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Land Use Screens in CPUC's Integrated Resource Planning

March 13, 2023

CEC's Workshop on Land Use Screens

Energy Division Staff Presentation

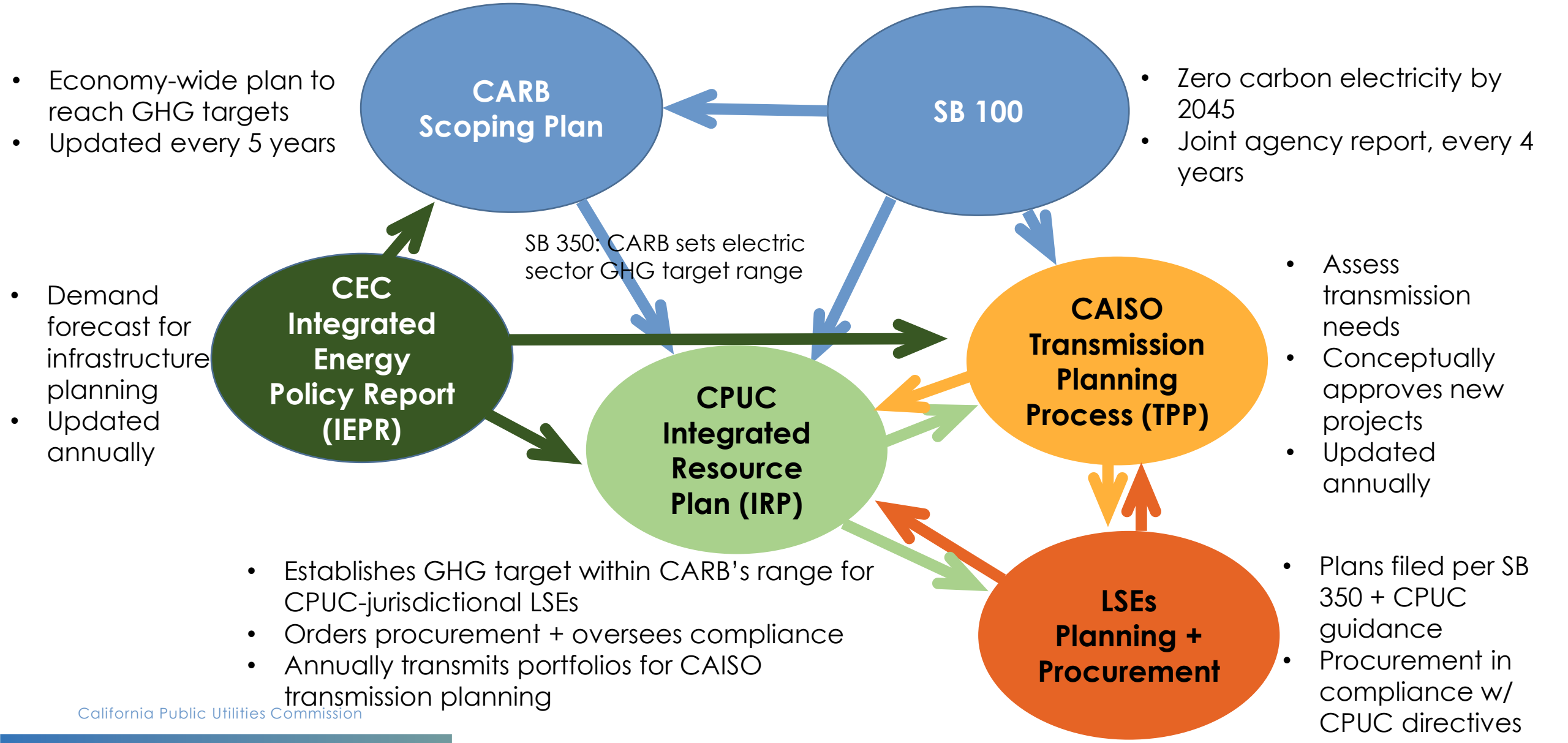
California Public
Utilities Commission

Integrated Resource Planning (IRP) in California Today

- The objective of IRP is to reduce the cost of achieving greenhouse gas (GHG) reductions and other policy goals by looking across individual LSE boundaries and resource types to identify solutions to reliability, cost, or other concerns that might not otherwise be found.
- Goal of the new 2022-23 IRP cycle is to ensure that the electric sector is on track, between now and 2035, to support California's economy-wide GHG reduction goals and achieve the SB 100 target of 100% renewable and carbon-free electricity by 2045.
- The IRP process has two parts:
  - First, it identifies an optimal portfolio for meeting state policy objectives and encourages the LSEs to plan and procure towards that future.
  - Second, it collects and aggregates the LSEs collective efforts for planned and contracted resources to compare the expected system to the identified optimal system. The CPUC considers a variety of interventions to ensure LSEs are progressing towards an optimal future.

