapped resources' alignment with the criteria.
- Improving descriptions of how various datasets are utilized for criteria analysis and how the alignment to each criterion is assessed.

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5. Guiding Principles

The following principles are intended to guide the busbar mapping process. Later sections of this document detail how to implement these principles, and criteria with which to assess whether the implementation is effective.

- The more granular resource and transmission cost, land use, environmental impact, and interconnection optimization done in the busbar mapping process should align with CPUC policy requirements, maintain reliability, and minimize cost to ratepayers. To the extent practical and feasible with the aforementioned criteria, busbar allocation should be consistent with the higher-level optimization that occurs during the IRP portfolio development process.
- Busbar allocations should, to the extent possible, reflect state-level land use and environmental planning priorities. Additionally, allocations should seek to reduce reliance on greenhouse gas and air pollutant emitting fossil-fueled resources, particularly to reduce or eliminate their impacts to historically burdened communities.
- Busbar allocations should generally ~~represent~~reflect the expected outcome of LSE procurement activity in response to policy requirements, maintaining reliability, and minimizing cost to ratepayers. This is achieved by observing to the extent practical and feasible the planned procurement indicated in LSEs' plans and the level of commercial interest in the CAISO and other relevant interconnection queues.
- The allocations should strive to minimize transmission congestion and potential increases in costs to ratepayers by respecting transmission constraint limits[12] and utilizing only identified transmission upgrades demonstrated to be cost-effective for ratepayers or necessary to

[12] Further described in the CAISO's ~~May 2019~~July 2023 White Paper "Transmission Capability Estimates as an input to the CPUC Integrated Resource Plan Portfolio Development" available at: ~~http://www.caiso.com/Documents/TransmissionCapabilityEstimates-CPUC-IRP-PortfolioDevelopmentRedacted.pdf~~ https://www.caiso.com/Documents/Presentation-UpdatedTransmissionCapabilityEstimates-use-CPUCsResourcePlanningProcess-Jul5-2023.pdf

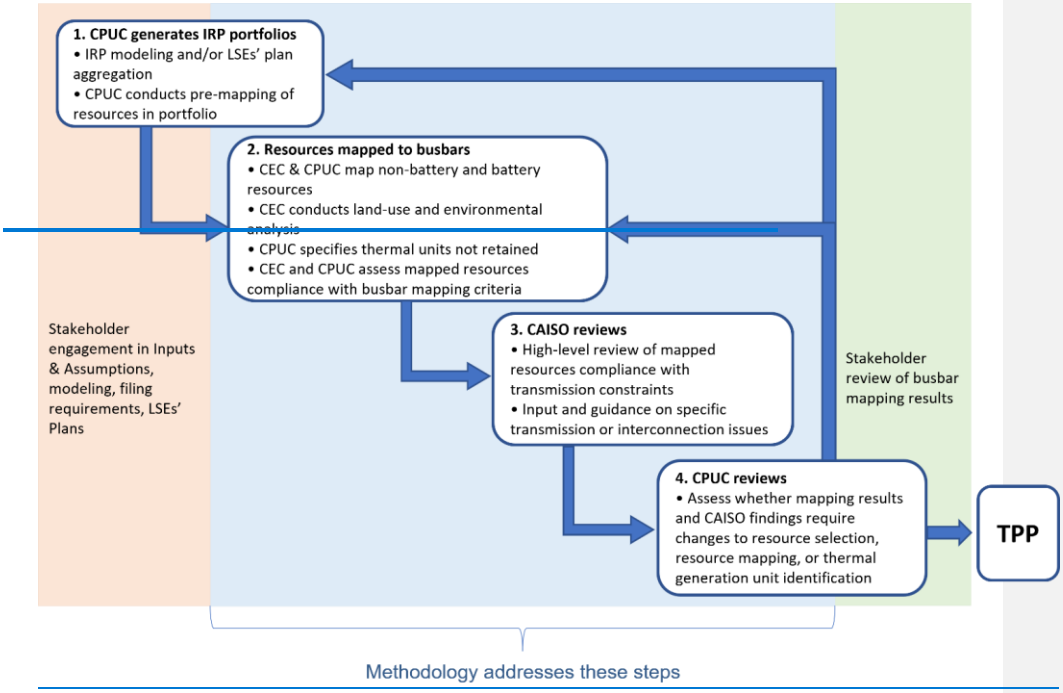
achieve policy or reliability requirements. The allocations should minimize local congestion and overloads, where known, understanding that these are typically addressed through local transmission upgrades ~~identified in the Generation Interconnection~~, and ~~Deliverability Allocation Process (GIDAP) rather than the TPP~~seek to improve reliability and reduce opportunities for market power in load pockets.

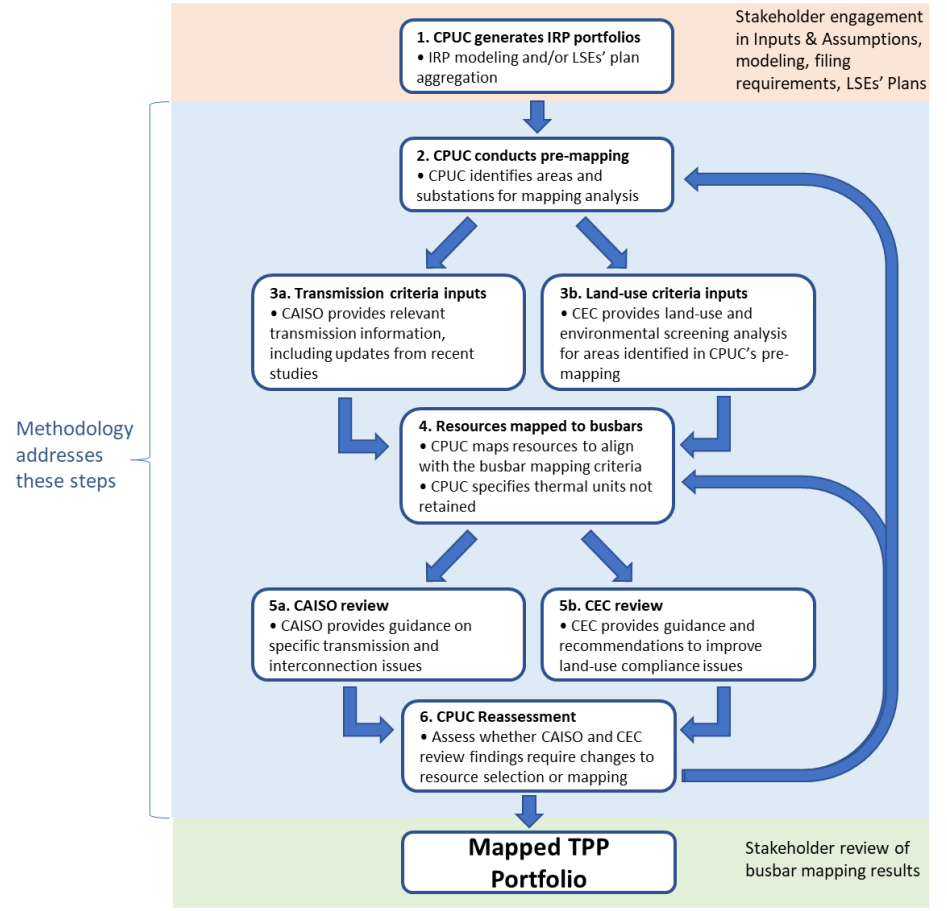
- A successful busbar mapping process should result in IRP portfolios that minimize post processing in the CAISO's TPP.
- Consistency with prior year mapping results for equivalent TPP cases is important to the IRP and TPP processes. Staff should consider whether changes are occurring due to exogenous factors (e.g., demand or resource cost shifts) or due to modeling margin of error. Where significant changes are proposed in the resource mapping from one year to the next, these should be explicitly justified.

6. High-level Busbar Mapping Steps

The busbar mapping process is completed through a sequenced transfer of information between the CPUC, CEC, and CAISO. It is an iterative process, as demonstrated by Figure 1.

Figure 1. Flowchart of the busbar mapping process


1. CPUC generates IRP portfolios
• IRP modeling and/or LSEs' plan aggregation
• CPUC conducts pre-mapping of resources in portfolio
2. Resources mapped to busbars
• CEC & CPUC map non-battery and battery resources
• CEC conducts land-use and environmental analysis
• CPUC specifies thermal units not retained
• CEC and CPUC assess mapped resources compliance with busbar mapping criteria
3. CAISO reviews
• High-level review of mapped resources compliance with transmission constraints
• Input and guidance on specific transmission or interconnection issues
4. CPUC reviews
• Assess whether mapping results and CAISO findings require changes to resource selection, resource mapping, or thermal generation unit identification
TPP
Stakeholder engagement in Inputs & Assumptions, modeling, filing requirements, LSEs' Plans
Stakeholder review of busbar mapping results
Methodology addresses these steps



7. Detailed Busbar Mapping Steps

~~Information transfers related to~~ The busbar mapping ~~follow~~effort follows this sequence of steps and information transfers between CPUC, CEC, and CAISO staff:

Step 1 - Draft portfolio(s) ~~prepared~~generated and shared with CEC ~~for busbar~~ and CAISO staff (CPUC).

Step 2 – CPUC staff lead the pre-mapping ~~(CPUC)~~effort, identifying potential substations and potential transmission upgrades for mapping analysis based on the RESOVLE results (CPUC).

Step 3 – CEC and CAISO staff provide analysis and information necessary for mapping and criteria analysis.

- Step 3a - Detailed transmission and substation interconnection information is analyzed and provided by the CAISO staff and the Participating Transmission Owners (PTOs) for transmission and interconnection related criteria. (CAISO)
- Step 3b - Land-use and other environmental screens are analyzed and provided by CEC staff for use in land-use and environmental related criteria. (CEC)

Step 4 – Using the criteria information provided by CAISO (Step 3a) and CEC (Step 3b), staff map the portfolio resources to busbars and conduct criteria alignment analysis. (CPUC)

- In this step, CPUC staff also communicates assumptions made on which thermal units are not retained (see Section 9 Thermal Generator Retirement Assumptions).

Step 5 ~~Step 2 - Draft busbar mapping performed (CEC and CPUC)~~– CAISO and CEC staff review, provide guidance, and make recommendations on potential improvements or mapping adjustments.

Step 5a – CAISO staff review the

- ~~Note: Step 2 is further divided into two parts below delineating CEC staff centered work and CPUC staff centered work.~~
- ~~Step 3 - Observations and recommended revisions (CAISO)~~

~~Step 4 - Review mapping results as well as observations and recommendations from CAISO staff (CPUC)~~

- ~~Note: Steps 1-4 make up a "round" of busbar mapping.~~
- ~~Step 5 - Repeat steps 1-4 if~~ mapping results ~~do not conform with~~and provide specific guidance and recommendations on transmission and interconnection related concerns. (CAISO)
- Step 5b – CEC staff review the mapping ~~criteria~~ results and provide specific guidance and recommendations on land-use related concerns. (CEC)

Step 6 ~~- Successfully~~ – CPUC staff review CAISO and CEC staff's feedback and the mapped resources criteria alignment to determine if additional adjustments are necessary. If changes are needed to improve criteria alignment, staff begin a new round of mapping at Step 4 or, if additional information is required, Step 2. (CPUC)

Step 7 – Mapped IRP portfolio(s) formally transmitted to the CAISO. (CPUC)

~~The~~ In previous mapping iterations, staff utilized separate processes for mapping renewable generation and battery storage. These efforts have been combined, and the discussion of each step below ~~centers on the mapping of non-battery resources. The detailed battery mapping steps are outlined in Section 8: Battery Storage. The mapping of batteries is conducted by CPUC staff in parallel with~~represents the mapping ~~processes of non-battery resources outlined in Step 1 and Step 2, with the CAISO staff reviewing the combined results of mapping~~of both battery and non-battery resources ~~in Step 3.~~.

