

# Draft Updates to the Busbar Mapping Methodology

Webinar

July 18, 2023



California Public  
Utilities Commission

# Introduction

# Logistics & Scope

- Webinar slides and Busbar Mapping Methodology Document will be available on the IRP webpage: [Assumptions for the 2024-2025 TPP](#).
- The webinar will be recorded, with the recording posted to the same webpage.
- The objectives of this webinar are to:
  - Provide an overview of the busbar mapping process and its role in the transmission planning process.
  - Present new and updated datasets from the CEC for use in the mapping criteria.
  - Familiarize stakeholders with the updates to the criteria and the criteria alignment thresholds.
  - Give opportunity to stakeholders to ask questions and provide comments on the busbar mapping methodology and the proposed criteria.
  - Request stakeholder's informal written feedback to be incorporated in the final updated methodology.

# Questions

- We invite questions using the "Q&A" feature of this Webex.
- We also invite verbal questions at specific intervals throughout this webinar.
  - All attendees have been muted. To ask questions:
    - In Webex:
      - Please "raise your hand"
      - Webex host will unmute your microphone and you can proceed to ask your question
      - Please "lower your hand" afterwards
    - For those with phone access only:
      - Dial \*3 to "raise your hand". Once you have raised your hand, you'll hear the prompt, "You have raised your hand to ask a question. Please wait to speak until the host calls on you"
      - WebEx host will unmute your microphone and you can proceed to ask your question
      - Dial \*3 to "lower your hand"
- The discussion in this webinar will be recorded and posted online, as well as the written portion of the Q&A transcript.
- Stakeholders will have until August 4th to submit their informal comments on the draft updates to the Busbar Mapping Methodology, per instructions to be provided later. These comments, though, will be informal and not part of the IRP proceeding record.

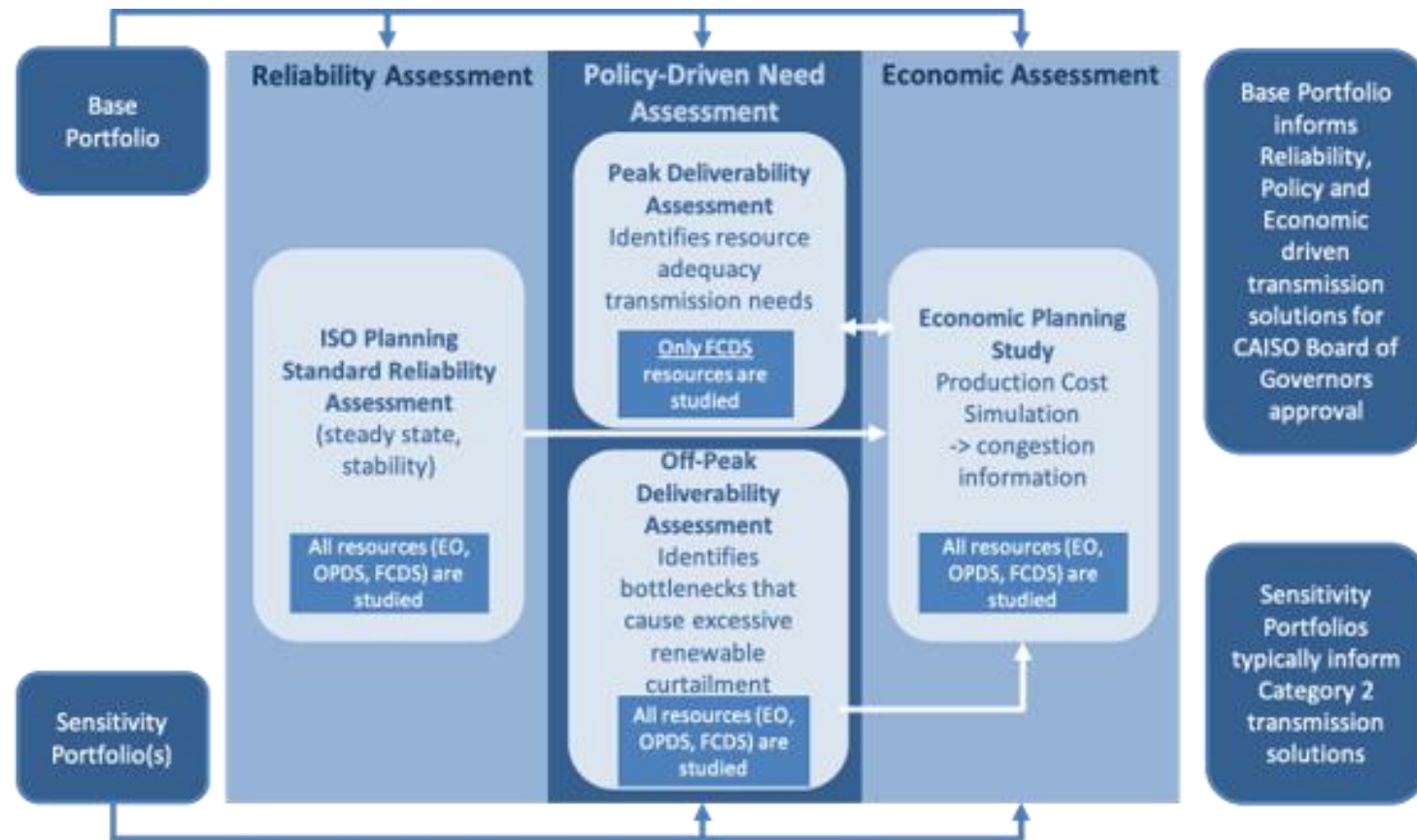
# Agenda

Timing (PDT)	Topic
9:00 AM	Introduction
9:10 AM	TPP and Busbar Mapping Overview & Background
9:15 AM	Busbar Mapping Process and Criteria Overview
9:25 AM	Land-Use and Environmental Implications Criteria Intro
9:35 AM	CEC Land-Use Screens Development and Implementation
10:15 AM	OOS Land-Use Screens and Land-Use Criteria Thresholds
10:30 AM	Questions on Land-Use Screens and Criteria
10:45 AM	Environmental Societal Criteria (expanded from batteries)
10:55 AM	Transmission and Interconnection Criteria
11:10 AM	Commercial Interest and Previous Base Case Criteria
11:20 AM	Wrap up and Next Steps
11:30 AM	Questions

# TPP and Busbar Mapping Overview

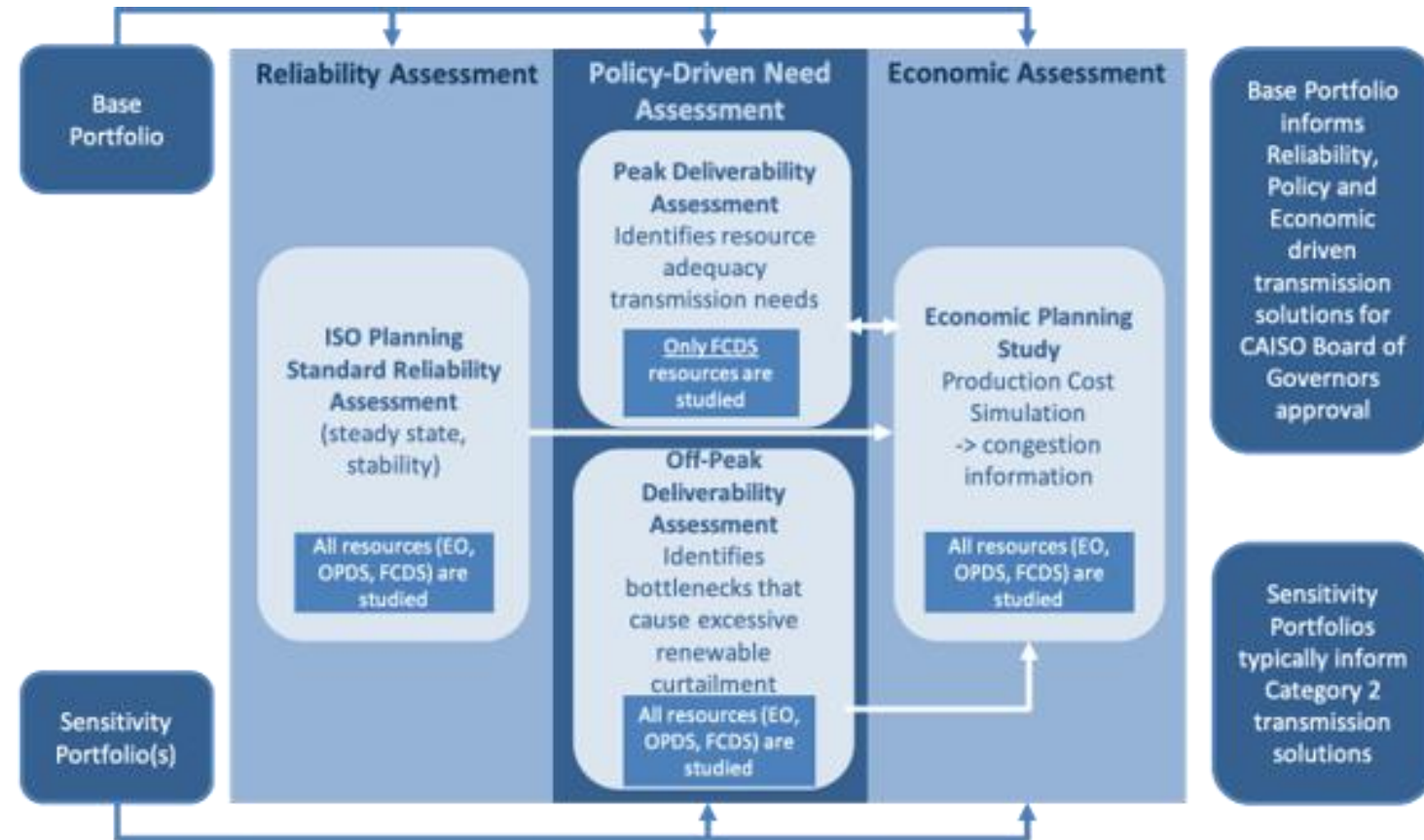
# IRP Role in the CAISO's Transmission Planning Process

- The CAISO's TPP is an annual comprehensive evaluation of the CAISO's transmission grid to:
  - Address grid reliability requirements,
  - Identify upgrades needed to successfully meet California's policy goals, and
  - Explore projects that can bring economic benefits to consumers.
- CPUC develops resource portfolios and CEC develops load scenarios for use by CAISO in the TPP.
  - In accordance with new CPUC-CEC-CAISO [Memorandum of Understanding](#) agreed to in Dec. 2022.
  - Replaced and expanded on the May 2010 MOU between the CAISO and the CPUC.



