Integrated Resource Planning (IRP) Recommended 27-28 CAISO Transmission Planning Process (TPP) Portfolios and Initial Busbar Mapping Results

Webinar

Energy Division Staff
October 22, 2026



California Public Utilities Commission

Introduction

Scope

- Recommended 27-28 TPP Portfolios August 31, 2026 Ruling comments were received September 28th, and reply comments were received by October 12th, 2026.
  - IRP staff are still in process of incorporating stakeholder feedback into the mapping efforts.
- Webinar focuses on an overview of the recommended base case and sensitivity portfolios for the 27-28 TPP and preliminary busbar mapping results, noting that the mapping process is still ongoing and further changes will occur.
- The objectives of this webinar are to:
  - Provide an overview of the recommended 27-28 TPP base case and sensitivity portfolios.
    - Including small modelling updates used in their development, consistent with what was presented in the June 2026 Model Advisory Group webinar
  - Re-familiarize stakeholders with busbar mapping process and criteria, and highlight improvements.
    - Recap on the criteria and changes incorporated since the 26-27 TPP mapping.
  - Preview preliminary mapping results of the base case.
    - Provide a summary of busbar mapping results for the recommended base case portfolio and a discussion of the busbar mapping analysis.
    - Provide overview of identified mapping issues and next mapping steps.
  - Provide an opportunity for stakeholders to ask clarifying questions about busbar mapping process and preliminary mapping results.

27-28 TPP Timeline

- The 2027-2028 Transmission Planning Process Portfolio Ruling was issued on August 31st, 2026
  - Described the TPP analysis and sought comment on the recommended base case for the Commission to pass to the CAISO for the annual TPP process, as well as a recommended sensitivity portfolio.

Activity	Timing
Modeling Advisory Group (MAG) Webinar on Potential Updates to the Busbar Mapping Methodology	June 16th, 2026
Ruling on 27-28 TPP (including proposed base case and recommended sensitivity, busbar mapping methodology, and RESOLVE updates)	August 31st, 2026
Ruling on Preliminary Busbar Mapping Results and release of the Dashboard	October 12th, 2026
Comments received on Busbar Mapping Results Ruling	November 2nd, 2026
Webinar on 27-28 TPP Portfolios and Initial Busbar Mapping Results	October 22nd, 2026
CPUC-CEC-CAISO Busbar Mapping Working Group iterates on busbar mapping of portfolios	September-December 2026
Proposed Decision	January 2027
27-28 TPP Adopted by Commission via Decision	February 2027

Logistics

- Webinar slides, updated busbar mapping dashboard, and supporting material are available on the IRP webpage: Assumptions for the 2027-2028 TPP.

Questions: We invite clarifying questions using the "Q&A" feature of this Webex.

- Open Slido by clicking on the three dots on the bottom right
- Write your question in the provided box
- Staff will post the written log of Q&As following the webinar

- 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"

- Comments to the October 12th, 2026 Ruling for the initial mapping and this webinar are due by November 2nd, 2026