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CPUC – Step #1

The CPUC staff will utilize and provide to CEC and CAISO staff the following materials ~~to the CEC and CAISO staff~~ for the annual busbar mapping process:

- IRP portfolios generated by RESOLVE and/or resulting from the aggregation of LSEs' plans, as applicable.
    - Baseline resources: megawatts (MW), by unit, by location.
        - This information will also identify new baseline resources, including their point of interconnection, that have recently come online or are in development which were not included in calculating the most recent CAISO transmission capability limits.
    - LSEs' in-development and planned resources: MW, by resource type, by location.
    - Selected generic new resources: MW, by resource type, location, and applicable transmission constraints.[13]
        - ~~For resources selected by RESOLVE, CPUC staff will conduct pre-mapping work to provide substation level granularity of for the CEC to conduct its land-use and environmental mapping analysis.~~
        - ~~This pre-mapping exercise maps resources from the few large regional areas that RESOLVE selects to candidate substations to enable CEC staff to perform land-use and environmental mapping analysis. This exercise utilizes the alignment with transmission capability limits, commercial interests, and consistency with previous TPP's mapping criteria (See Section 9 for detailed criteria descriptions) to identify candidate substations and potential MW amounts to map to those substations.~~
        - ~~As part of the pre-mapping, CPUC staff complete battery mapping as outlined in Section 8: Battery Storage to properly account for batteries within transmission constraints and to allow solar resources to be mapped to busbars as co-located with battery resources.~~
    - Resource potential estimates (geographic information system (GIS) data format – polygons and associated attribute tables) to give the CEC further information about the selected resources.[14]
- ~~Transmission upgrades triggered in RESOLVE and transmission upgrades identified as necessary in the pre-mapping work. (tabular format)~~[15]

[13] For example, see Excel-based results viewer, dated March 23, 2020, available at https://www.cpuc.ca.gov/General.aspx?id=6442464143. See "Portfolio Analytics" tab

[14] For example, see GIS Data available at http://www.cpuc.ca.gov/General.aspx?id=6442453965

~~[15] For example, see Excel-based results viewer, dated March 23, 2020, available at https://www.cpuc.ca.gov/General.aspx?id=6442464143 See "Portfolio Analytics" tab~~

Stakeholder participation:

- Stakeholders will be provided an opportunity to comment on the RESOLVE inputs and assumptions ~~(including CAISO transmission capability and cost values),~~ RESOLVE functionality, and the proposed portfolios for busbar mapping.
- Stakeholders will be provided opportunities to comment on this busbar mapping methodology ~~and to review the mapped resource portfolios.~~ Further, ~~stakeholders'~~stakeholder feedback during TPP may demonstrate the opportunity to better fulfill the guiding principles outlined in this document. Small changes to allocations may be made during TPP at CAISO staff's discretion in coordination with the CPUC.

~~CEC~~
CPUC – Step #2~~ – Part A~~

~~The CEC~~ For resources included in the portfolio, CPUC staff will ~~provide the following materials to the CPUC and CAISO staff after each round of busbar mapping:~~

- ~~Draft CEC busbar mapping results~~
  - ~~See CEC Busbar Mapping Results workbooks from previous cycles for examples of prior work~~[16]

~~The CEC is using a busbar mapping methodology that is summarized as follows:~~

1) ~~CEC staff will use the information described in Step #1 above from the CPUC to develop a land-use and environmental impacts map for the renewable energy resource technologies and for each portfolio, consistent with the RESOLVE model inputs and assumptions developed by the CPUC and the~~conduct pre-mapping ~~conducted by CPUC staff in Step #1.~~
2) ~~CEC staff will create a set of GIS layers to identify the potential environmental and land use implications of the RESOLVE-selected renewable resources. The layers use a combination of the following statewide data and information:~~
   - ~~Terrestrial Landscape Intactness (California Energy Commission and Conservation Biology Institute, 2016)~~[17]
   - ~~Areas of Conservation Emphasis, version 3.0 (ACE III) (California Department of Fish and Wildlife, 2018)~~[18]
     - ~~i. Terrestrial Connectivity~~[19]

~~[16] The 2021-2022 TPP results are available at Portfolios & Modeling Assumptions for the 2021-2022 Transmission Planning Process (ca.gov) and the 2020-2021 TPP results at https://www.cpuc.ca.gov/General.aspx?id=6442464144~~
~~[17] Available at https://databasin.org/datasets/e3ee00e8d94a4de58082fdbc91248a65~~
~~[18] Available at https://www.wildlife.ca.gov/Data/Analysis/Acc~~
~~[19] Available at https://data.cnra.ca.gov/dataset/terrestrial-connectivity-ace-ds2734~~

~~ii. Biodiversity[20]~~

~~iii. Rarity[21]~~

~~iv. Native species[22]~~

~~v. Irreplaceability[23]~~

- ~~California Agricultural Value (California Energy Commission and Conservation Biology Institute, 2018)[24]~~
- ~~NLB (Natural Landscape Blocks)[25]~~
- ~~Wildfire Threat[26]~~

~~The terrestrial landscape intactness, the terrestrial connectivity, and the biodiversity datasets above will be normalized and summed to create a comprehensive layer with numerical scores that represent the degree of potential environmental and land use implications if resources are utilized. The California Agricultural Value and Wildfire Threat data will either be incorporated into the model or used as separate overlays to compare different~~ analysis to provide substation ~~allocations. The remaining datasets are utilized individually to identify additional environmental implications.~~

~~The comprehensive layer and the other environmental and land use layers will be overlaid with the renewable resource potential geographies to identify the environmental implications (low and high) of developing renewable resources, particularly solar resources and where~~level granularity for the CEC and CAISO to conduct the criteria analysis necessary~~, wind energy resources.~~ for the mapping process. Staff will do the following:

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~~3)~~ ~~Due to the limited geographic extent of the GIS data layers used by CEC (datasets are California-specific), a separate set of GIS layers will be used to identify the potential environmental and land use implications of the out-of-state RESOLVE-selected renewable resources. The layers use the following information:~~

~~i. Environmental data from the WECC Environmental Data Working Group,[27] specifically Environmental Risk Category 2 (Low to Moderate Risk of Environmental or Cultural Resource Sensitivities and Constraints) and 3 (High Risk of Environmental or Cultural Resource Sensitivities and Constraints).[28]~~

- ~~CPUC will identify the~~Identify candidate substations ~~in Step #1~~ for potential resource mapping and the potential resources and MW amounts that may be mapped

[20] ~~Available at https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=150831~~
[21] ~~Available at~~ https://data.cnra.ca.gov/dataset/statewide-terrestrial-rare-species-richness-summary-acc-ds13331
[22] ~~Available at https://data.cnra.ca.gov/dataset/statewide-terrestrial-native-species-richness-summary-acc-ds1332~~
[23] ~~Available at https://data.cnra.ca.gov/dataset/statewide-terrestrial-irreplaceability-summary-acc-ds13341~~
[24] ~~Available at~~ https://databasin.org/datasets/f55ea5085e024a96b5f17e7ddddd1147
[25] ~~Available at~~ https://databasin.org/datasets/e3ee00e8d94a4de58082fdbe91248a65
[26] ~~Available at https://ia.cpuc.ca.gov/firemap/~~
[27] ~~https://www.wecc.org/SystemAdequacyPlanning/Pages/Environmental-and-Cultural-Considerations.aspx~~
[28] ~~https://ecosystems.azurewebsites.net/WECC/Environmental/Environmental_References.html~~

to them. This exercise utilizes the RESOLVE modeling results and/or LSE plans and alignment with transmission capability limits, commercial development interests, and consistency with previous TPP's mapping criteria (See Section 8 for detailed criteria descriptions) to identify candidate substations and potential MW amounts to map to those substations.

- Identify transmission upgrades triggered in RESOLVE and additional potential upgrades through preliminary analysis considering additional information not included in RESOLVE capacity expansion analysis.[29]
- Transmit the substation information and the identified potential resource types and MW amounts to CEC staff to conduct its land-use and environmental mapping analysis and to CAISO staff to obtain additional transmission and interconnection information for these substations.

~~4)~~ CPUC staff will identify the candidate substations from a set of available substations, including those that are planned and approved ~~as well as existing.~~. Available substations include ~~those~~substations outside of the CAISO, in other Californian (Balancing Area Authorities) BAAs~~, as well as in CAISO.~~ out-of-state BAAs. For resources eventually mapped to out-of-CAISO substations, staff will also identify the like intertie point with the CAISO system. A subset of total available substations is considered when mapping the portfolios. ~~This~~ This subset of substations is ~~identified in~~created using the following ~~manner~~methodology to identify substations:

- ~~i.~~ ~~GIS~~Geographic Information System (GIS) datasets for California substations are combined with the GIS data set for U.S. substations to help identify available substations for out-of-state resources.[30]
- ~~ii.~~ The combined set of substations is queried to select substations that meet any of the ~~following~~ criteria:
  - ~~1.~~ ~~Transmission~~Included in the transmission capability and constraint information available from CAISO, adjusted to account for newly added baseline resources not included in the baseline used by CAISO to establish the transmission ~~limited~~[31]limits. Transmission capability estimates are additionally adjusted to account for transmission upgrades which have already been approved.
  - ~~2.~~ ~~Location~~Have location information (GIS data) available from CEC ~~or~~, U.S. Homeland Infrastructure Foundation-Level Data (HIFLD), or other source.

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[29] For example, see Excel-based results viewer, dated March 23, 2020, available at https://www.cpuc.ca.gov/General.aspx?id=6442464143 See "Portfolio Analytics" tab

[30] Available at ~~https://data.ca.gov/dataset/california-electric-substation2~~ ~~https://hifld-geoplatform.opendata.arcgis.com/datasets/electric-substations~~ https://data.ca.gov/dataset/california-electric-substation2 https://hifld-geoplatform.opendata.arcgis.com/datasets/electric-substations

[31] ~~CAISO transmission capability estimates are available at: http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=82442AF7-0A68-4BFC-86FD-AAE1B066AF5E~~

3.○ Identified as currently operational or planned.

4.○ Identified as having both multiple buses and bus voltages of 115 kV and above; except in cases of remote resources where the only available buses are of lower voltages.

5.○ Identified ~~as having commercial interest per~~in CAISO interconnection queue. In some situations, when queue projects are listed as interconnecting to substations not currently included in the candidate substations set, staff may identify the nearest linked substation already in the set as the point of commercial interest.

iii.○ ~~Project~~Identified in project documents for new, approved powerline projects are examined to identify the mapped locations of proposed substations and they are hand-digitized to add them to the available substation dataset.

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CAISO – Step #3A

CAISO staff will provide detailed system-level transmission constraint and upgrade information. Additionally, CAISO and CPUC staff will engage with key Participating Transmission Owners (PTOs) to obtain substation-specific interconnection and upgrade cost information. CPUC will work with both CAISO staff to obtain updated data commercial development interest and in-development projects.

- CAISO staff will provide relevant system-level transmission capability and transmission upgrade data as well as transmission constraint areas information. Key data includes:
  - CAISO White Paper on Transmission Capability Estimates for use in the CPUC's Resource Planning Process[32], which provide transmission capability estimates for on-peak and off-peak deliverability; estimated costs, construction times, and additional MW capacity of identified transmission upgrades, and descriptions of the transmission constraint areas.
  - CAISO staff guidance on additional substation inclusions in the various transmission constraint areas.
  - If data is available, estimates of the impacts to the relevant transmission constraints due to upgrades identified and approved in previous TPPs but not included in the White Paper.
  - Relevant information and data from Local Capacity Requirement studies and other CAISO studies that are utilized in the busbar mapping criteria analysis.

[32] "Transmission Capability Estimates as an input to the CPUC Integrated Resource Plan Portfolio Development" (2023). CAISO White Paper. https://www.caiso.com/Documents/Presentation-UpdatedTransmissionCapabilityEstimates-use-CPUCsResourcePlanningProcess-Jul5-2023.pdf

- CPUC and CAISO staff will engage with the PTOs to obtain substation level interconnection availability and feasibility information for key substations identified in the CPUC staff's pre-mapping work. If the information can be provided, staff will seek the following from PTOs to inform mapping criteria analysis:
    - Additional cost estimates for interconnecting resources to the PTOs substations under a variety of interconnection conditions.
    - Substation-level data on the number of available positions for interconnections and possible upgrades to enable additional interconnections, including their scope, complexity, and potential costs.
    - Substation-level data on factors that could limit interconnections such as fault duty limits or physical infrastructure constraints.
- CPUC will work with CAISO staff and PTOs to gather updated data on the interconnection queue and in-development resources, including:
    - Updated CAISO interconnection queue information and Transmission Plan Deliverability (TPD) allocations.
    - Additional data in-development or under construction projects data that are not included in the existing resource baseline or in CPUC staffs existing dataset of in-development resources.

Stakeholder participation:

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- The CAISO has its own stakeholder process for the development of the transmission capability information provided to the CPUC through its White Paper on transmission capability estimates[33].
- Information provided by CAISO staff and the PTOs, if not determined to be confidential, will be reported in the mapping results and/or in the CPUC's report.
- Stakeholders will be provided opportunities to comment on this busbar mapping methodology and to review the mapped resource portfolios.~~The substation data is overlain with the~~

CEC – Step #3B

CEC staff will develop the land-use and environmental implications information necessary to conduct busbar mapping criteria analysis. CEC staff will assess land-use and environmental implications for the resource technologies at the substations and in the regions identified by CPUC ~~RESOLVE resource~~ staff in the pre-mapping effort (Step #2) utilizing the following methodology.

