Methodology for 2019 IRP Resource-to-Busbar Mapping

CPUC Energy Division
March 30, 2020

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 generation resources in 2019 IRP portfolios, which need to be adopted via a CPUC decision in early 2020 to be able to inform the CAISO's 2020-2021 TPP.

2. Document Revisions

Version	Revision Notes
March 30, 2020	Addition of methodology for battery resources
February 21, 2020[1]	Improvements informed by stakeholder feedback on the Staff Proposal, and staff experience during implementation of the process
October 18, 2019[2]	Staff Proposal

3. IRP & TPP Context

Through the IRP process, the CPUC generates portfolios of electrical generation, storage and transmission resources designed to meet the state's 2030 greenhouse gas emission reduction targets for the electric sector while minimizing cost and ensuring reliability. Specifically, the IRP process develops a Reliability Base Case, a Policy-Driven Base Case and Policy-Driven Sensitivities (the "IRP portfolios") every year. The 2-year cycle of IRP involves developing these portfolios with different approaches, depending on the year: in odd-numbered years RESOLVE[3], a capacity expansion model, is used; in even-numbered years Load Serving Entities' (LSE) plans are used. In any year, 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 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

[1] ftp://ftp.cpuc.ca.gov/energy/modeling/Busbar_Mapping-Methodology-2020-02-21.pdf

[2] https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/2018/IRP_Busbar_Mapping-Methodology-2019-10-18.pdf

[3] Further information on RESOLVE is available here: https://www.cpuc.ca.gov/General.aspx?id=6442459770

portfolios. Consequently, the selected generic resources need to be remapped outside of RESOLVE or LSEs' plans to specific busbars[4] in the transmission system before the portfolios can be transmitted to the CAISO and be considered as inputs to the TPP.

In order to disaggregate the zonal resource amounts into allocations to specific busbars, CEC staff translate the tabular format of the portfolios into geographic map format, while considering higher resolution information about transmission infrastructure and land use. This methodology identifies the guiding principles, busbar mapping steps and the associated criteria for making these considerations.

4. Scope of 2019 IRP 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 2030; and for California to be on the trajectory to achieve the state's SB 100 goal[5] of 100% clean electricity by 2045, as well as 80 percent below 1990 emissions by 2050.

The busbar mapping methodology outlined in this document is narrowly focused on achieving effective and timely busbar mapping of the utility-scale generation resources in 2019 IRP portfolios, which need to be adopted via a CPUC decision in early 2020 to be able to inform the CAISO's 2020-2021 TPP. Consequently, it is likely that this busbar mapping methodology will need to be revisited in 2020 to ensure that the co-optimization issues identified above are fully incorporated in the busbar mapping methodology in time to inform the 2021-2022 TPP.

Further, the 2019 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 what was used by the agencies in prior years: For 2017 IRP portfolios, the busbar mapping methodology proof-of-concept was posted to CEC Docket 17-MISC-03[6] on February 15, 2018. For 2018 IRP portfolios, the busbar mapping methodology and results were posted to CEC Docket 17-MISC-03 on February 28, 2019, and updated on March 19, 2019.[7] It is further informed by stakeholder feedback on the Staff Proposal, and staff experience during implementation of the process for 2019 IRP portfolios.

[4] "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.
[5] Detailed at: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100
[6] Available at https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=17-MISC-03
[7] Ibid.

This 2019 methodology aims to improve on past efforts by:

- Proposing guiding principles to guide the busbar mapping methodology
- Establishing criteria that should be used when mapping resources to busbars
- Identifying for stakeholders the specific busbar mapping steps performed by CPUC, CEC, and CAISO staff
- Establishing an iterative interagency review process that allows the CAISO to identify transmission-related issues with the mapping results before the CPUC transmits the portfolio(s) to the CAISO
- Using commercial interest identified in interconnection queues to validate the RESOLVE resource potential

Where applicable, improvements on past efforts are noted [NEW] in section 6 below.

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, and interconnection optimization done in the busbar mapping process should be consistent to the extent practical and feasible with the higher-level optimization that occurs during the IRP portfolio development process
- Busbar allocations should generally represent 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 avoid, or at least minimize, intra-zonal congestion that would otherwise be addressed – depending on the specific projects ultimately procured – through local transmission upgrades identified in the Generation Interconnection and Deliverability Allocation Process (GIDAP). This principle can be followed by respecting the transmission sub-zone capability limits, as well as zone limits.[8]
- Successful busbar mapping process should result in IRP portfolios that do not need additional post processing in the CAISO's TPP after the CPUC has transmitted the CPUC adopted portfolios to the CAISO
- 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.