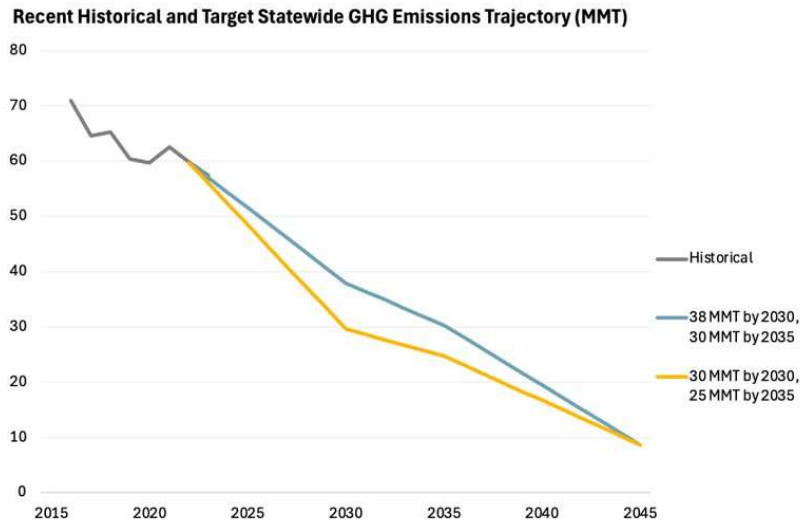
Agenda

Time	Topic	Presenter
9:00 AM	Introduction	Neil Raffan
9:10 AM	IRP Background	Neil Raffan
9:15 AM	TPP and Busbar Mapping Overview	Neil Raffan
9:20 AM	Overview of the Recommended 27-28 TPP Portfolio Analysis	Neil Raffan
9:25 AM	Input & Assumption Updates for 27-28 TPP Modeling	Sam Schreiber/ Madeline Macmillan
9:45 AM	27-28 TPP Recommended Base Case Portfolio	Sierra Withers
10:00 AM	27-28 TPP Sensitivity Portfolio Options	Sierra Withers
10:20 AM	Busbar Mapping Methodology	Kaj Peterson
10:35 AM	CEC: Land-use and Environmental Analysis in Busbar Mapping	CEC Staff
11:15 AM	Overview of Preliminary Mapping Results	Sierra Withers
11:40 AM	Questions & Wrap Up	Neil Raffan

IRP Background

CPUC & Integrated Resource Planning

- CPUC established the **Integrated Resource Planning** process for setting electricity resource planning targets for CPUC-Jurisdictional load serving entities in CAISO's Balancing Authority Area (BAA).
  - Consistent with Senate Bill (SB) 350 (2015) and SB 100 (2018).
  - Designed as a multi-step analytical planning process with input from load-serving entities and stakeholders.
- IRP process should achieve the least-cost resource portfolio subject to the following constraints:
  - Reliability;
  - Greenhouse Gas Emission (GHG) reductions and clean energy sales; and
  - LSEs' stated preferences.



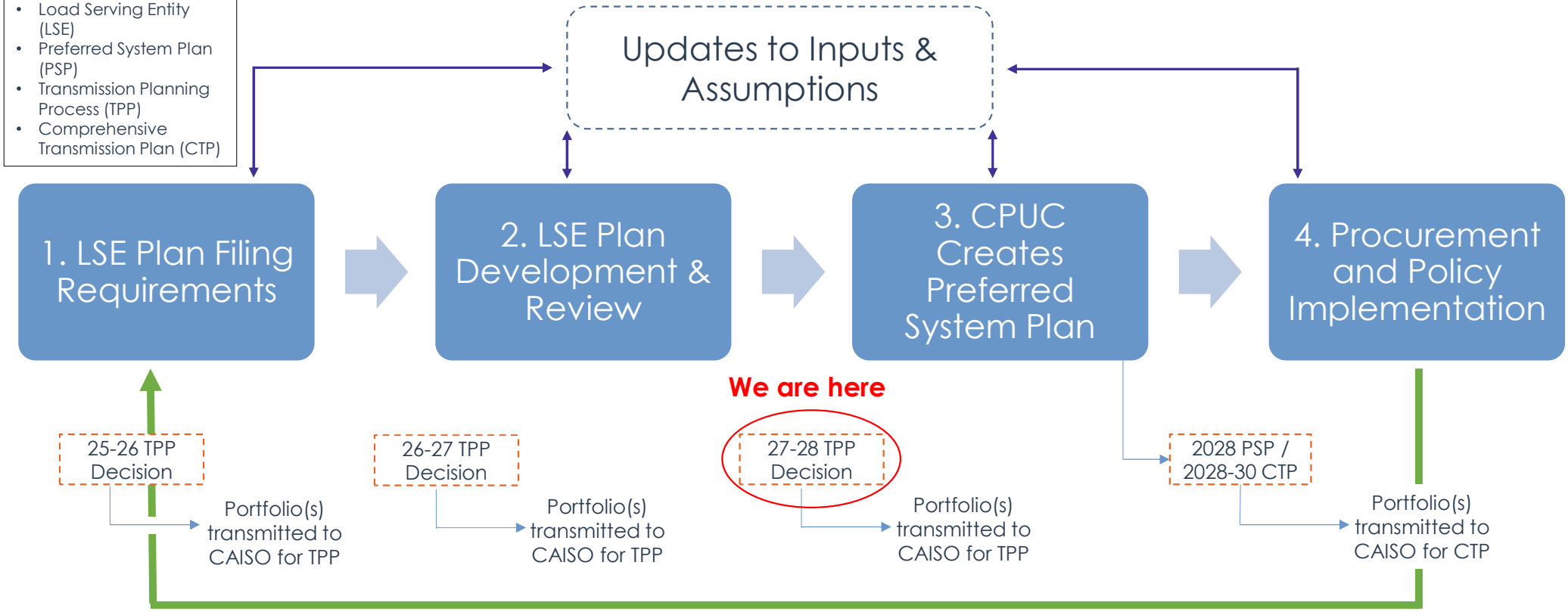
Note 1: CAISO emissions are ~81% of statewide emissions
Note 2: California statewide emissions in 2000 were approximately 461 MMT, including approximately 105 MMT from the electric sector.