- CEC staff will utilize their land use screens and additional screening datasets (see Section 8 for information on the specific data incorporated into the mapping criteria)

[33] http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=03DCF912-0ECF-4CF9-A304-A05F4ED5B2CD

to identify the potential ~~data and for substations with significant~~environmental and land use implications of the portfolio's renewable ~~resource~~ resources. Screens will be applied using the approaches described in the CEC's *Land-Use Screens for Electric System Planning* Commission Report[34] (Land-Use Screens Report).

- CEC and CPUC staff will establish several radii around each identified substation and potential ~~in reasonable proximity,~~ resource mapping area to guide CEC's analysis (see Section 8 for specific mile distances used in criteria analysis). Staff will also establish specific analysis guidance for each resource type. The CEC's Land-Use Screens Report outlines the unique approaches for assessing the land-use and environmental implications of solar, on-shore wind, and geothermal resources in the state of California.

~~iv.~~ • CEC staff will apply the land-use and environmental screens to the resource potential ~~is assigned to the relevant transmission constraint for that~~estimates within the established radii for the candidate substations. Using GIS modeling and analysis, CEC staff will derive estimated resource potential acreages within the various land-use and environmental implication factors for each substation.

- Several datasets CEC staff will use for land-use and environmental analysis are limited to the state of California. Since the portfolios may include resources out of state, CPUC staff will implement a similar process for these out-of-state resources, using a land-use implications dataset available across the western United States.
- CEC staff will develop a spreadsheet to report the results of their analysis. It will include acreage amounts and estimated MW amounts of resource potential by substation under the various land-use and environmental analysis implications levels, as well as the percentage of potential resource area around each substation that falls under the various screens' implication levels. It will include details of the specific methodology applied if changes or updates were made, and any notes needed to interpret and understand the allocation outputs. Reported results will enable application of the criteria alignment thresholds (outlined in the Busbar Mapping CriteriaSection 8) by CPUC staff in Step #4.
    - CEC and CPUC staff will use fixed power density assumptions for the solar and wind to estimate potential MW values from the resource potential acreage. In mapping efforts for the 2023-24 TPP and earlier TPPs, staff utilized a 7 acres/MW assumption for utility-scale solar resources and a 40 acres/MW assumption for onshore wind resources. For future mapping efforts, CPUC staff are proposing to use an 8.2 acres/MW (30 MW/km^2) assumption for utility-scale solar[35] and 91.5 acres/MW (2.7 MW/km^2) for onshore wind.[36]

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[34] Hossainzadeh, Saffia, Erica Brand, Travis David, and Gabriel Blossom. 2023. *Land-Use Screens for Electric System Planning: Using Geographic Information Systems to Model Opportunities and Constraints for Renewable Resource Technical Potential in California.* California Energy Commission. https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=21-SIT-01

[35] Ong, S. et. al. "Land-Use Requirements for Solar Power Plants in the United States." NREL, 2013. https://www.nrel.gov/docs/fy13osti/56290.pdf.

[36] Denholm, P. et. al. "Land-Use Requirements of Modern Wind Power Plants in the United States." NREL, 2009. https://www.nrel.gov/docs/fy09osti/45834.pdf

Stakeholder participation:

- In developing the *Land-Use Screens for Electric System Planning* Commission Report, CEC staff lead an in-depth stakeholder engage process to receive input and recommendations in developing and implementing the key land-use and environmental screen utilized in busbar mapping.[37]
- The CEC's analysis results s will be reported in the mapping results and/or in the CPUC's report.
- Stakeholders will be provided opportunities to comment on this busbar mapping methodology and to review the mapped resource portfolios.

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v. CPUC – Step #~~During iterative rounds of busbar mapping, individual substations from the identified data sources may be added if additional substation mappings are needed.~~

~~5) CEC and CPUC staff will establish a suitable standard radius around each available substation. The standard radius will be set to approximate the longest distance factoring the MW size of resources selected that economically feasible interconnection power lines (gen-ties) typically fall within. This standard radius, path viability, and busbar voltage – all key drivers of interconnection cost – will be used when mapping each resource type as follows:~~

~~a. Solar – calculate the amount of renewable resources with lower environmental implications within each substation radius. Allocate the transmission planning area-level solar resources to substations based on the available lower environmental implication area within the substation radius.~~

~~b. Wind – compare the location of wind energy resources to each substation radius and allocate the transmission planning area-level wind resources to substations in closest proximity. High- and low-environmental-implication information will be identified, but options for moving the resource to a different substation will be more limited for wind, given the site-specific nature of the resource.~~

~~c. Geothermal – compare the location of geothermal energy resources to each substation radius and allocate the transmission planning area-level geothermal resources to substations in closest proximity.~~

~~Biomass – compare the location of biomass and biogas energy resources to each substation radius and allocate~~4

Using the transmission and interconnection information provided by CAISO staff and PTOs (Step #3a), and the land-use and environmental analysis information provided by the CEC (Step #3b), CPUC staff will map the portfolio resources, both generation and storage,

[37] Commissioner Workshop on Land Use Screens, Hosted March 13, 2023, by California Energy Commission. https://www.energy.ca.gov/event/workshop/2023-03/commissioner-workshop-land-use-screens

to substations using the busbar mapping criteria, described in the Section 8. In mapping the resources to busbar, CPUC staff will do the following:

- CPUC staff will map the portfolio resources, both generation and storage, using the information and analysis from Steps #2 and #3. In doing so, staff apply the criteria thresholds detailed in Section 8 seeking to maximize the mapped resources' alignment with the criteria and minimize major non-compliances.
- CPUC staff will utilize the information provided by CEC staff in Step #3b to assess mapped solar, onshore wind, and geothermal resources calculate alignment with the land-use, environmental, distance to transmission criteria.
- CPUC staff will use the transmission and substation interconnection information provided by CAISO staff and obtained from the PTOs in Step #3a to perform the criteria alignment analysis for the system level transmission capability and substation level interconnection viability criteria.
- CPUC staff will utilize the CAISO interconnection queues, queues from the PTOs, other Balancing Authority Areas queues, and additional development information to analyze mapped resources alignment with the Commercial Development interest criteria.
- Due to limitations of the data and analysis, land-use and environmental criteria analyses are not applied to storage resources and some renewable generation categories including biomass/biogas, distributed solar, out-of-state wind on new transmission, and offshore wind. CPUC staff still apply the other criteria to these resources and use the following additional resource specific approaches:

  ~~d.~~ Biomass or Biogas – Allocation of the biomass/biogas resources to substations ~~in closest~~prioritizes proximity to biomass or biogas energy resource areas. Biomass/biogas energy resources areas are identified as regions with high energy potential for forest biomass, agricultural biomass and dairy biogas, and municipal waste biogas.[38]

  ~~e.~~ Distributed Solar – ~~compare~~ This resource represents in-front of the ~~location of distributed~~meter solar ~~energy~~ resources ~~and allocate resources~~less than a few MWs in size, corresponding to ~~substations in closest proximity.~~ commercial-scale rooftop to community scale solar). Resource potential is assessed based on resources identified in LSE plans and potential projects in the interconnection queues of the lower voltage transmission systems.[39] These resources are mapped to the nearest CAISO system level substation, the likely CAISO system interconnection point.

  ~~f. Location specific long duration energy storage – compare the location~~Offshore Wind – Allocation of ~~long duration energy storage~~offshore wind resources ~~that are limited to a specific geographic area to each~~

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[38] CPUC staff utilized information from the California Air Resources Board's 2015 Assessment of the Emissions and Energy Impacts of Biomass and Biogas Use in California (~~LINK~~LINK) and CEC's PIER Program's 2013 Biomass Energy in California's Future: Barriers, Opportunities, and Research Needs Report (~~LINK~~)LINK)

[39] CPUC staff utilized the Wholesale Distribution Access Tariff interconnection queues for PG&E, SCE, and SDG&E.

substation radius and allocate the transmission planning area level long duration energy storage resources to substations in closest proximity.

g. For resources which fall outside the standard substation radius or haveprioritizes existing offshore wind energy areas and considers identified issues likely to significantly increase interconnection costs, CPUC staff will conduct further analysis outline in Step 2B.

6) CEC staff will apply the land use and environmental screens [described in 2) and 3)] to the resource potential estimates [provided by the CPUC in Step #1] within the standard radii [described above in 5)] for the candidate substations [as noted in 4)]. CEC will utilize fixed energy density assumptions to assess the environmental and land use implications of the potential MW amount of resources identified by the CPUC in the pre-mapping in Step #1 at each candidate substation.

7) CEC staff will develop a spreadsheet to report out the results of the megawatt allocations by substation, for each renewable energy resource. It will include details of the specific methodology applied, enabling reporting against the criteria outlined in the Busbar Mapping Criteria section below, and any notes needed to interpret and understand the allocation outputs.

Stakeholder participation:

- Stakeholders will be provided opportunities to comment on this busbar mapping methodology and to review the mapped resource portfolios. Further, stakeholders' feedback during TPP may demonstrate the opportunity to better fulfill the guiding principles outlined in this document. Small changes to allocations may be made during TPP at CAISO staff's discretion. future offshore wind areas utilizing

CPUC – Step #2 – Part B

The CPUC staff will provide draft portfolio dashboards to the CAISO and CEC staff after each round of busbar mapping and do the following:

1. CPUC staff will utilize the information provided by CEC staff above to assess mapped resources compliance with land use, environmental, distance to transmission, and transmission capability limits described in Section 9 Busbar Mapping Criteria and Implementation. Staff will conduct additional review on mapped resources alignment with LSEs' plans and the CAISO and other BAA interconnection queues and consistency with prior years' base case portfolios.

2. With respect to mapped resources' interconnections to substations identified by CEC staff, CPUC staff will conduct, as necessary, further interconnection analysis on mapped resources that fall beyond the standard radius or CEC staff identified possible interconnection path viability issues or a busbar voltage that may lead to additional interconnection costs. For resources that fall beyond the standard radius, staff will compare their interconnection cost assumed in the supply curve, and the gen-tie distance it allows, to the distance to the busbar identified in busbar mapping. If the distance to the substation is greater, then depending on the busbar voltage and

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~~the amount of MWs mapped, this may mean a criterion has not been met; refer to the Busbar Mapping Criteria section below.~~

~~3. CPUC staff will update battery mapping as outlined in Section 8: Battery Storage based on any non-battery resource adjustment made during Step #2.B.~~

~~4.~~ ~~CPUC staff will assess mapped non-battery and battery resources' compliance with existing transmission capability limits – the "Estimated Full Capacity Deliverability Status Capability (MW)" and the "Estimated~~from the ongoing CEC AB 525 study work[40] and continuing research by the National Renewable Energy ~~Only Deliverability Status Capability (MW) – for each transmission constraint using the resource-specific capacity output factors and confirm any transmission upgrades triggered alleviate transmission capability exceedances in a demonstrated cost-effective manner (see Busbar Mapping Criteria section for transmission capability assessment). Staff will incorporate the transmission-related impacts of battery mapping and account for the co-location of battery storage with mapped solar resource. Any triggered transmission upgrades will be highlighted for and examined by CAISO staff in Step #3.~~Lab (NREL).

~~5.~~ CPUC staff, using the process established in the Thermal Generator Retirement Assumptions~~,~~ in Section ~~#10,~~9 will identify thermal generation units not retained and should be assumed as retired for the transmission planning process.

~~6.~~ CPUC staff will develop draft dashboard worksheets for each portfolio to summarize the mapping results~~, their transmission capability limit alignment,~~ and their ~~compliance~~alignment with the busbar mapping criteria. The dashboard worksheets will also calculate the estimated transmission constraints capability utilization, identify where transmission exceedances occur, and note which transmission upgrades could alleviate the exceedances.

~~Stakeholder participation:~~

~~Stakeholders will be provided opportunities to comment on this busbar mapping methodology and to review the mapped resource portfolios.~~CPUC staff will transmit the portfolio dashboards to CEC and CAISO staff for review in Step #5. Staff will highlight non-compliant resources and alignment issues and identify areas where CEC and CAISO should provide additional information to potentially improve the mapping.

Stakeholder participation:

- Stakeholders will be provided opportunities to comment on this busbar mapping methodology and to review the mapped resource portfolios. Further, stakeholders' feedback during TPP may demonstrate the opportunity to better fulfill the guiding principles outlined in this document. Small changes to allocations may be made during TPP at CAISO staff's discretion.