[8] Further described in the CAISO's May 2019 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

6. High-level Busbar Mapping Steps

The 2019 busbar mapping process is completed through a sequenced transfer of information between the CPUC, CEC, and CAISO. The process currently focuses on generation resources, with the approach for storage resources still under development by staff, informed by stakeholders. Information transfers related to generation resources follow this sequence:

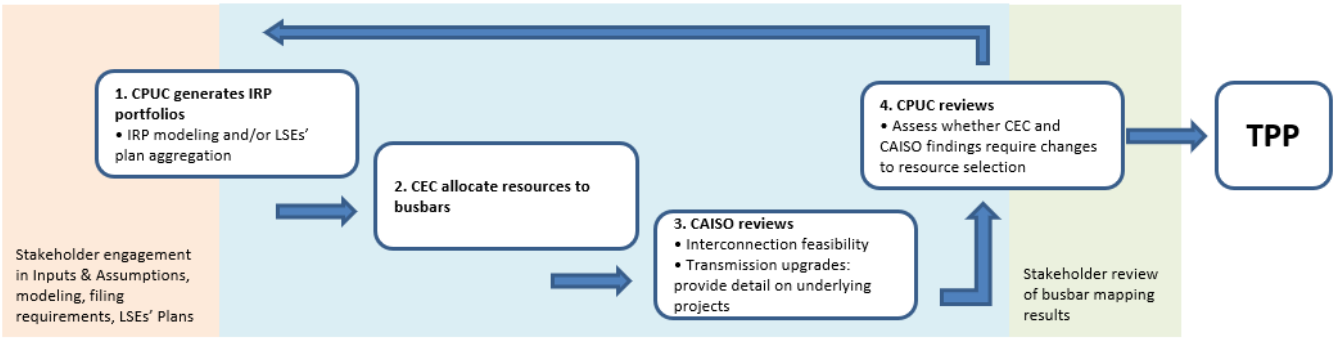
Step 1 - Draft portfolio(s) submitted to CEC for busbar mapping (CPUC)
Step 2 - Draft busbar mapping performed (CEC)
Step 3 - Observations and recommended revisions (CAISO)
Step 4 - Vet mapping results from CEC staff, as well as observations and recommendations from CAISO staff (CPUC)

- Note: Steps 1-4 make up a "round" of busbar mapping.

Step 5 - Repeat steps 1-4 if mapping results do not conform with mapping criteria
Step 6 - Successfully mapped IRP portfolio(s) formally transmitted to the CAISO (CPUC)

The steps for busbar mapping and the stakeholder review process are outlined in figure 1 below.

Figure 1. Flowchart of the 2019 busbar mapping process



CPUC – Step #1

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

- Draft Reference System Plan portfolios generated by RESOLVE and/or draft Preferred System Plan portfolios resulting from the aggregation of LSEs' plans, as applicable.
    - Baseline resources: megawatts (MW), by unit, by point of interconnection
    - Selected new resources: MW, by resource type, by transmission zone (tabular format)[9]. Where the baseline set of resources has been updated after the portfolio of

[9] For examples from the 2017-18 IRP cycle, see Excel workbooks "Reliability and policy-driven base case," and "Policy-driven sensitivity cases", available at https://www.cpuc.ca.gov/General.aspx?id=6442460548

selected resources was formed, CPUC staff should reconcile the two sets of resources to avoid double-counting.

  - Resource potential estimates (geographic information system (GIS) data format – polygons and associated attribute tables) to give the CEC further information about the selected resources[10]
    - Prior to the selection of candidate resources in RESOLVE the total capacity (MW) and online date of resource potential will have been validated by comparing the resource potential in the RESOLVE planning zones with the commercial interest as indicated by the interconnection queues in those planning zones [NEW]

- Transmission capability information (GIS data format)
- Transmission upgrades triggered in RESOLVE (tabular format)[11]

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 Reference System Portfolio (year 1) and proposed Preferred System Portfolio (year 2)
- Given the current IRP schedule, there is insufficient time for stakeholders to vet the mapping of the IRP portfolios prior to input to TPP. However, stakeholders' feedback during TPP may demonstrate the opportunity to better fulfil the guiding principles outlined in this document. Small changes to allocations may be made during TPP at CAISO staff's discretion, whereas other changes would need to be considered during the subsequent IRP busbar mapping process.