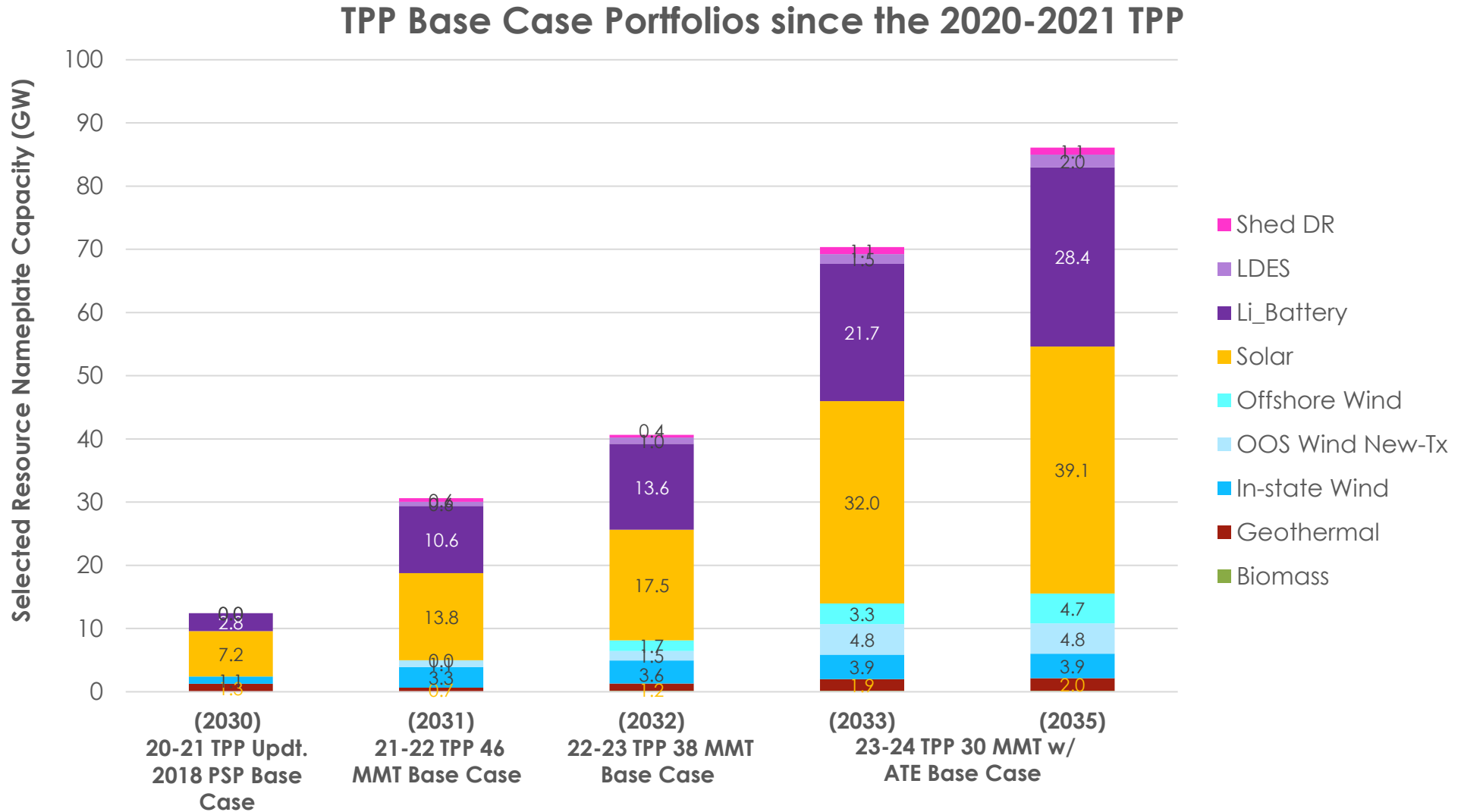
# IRP Role in the CAISO's Transmission Planning Process

- The CPUC typically transmits multiple distinct portfolios developed in the IRP process:
  - Reliability and Policy-Driven Base Case portfolio
  - Policy-Driven Sensitivity portfolio(s)
- Historically has focused on grid needs up to 10-years into the future.
- Shifting to transmitting portfolios that model further out into the future:
  - 22-23 TPP: studied the higher electrification sensitivity portfolio out to 2035
  - 23-24 TPP: will study the base case portfolio out to 2035
  - 24-25 TPP: CPUC staff planning to model and map portfolio(s) out to 2039.



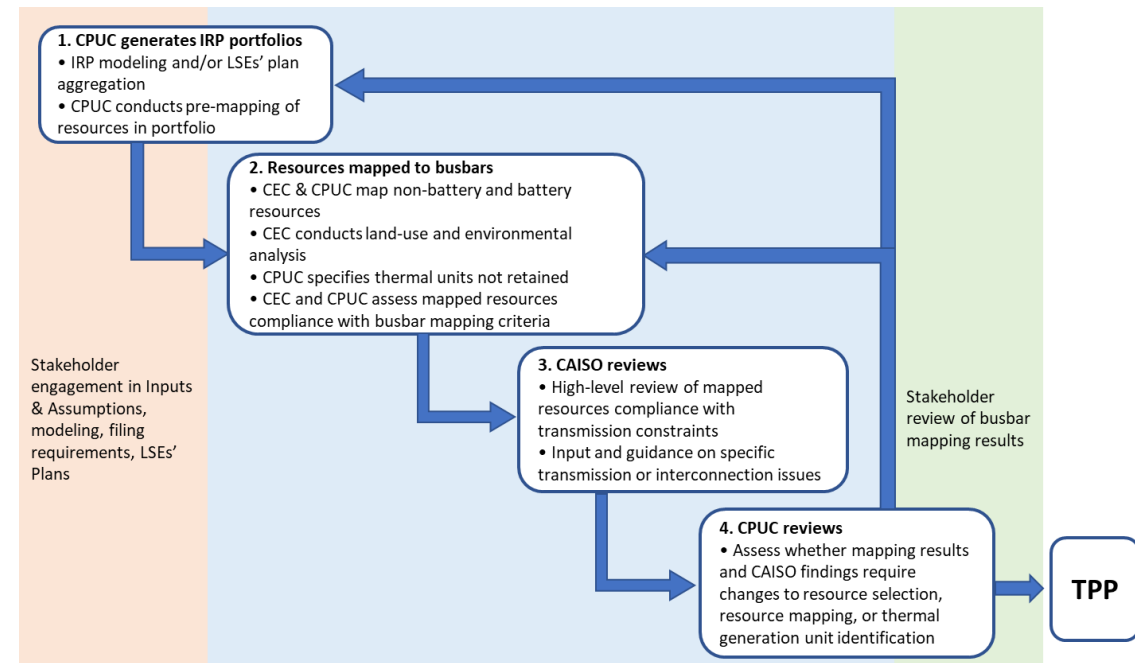


# Base Case Portfolios since the 2020-2021 TPP



# Role of Busbar Mapping in IRP and TPP

- **Resource to Busbar Mapping** (“busbar mapping”): The process of refining the geographically coarse portfolios developed through IRP to specific interconnection locations (i.e., substations) for analysis in the CAISO’s annual Transmission Planning Process (TPP).
  - First conducted as “proof of concept” for the 2018-2019 TPP portfolio ([CEC proof of concept report](#)).
  - Formalized into a joint effort by a working group comprised of CPUC, CEC, and CAISO staff.
  - Mapping is conducted based on stakeholder vetted methodology.
- **Busbar Mapping Scope:** Mapping focuses on utility-scale generation and storage resources that are not already in baseline.
- **Busbar Mapping Methodology:** Methodology document states guiding principles, establishes mapping criteria, and outlines the iterative inter-agency mapping process.
  - Proposed [Methodology](#) makes major refinements and updates to previous version used for the 23-24 TPP mapping efforts.