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[40] AB 525 Reports: Offshore Renewable Energy. California Energy Commission. Website: https://www.energy.ca.gov/data-reports/reports/ab-525-reports-offshore-renewable-energy

CAISO – Step #~~3~~5a

~~During each round~~Upon receipt of ~~busbar mapping~~ the review request and the dashboard workbooks from CPUC, CAISO staff will provide ~~the CEC and CPUC staff~~ the following:

- A high-level review of the ~~CEC's and CPUC's~~ draft busbar allocations and the conceptual transmission upgrades that the ~~CPUC and CEC~~mapping determined are likely to be required based on the mapping ~~in Steps #1 and/or #2~~ including:
  - Input on any specific transmission issues encountered during the mapping process.
  - Additional information on interconnection feasibility, including electrical suitability and physical space availability at each substation, if this information is available from the transmission owner.
  - New transmission information from ongoing TPP and GIDAP studies.
- If ~~the CEC and~~ CPUC staff map portfolio resources to substations in BAAs other than the CAISO, then the CAISO staff may consult appropriate planning entities during the resource modeling phase of TPP. These planning entities may recommend adjustments to locations and size of resources mapped in their BAAs. In such cases, the CAISO will consult the CPUC and CEC staff before incorporating any subsequent busbar allocation changes to the portfolios. Staff will engage with TPP stakeholders and/or IRP stakeholders if the changes may result in a materially different transmission outcome, in terms of constraints or upgrades. All changes will be publicly documented.
- Observations, problems encountered, and recommended portfolio modifications that might be needed.

CEC– Step #5b

Upon receipt of the review request and the dashboard workbook from CPUC, CEC staff will provide the following:

- Specific guidance on any land-use related concerns from the mapping results.
  - Particularly locations where mapped resources exceedance of land-use or environmental impact implications thresholds may be a particular issue.
- Recommendations for remapping options that address any raised concerns with the mapped resources non-alignment with the land-use and environmental impact criteria.

Stakeholder participation:

- Stakeholders will be provided opportunities to comment on this busbar mapping methodology and to review the mapped resource portfolios. Further, stakeholders' feedback during TPP may demonstrate the opportunity to better fulfill the guiding principles outlined in this document. Small changes to allocations may be made during TPP at the CAISO staff's discretion.
- The ~~CAISO's~~CEC and CAISO staff's observations and any recommended modifications to identified transmission upgrades from Steps #5a and #5b will be reported in the ~~CEC's~~ mapping results and/or in the CPUC's report.

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CPUC – Step #46

CPUC staff will review the analysis by CEC staff, (Step #5b), as well as observations and recommendations from CAISO staff. (Step #5a) Using the busbar mapping criteria, described in the Implementation of the Busbar Mapping Criteria section belowSection 8 and the resulting portfolio dashboards developed in Step #24, CPUC staff will determine whether the mapping results are ready to be transmitted to the CAISO for TPP, or require a further round of mapping. Resource selections with multiple high priority criteria violations will be considered for adjustments or further rounds of mapping.

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If a further round of mapping is required, CPUC staff may reallocate resources between transmission constraint areas. Such changes should not result in material changes to the expected cost, reliability or emissions performance of the portfolio. This can be implemented and demonstrated by using RESOLVE directly, or manually while mirroring the resource optimization criteria RESOLVE usesDepending on the extent of mapping adjusted required, CPUC staff may seek additional input information for the criteria analysis beginning the round of remapping at Step #2. If relatively minor adjustments are required, CPUC staff may only utilize the criteria information already provided and begin the next round at Step #4.

CPUC Step #7

If the busbar mapping working group determines no further rounds of mapping adjustments are needed in Step #6, the mapping results are ready to be transmitted to the CAISO for the TPP. Mapped portfolios will be adopted and transmitted to the CAISO through a CPUC Decision.

Stakeholder participation:

- Stakeholders will be provided opportunities to comment on this busbar mapping methodology and to review the mapped resource portfolios. Further, stakeholders' feedback during TPP may demonstrate the opportunity to better fulfill the guiding principles outlined in this document. Small changes to allocations may be made during TPP at CAISO staff's discretion.

8. Battery Storage Mapping Steps

Introduction

Mapping battery storage to busbars differs from the methodology for non-battery resources described earlier in this document for reasons including:

- RESOLVE provides some locational information about selected new batteries at a granularity that is equivalent to that of solar PV resources but not as granular as that provided for other generation resource types;
- RESOLVE provides some flexibility in siting storage due to not directly linking the battery storage to solar, wind or other input resources;
- Land use considerations and environmental implications associated with siting batteries are different than for other resources; and

- Busbar mapping of battery storage provides the opportunity to consider local values not modeled in RESOLVE.

The methodology used for mapping batteries is centered around the intersection of policy objectives and commercial interest. The feedback from stakeholders and the lessons learned from the previous mapping effort highlighted a few reasons why this update to the methodology is necessary. They include:

- Busbar mapping of batteries presents an opportunity for proactive planning that helps ensure that the battery storage development contributes to achieving the range of state policy goals – like GHG reduction, reliability, and cost minimization – for which the battery resources were selected in RESOLVE;
- Busbar mapping of batteries also allows batteries to contribute to achieving additional policy goals which were not optimized for in the RESOLVE model (i.e. policy goals that require locational specification of batteries); and
- Busbar mapping of batteries can contribute to addressing issues related to operations and retirements of specific plants located in disadvantaged communities (DACs) and locations with high air quality health impacts.

The execution of the battery mapping effort to achieve the policy objectives will be completed in such a way that they are in accordance with the guiding principles outlined in Section 5: Guiding Principles above. The following sections highlight the proposed policy objectives, the issues to be addressed, and the data required to ensure the execution of the battery mapping will achieve the desired results.

Stakeholders will be provided opportunities to comment on the battery busbar mapping methodology and to review the mapped resource portfolios. Further, stakeholders' feedback during TPP may demonstrate the opportunity to better fulfill the guiding principles outlined in this document. Small changes to allocations may be made during TPP at CAISO staff's discretion.

Battery Mapping Policy Objectives

The RESOLVE model selects a least-cost optimized portfolio that meets a range of system-level policy goals. To remain consistent, it is important that the battery mapping effort is also grounded in a policy objective that ensures costs are minimized.

Policy Objective #1: Minimizing Ratepayer Costs

The first policy objective that will be achieved by this battery mapping effort is a minimization of ratepayer costs. This will be done by maximizing the value of the storage MW and durations selected by RESOLVE as needed to meet system needs, by considering additional locational benefits.

Issues Addressed:

The execution of the battery mapping effort to achieve this policy directive will address the following issues:

- Increasing the amount of co-located battery resources. Generally, co-located batteries are cheaper than stand-alone batteries. The integrated non-battery and battery mapping exercise will be executed in such a manner that siting of co-located batteries will be maximized to the limits of available solar resource for charging and without triggering a need for new transmission development. The meaning of the term "co-located" in this busbar mapping exercise is based on the CAISO tariff definition.
- Reducing congestion. In the CAISO analysis of Local Capacity Requirement (LCR) areas battery resources are proposed as solutions for improving resource dispatch in constrained areas during off peak periods. An additional benefit of siting battery storage resources in LCR areas, particularly LCR areas with solar resources with which the battery resource can be co-located, is to reduce transmission congestion and curtailment (for instance in the Southern California Desert and Southern Nevada zone, where congestion in the off-peak period leads to high curtailment). The mapping exercise will be executed in such a way that these benefits will be evaluated, to the extent possible, when assigning battery resources to LCR areas with congestion.
- Reducing opportunities for market power. For certain LCR areas, local RA price premiums exist when natural gas-fired power plants are needed to provide capacity to local areas. In LCR areas with, or approaching, tight load/resource balances, these power plants may have the opportunity to exert market power (for instance, by seeking market exit but necessitating a reliability must run agreement). The execution of the battery mapping exercise will seek to site battery storage resources in such local capacity areas, which can reduce market power and the local price premiums paid to such resources. Concerns around reliability, particularly given the August 2020 rotating outages, require that some additional consideration will need to be given to the impact of the elimination of such premiums on resource retention needed for both local and system reliability.

Policy Objective #2: Minimizing Criteria Pollutants

The second policy directive is borne out of a desire to use the battery mapping effort to achieve additional policy goals which are not necessarily yet considered explicitly in the RESOLVE modeling. The minimization of criteria pollutants is proposed to utilize the batteries, especially the stand-alone resources. Battery storage mapping is proposed to address a range of localized issues which are not represented in the RESOLVE optimization.

Issues Addressed:
The execution of the battery mapping effort to achieve this policy directive will address the following issues:

- Reduction of local emissions, particularly in areas with high air quality impacts. Siting batteries in these areas can reduce local price premiums for the criteria air pollutant emitting fossil fuel resources, yet those resources may still be required for system RA needs. However, even if emitting plants do not retire, siting batteries in areas with acute air quality concerns has the potential to reduce local power plant emissions, especially in transmission-constrained LCR areas.

Similarly, a consideration is the necessity of the emitting resources for system reliability needs.

- Reduction of emissions in Disadvantaged Communities (DACs). Siting of battery resources specifically within DACs may enable pollution reduction in these communities and may bring potential economic benefits from battery storage development. PU Code Section 454.51 requires the CPUC to "*...adopt a process for each load serving entity…to file an integrated resource plan…to ensure that load serving entities do the following… Minimize air pollutants with early priority on disadvantaged communities...*" among other requirements. LSEs can procure batteries in DACs to prioritize the minimization of air pollutants in these specific communities.

The battery mapping for the 2020-2021 TPP considered LCR areas and the mapping of batteries to ameliorate the issues in those areas. However, the possibility of using batteries to reduce the air quality issues in DACs was not addressed by the methodology utilized to map resources to busbars for the 2020-2021 TPP. The methodology developed for the 21-22 TPP improved on the 2020-2021 TPP battery mapping by explicitly considering the alignment of LCR opportunities with disadvantaged communities and/or those areas facing air quality concerns, and this is maintained in this version of the methodology.

Battery Mapping Steps

The battery mapping steps detailed below will holistically consider the policy directives described in the previous section. The steps represent a direction for assigning both co-located and stand-alone batteries. To complete this task, information on battery opportunities in LCR areas, local air quality, and characterization of DACs will be used. Additionally, the battery mapping effort will coordinate with the non-battery busbar mapping effort to optimize for co-location with solar resources, and to account for availability of transmission headroom, triggering transmission development where it is determined to be cost-effective. The CalEnviroScreen dataset provides information on emissions, air quality, and DAC assignments. This busbar mapping exercise will consider only DACs located within California as defined by SB535[41]. Ozone and PM nonattainment areas data from the EPA Green Book also provide information on air quality burdens for areas outside of DACs. GIS level data on local emissions, DACs, and LCR areas will be needed to ensure the mapping effort is consistent with the available data being used in the non-battery mapping efforts. CAISO Local Capacity Technical studies provide information on opportunities to displace LCR resources with battery storage. The non-battery mapping exercise will provide information on the amount of solar that is mapped to a busbar and the available transmission headroom.

Outline of Battery Mapping Steps

The battery mapping in Step 1 of the process discussed in Section #6 above will be done in two phases:

[41] Available at: https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30

- First Phase: Battery resources will be assigned to zones based on the zonal battery resource selections results from RESOLVE.
- Second Phase: A manual check will be carried out to identify if there is any available transmission headroom which was not reflected in the RESOLVE analysis due to the simplified approach used in interpreting the CAISO transmission deliverability data in RESOLVE. If there is any available headroom, coordination with the non-battery mapping analysis will determine whether battery resources will be assigned to these zones or not.