CEC – Step #2

The CEC staff will provide the following materials to the CPUC and CAISO staff after each round of busbar mapping:

- Draft CEC busbar mapping results
  - See March 2019 report for example of prior work[12]

The CEC is using a busbar mapping methodology that is similar to the methodology used in 2018:

[10] For examples from the 2017-18 IRP cycle, see GIS Data available at http://www.cpuc.ca.gov/General.aspx?id=6442453965

[11] For examples from the 2017-18 IRP cycle, see RESOLVE Results Viewer, Portfolio Analytics tab, available at https://www.cpuc.ca.gov/General.aspx?id=6442457210

[12] CEC Docket 17-Misc-03, TN# 227311, UPDATED 2019 IRP Portfolio Allocations to Substations, filed March 11, 2019, available at https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=17-MISC-03

1) CEC staff will use the information described in Step #1 above from the CPUC to develop a geographic map for the renewable energy resource technologies and for each portfolio, consistent with the RESOLVE model inputs and assumptions developed by the CPUC.

2) CEC staff will create a GIS layer to identify the potential environmental and land use implications of the RESOLVE-selected renewable resources. The layer is a combination of the following statewide data and information:

    - Terrestrial Landscape Intactness (California Energy Commission and Conservation Biology Institute, 2016)[13]
    - Areas of Conservation Emphasis, version 3.0 (ACE III) (California Department of Fish and Wildlife, 2018)[14]
    - Terrestrial Connectivity[15]
    - California Agricultural Value (California Energy Commission and Conservation Biology Institute, 2018)[16]

3) The 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 data will either be incorporated into the model or used as a separate overlay to compare different substation allocations.

4) The environmental and land use layers will be overlain with the renewable resource potential geographies to identify the environmental implications (low and high) of developing renewable resources, particularly solar resources and where necessary, wind energy resources.

5) Available transmission substations, including those that are planned and approved as well as existing, will be identified and a suitable standard radius will be established around each substation. Available substations include those in Californian BAAs, as well as CAISO. The standard radius will be set to approximate the longest distance that economically feasible interconnection power lines (gen-ties) typically fall within. This standard radius will be used when mapping each resource type as follows:

    a. Solar – calculate the share 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 weight of 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,

[13] Available at https://databasin.org/datasets/e3ee00e8d94a4de58082fdbc91248a65
[14] Available at https://www.wildlife.ca.gov/Data/Analysis/Ace
[15] Available at https://www.wildlife.ca.gov/Data/Analysis/Ace#523731772-connectivity
[16] Available at https://databasin.org/datasets/f55ea5085c024a96b5f17c7ddddd1147

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.

d. Biomass - compare the location of biomass energy resources to each substation radius and allocate the transmission planning area-level biomass resources to substations in closest proximity.

e. For resources which fall outside the standard substation radius, their interconnection cost assumed in the supply curve, and the gen-tie distance it allows, will be compared to the distance to the substation. If the distance to the substation is greater this means a criterion has not been met; refer to section 7 below.

6) CEC staff will review the CAISO's Transmission Capability Estimates to check that resources are not mapped in such a way that departs from the high level allocation of the IRP portfolios, which should already be respecting capability limits - the existing system "Estimated FCDS Capability (MW)" and the "Estimated EODS Capability (MW)" for each overarching transmission zone and the nested constraints within, or triggering upgrades where intended. Any triggered transmission upgrades will be highlighted by CEC staff and examined by the CAISO and CPUC staff in Steps #3 and #4 [NEW].

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

Stakeholder participation:

- Given the current IRP schedule, there is insufficient time for stakeholders to vet the mapping of the IRP portfolios prior to input to TPP. However, stakeholders' feedback during TPP may demonstrate the opportunity to better fulfil the guiding principles outlined in this document. Small changes to allocations may be made during TPP at CAISO staff's discretion, whereas other changes would need to be considered during the subsequent IRP busbar mapping process.

<u>CAISO – Step #3</u>

During each round of busbar mapping the CAISO staff will provide the CEC and CPUC staff the following:

- Without new modeling or formal assessments, if the CAISO staff determines conceptual transmission upgrades are likely to be required based on the mapping in Steps #1 and/or #2, CAISO will provide an estimate of the conceptual transmission upgrades' in-service date.