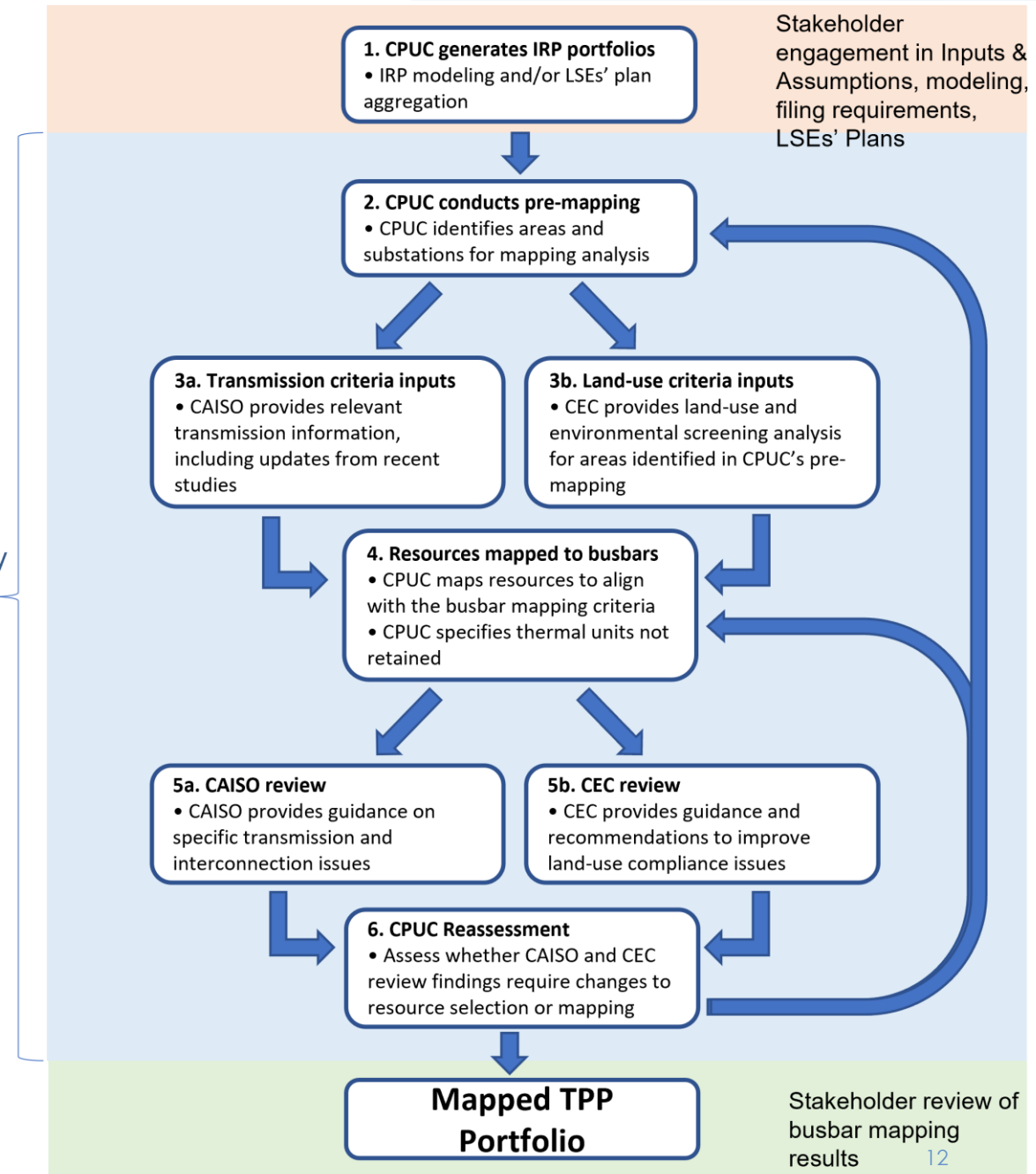


# Busbar Mapping Process and Criteria Overview

# Busbar Mapping Process

- Busbar Mapping can be viewed as a sequence of steps between CPUC, CEC, and CAISO after the portfolios are developed.
  - CEC staff provide land-use and environmental information, data analysis, and implications assessment.
  - CAISO staff provide similar info for transmission and interconnection topics.
  - CPUC applies analysis and information to conduct the mapping itself and coordinates the information transfers.
- Updated Methodology Document includes significant changes to the mapping steps that better reflect the flow of information and analysis between CPUC, CEC, and CAISO staff.

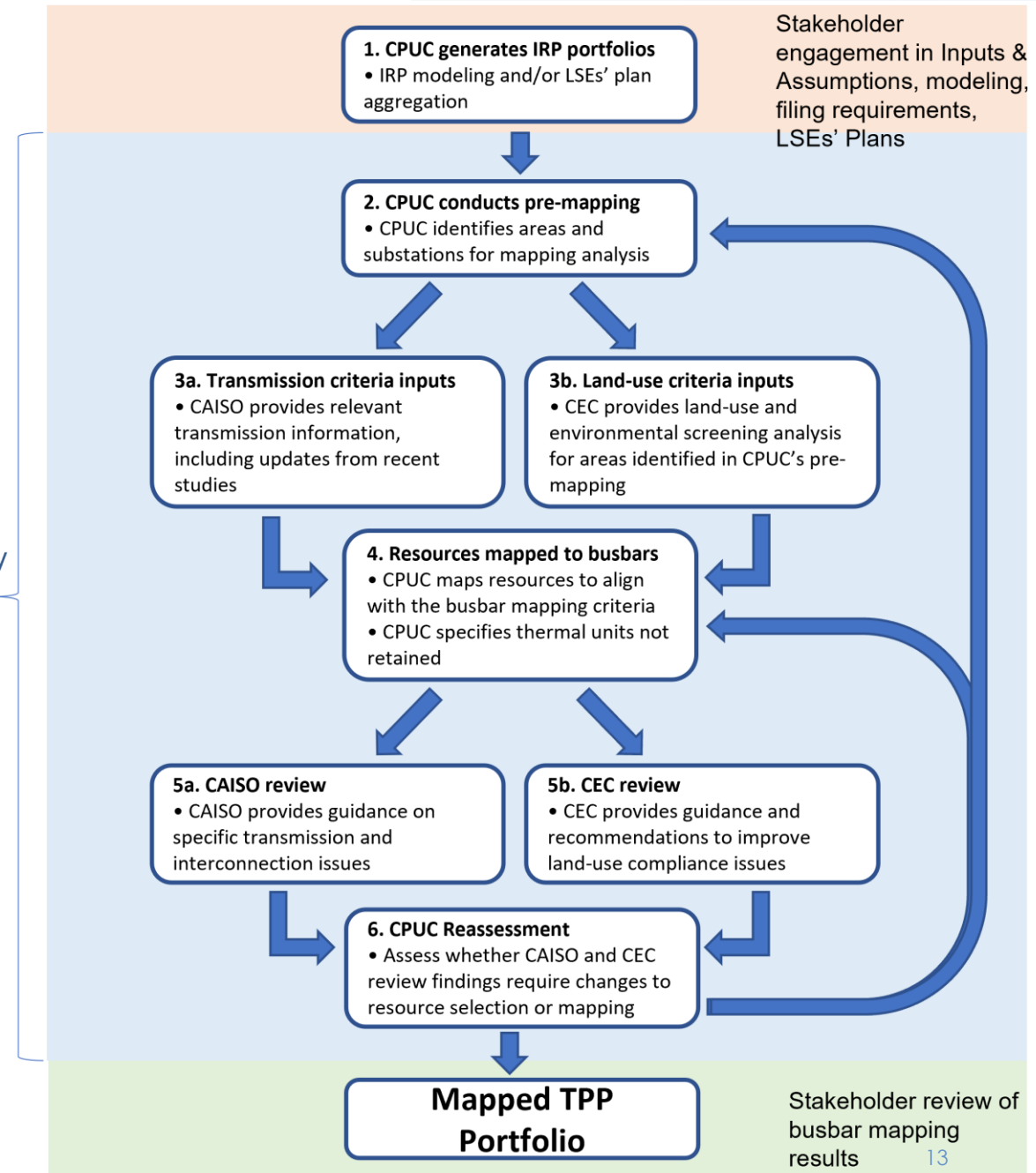
Methodology addresses these steps



# Mapping Steps #1 & #2

- The first two steps are centered on CPUC staff preparing and sharing with CEC and CAISO staff the portfolio results and relevant information for mapping analysis.
- Step 1: CPUC staff compiles selected portfolio information necessary for mapping:
  - Portfolio resources, RESOLVE identified transmission upgrades, newly in-development resources not in baseline.
- Step 2: CPUC staff conduct pre-mapping to identify key substations and areas that resources can be mapped to.
  - Identify additional information and analysis that CEC and CAISO staff need to provide.