The battery mapping analysis for Step 1 and Step 2 of the process discussed in Section #6 will utilize the steps described below:

1. Identify primary substation list – substations to be considered and their assigned transmission constraints
    a. This step will utilize the same substations list as the non-battery mapping.
    b. All substations located in identified transmission constraint, with voltage >= 115 kV, unless otherwise indicated in the non-battery mapping.
2. Identify whether the substation is in an LCR area
    a. Batteries mapped to LCR areas will be prioritized based on the CAISO's 2030 Local Capacity Technical study results[42], which show the level of 4-hour battery storage that can provide both system and local capacity value within each LCR area.
        i. The 4-hour battery storage limit represents the amount of 1 MW-for-1 MW replacement of resources that the battery storage resource can achieve while providing both system and local capacity value within the LCR area
        ii. Beyond these 4-hour limits, the battery mapping will also allocate system-only battery resources within the LCR areas, unless the 4-hour battery storage quantity is indicated by CAISO to be a physical constraint for siting in the LCR area.
    b. Assign a value 1 if the substation is in an LCR area.
3. Identify whether the substation is in a DAC
    a. This step will utilize the CalEnviroScreen DAC status
        i. Assign a value 1 if the substation is in a DAC
4. Identify whether the substation is in an air quality standard non-attainment area
    a. This step will utilize the EPA Greenbook data
        i. Assign a value 1 for each of the non-attainment areas for each substation
5. Identify whether the substation is in a zone that has high renewable curtailment
    a. This step will utilize the CAISO 2020-2021 Transmission Planning Process results[43]
    b. Three tiers of curtailment value are used.
        i. Greater than 10% but less than 20% - assign a value 0.25
        ii. Greater than 20% but less than 30% - assign a value 0.5
        iii. Greater than 30% - assign a value 1

[42] Available at: www.caiso.com/Documents/AppendixG-BoardApproved2020-2021TransmissionPlan.pdf
[43] Available in Section 3.7 of the 2020-2021 TPP at: www.caiso.com/Documents/BoardApproved2020-2021TransmissionPlan.pdf

6. Identify whether the substation is in the proximity of a fossil-fueled plant that has been identified by the process established in Thermal Generator Retirement Assumptions, in Section #10
    a. Four tiers of rank values are used
        i. Distance greater than or equal to 7 miles – assign a value of 0.
        ii. Distance greater than or equal to 2.5 miles but less than 7 miles – assign a value of 0.25
        iii. Distance greater than or equal to 0.25 miles but less than 2.5 miles – assign a value of 0.5
        iv. Distance less than 0.25 mile – assign a value of 1
7. Rank all substations in order of highest rank to lowest rank based on sum of all assigned values.
    a. The rank order represents the priority of a substation for consideration of allocation of battery resources.
    b. If there is no available transmission headroom to assign battery resources at a substation the allocation will move to the next highest ranked substation
8. Receive zonal build results from RESOLVE capacity expansion analysis
9. Identify the transmission headroom available for the corresponding transmission constraints for the zone
    a. This step will consider the transmission headroom available for the transmission of each busbar using the most recent TPP base scenario
    b. This step will utilize the most recent CAISO transmission deliverability data
10. Identify commercial interest at that substation
    a. This step will use the CAISO interconnection queue data and the Cluster 14 study data
    b. This step will also utilize information from the non-battery busbar mapping exercise
    c. This step will also utilize the planned procurement indicated in the most recent LSEs' plans
    d. This step will also utilize the previous TPP busbar mapping results
11. Allocate batteries based on the rankings from step 7 using the following order and considerations.
    a. Batteries will first be assigned to substations with transmission headroom and commercial interest and consistency with previous TPP busbar mapping. After these initial considerations, then priority will be given to resources located in LCR areas that will provide both system and local capacity value. The hierarchy followed is shown below
        i. Substations contained within LCR areas, DACs, non-attainment status areas and high curtailment areas
        ii. Followed by substations in descending order of rank
    b. The order of battery allocation is determined by the following considerations for commercial interest
        i. Priority is given to the quantity of high-confidence commercial interest, i.e., resources with allocated transmission plan deliverability (TPD) or executed interconnection agreements.

ii. After this quantity has been exhausted, the quantity of lower confidence commercial interest is referenced, i.e., resources at any stage of development or study in the interconnection queue.

c. If there are still unassigned battery resources after steps a and b have been executed, then batteries will be assigned manually based on further interaction with the non-battery busbar mapping and consistency with previous TPP busbar mapping results. Similar to the non-battery mapping, CPUC staff will consider moving batteries to different regions based on the criteria described above for battery mapping steps.

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~~9.~~8. Busbar Mapping Criteria and Implementation

Busbar Mapping Criteria

The busbar mapping process should result in plausible network modeling locations for the portfolios, assuming the portfolios do not violate predetermined busbar mapping criteria. If the busbar mapping results in any of the criteria not being met, then the violation(s) would require interagency discussion and potentially necessitate the remapping of ~~the IRP portfolios. The busbar mapping~~portfolio resources. The busbar mapping criteria, the guiding principles around the criteria, and the datasets and analytical approach for the criteria are as follows:
~~Distance to~~

- ~~•~~ System level transmission ~~of an appropriate voltage~~
    - ~~o Selected candidate resources should fall within an economically viable distance to transmission; and the resource interconnection path should be viable from an environmental and land use perspective (i.e., path that does not unreasonably cross high-environmental implication areas, water bodies, or dense urban areas) as well as a project size perspective (i.e., a longer gen-tie may be economically feasible for a larger MW amount of selected resources).~~
    - ~~o CEC will flag applicable resources for which the recommended busbar allocation results in an exceedance of a predetermined standard radius (explained below). As described in Section 7: Detailed Busbar Mapping Steps, the exceedance of the predetermined standard radius does not necessarily mean the busbar allocation is not plausible because the resources might still be economically viable with a longer/higher cost gen-tie.~~
- ~~Transmission~~ capability ~~limits~~
    - Selected resource allocation to a given busbar should abide by all the estimated system level transmission constraints that apply to that busbar, triggering only those upgrades which are determined to be cost-effective or necessary to meet policy and reliability requirements. Mapped resources should also utilize existing transmission and selected upgrades optimally and cost-effectively and seek to limit congestion, improve dispatch in locally constrained areas, and co-locate with compatible resources when possible.
    - Transmission capability limits for both ~~"Estimated~~CAISO's estimated Full Capacity Deliverability Status Capability (~~MW)"~~FCDS) and the ~~"Estimated~~estimated Energy Only Deliverability Status Capability (~~MW~~EODS) of identified transmission constraints, the information on previously identified transmission upgrades, and the resource specific output factor assumptions for resources' transmission capability utilization are sourced from the most recent version of the CAISO's white paper – Transmission Capability Estimates for use in the CPUC's Resource Planning Process[44] and the results of the most recently

44 White Paper – ~~2021~~2023 Transmission Capability Estimates for use in the CPUC's Resource Planning Process: Link for the most recent White Paper, ~~revised on~~

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completed TPP Report[45]. Staff will also incorporate updated constraint and upgrade information identified in ongoing TPP and GIDAP studies provided by CAISO staff through working group communications.

- ~~Where busbar mapping utilizes planned substations rather than existing substations, this will be highlighted because of the inherently higher uncertainty regarding the substation in-service date.~~
- Information on locally constrained areas is sourced from the CAISO's analysis of Local Capacity Requirement (LCR) areas using the CAISO's Local Capacity Technical study results. One key dataset particularly for mapping battery storage resources is the results showing the level of 4-hour battery storage that can provide both system and local capacity value within each LCR area. Mapping stand-alone storage up to the CAISO identified limits, renewable resources, and co-located storage to LCR areas will be prioritized particularly in areas where such mapping would aid in the displacing of existing fossil fuel resources.
- Staff will seek to limit mapping large amounts of renewable generation to areas with high renewable curtailment without co-locating storage resources or identifying cost-effective transmission upgrades. Co-locating storage with renewable generation is a transmission criteria mapping priority, as it enables complementary utilization of the CAISO identified transmission capability.
- If mapped resources result in a transmission constraint capability exceedance and the CAISO identified upgrade is assessed to not be cost effective or there is no identified upgrade, then these issues will be flagged and addressed in a further round of mapping. Staff may seek to reallocate resources to other areas with substations that have spare transmission capability or more cost-effective upgrades.
- Busbar mapping process ~~might also identify~~may map resources~~ that cannot interconnect~~ to an existing or planned substation ~~because the resource is triggering~~that mapping analysis shows would trigger a transmission upgrade that has not been previously studied or identified by the CAISO. Such resources will be highlighted, and CAISO staff input will be sought per Step #3, with assumptions and implications documented. During the TPP that follows, the specific assumed interconnection and transmission solutions for those resources should be tested.

- ~~Land use and environmental constraints~~
  - ~~Allocation in each area should not exceed available land area to accommodate the resources, based on environmental information applied in Step #2 above.~~
- Substation level interconnection viability

~~10/28/2021.~~https://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=03DCF912-0ECF-4CF9-A304-A05F4ED5B2CD, posted on 6/29/2023.

45 ~~Most recent CAISO Board approve report: 2021-2022 TPP Report~~ Most recent CAISO Board approve report: 2022-2023 Transmission Plan, https://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=13E8A7DF-2D59-4BAE-9794-C99CC5945FA5, posted on 5/22/2023.

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- Mapped candidate resources should fall within a viable distance of transmission, from economic, land-use, and environmental perspectives and be able to interconnect to transmission of an appropriate voltage in a viable and cost-effective manner.
- Interconnection viability criteria analysis is divided into three aspects:
  - Viable distance to transmission – The resource interconnection path should be viable from an economic perspective, environmental and land use perspective (i.e., path that does not unreasonably cross high-environmental implication areas, water bodies, or dense urban areas), resource type perspective (i.e., longer interconnection paths may be more reasonable for wind and geothermal resources), as well as a project size and interconnecting voltage perspective (i.e., a longer gen-ties may be economically feasible for larger amounts of selected resources connecting to higher voltage transmission).
  - Interconnection to transmission of appropriate voltage – Mapped resources should interconnect to transmission voltage appropriate for the MW number of resources mapped. Staff will seek minimize expected interconnection costs for ratepayers by limiting mapping of small MW amounts to high voltage buses with their higher costs per interconnection and significant MW amounts to lower voltage buses, which are unlikely to be able to accommodate such resources without significant upgrades.
  - Accessibility and costs of interconnecting to the substation-level transmission infrastructure – Mapped resources should utilize cost-effective interconnections to the transmission system. Staff will analyze interconnection opportunities and potential upgrade costs at substations being considered for busbar allocation, considering the number of resources being mapped and potential project sizes. Priority will be given to substations with known available open positions and cost-effective minor upgrades (e.g., in fence line bus expansion). Substations requiring more complex and costly expansions (e.g. beyond existing fence-line upgrades or configuration overhaul) will also be considered along with the potential for new substation development. Mapping to substations at or near their fault/short-circuit duty limits and substations that cannot be expanded will be limited appropriately.
- As necessary, staff will also seek to identify approximate locations and estimated costs of new substations for areas not within interconnection distance of a voltage appropriate existing substation or near substations which cannot be cost-effectively expanded to accommodate additional resource interconnections.
- In conducting this analysis, staff will utilize the CAISO's participating transmission owners (PTOs) per unit cost guides[46] for upgrade cost estimates. Staff will also seek information from the PTOs on substations' available positions, potential need for upgrades, and additional factors that could impact interconnections.

[46] CAISO's 2022 Final Per Unit Cost Guides by PTO, http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=103245F7-FC35-4565-BDF0-193BFFF440E2

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- Commercial interest information will be used to estimate average and likely project MW sizes to incorporate into the interconnection analysis.
- For resources initially mapped to substations that analysis determines to not have an appropriate level of interconnection capability or require major interconnection related upgrades assessed to not be cost-effective, staff will seek to remap those resources to better suited existing or potentially new substations.

- Land-use implications and feasibility
  - Resources allocated should not exceed available land area to accommodate the resources within the viable distance of the substation and should limit the potential implications, i.e., potential impacts to or conflicts with existing and future land use applications. Mapping will prioritize areas of lower potential land-use implications and higher feasibility for resource development, while seeking to limiting locating resources to areas of high potential implications and likely more difficult development potential.
  - Staff will incorporate the following geospatial datasets and analysis for the land use feasibility criteria:
    - CEC's Core Land-use Screen – This land-use screen addresses several state policy priorities, including sustaining agriculture and protecting natural lands that support biodiversity. CEC staff developed this screen by incorporating geospatial analyses representing land-use planning considerations related to biodiversity, croplands, landscape intactness, and terrestrial climate resilience on top of a base exclusion layer consisting of technical-economic exclusions and administratively protected areas. The details of this screen and its development are found in the CEC's Land Use Screens Report. Mapped resources should avoid areas of high potential implications as identified by this screen or fulling utilizing the low potential implication area. Staff seek to prioritize resource mapping that utilizes only a limited portion of the low potential implications area within the identified distance of the selected substation.
    - Parcelization – In collaboration with stakeholders, the CEC staff have developed a parcelization dataset that assesses how fragmented into separate property tracks land for potential resource development is. An area of many small parcels has high parcelization while an area of fewer large parcels has low parcelization. Priority will be given to low parcelization areas due to their higher commercial development attractiveness, both in terms of fewer landowners for the generation site, and fewer landowners for the interconnection path route to the substation. However, it should be noted that current solar development indicates that development is possible on a moderate amount of parcelization. Therefore, these areas will not be excluded. Mapped resources should seek to avoid mapping to areas of high parcelization. The details of this screen and its development are found in the CEC's Staff Report on parcelization.[47]

[47] To be released by CEC staff. https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=21-SIT-01

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- CEC's Cropland Index Model – This model developed by CEC staff as part of the CEC's Land Use Screens Commission Report evaluates land used to produce crops using several datasets. The index model identifies cropland with higher and lower implications to screen out areas with more factors that support high-value cropland. In identifying substations for resources, staff seek to prioritize mapping to areas in the lower potential implications category. Staff do not seek to exclude mapping resources to areas of higher implications, noting that such lands may still be suitable and attractive for development particularly in areas facing significant water scarcity as identified by the next dataset.
- Critically Overdrafted Ground Water Basins[48] – Groundwater basins subjected to critical overdraft as defined by the Sustainable Groundwater management Act (SGMA)[49] and identified by the California Department of Water Resources. Within critically overdraft basins, local management agencies are charged with achieving groundwater sustainability through integrated land-use planning and repurposing agricultural lands to less water intensive uses, one of which is clean energy development. When mapping solar resources, staff seek to prioritize mapping to areas within a critically overdrafted basin; however, staff are not seeking to limit mapping to areas that are not in critical overdraft.
- High Fire Threat – The CPUC Fire-Threat Map[50] was developed and adopted by CPUC Decision D.17-01-009, as changed by D.17-06-024, and most recently updated in 2021. When mapping resources, staff will seek to limit mapping resources to and corresponding potential transmission upgrades in extreme and elevated fire threat districts.