Leads to development of a Preferred System Plan (PSP)

IRP within California's Electricity Planning Ecosystem



- Economy-wide plan to reach GHG targets
- Updated every 5 years

- Zero carbon electricity by 2045
- Joint agency report, every 4 years

- Demand forecast for infrastructure planning
- Updated annually

- Assess transmission needs
- Conceptually approves new projects
- Updated annually

- Establishes GHG target within CARB's range for CPUC-jurisdictional LSEs
- Orders procurement + oversees compliance
- Annually transmits portfolios for CAISO transmission planning

- Plans filed per SB 350 + CPUC guidance
- Procurement in compliance w/ CPUC directives

Land Use Analysis in IRP

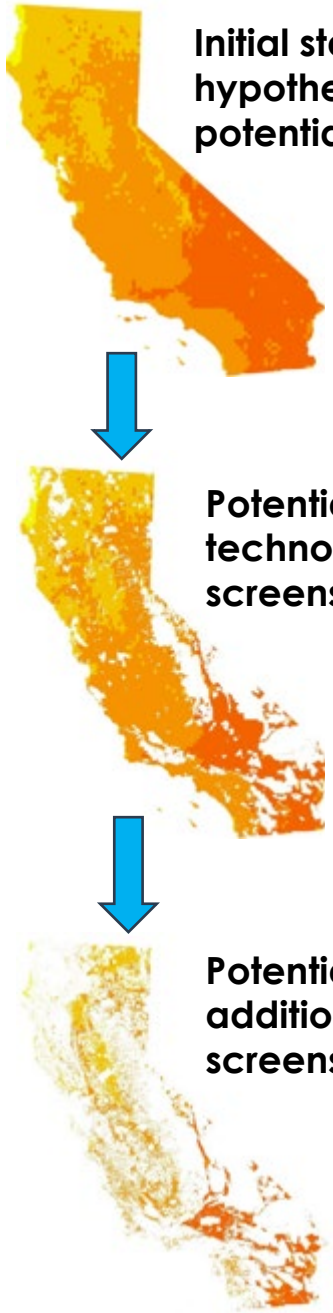
Two main uses in IRP for land-use /environmental data implementation:

- **Candidate Resource Screens in RESOLVE:** RESOLVE is used in the CPUC IRP process for capacity expansion modeling to create optimal least-cost portfolios that inform the resource types and quantities needed within specific time horizons.
  - Utilized to help develop the portfolios adopted in the Reference System and Preferred System Plans
  - Model informs generation + transmission infrastructure planning needs within the planning horizon (i.e. now through 2035)

- **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).
  - Joint effort by a working group comprised of CPUC, CEC, and CAISO staff.
  - Mapping based on stakeholder vetted methodology.

Land Use Screens in RESOLVE

- RESOLVE model utilizes a broad array of inputs and assumptions:
  - Last developed at the start of the current IRP cycle in 2019 (I&A Document for 2019-20 IRP)
  - Update to the Inputs & Assumptions for new 2022-23 IRP cycle is in progress, with draft I&A ready soon. (LINK to Sept I&A kickoff MAG slides)
  - Update will include overhaul of the resource potentials and the RESOLVE resource areas.
- Resource potentials for utility-scale solar and onshore wind in RESOLVE are developed as follows:
  1. Begin with area-wide hypothetical potential based on NREL data for solar (insolation and capacity factors) and wind (wind speed and CFs).
  2. Screen out areas limited by technological and economic factors (physical constraints, e.g., slope, and minimum CF threshold).
  3. **Screen out areas limited by land-use and environmental factors (e.g., legally protected areas, prime farmland, high environmental impact areas).**
     - Currently use RETI Cat 1 and 2 screens but include development and least conflict areas identified in DRECP and SJV.
     - CPUC staff plan to utilize new CEC land-use screens for calculating RESOLVE resource potentials within California once they are ready.