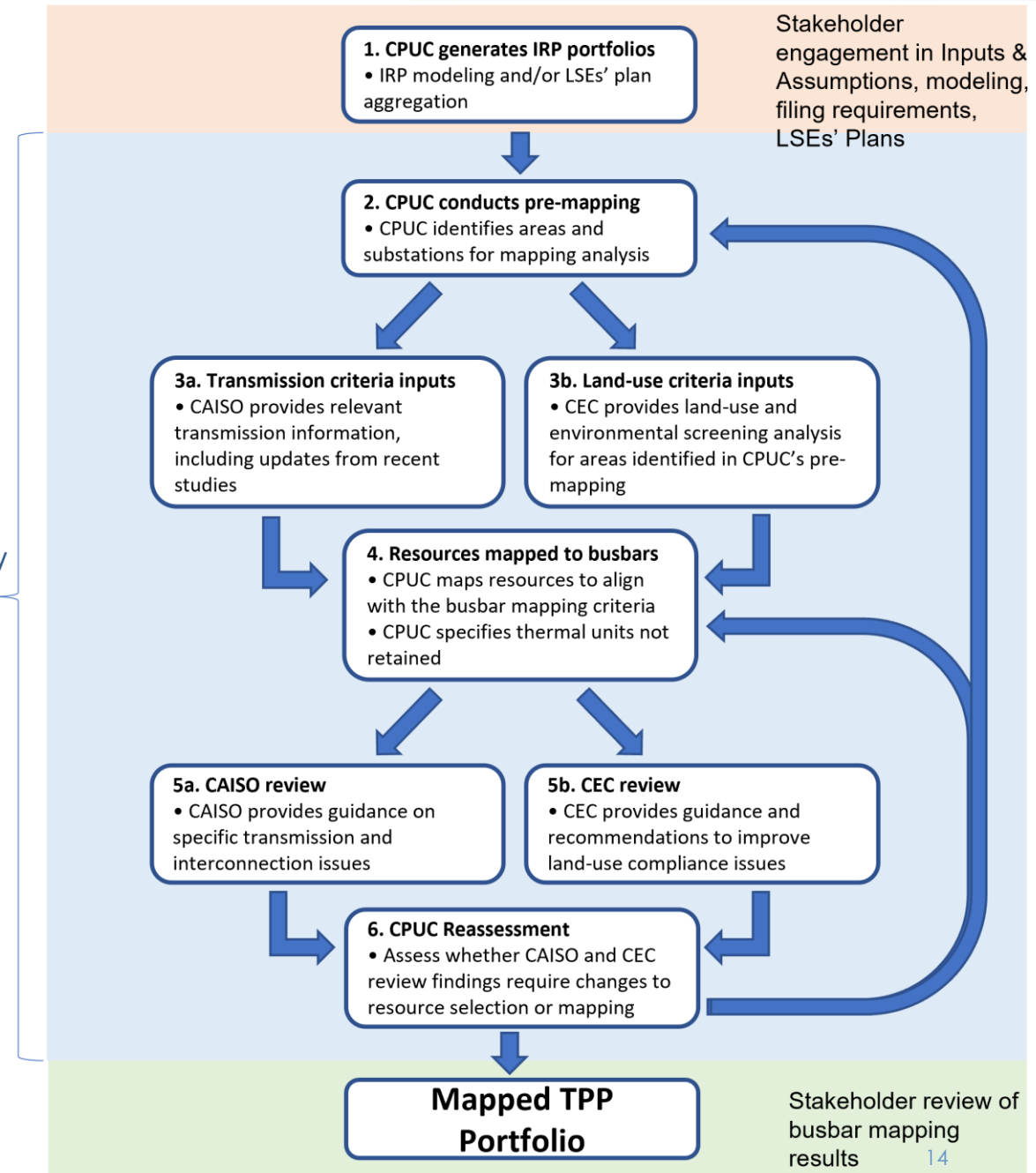
Methodology addresses these steps



# Mapping Steps #3a & #3b

- Step 3a is centered on obtaining the information on transmission and interconnection needed to conduct busbar mapping analysis.
  - CAISO staff already developed their transmission White Paper
  - Additional constraint information and recent updates.
  - Engaging with PTOs for specific substation-level interconnection info.
- Step 3b is centered on obtaining information and analysis for land-use and environmental criteria.
- Note that these steps do not have to take place sequentially as displayed.
  - Staff have been already working on portions of this information gathering and analysis.

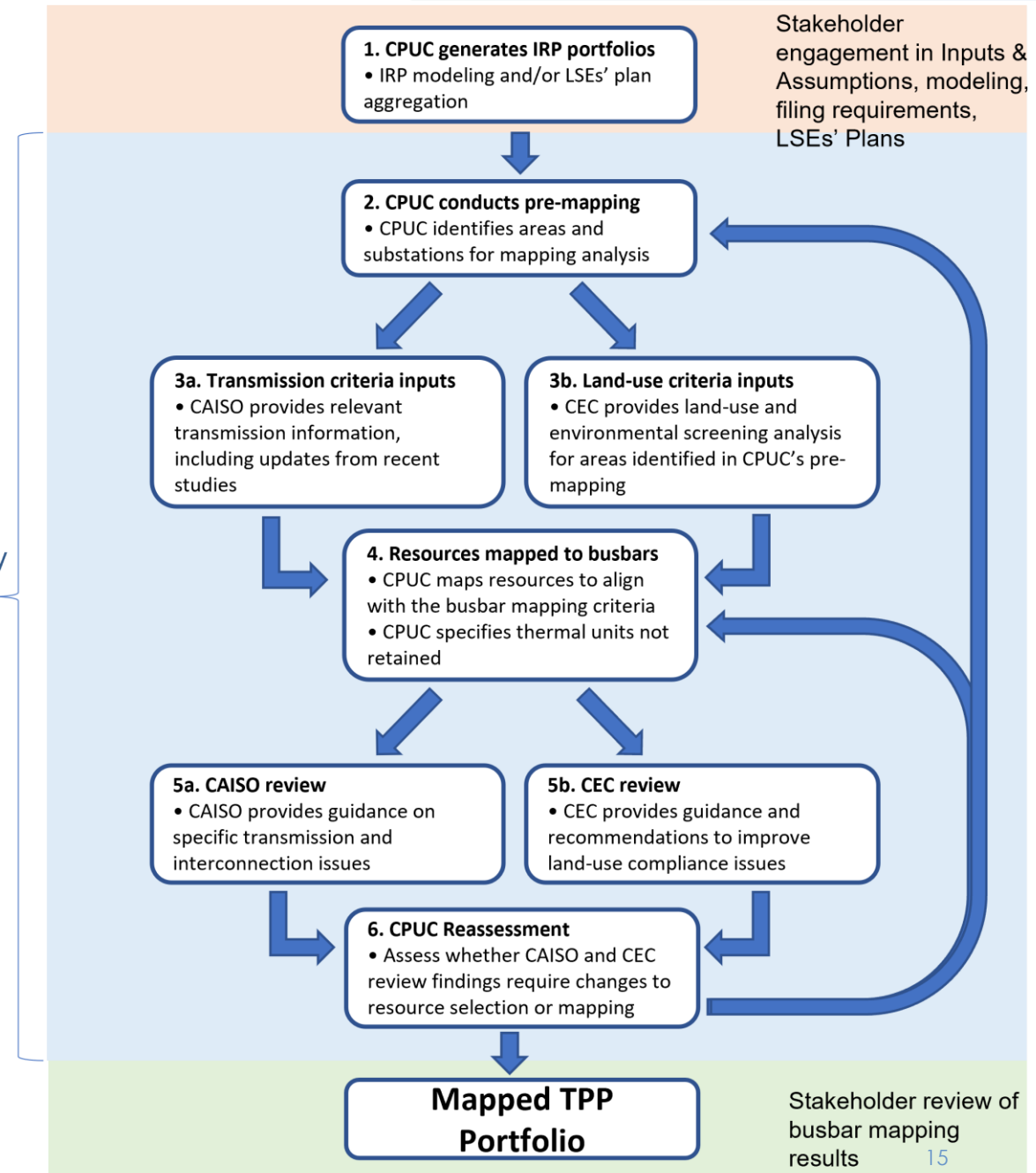
Methodology addresses these steps



# Mapping Steps #4 - #6

- Step 4: CPUC staff conduct mapping and criteria analysis using information provided in Step 3.
  - Amalgamate mapping results into a “Dashboard” that summarizes mapped resource compliance with criteria.
  - Identify non-complaint resources that may need further review and mapping adjustments.
- Step 5: CEC and CAISO staff review the mapping results and provide feedback and recommendations on improving criteria alignment.
  - High-level general feedback and recommendations on specific issues identified by CPUC.
- Step 6: CPUC staff assess, based on Step 5 reviews and criteria alignment dashboard, whether further rounds of mapping are needed.