- The geospatial analysis methods used to incorporate CEC's Core Land-use Screen and CEC's Cropland Index Model into the criteria analysis are outlined in the CEC's Land Use Screens Commission, while the Parcelization Staff Paper outlines the analysis methods for the parcelization dataset.
- Staff will seek to identify areas not within interconnection distances of existing substations that have very low implications and very favorable criteria alignment to assess the potential and cost-effectiveness of mapping resources to a proposed new substation in the location.
- If the available land area is insufficient to accommodate selected resources within reasonable distance to the substation, or if the resources have high ~~environmental~~potential implications, then these issues will be flagged and addressed in a further round of mapping. Possible solutions may include increasing the gen-tie beyond the standard radius for the particular resources if their interconnection cost estimates allow or ~~re-optimizing the IRP portfolio(s)~~

[48] "Critically Overdrafted Basins" (2020). California Department of Water Resources. https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118/Critically-Overdrafted-Basins
[49] "Overview of the Sustainable Groundwater Management Act (SGMA)." California Department of Water Resources. https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management
[50] "CPUC High Fire-Threat District Map" (Revised 8/19/2021). California Public Utilities Commission. https://www.cpuc.ca.gov/industries-and-topics/wildfires/fire-threat-maps-and-fire-safety-rulemaking

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~~with updated assumptions about resource potential informed by this busbar mapping process~~remapping the resources to other more favorable substation.

- Environmental (conservation and biological) impact factors
    - The overall purpose of this criteria is a more detailed breakdown of several datasets utilized in the CEC's Core Land-use Screen to identify high implications for conservation and biological diversity planning priorities. Resources mapped should not exceed the amount of lower potential implications areas of the conservation and biological diversity datasets. Mapping will prioritize resources amounts that utilize only a certain percentage of the lower potential implication areas to avoid potential development impacts to areas of higher potential implications.
    - Staff will incorporate the following geospatial datasets and analysis for the conservation and biological environmental impact factors:
        - California Department of Fish and Wildlife's (CDFW's) Areas of Conservation Emphasis (ACE) Terrestrial Connectivity[51], Biodiversity[52], and Irreplaceability[53] – These three datasets represent the states biological diversity planning priorities. In mapping resources, staff seek to avoid mapping to areas of high implication for each of these datasets represented by ranks 4 and 5 for ACE Connectivity, rank 5 in ACE Biodiversity, and ranks 4 and 5 for ACE Irreplaceability and prioritizing mapping resource amounts that utilize only a limited percentage of the lower implication area around the selected substation.
        - Terrestrial Landscape Intactness[54] – A measure of landscape condition based on the extent to which human impacts such as agriculture, urban development, natural resource extraction, and invasive species have disrupted the landscape across California developed by the Conservation Biology Institute utilizing a multicriteria evaluation model using more than 30 data layers. As with the ACE data layers, staff seek to avoid mapping to areas of high implications and prioritize mapping resource amounts that utilize only a limited percentage of the lower implication area.
        - Wetlands[55] – Mapped resources should avoid impacting lands classified as wetlands and staff seek to prioritize mapping to areas that do not have large portions of the potential development land categorized as wetlands.

[51] "Terrestrial Connectivity" (2018). California Department of Fish and Wildlife. https://wildlife.ca.gov/Data/Analysis/Ace#523731772-connectivity
[52] "Terrestrial Biodiversity Summary" (2018). California Department of Fish and Wildlife. https://wildlife.ca.gov/Data/Analysis/Ace#523731770-species-biodiversity
[53] "Terrestrial Irreplaceability" (2018). California Department of Fish and Wildlife. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=150816&inline
[54] Degagne, R., J. Brice, M. Gough, T. Sheehan, and J. Strittholt. 2016. "Terrestrial Landscape Intactness 1 km, California." Conservation Biology Institute. From DataBasin.org: https://databasin.org/datasets/e3ee00e8d94a4de58082fdbc91248a65.
[55] "Habitat and Land Cover (FVEG Derived)" (2022) CA Nature. https://www.californianature.ca.gov/maps/habitat-and-land-cover-fveg-derived

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- As with the datasets utilized for the land-use feasibility criteria, the geospatial analysis methods used to incorporate these datasets into the criteria analysis are outlined in the CEC's Land Use Screens Report.
- Staff will assess both the percentage of area of lower and higher implications that the mapped resources would potentially utilize and the net percentage of higher and lower implications resource potential area around the identified substation. Utilizing a large percentage of the available lower implication land and mapping to a location that has a large percentage of the land around the substation with higher implications can both increase the implications for potential conflicts with the alterative land uses.
- Staff will seek to remap resources that have high potential implications to substations that have more low potential implications area available or, if the interconnection cost estimates permit, increase the gen-tie beyond the standard radius for the particular resources.

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Note: Many of the datasets implemented by CEC staff for the above land-use feasibility and environmental impact factors criteria have limited geographic extent (datasets are California-specific). A separate dataset, the Western Electricity Coordinating Council (WECC's) Environmental and Cultural Considerations Data Layer[56] will be used to identify the potential environmental and land use implications of the renewable resources mapped out-of-state. For out-of-state areas, the WECC environmental data later will be applied in a similar manner as the CEC's Core Land-use Screen by seeking to avoid mapping to WECC's Environmental Risk Category 3 (High Risk of Environmental or Cultural Resource Sensitivities and Constraints) [57] and prioritizing limited utilization of land ranked as WECC Environmental Risk Category 2 (Low to Moderate Risk of Environmental or Cultural Resource Sensitivities and Constraints). For future busbar mapping efforts staff are seeking to develop a more robust set of data layers and analysis for out-of-state resources comparable to the in-state data analysis.

- Community and environmental (societal) impact factors
  - Mapped resources should seek to bolster and benefit pollution-burdened and disadvantaged communities where feasible, particularly by reducing emissions and impacts of air-pollutant emitting fossil-fuel generators.
  - For the community and societal environmental impact factors criteria analysis, staff will incorporate the following datasets:

[56] "Environmental and Cultural Consideration Datasets" (2015). Western Electricity Coordinating Council. https://www.wecc.org/SystemAdequacyPlanning/Pages/Environmental-and-Cultural-Considerations.aspx
[57] "Environmental Data Layer Description" (2014). Western Electricity Coordinating Council. https://ecosystems.azurewebsites.net/WECC/Environmental/Environmental_References.html

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- SB 535 Disadvantaged Communities – CalEnviroScreen 4.0 dataset[58] identified disadvantaged communities.
- Inflation Reduction Act Energy Communities – As established under the Inflation Reduction Act, includes places with a history of employment in fossil fuel industries and higher unemployment than the U.S. average.
- Air Quality Standard Non-Attainment Areas – Ozone and $PM_{2.5}$ non-attainment areas from the U.S. Environmental Protection Agency's Green Book[59] datasets.
- Proximity to existing thermal generator – Staff will identify the proximity of substations to existing fossil-fueled thermal plants, with priority given to resources identified through the Thermal Generation Retirement Assumptions in Section 9.

  - Staff will identify substations and areas within these criteria and give priority to mapping resources to those substations particularly if the resources could assist in reducing the use of existing fossil-fueled thermal resources. Staff will not seek to limit or avoid mapping to areas not identified as within these criteria.

- Commercial development interest
  - To the extent possible, busbar allocations should reflect the planned procurement indicated in LSEs' plans and the level of commercial interest in the CAISO and other relevant interconnection queues including queues from other Balancing Area Authorities and participating transmission operators, as well as projects in advanced stages of development that may not be reflected in the interconnection queues identified through working group communications.
  - In considering commercial interest, the ~~CPUC~~staff will:
    - Compare selected portfolio resources to interconnection queues and other sources of potential projects, on a busbar basis.
    - ~~Take into account~~Consider the stage of development as well as the expected online date of the commercial interest.
    - Prioritize alignment with ~~"high-~~in-development resources, which are resources contracted by LSEs or identified as under construction by PTOs but are not in the current modeling baseline, and other "higher confidence" commercial interest. "~~High-~~Higher confidence" commercial interest ~~is defined by those~~are projects that have been assigned transmission plan deliverability (TPD) by the CAISO or resources that have an executed interconnection agreement executed~~, followed by resources specifically identified in LSE plans.~~. Projects that ~~are in~~have executed IAs or have completed Phase II in the CAISO interconnection queue have the next level

[58] "SB 535 Disadvantaged Communities" (2022). California Office of Environmental Health Hazard Assessment. https://oehha.ca.gov/calenviroscreen/sb535
[59] "Nonattainment Areas for Criteria Pollutants (Green Book)" (2023). U.S. Environmental Protection Agency. https://www.epa.gov/green-book

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of priority~~. Finally, commercial~~, followed by resources identified in LSE plans but not yet contracted.

- Commercial interest represented by projects in Phase I in the CAISO interconnection process or that have not completed any interconnection studies by their respective balancing area authority or transmission owner are weighted as "lower confidence" commercial interest. While not prioritized for mapping, staff use these resources as guidance for areas of commercial development interest.
- Flag any busbars which have large portfolio selection but no commercial interest or a selected resource amount that is significantly lower or higher than the amount of commercial interest at the substation prioritizing "~~high-~~higher confidence" commercial interest.

- Busbar allocations occurring at busbars with no commercial interest or that deviate significantly from the amount of commercial interest may be adjusted in a further round of mapping.

- Consistency with prior ~~year~~TPP portfolios
  - Busbar allocations for equivalent TPP cases should be relatively consistent year to year: for example, Base Cases from one year to the next; and Policy-driven Sensitivity Cases exploring the same issue from one year to the next. Where large changes are necessary, the reasons for these should be clear. Staff should consider whether changes are occurring due to exogenous factors (e.g., demand or resource cost shifts) or due to modeling margin of error. Where significant reductions are proposed in the resource mapping from one year to the next, these should be explicitly justified.

Detailed criteria thresholds applied for each dataset noted above are described in the next section below. The overall mapping goal is to maximize compliance across all these criteria groups with generally no one group taking automatic precedence over the others. Busbar mapping working group staff will seek to address mapped resources not aligned with criteria on an individual situation basis and work to assess if alternative mapping locations would improve alignment within the non-aligned criteria without decreasing overall criteria alignment.