Overview of the 2024-27 IRP Cycle

Last year BUT UPDATED

Year 1 | Year 2 | Year 3 | Year 4 & Beyond

Abbreviation key
- Load Serving Entity (LSE)
- Preferred System Plan (PSP)
- Transmission Planning Process (TPP)
- Comprehensive Transmission Plan (CTP)



TPP and Busbar Mapping Overview

Overview of the CAISO's TPP

- Every year Commission staff develop a recommended set of portfolios for the California Independent System Operator (CAISO) to use in its annual Transmission Planning Process (TPP). Pending FERC approval of CAISO's tariff changes, this process will move to a biennial schedule starting in 2028.
- Generally, in each TPP cycle, the CAISO evaluates a reliability and/or policy-driven base case portfolio
  - Under the CAISO tariff adopted by the Federal Energy Regulatory Commission (FERC), if the results of the base case analysis show the need for additional transmission development, the transmission projects are brought to the CAISO Board for approval in the spring of the second year of the TPP
  - If approved by the CAISO Board, under the FERC tariff, the project would receive cost recovery through the transmission access charge
- Along with the base case analysis that generally leads directly to transmission project approval, in each TPP cycle the CAISO can typically analyze one or more sensitivity portfolios
  - The purpose of the sensitivity portfolio analysis is not to lead directly to transmission development immediately, but rather to assist in future planning by identifying relevant transmission needs and potential costs
- The Commission adopted the 26-27 TPP portfolio in Decision (D.) 26-02-057. This Decision included both a base case and a sensitivity portfolio that the CAISO is in the process of analyzing for the current TPP cycle
  - The base case portfolio was based on the scenario that achieves a 30 million metric ton (MMT) greenhouse gas (GHG) emissions target by 2030, and 25 MMT by 2035, including 4.5 gigawatts (GW) of offshore wind from CPUC jurisdictional LSEs' IRPs submitted in November 2022
  - The recommended sensitivity portfolio tests a low-wind-development scenario, and represents an opportunity to identify other transmission development that could be needed under a worst-case scenario slowdown in wind development

Role of Busbar Mapping in IRP and TPP

- **Resource to Busbar Mapping** ("busbar mapping"): The process of refining the geographically coarse portfolios developed through capacity expansion modeling 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 focuses on utility-scale generation and storage resources that are not already in baseline.
  - First conducted as "proof of concept" for the 2018-2019 TPP portfolio (CEC proof of concept report).
  - Guided by the stakeholder-vetted mapping methodology, a document that states guiding principles, establishes mapping criteria, and outlines the iterative inter-agency mapping process.
    - Current Mapping Methodology for the 27-28 TPP

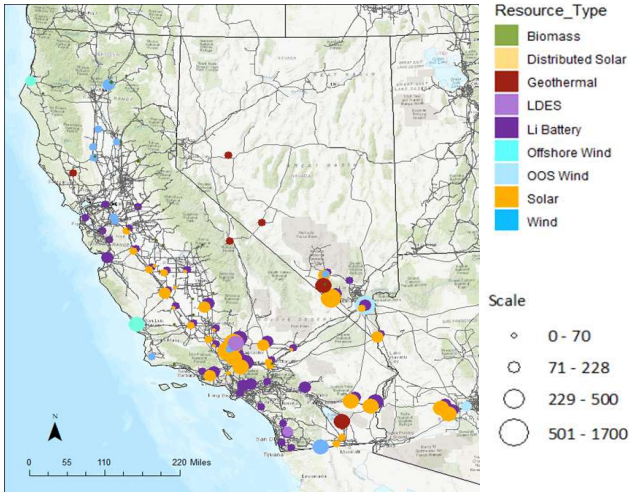
Input: Portfolio developed from LSE plans & RESOLVE model results - *Illustrative*