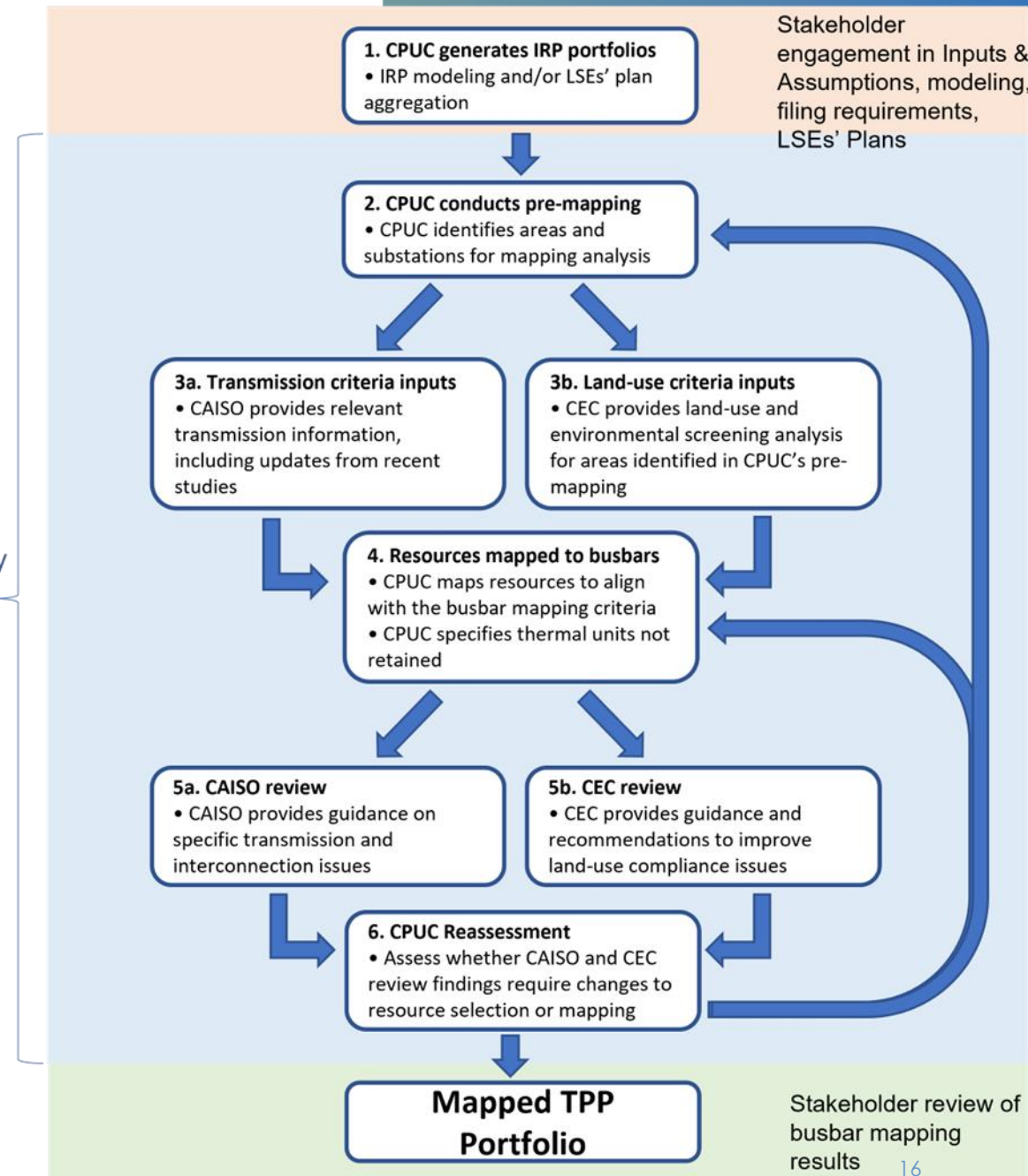
Methodology addresses these steps



# Mapping Criteria Goals

- Goals of the mapping process:
  - Identify plausible locations for portfolio resources that do not violate established busbar mapping criteria.
  - Align mapped resources to the extent feasible with the mapping priorities of each criteria.
- In the iterative mapping process, the working group will seek to address mapped resources non-compliance with criteria on an individual situation basis.
- Working Group will assess if alternative mapping locations would improve alignment within the non-compliant criterion without decreasing overall criteria alignment.

Methodology addresses these steps





# Mapping Criteria Overview

- Staff are proposing an overhaul to the mapping criteria: updating several screens, expanding criteria with the incorporation of new data and screens, and reorganizing how the specific criteria are organized into larger categories.
- For the 23-24 TPP mapping effort the criteria were organized into five categories:
  1. Distance to transmission of appropriate voltage
  2. Transmission capability limits
  3. Land-use and environmental constraints
  4. Commercial interest
  5. Consistency with prior year mapping
- Battery storage had additional separate criteria centered on siting in local areas and reducing criteria pollutants.
- Staff are proposing the following categories for busbar mapping criteria.
  1. System level transmission capability
  2. Substation level interconnection viability
  3. Land-use implications and feasibility factors
  4. Environmental (conservation and biological) impact factors
  5. Community and environmental (societal) impact factors
  6. Commercial development interest
  7. Consistency with prior TPP portfolios
- Incorporating the previously battery storage specific criteria for all resources.

# Mapping Criteria Alignment

- Previous mapping efforts utilized a three-level criteria compliance ranking metric:
  - Level 1 – Strong compliance
  - Level 2 – Possible or moderate breach of a criterion
  - Level 3 – Likely or material breach
- Staff are proposing an expanded criteria alignment scale to provide a more detailed summary and to better capture alignment with criteria priorities.
- Five levels of criteria alignment.
  - Level 1 – Strong compliance with criteria, alignment with criteria's prioritized or favorable conditions.
  - 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.

# Land Use and Environmental Implications Criteria

# Land Use and Environmental (Conservation and Biological) Implications Criteria

- Mapping should limit the potential implications (i.e., potential impacts to or conflicts with existing and future land use applications) of the selected resources.
  - Prioritize areas of lower potential land-use implications and higher feasibility for resource development.
  - Limit locating resources to areas of high potential implications and likely more difficult development potential.
- Mapped resources should, to the extent possible, reflect state-level land-use and environmental planning priorities.
- Staff are proposing a major overhaul of the data used for land-use and environmental criteria including.
  - Update of key screens.
  - Addition of new screens to better capture areas more favorable for development.
  - Retention of key conservation and biological diversity implications screens.
  - Streamlining the analysis with the removal of several duplicated screens.

# Land-Use Implications and Feasibility Criteria

- Criteria are proposed to screen for areas that have less implications to alternative land-use and conservation priorities and, overall, are more favorable for development of the mapped resources.
- The key screen that combines the broader land-use and environmental datasets to provide an overall potential implications impact is the new CEC Core Land-use Screen.
  - Replacing previously used higher and lower implications land-use screen that CEC developed for busbar mapping.
- Staff are also planning to use the following datasets as screens for the land-use criteria:
  - New CEC parcelization model screen (new analysis).
  - New CEC Cropland Index Model screen (replacing previously used analysis based on California Agricultural Value dataset).
  - Critically Overdrafted Groundwater Basins (new analysis).
  - High Fire Threat Districts (retained from previous mapping methodology).

# Environmental (Conservation and Biological) Implications Criteria

- Criteria are proposed to provide a more detailed breakdown of land-use implications focusing on the conservation and biological diversity implications and planning priorities.
  - Several of the screens in this criteria are included in the analysis used to develop the CEC's Core Land-use Screen.
- Criteria includes screens centered on the following:
  - CDFW's Areas of Conservation Emphasis (ACE) datasets, specifically:
    - Terrestrial Connectivity,
    - Biodiversity, and
    - Irreplaceability
  - Conservation Biology Institute's Terrestrial Landscape Intactness
  - Wetland category of California's Habitat and Land Cover dataset
- Staff are streamlining analysis by removing several data that are duplicative and their implications are already covered by the datasets included. Screening datasets used in the 23-24 TPP that are proposed to be removed are:
  - ACE Rarity and Native Species datasets,
  - Audubon Important Bird Areas, and
  - Natural Landscape Blocks dataset.

# **CEC Land-Use and Environmental Screens Development and Implementation**

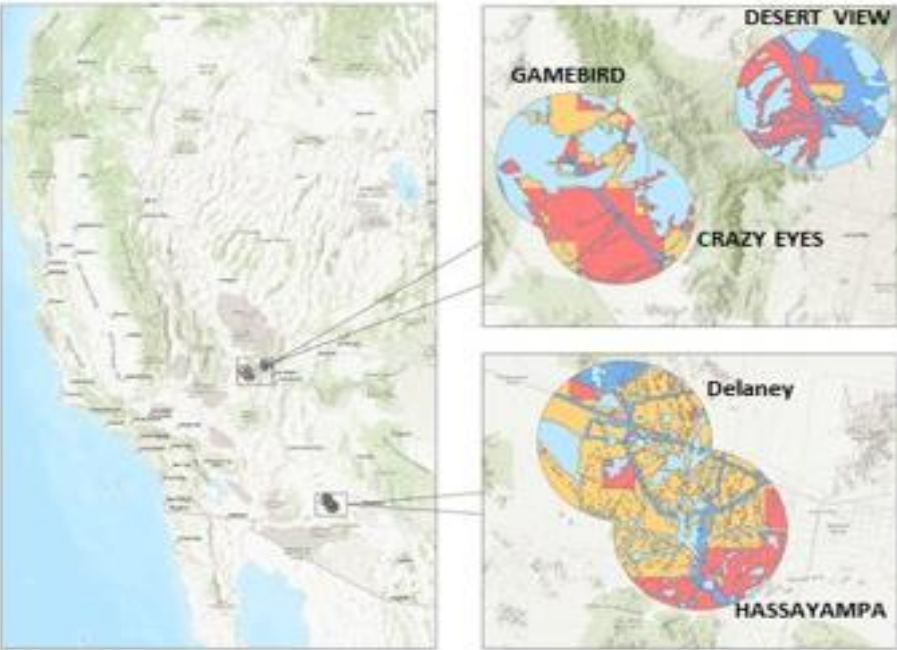
# See Separate CEC Staff Presentation



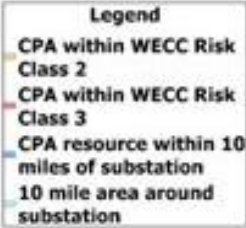
# OOS Land-Use Screens and Land-Use Criteria Thresholds

# Out-of-State Land-Use and Environmental Screens

- For out-of-state resource still within the CAISO BAA, CPUC staff utilize alternative land-use datasets available for areas outside of California.
  - Approach is consistent to implementation in previous mapping efforts.
- Data source: [WECC Environmental Data Viewer](#)
  - Risk class 1: Least Risk of Environmental or Cultural Resource Sensitivities and Constraints.
  - Risk class 2: Low to Moderate Risk of Environmental or Cultural Resource Sensitivities and Constraints.
  - Risk class 3: High Risk of Environmental or Cultural Resource Sensitivities and Constraints.
  - Risk class 4: Areas Presently Precluded by Law or Regulation.
- Class 4 land is excluded from resource potential.
- Class 2 land is correlated to lower implications; Class 3 land is correlated to higher implications.



0 90 180 360 Miles



Substation	Percent of solar resource that occurs on RC3 land	Percent of solar resource that occurs on RC2 land
DELANEY	8.5%	75.7%
GAMEBIRD	54.7%	39.7%
HASSAYAMPA	31.2%	57.7%
CRAZY EYES	40.8%	20.5%
DESERT VIEW	54.3%	4.1%

# Land-Use – Core Screen and Parcelization Criteria Alignment

- The criterion using the CEC’s Core Land-use Screen seeks to:
  - Avoid resources mapping to higher implication areas.
  - Prioritize mapped resources utilizing a limited percentage of the lower implication areas.
- Staff are proposing to limit parcelization criteria analysis to only utility-scale solar resources.
  - Staff are seeking stakeholder feedback if parcelization should be applied to other resources.
- Criteria for parcelization seek to have mapped resources utilizing low parcelization areas, still feasible in medium parcelization areas, and avoiding higher parcelization areas:
  - Low parcelization: 6 and less
  - Medium parcelization: between 6 and 30
  - Higher parcelization: greater than 30
- Medium parcelization reflects CEC’s analysis showing significant existing solar footprint is in areas with parcelization of this range.