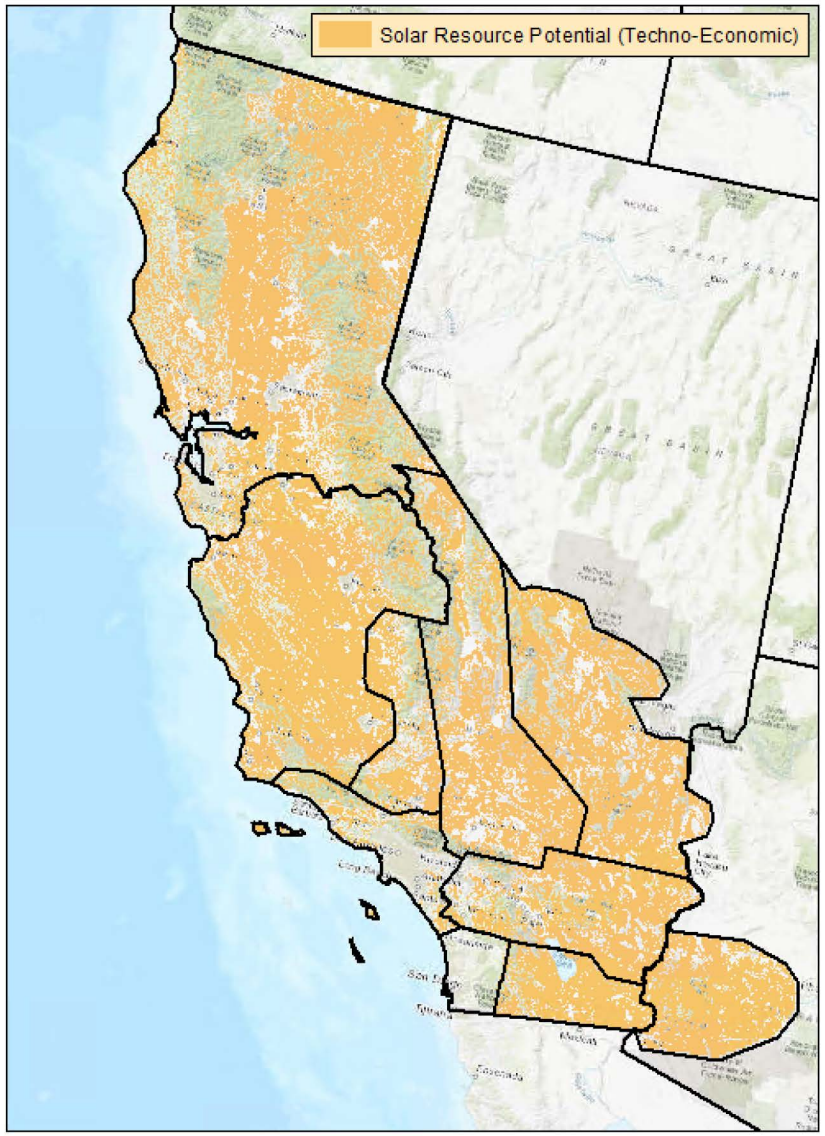


Land Use Screens – Draft Techno-Economic Screens

- Preview of the draft techno-economic screens for onshore wind and utility-scale solar resources from the upcoming 2022-2023 IPR Inputs and Assumptions.
  - Note: I&A process is still ongoing including future stakeholder review in Q2, and screening criteria may be changed.
- Techno-Economic screens are exclusions centred on physical constraints and economic viability limitations and represent the maximum potentially possible based on technological assumptions.
  - Proposed onshore wind turbine assumptions are: 4 MW turbine size, 110 m hub height, and 150 m rotor diameter.
- Exclusions do not incorporate legally protected areas, historical/cultural sites, BLM and other agency exclusions, prime farmland, flood zones, and tribal lands.
  - **These are left for assessment in the land-use and environmental screens**
- **CPUC has shared these draft screens with CEC staff for their land-use screen development work.**