    - This is important because the theoretical in-service date for the upgrade might not align with the on-line date for the selected candidate resources that triggered the transmission upgrade [NEW]
    - If the transmission upgrades likely to be required are at a scale that exceeds any that has been studied by the CAISO, there is unlikely to be any further information available, and this will be noted [NEW]
- The CAISO staff will provide feedback on the CEC's draft busbar allocations, including verifying:
    - Transmission zone and sub-zone capability limits
    - Interconnection feasibility, including electrical suitability and physical space availability at each substation, if this information is available from the transmission owner
    - Status of active and previously queued resources as indicated by interconnection queues; which is a supplemental check to the upstream validation of resource potential performed by the CPUC staff as described in Step #1 above
- If the CEC staff maps portfolio resources to substations in BAAs other than the CAISO, then the CAISO staff will consult appropriate planning entities during the resource modeling phase of TPP. These planning entities may recommend adjustments to locations and size of resources in their BAAs mapped by the CEC staff. 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, recommended portfolio modifications needed

Stakeholder participation:

- Given the current IRP schedule, there is insufficient time for stakeholders to vet the mapping of the IRP portfolios prior to input to TPP. However, stakeholders' feedback during TPP may demonstrate the opportunity to better fulfil the guiding principles outlined in this document. Small changes to allocations may be made during TPP at CAISO staff's discretion, whereas other changes would need to be considered during the subsequent IRP busbar mapping process.
- CAISO observations and any recommended modifications to identified transmission upgrades will be reported in the CEC's mapping results and/or in the CPUC's report

<u>CPUC – Step #4</u>

CPUC staff will review the draft mapping by CEC staff, as well as observations and recommendations from CAISO staff. Using the busbar mapping criteria, described in section 7 below, 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.

If a further round of mapping is required, CPUC staff may reallocate resources between transmission zones. Such inter-zonal 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 uses.

Stakeholder participation:

- Given the current IRP schedule, there is insufficient time for stakeholders to vet the mapping of the IRP portfolios prior to input to TPP. However, stakeholders' feedback during TPP may demonstrate the opportunity to better fulfil the guiding principles outlined in this document. Small changes to allocations may be made during TPP at CAISO staff's discretion, whereas other changes would need to be considered during the subsequent IRP busbar mapping process.

7. 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 criteria are as follows:

- Distance to transmission
    - 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 cross high-environmental implication areas or dense urban areas)
    - CEC will flag applicable resources for which the recommended busbar allocation results in an exceedance of a predetermined standard radius[17]. As described in Section 6, 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
    - Busbar allocation in given area should abide by the estimated transmission capability in each zone and sub-zone, triggering only those upgrades which are determined to be cost-effective during the formation of the IRP portfolios
    - 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
    - Busbar mapping process might also identify resources that cannot interconnect to an existing or planned substation because the resource is triggering a transmission upgrade that has not been previously studied by the CAISO. Such resources will be

[17] For reference, a radius of 15 miles was used in the 2018 busbar mapping process

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
    - If available land area is insufficient to accommodate selected resources within reasonable distance to the substation, or if the resources have high environmental 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) with updated assumptions about resource potential informed by this busbar mapping process.
- Commercial interest
    - 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
- Consistency with prior year
    - 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 changes are proposed in the resource mapping from one year to the next, these should be explicitly justified.

8. Battery Storage

The following section describes the methodology used to map battery storage to busbars for transmission planning in the CAISO for the first time.

Types of battery storage considered in-scope:

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

Criteria and Prioritization

Mapping battery storage to busbars differs significantly to the methodology for generation resources described earlier in this document for reasons including: RESOLVE provides no locational

information about selected new batteries[18]; RESOLVE provides flexibility in siting storage due to not linking the battery storage to solar, wind or other input resources; and land use considerations and environmental implications associated with siting batteries are very different in nature. Accordingly, the methodology outlined here is distinctly different. It does, however, draw upon two criteria common across all resource types: consideration of commercial interest; and consideration of transmission capability limits. The methodology addresses LCR areas as a particularly important consideration for battery storage due to the value that batteries can provide but also due to the challenges that may arise.

Commercial Interest

In accordance with the guiding principles outlined in section 5 above, higher accuracy in mapping resources within planning processes to locations in which projects are likely to be developed, improves both the CPUC's and the CAISO's ability to plan for a more reliable and cost-effective system.