# Land-Use – Core Screen and Parcelization Criteria Alignment Thresholds Summary

- Both Core Land-use screen and Parcelization criteria will use an estimated mapped MWs' acreage percentage utilization of identified lower implications resource potential acreage within a set distance from substation.
  - $\% \text{ Impacted} = [(MWs \text{ mapped}) \cdot (\text{Fixed Power Density Assumption})] / (\text{Lower Implications Acreage}) \cdot 100$
- Power Density Assumptions:
  - From IRP Draft I&A: 30 MW/km<sup>2</sup> (~8.2 acres/MW) for solar, and 2.7 MW/km<sup>2</sup> (91.5 acres/MW) for onshore, instate wind; reviewing stakeholder feedback from IRP's I&A process on adjusting values.
  - Previous TPP mapping: 7 acres/MW for solar and 40 acres/MW of onshore wind
- Parcelization alignment will use the 10<sup>th</sup> percentile parcelization value around the identified substations.
  - Intended to help present potential impacts from the overall landscape fragmentation around the substation.

Criteria	Comparative Point(s)		Level 1	Level 2	Level 3	Level 4	Level 5
Land Use – Feasibility Factors	CEC - Core Suitability Screen	Acreage of MW's Mapped	<20% of Lower Impact Area	<50 % of Lower Impact Area	<80 % of Lower Impact Area	< 10% of Higher Impact Area	> 10% of Higher Impact Area
		Parcelization	<20% Low Parcelization	<80% Low Parcelization	<20% Mid Parcelization	<80% Mid Parcelization	>80% Mid Parcelization
	10th percentile Parcelization value	<12	<20	<30	-	-	

# Land-use – Cropland, Groundwater, and Fire Threat Criteria Alignment Summary

- Proposed criteria alignment guidance for remaining three land-use feasibility screens:
  - CEC Cropland Index: Prioritize mapping to a limited portion of low-value cropland, but not fully exclude potential mapping to high-value land.
  - Overdrafted Basin: Prioritize critically overdrafted areas.
  - Fire Threat: Prioritize low fire threat and limit mapping to areas of very high fire threat.
- Staff are seeking stakeholder input on how high-value cropland should be prioritized in mapping, particularly if different alignment thresholds should be applied in overdrafted basins.

Criteria	Comparative Point(s)		Level 1	Level 2	Level 3	Level 4	Level 5
	Land Use – Feasibility Factors	CEC's Ag layer for high value crops	Acreage of MW's Mapped	<20 % of Non-High	<50% of Non-High	< 100% of Non-High	> 100% of Non-High
Total RPB Acreage			<50% High Value	>50% High Value	>75% High Value	-	-
Critically Overdrafted Groundwater Basin		Majority of area around substation	Is In Basin	Outside Basin	-	-	-
Fire Threat Zone		Acreage of MW's Mapped	0% of any Fire Threat	0% of any Fire Threat	<50% of any Fire Threat	>50% of any Fire Threat	>0% Very High Fire Threat
		Total RPB Acreage	<20% any Fire Threat, 0% Very High	<50% any Fire Threat, <10% Very High	<75% any Fire Threat, <20% Very High	<75% any Fire Threat, <30% Very High	>75% any Fire Threat, >30% Very High

# Environmental (Conservation and Biological) Criteria Alignment

- Proposed to provide a more detailed breakdown of land-use implications focusing on the conservation and biological diversity implications and planning priorities.
  - CDFW's ACE Terrestrial Connectivity, Biodiversity, and Irreplaceability datasets.
  - CBI's Terrestrial Landscape Intactness dataset.
  - California Wetlands dataset.
- Overall seek to limit impacts to higher implication lands and prioritize limited utilization of lower implication lands around identified substations.
- In aligning with these criteria, mapped resources should generally:
  - Should seek to avoid utilizing higher implications area of the datasets.
  - Should seek to avoid mapping to areas of mostly higher implications acreage.
  - Prioritize utilizing only a limited percentage of the lower implication areas.
  - Prioritize mapping to areas of mostly lower implications acreage.
- Utilize two metrics in the criteria alignment analysis:
  - Estimated acreage of mapped MWs' percentage utilization of identified lower implications resource potential acreage.
  - Percentage of total area around identified substation that is higher implications.

# Environmental (Conservation and Biological) Criteria Alignment Thresholds Summary

- For the datasets analyzed under the Environment (Conservation and Biological) Implications criteria, staff are proposing the same criteria alignment thresholds for all five shown in the table below.

Criteria	Comparative Point(s)		Level 1	Level 2	Level 3	Level 4	Level 5
<b>Environmental Risk Factors</b>	<b>ACE biodiversity (rank 5)</b>	Acreage of MW's Mapped	<20 % of Lower Rank Area	<50% of Lower Rank Area	<75% of Lower Rank Area	<10% of Higher Rank Area	>10% of Higher Rank Area
		Total RPB Acreage	<50% High Value	<70% High Value	<90% High Value	<95% High Value	>95% High Value

# Questions



# Community and Environmental (Societal) Impact Factors Criteria

# Community and Environmental (Societal) Impact Factors

- Staff are proposing to expand key criteria only analyzed for battery storage in previous mapping efforts to all resources.
- For 23-24 TPP battery mapping, these criteria prioritized locating batteries in local areas and pollution burdened communities and near existing fossil-fueled generators.
  - Goal: Reduce criteria pollutants by limiting the need to rely on pollutant emitting existing resources.
- Criteria expanded to all mapped resources include:
  - Proximity to disadvantaged communities as identified by CalEnviroScreens 4.0.
  - Located in a PM<sub>2.5</sub> or Ozone EPA non-attainment zone.
  - Proximity to fossil-fueled generator (particularly those identified through the Thermal Retirement Assumptions).
  - Located in an LCR area (incorporated into transmission analysis criteria).
- One new addition to criteria: assessing if resource would likely be in an Inflation Reduction Act Energy Community.
- Working with CEC staff to assess how to better tailor or expand these criteria and this type of analysis.
  - Seeking feedback from stakeholders on role and scope of such criteria.

# Community and Environmental (Societal) Impact Factors Criteria Alignment

- Proposed criteria alignment thresholds for the four datasets.

Criteria	Comparative Point(s)		Level 1	Level 2	Level 3	Level 4	Level 5
<b>Societal - Environmental Factors</b>	<b>Disadvantaged Communities</b>	Majority of area around substation	Is in DAC	<10 mi from DAC	Not in DAC	-	-
	<b>Ozone Non-Attainment Zone</b>	Majority of area around substation	Is in O3 NAZ	Not in O3	-	-	-
	<b>PM2.5 Non-Attainment Zone</b>	Majority of area around substation	Is in NOx NAZ	Not in NOx	-	-	-
	<b>Proximity to existing thermal resources</b>	Substation Location	Adjacent to thermal (<1 mi)	<10 mi from thermal	>10 mi from thermal	-	-
	<b>I.R.A. Energy Communities</b>	Majority of area around substation	Is in IRA Community	Outside IRA Community	-	-	-

# Thermal Retirement Assumptions

- TPP Resource portfolios can include thermal generation not retained, which like other resources needs to be mapped to specific locations.
  - Recent portfolios generally have had all thermal generation retained through the modeling years used for the TPP.
- In assessing where to mapping thermal generation not retained for transmission planning purposes only, staff plan to consider the following:
  - Age of thermal units and technology type.
  - Pollutant and non-attainment Lists.
  - Proximity to disadvantaged communities.
  - Location with LCR areas.
  - Additional policy guided criteria.
- Retirement assumptions are still under development, so specific rankings and criteria thresholds are not included in the methodology.
  - Final criteria will be impacted by ongoing policy guidance development on modeling gas reduction and retirements.

# Transmission and Interconnection Criteria

# System-level Transmission Capability Criteria

- Mapped resources 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.
  - Also seek to limit renewable resource congestion, co-locate compatible resources when possible, and strive to improve dispatch in locally constrained areas.
- Primary source of transmission constraint and upgrade information is the new CAISO White Paper – 2023 Transmission Capability Estimates for use in the CPUC’s Resource Planning Process
  - [Link](#) to 06/28/2023 Draft White Paper, and CAISO stakeholder call [presentation](#) on 07/05/2023
  - Updates constraint and upgrade data based on Cluster 14 Phase I studies.
  - White Paper does not factor into existing capacity the upgrades approved in the recent TPPs.
    - 21-22 TPP upgrades are identified as mitigation options in White Paper and can readily be incorporated.
    - Some 23-24 TPP upgrades are not identified in the White Paper; CPUC staff will work with CAISO to identify estimates for these approved upgrades.
- Rely on CAISO Local Capacity Requirement studies to aide in storage and resource mapping in local areas.

# Transmission Capability – Transmission Constraints

- Analysis will incorporate on-peak and off-peak limits and identified upgrades for 104 transmission constraints (compared to 44 in the 2021 White Paper).
  - Actual limits: binding amounts identified in CAISO studies,
  - Default constraints are non-binding limits, which represent the largest amount CAISO has studied.
- In-CAISO resources are accounted for at substations to which they are mapped.
- For out-of-CAISO resources, staff seek to identify out-of-CAISO location and account for resources in CAISO constraints at estimated intertie point.
  - Identify mapped OOS resources as utilizing existing Maximum Import Capability (MIC) or require MIC expansion.