Implementation of the Busbar Mapping Criteria

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 above. This informs whether changes to the allocation may be required. An assessment using the criteria will be 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.~~ with a mapped resource' compliance with the criteria delineated by the five levels of criteria alignment listed below:

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1. Distance to transmission of an appropriate voltage
    a. Level 3 non-1 – Strong compliance threshold (i.e., exceedance of this threshold results in Level 3 assessment):
        i. Resources for which the busbar allocation results in viable gen-tie lengths that exceed a 20-mi. threshold (standard radius) approximated from the 90th percentile for planned solar and wind facilities.[60,61,62]
    b. Level 2 non-compliance threshold:
        i. Resources for which the busbar allocation results in viable gen-tie lengths that exceed a 10-mi threshold (standard radius) approximated from the 75th percentile distances for planned solar and wind facilities.
    c. Consideration of busbar voltage: When assessing distance staff will check the voltage of the busbar to ensure the combination of gen-tie length and interconnection voltage broadly align with the interconnection cost allowed for in the resource's selection. Accordingly, assessment of compliance with this criterion should not be based solely on the standard radius; in general, the thresholds above apply to busbar voltages in the range of 115-230kV. Further, staff should look for opportunities to minimize expected costs for ratepayers, for example by mapping to a busbar that may be more distant yet with a lower voltage than the alternative busbar.
        i. Resources allocated to a busbar which exceeds 230kV will initially be considered Level 2 non-compliance and assessed for opportunities to re-map to lower voltage busbar.
    d. Consideration of the MW amount of selected resources mapped to substation: When assessing interconnection distance and cost, staff will also consider the MW amount of resources selected at a substation and the per MW cost of interconnection. A small MW amount of a selected resource may economically require a shorter gen-tie distance or a lower voltage busbar than a potential larger project of the same resource type.
    e. For out-of-state resources staff will take the following approach:
        i. For out-of-state land area availability
            1. Use spatial wind and solar resource potential information and the WECC environmental data viewer[63] to assess distance to transmission
            2. Note this source identifies four levels of environmental risk. from 1-4, with 1 representing least risk, and 4 representing

[60] 90th percentile of planned facilities, per publicly available filings: EIA (last) (2019). Preliminary Monthly Electric Generator Inventory (Based on FormEIA-860M as a Supplement to Form EIA-860).[Online]. Available at: https://www.eia.gov/electricity/data/eia860m/.11

[61] Spatial analysis was performed to check the interconnection distances for existing and planned solar facilities in the U.S. Source data for existing solar facilities: USGS "National Solar Arrays" https://www.sciencebase.gov/catalog/item/57a25271e4b006eb45553efa. Source data for planned facilities: U.S. Energy Information Administration, Form 860, public filings https://www.eia.gov/electricity/data/eia860m/.11

[62] Spatial analysis was performed to check the interconnection distances for existing and planned wind facilities in the U.S. Source data for existing wind facilities: USGS national wind turbine database "USWTDB" https://doi.org/10.5066/F7TX3DN0. Source data for planned facilities: U.S. Energy Information Administration, Form 860, public filings https://www.eia.gov/electricity/data/eia860m/.11

[63] https://ecosystems.azurewebsites.net/WECC/Environmental/

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~~greatest risk (areas where development is currently prohibited by existing law or regulation).~~[64]

~~2. Transmission capability limits~~
~~a. Level 3 non-compliance threshold:~~
~~i. Selected resource exceeds transmission capability for the applicable transmission constraints (FCDS or EODS)~~
~~b. Level 2 non-compliance threshold~~
~~i. Selected resource exceeds transmission capability for the applicable default transmission constraint~~

- ~~Note: If the selected resources exceed transmission capability for the applicable transmission constraints but the exceedance is alleviated by a transmission upgrade determined to be cost-effective or necessary then the selected resources are considered compliant with the~~ criteria, alignment with criteria's prioritized or favorable conditions.

~~3a. Available land area~~
~~a. Level 3 non-compliance threshold:~~
~~i. Exceeds 75% of candidate project area land within the standard radius~~
~~ii. For out-of-state resources, Level 3 flags are assigned when mapped resources exceed 75% of the total available resource acreage in that radius.~~
~~b. Level 2 non-compliance threshold:~~
~~i. Resources for which the busbar allocation results in exceedance of 50% of the low-value land area estimated to be available to accommodate a resource~~
~~ii. For out-of-state resources, a Level 2 flag occurs when the mapped resources for a substation exceed 50% of the available low implication land. WECC Risk Class 2 was used as a proxy for "low implication land" (low to moderate risk).~~

~~3b. Environmental Impact~~
~~a. Level 3 non-compliance threshold:~~
~~i. Exceeds 75% of high-value land (terrestrial) in the resource potential areas within the standard radius, for four or more, or 95% for two or more of the following:~~
~~1. Intactness~~
~~2. Biodiversity~~
~~3. Connectivity~~
~~4. Rarity~~
~~5. Native species~~
~~6. Audubon Important Bird Areas (IBA)~~
~~7. Important habitat~~
~~8. Wildfire threat~~
~~9. Irreplaceability~~

~~b. Level 2 non-compliance threshold:~~

~~[64] https://ecosystems.azurewebsites.net/WECC/Environmental/Environmental_References.html~~

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~~i. Resources for which the busbar allocation results in 75% of two or more, or 95% or more of one~~

~~Notes regarding available land area and available low-value land area criteria:~~

- ~~Refer to the approaches described above for criterion 1, for out-of-state resources, which are also applicable for criteria 3a and 3b~~
- ~~If based on review of the portfolios, these thresholds turn out to be too low (for example, if approximately half or more of the new resources get flagged at level 3 non-compliance, and this would trigger further rounds of mapping of a large portion of the portfolio, creating a major departure from the logic and optimization objective within RESOLVE), then staff may adjust these thresholds accordingly~~

~~4. Commercial interest~~

~~a. Level 3 non-compliance threshold:~~

~~i. Selected resource (any amount) at a busbar without any commercial interest; or~~

- ~~Commercial interest at selected busbar is evident, yet selected~~Level 2 – Mostly favorable compliance with criteria, not fully aligned with prioritized conditions but not near to triggering unfavorable criteria conditions.
- Level 3 – Mixed compliance with criteria, little alignment with prioritized conditions, potential alignment with conditions criteria seek to limit or avoid.
- Level 4 – Some noncompliance with criteria, some alignment with conditions criteria seeks to limit or avoid.
- Level 5 – Significant noncompliance with criteria, no alignment with stated criteria, fully meets conditions criteria seek to limit or avoid.

Some criteria assessments will not utilize all five levels of compliance alignment. Those criteria consist of mapping priorities and staff are not seeking to limit or avoid nonalignment with those specific conditions. The criteria data are not available for all resources and all substations. Blank cells and cells labeled "n/a" are shown in the dashboards where there is insufficient data to assess compliance.

Detailed descriptions of the thresholds for compliances levels of the criteria are listed below. Some thresholds have values explicitly set in the descriptions while other thresholds will be set during the mapping process as they rely on mapping specific information and information that will be obtained through the mapping process.

1. **System level transmission capability criteria thresholds:**

   FCDS and EODS transmission constraint limits exceedances – alignment thresholds will be assessed for the FCDS and EODS transmission capabilities separately.

   a. Level 1 alignment: No exceedance in transmission constraint capability
   b. Level 2 alignment: No exceedance with identified cost-effective transmission upgrade
   c. Level 3 alignment: Minor exceedance in a default constraint limit
   d. Level 4 alignment: Large exceedance in a default constraint limit

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e. Level 5 alignment: Exceedance in actual constraint limit where identified transmission upgrade has been assessed to be not cost-effective

Mapping to LCR areas – alignment thresholds center on the selected substation's location in an LCR area and the amount and type of mapped resources.

a. Level 1 alignment: Mapped resources are stand-alone storage that is within the CAISO identified 4-hr charging limit amount, renewable, or co-located storage in an LCR area where gas is the primary resource displaced
b. Level 2 alignment: Same requirement as for Level 1 alignment but an identified cost-effective transmission upgrade enables stand-alone storage beyond the charging limit
c. Level 3 alignment: mapped resources are outside an LCR area
d. Level 4 alignment: mapped stand-alone storage exceeds the CAISO identified charging limit and no cost-effective upgrade is identified

2. **Substation level interconnection viability criteria thresholds:**

Distance to interconnection point – Distance criteria alignment is both expected project size dependent and resource type dependent with further distances being considered still economically for larger projects and for wind and geothermal resources.

a. Level 1 alignment:
    i. Solar: Area is ≤ 5 miles from substation
    ii. Wind & Geothermal: Area is ≤ 10 miles from substation
b. Level 2 alignment:
    i. Solar: Area is ≤ 10 miles from substation (≤ 15 miles for area with potential projects size of ≥ 400 MW)
    ii. Wind & Geothermal: Area is ≤ 15 miles from substation (≤ 20 miles for area with potential project size ≥ 200 MW)
c. Level 3 alignment:
    i. Solar: Area is ≤ 15 miles from substation (≤ 20 miles for area with potential project size of ≥ 400 MW)
    ii. Wind & Geothermal: Area is ≤ 15 miles from substation (≤ 20 miles for area with potential project size ≥ 200 MW)
d. Level 4 alignment:
    i. Solar: Area is ≤ 20 miles from substation (≤ 30 miles for area with potential project size of ≥ 400 MW)
    ii. Wind & Geothermal: Area is ≤ 30 miles from substation (> 30 miles for area with potential project size ≥ 200 MW)
e. Level 5 alignment:
    i. Solar: Area is > 20 miles from substation (> 30 miles for area with potential project size of ≥ 400 MW)
    ii. Wind & Geothermal: Area is > 30 miles for potential project size < 200 MW

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Substation interconnection ease/feasibility – For substations that PTOs are able to provide the necessary information, the following criteria alignment levels will be applied:

a. Level 1 alignment:
    i. Existing open bus positions or bays can likely accommodate the mapped resources MW amount and estimated number of interconnections
b. Level 2 alignment:
    i. Cost-effective minor substation upgrades or new substation development can likely accommodate the mapped resources MW amount and estimated number of interconnections
c. Level 3 alignment:
    i. Larger or more complex upgrades can likely accommodate the mapped resources MW amount and estimated number of interconnections cost-effectively
d. Level 4 alignment:
    i. Larger or more complex upgrades are required but have been assessed as likely not cost effective for the MW amount and estimated number of interconnections.
e. Level 5 alignment:
    i. Substation cannot accommodate additional interconnections with no feasible upgrade identified.

Interconnection Voltage – The following alignment level thresholds will be applied; however, specific numerical values may be substation or PTO dependent and will be established during the mapping process following incorporation of interconnection cost analysis and information solicited from the PTOs. Interconnection voltage analysis also links close with the interconnection ease and feasibility analysis and serves as a secondary set of criteria of substation where more detailed interconnection information is not available.

a. Level 1 alignment: Mapped resources interconnect to a substation with voltage greater than 100 kV within the range of MW amounts
b. Level 2 alignment: Mapped resources interconnection to a substation with voltage greater than 100 kV at a lower MW amount likely increasing interconnection costs per MW
c. Level 3 alignment: Mapped resource amount is more than the substation's voltage can likely accommodate and may require substation upgrades
~~ii.~~d. Level 4 alignment: Mapped resource amount is significantly ~~higher than the amount of commercial interest by an amount to be specified at the time of mapping.~~ more than the substation's voltage can accommodate and likely requires major substation upgrades to accommodate resources
    ~~iii. Selected~~Level 5 alignment: Mapped resources ~~mapped~~interconnect to ~~the busbar are significantly lower~~a substation with voltage less than ~~the~~100 kV, or only a small MW amount of ~~"high-confidence" commercial interest at the substation.~~

~~b. Level 2 non-compliance threshold:~~
~~i.~~e. ~~Commercial interest at selected busbar is evident and comparable to the amount of selected~~ mapped resources ~~mapped, but selected resource amount is higher~~

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than the "high confidence" commercial interest by an amount to be specified at the time of mapping.interconnect to a 500 kV substation

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3. **Land-use feasibility criteria thresholds:**

ii.CEC Core Land-Use Screen – Alignment thresholds are centered on mapped resources mapped to the busbar are significantly lower than the amount of commercial interest at the substation.

iii. **Commercial** interest at selected busbar is evident but the expected online date is a year or more later than the portfolio's resources' online date.

iv. No commercial interest at selected busbar, but selected resource's modeled online date is beyond expected online dates for any commercial interest.

5. Consistency with prior year's mapping

a. Level 3 non-compliance threshold:

i. 500 MW or greater or a 50% or greater reduction from prior year's base case portfolio (to identify material absolute changes from prior year's mapping or changes that may be smaller in absolute terms yet are still significant in percentage terms) utilization of lower and higher implications areas:

a. Level 1 alignment: Mapped resource amount would utilize less than 20% of the lower implications area

b. Level 2 non-compliancealignment: Mapped resource amount would utilize less than 50% of the lower implications area

c. Level 3 alignment: Mapped resources amount would utilize less than 80% of the lower implications area

d. Level 4 alignment: Mapped resources amount would utilize less than 10% of the higher implications area

e. Level 5 alignment: Mapped resources amount would utilize greater than 10% of the higher implications area

b. Parcelization – Alignment thresholds center on mapped resources utilization of low parcelization areas (parcels with a value of 6 or lower) and medium (parcels with a values of 6 to 30) parcelization areas. For higher alignment thresholds the identified substation must have a lower 10th percentile parcelization as well. This additional threshold: seeks to reflect overall landscape parcelization near the substation and potential interconnection impacts of higher parcelization.

i. Any reduction from prior year's base case portfolio

ii. Level 3 non-compliance can be reduced to level 2 in subsequent rounds of mapping, if the working group determines that the reduction from the prior year's base case portfolio significantly improves other criteria compliance, does not significantly reduce the total resources mapped to an area when compared to the previous base case, or would be unlikely to significantly impact the results of the previous TPP study.

a. Level 1 alignment:

i. Mapped resource amount would utilize less than 20% of the available low parcelization area

ii. Substation's 10th percentile value is less than 12

b. Level 2 alignment:

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i. Mapped resource amount would utilize less than 80% of the available low parcelization area
ii. Substation's 10th percentile value is less than 20

c. Level 3 alignment:
i. Mapped resource amount would utilize less than 20% of the available mid parcelization area
ii. Substation's 10th percentile value is less than 30

d. Level 4 alignment:
i. Mapped resource amount would utilize less than 80% of the available mid parcelization area

e. Level 5 alignment:
i. Mapped resource amount would utilize more than 80% mid parcelization area