Techno/Economic constraint exclusions	Onshore Wind	Utility Scale Solar
Steeply sloped areas	>10° (~18%)	>10° (~18%)
Population density	> 100/km^2	>100/km^2
Urban areas	< 1000 m	< 500 m
Military Installations	< 3000 m	< 1000 m
Water bodies	< 250 m	< 250 m
Railways	< 250 m	< 30 m
Major highways	< 125 m	< 125 m
Airports	< 5000 m	< 1000 m
Active mines	< 1000 m	< 1000 m
Minimum CPA size	< 0.5 MW/km^2	< 0.5 MW/km^2
Capacity factor	< 20%	< 16%

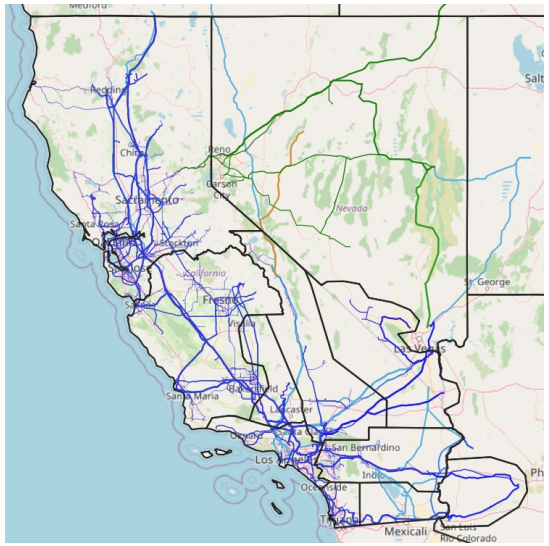
Land Use Screens – Draft Techno-Economic Screens



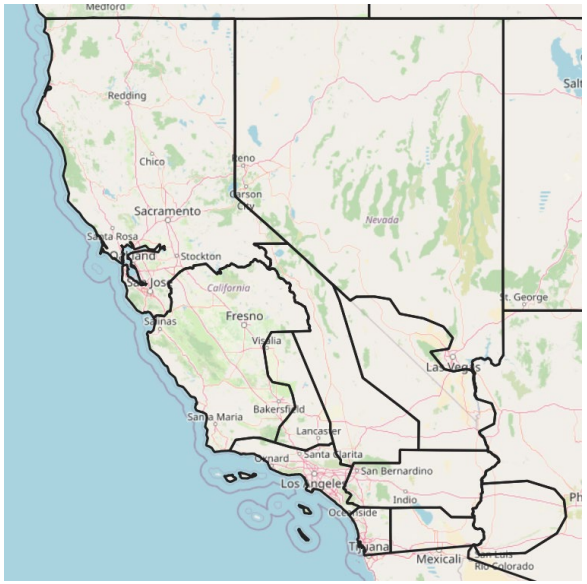
Land Use Screens – RESOLVE Resource Areas

- RESOLVE has some geographic granularity to selecting solar, wind, geothermal, and storage resources.
  - Allows the application of differing capacity factors, cost assumptions, and available transmission and identified transmission upgrade information.
- These resources areas are centered around the transmission system and key constraints identified from the CAISO's 2021 White Paper on Transmission Capability Estimates
  - Limited number of areas is a balance between geographic granularity and RESOLVE computational load.
  - Solar and battery storage share areas to capture transmission interplay between storage and EODS solar.
- Final resource potentials after all screens are applied are summed up across each area and that MW number serves as the potential resource amount RESOLVE can select.

Snapshot of system level transmission



Solar Resource Areas



Wind Resource Areas

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Busbar Mapping of IRP Portfolios for the TPP