Transmission Constraint	Affected Resource Locations	Condition Under Which Constraint is Binding	Estimated FCDS		ADNU & Cost Estimate (\$million)		Estimated EODS		AOPNU & Cost Estimate		Wind/Solar Area Designation
			Transmission Plan Capability (MW)	Incremental due to ADNU (MW)	ADNU (Time to Construct)	Cost (2022\$)	Transmission on Plan ***	Incremental due to AOPNU	AOPNU (Time to Construct)	Cost (2022\$)	
SCE Eastern Interconnection Area Constraints											
Colorado River 500/230 kV Constraint	Colorado River 230 kV	On-Peak, Off-Peak	545	1,370	New Colorado River No. 3 500/230 kV transformer (4 years)	\$67	1,414	1,299	Same as ADNU	\$67	Solar
Colorado River-Red Bluff Constraint	SCE Eastern (east of Colorado River), East of Pisgah, and SDG&E areas	On-Peak	10,933	1,000	New Colorado River-Red Bluff No. 3 500 kV line (10 years)	\$305	10933*	N/A	N/A	N/A	Solar
DCRT Constraint	Cielo Azul, Delaney	On-Peak	2,300	3,000	New Cielo Azul - Colorado River No. 2 500 kV line, Upgrade the series cap on Cielo Azul - Colorado River No.1 500 kV line to match the conductor rating (6 years)	\$463	2300*	N/A	N/A	N/A	Solar
Devers-Red Bluff Constraint	SCE Eastern (east of Red Bluff), East of Pisgah, and SDG&E areas	On-Peak, Off-Peak	4,050	2,500	New Devers-Red Bluff No. 3 500 kV line (9 years)	\$875	10,167	4,334	Same as ADNU	\$875	Solar

**Table:** White paper information on several of the transmission constraints in the SCE Eastern, Riverside, Area

# Transmission Capability – Deliverability Status

- Mapped resources are considered either Fully Deliverability (FCDS) or Energy Only (EODS)
  - FCDS resources require on-peak capacity at both CAISO's HSN and SSN scenarios and off-peak capacity
  - EODS resources require only off-peak capacity
- CAISO's White Paper includes resource specific output factors that represent a resource's utilization of transmission capacity.
  - Different values for On-peak (HSN and SSN) and Off-peak.
  - Different values based on geographic area and dominate resource type.
- Batteries in off-peak viewed as charging and thus enabling additional off-peak transmission capacity

## On-Peak FCDS Output Factors

Resource type	HSN			SSN		
	SDG&E	SCE	PG&E	SDG&E	SCE	PG&E
Solar	3.00%	10.60%	10.00%	40.20%	42.70%	55.60%
Wind	33.70%	55.70%	66.50%	11.20%	20.80%	16.30%
Non-Intermittent resources	100%					
Energy storage	100%			50%		
	if duration is ≥ 4-hour or MW*(duration/4) if duration is < 4-hour					

\* NM, ID, and WY wind values and Offshore wind values not depicted

## Off-Peak EODS Output Factors

Resource type	Wind Area			Solar Area		
	SDG&E	SCE	PG&E	SDG&E	SCE	PG&E
Solar	68%			79%	77%	79%
Wind	69%	64%	63%	44%		
Hydro	30%					
Thermal	15% - 0%					
Energy storage	-100% in charging mode (if duration is ≥ 4-hour or 4-hour equivalent if < 4-hour)					



# Transmission Capability – Calculating Tx Utilization

- Multi-step process to calculate transmission utilization within a constraint
  - Aggregate all resources within constraint
    - Includes recently online resources in addition to in-development and generic resources
    - Need to account for all resources within constraint that have come online since the White Paper information was developed.
  - Calculate transmission utilization of each resource type for each transmission use scenario.
  - Sum across all resources for each constraint and comparing to existing transmission capacity.
  - Assess exceedances and if any CAISO identified upgrades could alleviate the exceedances.
- Tables on right show calculations and then criteria alignment using the 23-24 TPP methodology.

Tx Capacity Utilized by Mapped Resources (MW)	Kramer- Victor/Roadway - Victor Constraint			Kramer- Victor/Roadway - Victor Constraint			Lugo 500/230 kV Transformer Constraint		
	HSN	SSN	Off-Peak	HSN	SSN	Off-Peak	HSN	SSN	Off-Peak
<b>Existing Capacity:</b>	826	826	1,237	1,156	1,156	1,311	1,576	1,576	1,619
Wind	-	-	-	-	-	-	-	-	-
Solar	103	415	1,567	114	457	1,644	145	585	2,053
Geothermal	53	53	-	53	53	-	53	53	-
Biomass	-	-	-	25	25	-	25	25	-
Li_Battery	1,029	514	(1,029)	1,079	539	(1,079)	1,264	632	(1,264)
<b>Total Utilized:</b>	1,185	982	539	1,270	1,075	566	1,487	1,295	789
<b>Remaining:</b>	(359)	(156)	698	(114)	81	745	89	281	830
<b>Tx Upgrade Amt:</b>	430	430	480	430	N/A	N/A	980	N/A	N/A



Flags without (left) and with (right) upgrades

Total Resources (MW) by Substation		Geothermal	Biomass	Distributed Solar	Solar	Solar	Li_Battery	Tx Criteria Flag	Tx Criteria Flag	Tx Criteria Flag	Tx Criteria Flag
Substation	Voltage	FCDS	FCDS	FCDS	FCDS	EODS	FCDS	FCDS	EODS	FCDS	EODS
Calcite	230	-	-	-	200	230	185	1	1	1	1
Control	115	53	-	-	-	-	-	3	1	1*	1
Coolwater	115	-	-	-	150	204	104	3	1	1*	1
Kramer	230	-	-	-	620	741	700	3	1	1*	1
Kramer	115	-	-	2	90	-	75	3	1	1*	1
Pisgah	230	-	-	-	100	-	-	1	1	1	1
Roadway	115	-	-	3	111	120	150	3	1	1*	1
Victor	230	-	3	2	100	-	50	3	1	1*	1
Victor	115	-	22	-	-	-	-	3	1	1*	1

**Table:** 23-24 TPP non-compliance flags determined from transmission constraints utilization calculations

# System-level Transmission Capability Criteria Alignment

- Tables show the proposed alignment thresholds for the FCDS and EODS constraint exceedances and the mapping priorities for LCR areas.
- Specific values for the exceedance thresholds will be determined during the mapping process, working with CAISO staff.

Criteria	Comparative Point(s)		Level 1	Level 2	Level 3	Level 4	Level 5
System-Level Transmission	On-peak Capability Limit	FCDS transmission capacity	No Exceedance	No Exceedance with identified upgrade	Small Exceedance in default constraint	Large Exceedance in default constraint	Exceedance in actual constraint, upgrade is likely not cost-effective
	Off-peak Capability Limit	EODS transmission capacity	No Exceedance	No Exceedance with identified upgrade	Small Exceedance in default constraint	Large Exceedance in default constraint	Exceedance in actual constraint, upgrade is likely not cost-effective
	LCR areas	MW amount & Resource type	Generation in LCR area w/ displaced gas; stand-alone storage within charging limit	Level 1 requirements but met by cost-effective transmission upgrade	Resources outside LCR area	Stand-alone storage in LCR area exceeds charging limit	-

# Substation-level Interconnection Criteria

- Mapped resources should
  1. Be within a viable distance of transmission from economic, land-use, and environmental perspectives and
  2. Be able to interconnect to transmission of an appropriate voltage in a viable and cost-effective manner.
- Staff seek to implement expansion of the previous Criteria #1 – Distance to Transmission of Appropriate Voltage.
- For key substations, staff plan to work with PTOs to obtain information on ease and costs of interconnection, including:
  - Number of open positions on existing buses.
  - Ability to allow additional interconnections or substation expansion (e.g., stations at or near fault duty limit, maximum generation capabilities, physical space or technical limitations to expansions/upgrades).
  - Cost/ease of expanding substation's interconnection ability (e.g., in-fence line upgrades, substation expansion options).
- Utilize PTO's Per Unit Cost Guides to compare the rough costs of interconnection, potential interconnection upgrades, and alternatives such as new loop-in substations.
  - Incorporate potential number of projects and project size estimates from the interconnection queue.

# Substation-level Interconnection Criteria Alignment

- Distance to point of interconnection: Estimated project size and resource type specific, with larger projects and wind or geothermal resources still in alignment at further distances.
- Substation interconnection availability/feasibility: Prioritize substations with existing interconnection capacity or cost-effective upgrades to enable interconnection.
  - Utilized for substations for which PTOs can provide the necessary information.
- Interconnection Voltage: Priority is right-sizing interconnection MW amount with substation voltage: avoiding large MW amounts mapped to lower voltages, where major upgrades may not be cost effective, and small MW to high voltages, where higher interconnection cost are likely.
  - Serves as secondary analysis to the interconnection feasibility data, which would take precedence when it is available.

# Substation-level Interconnection Alignment Thresholds

- Table shows proposed alignment thresholds for the three criteria within Substation-level interconnection.
- Staff have proposed specific numerical values for the distance criteria alignment.
  - Seeking stakeholder feedback on assumptions.
- Staff have not established specific values for the interconnection availability and voltage criteria yet and intended to do so during the mapping process.
  - Criteria heavily dependent on information work group will seek from the PTOs, which is obtained during the busbar mapping process.