This methodology for busbar mapping of battery storage is generally guided by commercial interest as indicated by the CAISO Generator Interconnection Queue[19] and supplemented by the material modification assessment (MMA) requests received by CAISO on December 2, 2019, to add energy storage to existing and active queued projects[20].

Under the material modification assessments[21]:

- Adding resources such as storage that do not exceed existing or queued plant output from a site may qualify as additions that are not material modifications, and can proceed outside of the ISO interconnection process – for projects that are in the queue or online
- Options are available at present regarding managing deliverability, that change if and when the CAISO's proposed deliverability methodology goes into effect

On October 10 and November 4, 2019, the CAISO presented opportunities for adding storage to existing or new generation sites. Stakeholders submitted over 10,000 MW of requests which have been aggregated at or near their points of interconnection and posted publicly.[22]

Due to the limitations of the publicly available MMA list, CPUC Staff does not have details regarding which Interconnection Queue projects the MMA MW are modifying. This lack of knowledge includes information such as what phase of the interconnection process the queue project of origin is currently at.

CPUC Staff will use the data sources described above to analyze the commercial interest and allocate battery storage to busbars using objective criteria.

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[18] However LSE IRP plans may include locational information, in which case the mapping methodology for an IRP portfolio based on those would need to take this into account

[19] http://www.caiso.com/planning/Pages/GeneratorInterconnection/Default.aspx

[20] http://www.caiso.com/Documents/OpportunitiesAddingStorageExisting-NewGenerationSitesCall101019.html

[21] http://www.caiso.com/Documents/Presentation-OpportunitiesforAddingStorageatExistingorNewGenerationSites.pdf

[22] http://www.caiso.com/Documents/MMARequestsReceived-AddStorage-Existing-NewGenerationSites.pdf

Local Capacity Requirements Areas

Recent IRP results have found that most thermal generation, not already scheduled to retire, will be needed to stay online through 2030 to maintain system reliability. However, reduction of reliance on thermal generation in local capacity areas can provide two benefits: ratepayer savings, and reductions in criteria air pollutants and GHG emissions. California has prioritized minimizing pollution in Disadvantaged Communities (DAC)s, and this can in part be accomplished by reducing reliance on power plants in local capacity areas, many of which overlap with DACs. Battery storage may provide an opportunity to achieve that. Considering the significant amount of commercial interest for battery storage projects in LCR areas, the opportunities batteries provide, but also the existing challenges, the methodology includes two distinct steps:

Step 1: CPUC staff will transmit to CAISO as inputs to the 2020-21 TPP, battery storage mapped to LCR areas. However, the methodology for battery storage busbar mapping is iterative and includes flexibility due to the evolving nature of battery storage information available.

Step 2: The busbar mapping of storage in LCR areas provided by CPUC Staff, to the degree possible, will be supplemented by the CAISO with two additional sources of information.

First, the 2020-21 TPP assessments can be supplemented by the work CAISO previously conducted on the ability of storage projects to reduce reliance on gas-fired generation capacity in LCR areas and sub-areas.[23]

In the 2018-2019 TPP, the CAISO explored and identified alternatives for reducing reliance on local gas-fired generation capacity in most of the areas and sub-areas. Several of these alternatives were transitioned to the CAISO's economic study phase in this transmission planning cycle for further consideration as potential economic-driven transmission solutions.

The CAISO did not study the economics of "resource substitution", e.g. replacing one form of local capacity resource with another, as that is a resource procurement decision falling under the CPUC's procurement processes. However, CAISO's findings can still be utilized to prioritize which LCR areas and sub-areas would benefit most from battery storage projects.

Second, the 2020-21 TPP assessments can be supplemented by the Local Capacity Technical (LCT) study the CAISO expects to complete by May 2020. Additional consideration is needed for storage being considered in meeting local capacity requirements. For all requirements and contingencies other than extreme event considerations, the CAISO expects that for batteries that qualify as local capacity resource adequacy resources, the transmission and the other local capacity resources must be sufficient to recharge the batteries in anticipation of the outage continuing into the next day's peak load period. As part of the ongoing LCT study, the CAISO expects to identify by May 2020 the amount of energy storage devices that can be seamlessly integrated in local areas and sub-areas such that the peak capacity needs and the off-peak charging needs are both met under contingency conditions. Due to the current unavailability of these results, CPUC Staff is not able to consider this important information in this phase of the battery storage busbar mapping effort.

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[23] http://www.caiso.com/Documents/AppendixG-BoardApproved2018-2019TransmissionPlan.pdf