March 13, 2023

CEC's IEPR Workshop on Land Use Screens

Energy Division Staff Presentation

California Public
Utilities Commission

Busbar Mapping in IRP and TPP

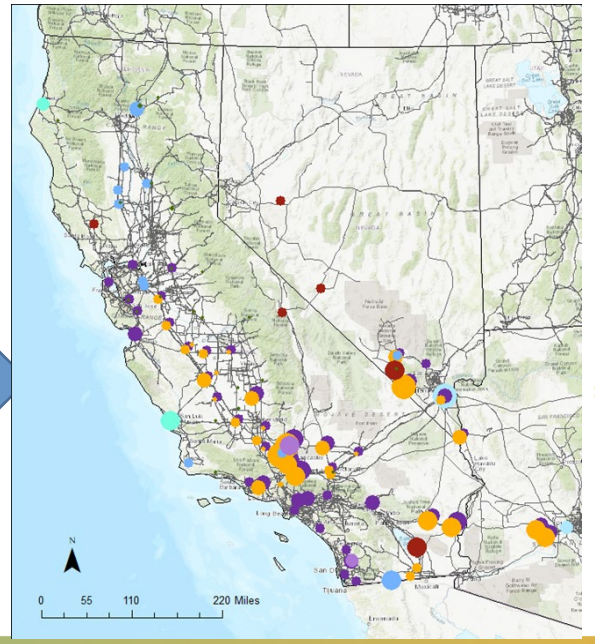
- **Resource to Busbar Mapping** ("busbar mapping"): The process of refining the geographically coarse portfolios developed through IRP to specific interconnection locations (i.e. substations) for analysis in the CAISO's annual Transmission Planning Process (TPP).
  - First conducted as "proof of concept" for the 2018-2019 TPP portfolio
  - Formalized into a joint effort by a working group comprised of CPUC, CEC, and CAISO staff.
- **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.
  - Most recent 23-24 TPP Mapping Methodology.

Input: Portfolio developed from LSE plans & RESOLVE model results

Resource Type	MW by 2032
Biomass	134
Geothermal	1,160
Wind	3,531
Wind OOS New Tx	1,500
Offshore Wind	1,708
Utility-Scale Solar	17,506
Battery Storage	13,571
Long-duration Storage	1,000
Shed Demand Response	441
Total	40,551

RESOLVE Resource Name	2032 Total (MW)
Greater_LA_Solar	1
Northern_California_Solar	-
Southern_PGAE_Solar	1,238
Tehachapi_Solar	2,969
Greater_Kramer_Solar	3,166
Southern_NV_Eldorado_Solar	7,382
Riverside_Solar	4,001
Arizona_Solar	-
Imperial_Solar	-