Criteria	Comparative Point(s)		Level 1	Level 2	Level 3	Level 4	Level 5
Substation Level Interconnection	Interconnection Capability	MW & No. of projects	Likely need only existing open positions	Likely need cost-effective minor substation upgrades or new substation	Likely need major/complex upgrades but still cost-effective	Likely need major/complex upgrades, but not cost-effective	Cannot be accommodate by substation (no feasible upgrade identified)
	Max distance to substation	Solar MW & Distance	< 5 mi, any size	< 10 mi, (>400 MW per project: < 15 mi)	< 15 mi, (>400 MW per project: < 20 mi)	< 20 mi, (>400 MW per project: < 30 mi)	> 20 mi, (>400 MW per project: > 30 mi)
		Wind/Geothermal MW & Distance	< 10 mi any size	< 15 mi, (>200 MW per project: < 20 mi)	< 20 mi, (>200 MW per project: <30 mi)	<30 mi, (>200 MW per project: >30 mi)	>30 mi for <200 MW projects
Substation voltage	Bus's voltage & resource MWs	> 100 kV and reasonably accommodated MW amounts	> 100 kV and smaller MW amounts that increase costs per MW	Larger MW amounts that may require substation upgrades/overhaul	Significantly larger MW amounts, likely require major upgrade to accommodate	< 100 kV & large MW amount; 500 kV & small MW amount	

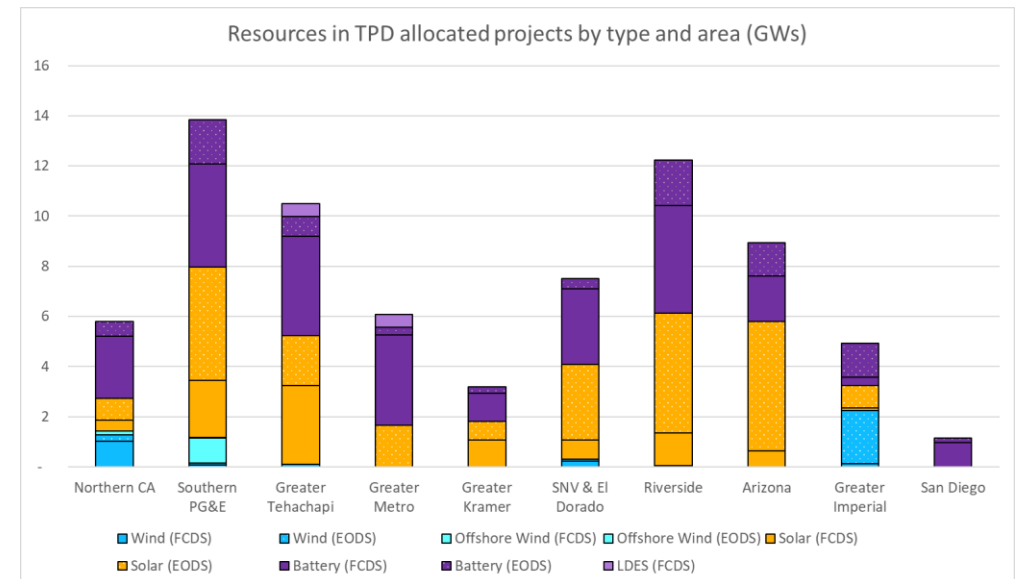
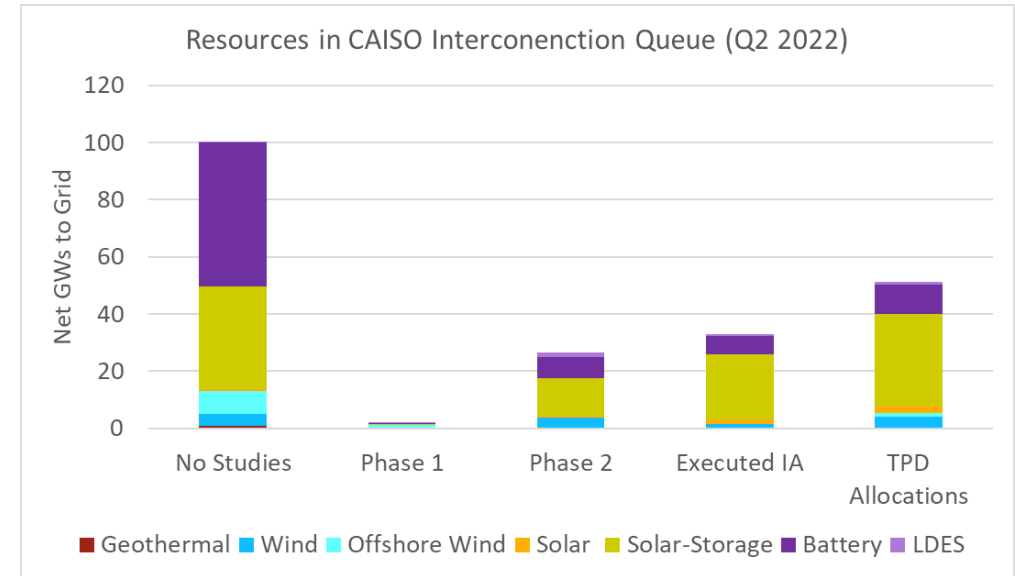
# Commercial Interest and Previous Base Case Criteria

# Commercial Development Interest

- Mapping, to extent possible, should align with planned procurement by LSEs and the level of resources proposed in the CAISO interconnection queue and other relevant in queues.
- Continuing use of key improvements from previous mapping efforts:
  - Busbar-level analysis in addition to regional level (implemented in 22-23 TPP mapping).
  - Inclusion of TPD allocation into the commercial interest analysis (implemented in the 23-24 TPP).
  - Prioritizing “higher confidence” commercial interested (implemented in 22-23 TPP mapping).
- Interconnection Queues previously utilized:
  - CAISO Interconnection Queue
  - IID Interconnection Queue
  - NVEP Interconnection Queue
  - SCE WDAT Interconnection Queue
  - PG&E WDT Interconnection Queue
  - SDGE WDAT Interconnection Queue

# Commercial Development Interest (cont'd)

- Methodology divided identified commercial development interest into two categories.
- “Higher-confidence” commercial interest:
  - In-development resources – contracted in LSE plans and PTO identified as under construction.
  - Resources with executed IAs.
  - Resources with CAISO TPD allocations.
  - Other resources with Phase 2 completed in the CAISO queue.
- “Lower-confidence” commercial interest:
  - Resources that have only completed or are still in initial study phases.
  - Known potential projects not yet in an interconnection queue.





# Commercial Development Interest Criteria Alignment

- Criteria alignment assesses both if mapping exceeds commercial interest or if it is significantly less than the commercial interest.
- Criteria prioritizes alignment with “higher confidence”; and non-alignment results in high non-compliance.
  - Seek to guarantee mapping aligns with in-development resources that are not resource baselines. Ensures properly accounted for in the transmission modeling.
  - Next highest priority is resources with TPD allocations and Executed IAs.
  - Remaining higher confidence commercial interest.
- “Lower confidence” commercial interest utilized in a guidance role, lower non-compliance for misalignment.
- Specific threshold values for the alignment levels will be determined during the mapping process following analysis of the most up to date interconnection queues.

Criteria	Comparative Point(s)		Level 1	Level 2	Level 3	Level 4	Level 5
Commercial Development Interest	Interconnection Queue and In-Development Resources	MW amount exceeds CI	Aligns with In-Dev and TPD or IA resources	Exceeds TPD/IA/In-Dev Res but aligns with total higher confidence CI	Exceeds higher confidence CI but not total CI	Exceeds total CI	No CI at substation
		MW amount less than CI	1+ amount mapped is significantly less than total CI	2+ Amount mapped is less than than high confidence CI	3+ Amount mapped is less than TPD/IA/In-Dev Res	4+ Amount mapped is significantly less than TPD/IA/In-Dev Res	-

# Alignment with prior TPP portfolios

- Mapping should be relatively consistent with prior years.
  - The Base Case compared to base cases of prior years and similar sensitivity portfolios.
  - Sensitivity Portfolios compared to similar issue-focused portfolios of prior years.
- Goal is to avoid significantly reducing transmission impacts of prior years' mapping without clear reasons which are explicitly justified.
- Following working group discussion, non-compliance can be reduced if changes are estimated to not significantly affect transmission implications.

Criteria	Comparative Point(s)		Level 1	Level 2	Level 3	Level 4	Level 5
<b>Consistency with prior TPP Portfolios</b>	<b>Previous TPP portfolios mapped resources</b>	<b>MW amounts mapped</b>	Not less than in previous most similar TPP portfolio	Not less than (FCDS & Total) total in previous base case	Slightly less FCDS or total than in previous base case	Significantly less total than in previous base case	Level 4 but in area with approved/triggered Tx upgrade

# Next Steps

# Next Steps

- Draft Busbar Mapping Methodology Document is on the IRP's [Assumptions for the 2024-2025 TPP](#) webpage.
- Staff invite stakeholders to submit written feedback on the draft updates to the busbar mapping methodology by **Friday, August 4, 2023**.
  - Please submit your comments to [IRPDataRequest@cpuc.ca.gov](mailto:IRPDataRequest@cpuc.ca.gov) and use “Busbar Mapping Methodology” in the subject line
  - Stakeholders are encouraged to include the IRP service list as well.
  - Please categorize your comments based on sections and topics in the draft Busbar Mapping Methodology Document.
  - Stakeholders should support their recommendations with data and/or explanations. Please include links if referencing specific datasets.
- Staff will review and work to incorporate into the updated Busbar Mapping Methodology
- Staff expects to release the updated Busbar Mapping Methodology later in Q3 2023.