CEC's Cropland index – Alignment thresholds center on mapped resources utilization of low and high value cropland areas. Higher alignment thresholds also factor in overall cropland value percentages around the mapped to substation.

a. Level 1 alignment:
i. Mapped resource amount would utilize less than 20% of lower value cropland
ii. The total resource potential acreage is less than 50% high value cropland

b. Level 2 alignment:
i. Mapped resource amount would utilize less than 50% of lower value cropland
ii. The total resource potential acreage is less than 75% high value cropland

c. Level 3 alignment: Mapped resource amount would utilize less than 100% of non-high value cropland

d. Level 4 alignment: Mapped resource amount would utilize less than 50% of high value cropland

e. Leve 5 alignment: Mapped resource amount would utilize more than 50% of high value cropland

Critically overdrafted groundwater basin – alignment thresholds center on area within mapping distance of identified substation inclusion in a critically overdrafted groundwater basin.

a. Level 1 alignment: The majority of the area around the substation is in a critically overdrafted groundwater basin

b. Level 2 alignment: The majority of the area around the substation is not in a critically overdrafted groundwater basin

Fire threat district – alignment thresholds center on percentage of total area in the mapping radius of identified substation within the high fire threat district.

a. Level 1 alignment:
i. Less than 20% of the area around the substation is within the Tier 2 fire threat district, and
ii. No Tier 3 fire threat district

b. Level 2 alignment:

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i. Less than 50% of the area around the substation is within the Tier 2 or 3 fire threat district, and
ii. Less than 10% of the area is within Tier 3

c. Level 3 alignment:
i. Less than 75% of the area around the substation is within the Tier 2 or 3 fire threat district, and
ii. Less than 20% of the area is within Tier 3

d. Level 4 alignment:
i. Less than 75% of the area around the substation is within the Tier 2 or 3 fire threat district, and
ii. Less than 30% of the area is within Tier 3

e. Level 5 alignment:
i. Greater than 75% of the area around the substation is within the Tier 2 or 3 fire threat district, or
ii. Greater than 30% of the area is within Tier 3

4. **Environmental (conservation and biological) impact factors criteria thresholds:** The five datasets included in the conservation and biological impact factors criteria analysis (ACE terrestrial connectivity, ACE biodiversity, ACE irreplaceability, terrestrial landscape intactness, and wetlands) will use the same thresholds identified below. Each alignment level has two analysis thresholds: one centered on the percentage of high and low implications area utilized by the mapped resource amount and the other centered on the total amount of high implications area around the substation. Both analyses are conducted using the radius distance from the substation determined in the viable distance criteria analysis.

a. Level 1 alignment:
i. Mapped resource amount would utilize less than 20% of the lower implications area within the identified appropriate distance from the substation.
ii. < 50% of the total resource potential area around the substation has higher implications.

b. Level 2 alignment:
i. Mapped resource amount would utilize less than 50% of lower implications area.
ii. Total resource potential area is less than 70% higher implications.

c. Level 3 alignment:
i. Mapped resource amount would utilize less than 75% of lower implications area.
ii. Total resource potential area is less than 90% higher implications.

d. Level 4 alignment:
i. Mapped resource amount would utilize less than 10% of Higher implications area.
ii. Total resource potential area is less than 95% higher implications.

e. Level 5 alignment:
i. Mapped resource amount would utilize greater than 10% of Higher implications area.
ii. Total resource potential area is greater than 95% higher implications.

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Note: If based on review of the portfolios, ~~these thresholds~~the thresholds for the environmental impact factors or the land-use feasibility factors turn out to be too low (for example, if approximately half or more of the new resources get flagged at level ~~3 non-compliance~~4 alignment or higher, and this would trigger further rounds of mapping of a large portion of the portfolio, creating a major departure from the logic and optimization objective within RESOLVE), then staff may adjust these thresholds accordingly.

5. Environmental (Societal) and community Impacts Criteria Thresholds:

Disadvantaged Communities – alignment thresholds center on whether the majority of the area around selected substation is in or near an identified disadvantaged community.

a. Level 1 alignment: majority of area around substation located within a disadvantaged community
b. Level 2 alignment: majority of area is within 5 miles of a disadvantaged community
c. Level 3 alignment: majority of area is greater than 5 miles from a disadvantaged community.

IRA Energy Communities – alignment thresholds center on whether the area around the selected substation is in an identified IRA energy community.

a. Level 1 alignment: located in Energy Community
b. Level 2 alignment: not located Energy Community

Air Quality Non-Attainment District – alignment thresholds are applied for both Ozone and $PM_{2.5}$ datasets and center on whether the area around the selected substation is within the respective Air Quality Non-Attainment District.

c. Level 1 alignment: located in Air Quality Non-Attainment District
d. Level 2 alignment: not located Air Quality Non-Attainment District

Proximity to Existing Thermal Generator – alignment threshold center on location of substation of interconnection for mapped resources proximity to an existing fossil-fueled thermal generator.

a. Level 1 alignment: adjacent to an identified thermal generator
b. Level 2 alignment: less than 10 miles from an identified thermal generator
c. Level 3 alignment: greater than 10 miles from an identified thermal generator

6. Commercial Development Interest Criteria Thresholds: Alignment analysis for commercial development interest is bifurcated into identifying mapped resource that exceeds commercial interest and that is significantly less than commercial interest. Alignment thresholds are dependent on both magnitude of misalignment and the confidence of the commercial interest. Specific threshold values for the alignment levels will be determined during the mapping process following analysis of the most up to date interconnection queues.

a. Level 1 alignment:
    i. Mapped resources align with in-development resources and commercial interest with TPD or an executed IA
    ii. (1+): Amount mapped is significantly less than the total commercial interest

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b. Level 2 alignment:
   i. Mapped resource amount exceeds the amount of commercial interest with TPD or an executed IA
   ii. (2+) Amount mapped is less than higher confidence commercial interest by a to be specified MW amount
c. Level 3 alignment:
   i. Mapped resource amount exceeds the amount of higher confidence commercial interest
   ii. (3+) Amount mapped is less than the amount of commercial interest with TPD or an executed IA by a to be specified amount
d. Level 4 alignment:
   i. Mapped resource amount exceeds the total amount of commercial interest
   ii. (4+) Amount mapped is significantly less than the amount of commercial interest with TPD or an executed IA by a to be specified amount
e. Level 5 alignment:
   i. There is no commercial interest at the substation where resources are mapped

7. **Consistency with Prior TPP Portfolio Criteria Thresholds:** Alignment thresholds center on the amount and type of mapped resources at the selected substation compared to the amount and type mapped in the previous TPP portfolios.
   a. Level 1 alignment
      i. Mapped resources amount is greater than or equal to the amount in most similar previous TPP portfolio
   b. Level 2 alignment
      i. Mapped resources amount is greater than or equal to the FCDS and Total amounts mapped in the previous base case
   c. Level 3 alignment
      i. Mapped resources amount is only slightly less than the FCDS or total mapped in previous base case
   d. Level 4 alignment
      i. Mapped resources amount is significantly less than in previous base case
   e. Level 5 alignment
      i. Same threshold has Level 4 alignment and is mapped to a substation within a constraint with a previously identified or approved transmission upgrade

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~~10.~~9. Other TPP Assumptions

Thermal Generator Retirement Assumptions

RESOLVE reports the aggregate amount of thermal generation not retained (due to economic optimization) by resource category. Unit-specific information is not modeled. Because the TPP studies require modeling of specific units and locations, CPUC staff will ~~apply~~consider the following ~~steps to~~metrics to determine which thermal units will be affected by RESOLVE's aggregate data on thermal generation not retained, in order to specify in the transmitted portfolios which units should be assumed as retired for transmission planning purposes:

~~1. Rank all existing thermal generation units by age in the categories of combined cycle (CCGT), combustion turbine (Peaker), reciprocating engine (ICE) and combined heat and power (CHP). Staff recognizes there are additional economic considerations on CHP operations.~~

1. ~~Model offline the oldest units, up to but not exceeding the total amount selected in RESOLVE, broken down by resource category up to the limits below. While CHP is not specifically modeled in RESOLVE and therefore cannot be one of the thermal generator types not selected for retention, CHP often operates similarly to a CCGT unit, so CPUC staff will retire CHP and CCGT up to the limit for the CCGT category in the table below.~~Age-based retirements: Considering the relative age of the individual thermal units.
2. Pollutant/non-attainment List: Considering the location of individual thermal units within criteria pollutant and non-attainment areas.
3. Disadvantaged Communities (DACs) List: Considering the location of individual thermal units within DACs areas.
~~2.~~4. Local Capacity Requirement (LCR) Area: Considering the location of individual thermal units within areas that are flagged as needing local capacity for reliability purposes.

~~3.~~ CPUC staff will share the specific list of retired units with CAISO, and if necessary, through consultation, CPUC staff will assemble a list that does not create additional transmission needs. This will include in the following order:

a. Maintaining the retirement of the thermal generation unit in the area with identified transmission needs but adequately replacing the capacity with generation and/or battery storage resources; and/or
b. Restoring the thermal generation units in areas with identified transmission needs in reverse order of the list developed ~~in steps 1 and 2~~using the metrics above.

~~4.~~ If specific local units are turned back on in ~~step 3.~~b. then an equal amount of additional system generation capacity will be modeled off-line following ~~steps 1 and 2.~~

c. ~~The~~ the metrics considered above ~~steps.~~

The aim is to minimize any post-processing work by the CAISO. Once the IRP portfolios are transmitted to the CAISO, if within the TPP it is identified that known local area requirements are

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not met, then CAISO staff may reallocate mapped battery storage from a general CAISO System area to a particular local area to meet the local area requirement up to known battery storage charging limits. If known local area requirements are still not met, then local thermal generation will be restored in reverse order of the list developed ~~in steps 1 and 2~~using the metrics above.

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~~21-10-002 or its successor) determines what resources can provide system and local resource adequacy capacity. Current RA accounting rules indicate that all existing DR programs count to the extent those program impacts are located within the relevant geographic areas being studied for system and local reliability. For its TPP studies the CAISO utilizes data from Supply-Side Resource Demand Response, which is registered in the CAISO market as either dispatchable, Emergency DR (RDRR) or Economic DR (PDR).

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

~~Separately, and coupled with the CPUC's annual Load Impact Protocols (LIP) filings,[65] IOUs are to submit a second, updated filing. Thus, the data for the TPP is first filed in mid-February, followed by the LIP final Report filing in April, which is then followed by the updated filing in August of the same year. These filings and timelines are subject to change when and if the CPUC approves a new DR QC methodology.~~

~~While we recognize that the annual TPP Study Plan that concludes in March already incorporates busbar level details, this additional reporting will validate the results from the earlier filings.~~

~~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.~~

~~Contact and recipient details for these filings will be provided by the CAISO. Both the TPP and updated filings are to contain the following:~~

~~[65] D. 08-04-060 in R. 07-01-041, "Decision Adopting Protocols for Estimating Demand Response Load Impacts" LIP Final Reports are filed annual on April 1.~~

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1. Portfolio aggregate ex-ante load impacts (in MW), by program, for 1-in-2 under CAISO's August system peak, for each of the full ten-year forecast period, disaggregated by Western Electricity Coordinating Council (WECC) transmission level busbar, in plain Excel format. The WECC busbar shall be identified by the following columns (fields):
    a. WECC busbar number as used in CAISO power flow models;
    b. Substation identifier/name (for example, [22256, ESCNDIDO] for SDG&E; [24214, SANBRDNO] for SCE; and [33207, BAYSHOR2] for PG&E). This applies to all dispatchable IOU DR programs and does not include non-dispatchable programs such as Time-of-Use (TOU) rates;
    c. The final year of the forecast (furthest into the future), for all program operating hours (not just the Resource Adequacy [RA] operating window). Disaggregate the data into four geographic zones: PG&E Bay, PG&E Valley, SCE, and SDG&E. PG&E Bay is defined as the Greater Bay Area Local Capacity Area (LCA) and PG&E Valley is defined as everything else in PG&E. This requirement applies to all dispatchable and non-dispatchable programs.
2. The methods and assumptions for disaggregating DR impacts by WECC transmission level busbar shall be standard and uniform across each IOU and documented in a supplemental report. To the extent this data does not sufficiently mask individual customer load information, the IOUs shall provide both a public version of the data with individual customer load information masked, and a confidential version of the data with complete information. The IOUs shall make the confidential dataset known and available to the CAISO (with applicable NDAs) by the annual deadline for its request for stakeholder input on "unified planning assumptions" for the TPP.

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