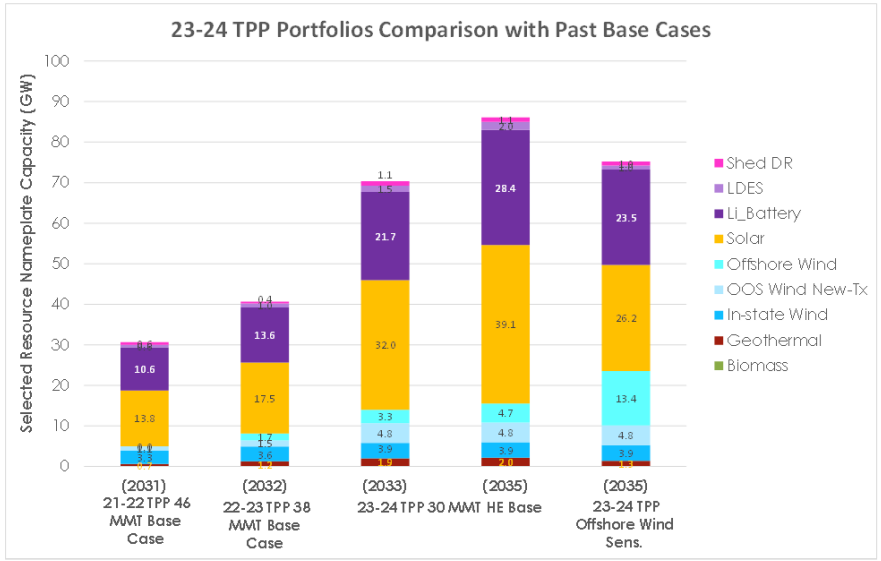
Mapping Process

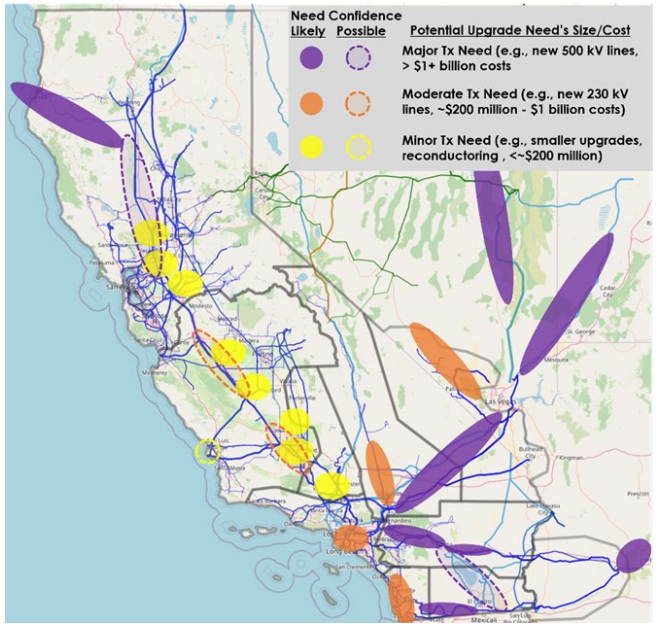


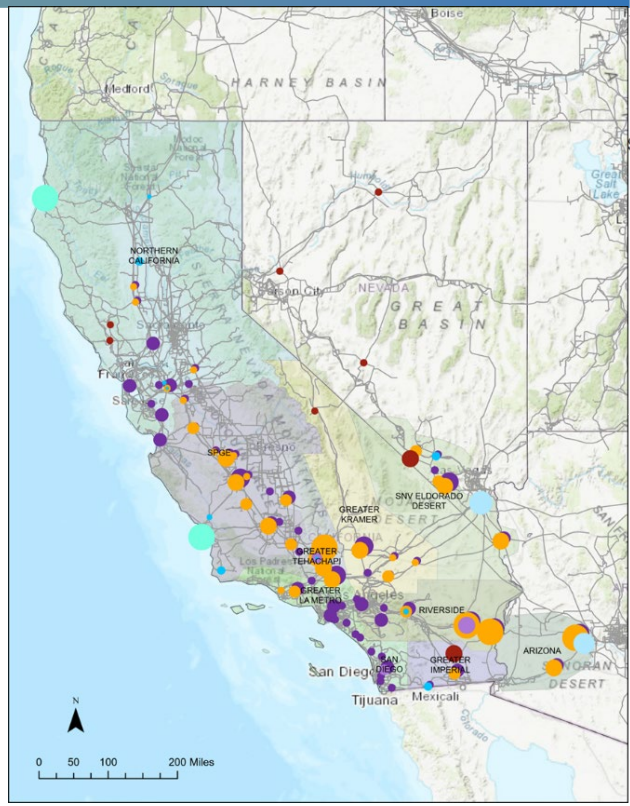
Output: Substation-level location for resources

2023-2024 TPP Portfolios

- Feb. 23, 2023, CPUC Decision 23-02-040 transmitted two portfolios to the CAISO for the 2023-2024 TPP.
  - Reliability and policy driven base case portfolio
    - 30 MMT portfolio using the 2021 IEPR's Additional Transportation Electrification Scenario and modeling out to 2035.
    - To be used by the CAISO in the TPP assessment to identify transmission solutions that then go to the CAISO Board of Governors for approval.
  - Offshore wind policy driven sensitivity portfolio
    - Also models out to 2035 and includes 13.4 GW of offshore wind.
    - To be used for study purposes and transmission solutions historically do not go for approval; results provide transmission information for future IRP work.







Above: Mapping results for the 2035 base case portfolio

Left: Potential transmission upgrades needed by the 2035 base case portfolio based on busbar mapping analysis

Busbar Mapping Methodology – Mapping Criteria

- Goal of mapping process is to identify plausible locations for portfolio resources that limit violations of the established busbar mapping criteria.
- Criteria are organized into five categories:
  1. Distance to transmission of appropriate voltage
  2. Transmission capability limits
  3. **Land-use and environmental constraints**
  4. Commercial development interest
  5. Consistency with prior year mapping
- Additional criteria just for battery storage with goals of minimizing ratepayer costs and minimizing criteria pollutants
  - Co-location with renewable resources and reducing congestion/curtailment
  - Reducing market power in Local Capacity Requirement (LCRs) areas
  - Prioritizing transmission-constrained LCR areas, areas with high air quality impacts, and disadvantaged communities (DACs) to potentially reduce use of local power plant emission sources.

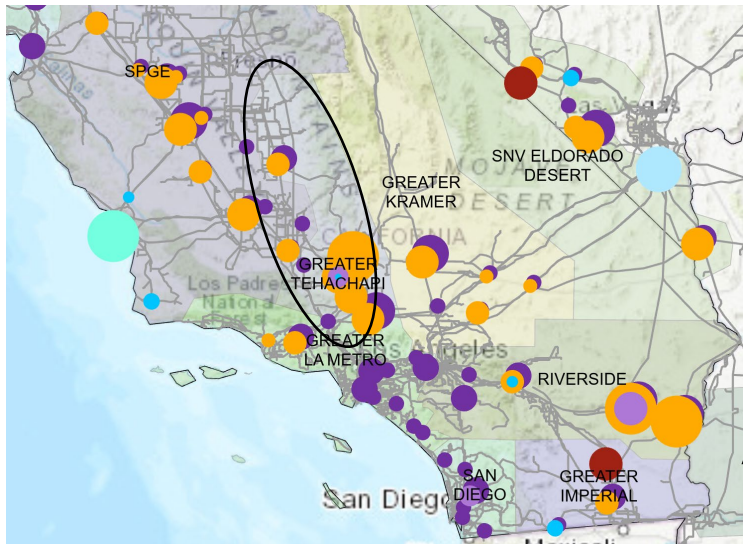
Transmission Constraint	Affected Zones	Condition under which Constraint is Binding	Estimated FCDS		ADNU & Cost Estimate ($million)	
			Existing System (MW)	Incremental due to ADNU	ADNU (Time to Construct)	Cost (Escalated to COD)
SCE North of Lugo (NOL) Study Area Constraints						
Lugo 500/230 kV Transformer Constraint	Inyokern North Kramer, Victor, Pisgah	On-peak	1,576	980	New Lugo 500/230kV No. 3 transformer (42 months)	$70
Victor-Lugo Constraint	Inyokern North Kramer, Victor	On-peak	1,156	430	Reconductor Lugo - Victor 230kV lines (27 Months)	$226
Kramer- Victor/Roadway - Victor Constraint	Inyokern North Kramer	On-peak, Off-peak	826	430	Loop in Kramer - Victor 115kV line into Roadway and reconductor Kramer to Lugo 230kV lines (81 months)	$108

Environmental and Land Use Data Sets Utilized in Busbar Mapping

- Terrestrial Landscape Intactness (California Energy Commission and Conservation Biology Institute, 2016)
- Areas of Conservation Emphasis, version 3.0 (ACE III) (California Department of Fish and Wildlife, 2018)
  - i. Terrestrial Connectivity
  - ii. Biodiversity
  - iii. Rarity
  - iv. Native species
  - v. Irreplaceability
- Natural Landscape Blocks
- Wildfire Threat
- Western Electricity Coordinating Council (WECC) Environmental Risk Dataset (utilized for resources mapped outside of California)

Mapping Results Alignment with Criteria

- Example mapping results for the Greater Tehachapi area from the 23-24 TPP base case portfolio 2035 model year.
- Table depicts resources mapped to each substation and their compliance with the mapping criteria



Locations of 2035 mapped resources (solar – gold, battery – purple) in the Greater Tehachapi area (circled)

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

Legend for Criteria Flags

General

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

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

Substation	MW Total	Criteria 4
Sample Sub	-	2

*Asterik after substation name indicates import into CAISO system

Criteria Specific Flags

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

Updating the Busbar Mapping Methodology

- The 2023-2024 TPP portfolios contained an unprecedent number of resources, but the upcoming 2024-2025 TPP will likely have significantly more.
  - SB 887 (2022, Becker) requires CPUC portfolios transmitted to CAISO to model out at least 15-years.
- In preparation for the 24-25 TPP mapping effort, staff are considering significant updates to the busbar mapping methodology.

Goals of Potential Changes to Methodology

- Update and improve land-use and environmental criteria screens by implementing new CEC datasets.
- Better enable the mapping process to accommodate the longer (15-year) planning horizon and the additional resources resulting from it.
  - How can the working group assess mapping potential beyond existing and planned substations?
- More systematically account of existing resources in both land-use and substation-level transmission analysis.
- Incorporate various ideas and recommendations from stakeholders (e.g., factoring parcel size into land feasibility analysis and expansion of the additional battery criteria to all resources).

Timeline and Process

- Plan to share draft methodology through IRP MAG-like process and incorporate stakeholder feedback before starting mapping for the 24-25 TPP.

For more information:

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