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 - *Illustrative*



Overview of 27-28 TPP Recommended Portfolios Analysis

Overview of 27-28 TPP Analysis

- Staff has conducted analysis to support the development of portfolios for consideration for study in CAISO's 27-28 TPP.
  - The analysis is based on the 26-27 TPP portfolio that the Commission adopted in Decision (D.) 26-02-057.
- On August 31st, 2026, the Commission issued an Administrative Law Judge Ruling Seeking Comments on Electricity Portfolios for 2027-2028 Transmission Planning Process And Potential for Geographically-Targeted Procurement Ruling, and the accompanying slide deck, included two TPP portfolio classifications:
  - A recommended 27-28 TPP Base Case
  - A recommended Sensitivity Portfolio
- Today's webinar will cover the overview of the base case and sensitivity portfolios, as well as preliminary mapping results of the base case portfolio.

Summary of Input Updates for 27-28 TPP Modeling

Summary of RESOLVE Updates Since 26-27 TPP (1)

Data	Change
Baseline Resources	Updated with more recent CAISO (MGC, GIRR) and WECC (ADS) data; updated thermal resource classifications including CHP
RESOLVE Minimum Builds	Updated to the June 2025 LSE filings, incremental to the updated baseline
External Region Resources	Updated with new non-CAISO utility IRPs
Minimum Gas Retention	Updated with more recent CAISO LCTS study; CCS candidates excluded from non-retention decisions
In-State Resource Potential	Minor increases to Northeast CA and Baja California Wind potential
Out-of-State Resource Potential	Specific in-development, proposed, and generic transmission options and tie-in locations used as the basis for revising OOS wind, geothermal, and EGS resource potential; removed UT hydrothermal resource potential and increased UT EGS potential to 2,000 MW
First Available Years	Adjusted lead-time assumed for generic in-state wind (2034), geothermal and EGS (2034) and generic out-of-state wind and geothermal (2037/2042); offshore wind available year adjusted for federal permitting delays
Near-Term Build Limits	Wind and geothermal limits based on queue analysis and stakeholder feedback until above years; solar near-term build limit adjusted to 13 GW by 2028
Out-of-State Transmission Costs	Specific transmission options studied by CAISO are costed based on per-unit estimates for HVDC and HVAC options

Summary of RESOLVE Updates Since 26-27 TPP (2)

Data	Change
SunZia Wind Representation	SunZia wind modeled as a baseline (existing) resource; 2,131 MW limit for delivery into CAISO enforced (with excess dumped into the SW Zone); upgrades in 2034 allow SunZia to receive FCDS[1] and expand simultaneous flow constraints by 2,131 MW
CAISO Transmission Constraints & Upgrades	Approved policy-driven project from the 25-26 TPP (Trout Canyon-Lugo), as well as a 2nd generic upgrade in EOP and a new constraint affecting AZ solar and storage
PG&E-SCE Path Expansion	Incorporated Busbar Mapping Working Group feedback to refine Path 15/Path 26 expansion options
Cap-and-Trade (Carbon) Price	Updated from 2023 to 2025 forecast
Modeling of Reliability Procurement Orders	D.26-02-057 procurement order modeled as an adder to the RESOLVE Planning Reserve Margin (PRM) target
Forced Outage Rates & Static ELCC	EFOR incorporated as a derate to the monthly Pmax of thermal and storage resources, for RESOLVE-SERVM calibration and better representation of resource availability
LDES ELCC Multipliers	Improved estimates of LDES ELCC based on SERVM analysis of the 2025 LSE Plan Filing Requirements portfolio
Historical Weather-Varying Profiles	2023 and 2024 weather years added; solar profiles calibrated with 30-min NSRDB data and CAISO historical settlement data, solar CF decreases by ~1% on average

1 Full Capacity Deliverability Status

Resource Potential and Transmission Updates

Process for Developing Resource Potential



Raw Resource Potential	Techno-Economic Screen	Environmental Screen

• Solar insolation
• Wind speed
• Known geothermal fields
• EGS temperature-at-depth estimates
• Pumped hydro storage sites
	• Minimum capacity factor thresholds
	• Ground slope
	• Urban areas and population density
	• Feasibility screens (e.g. setback from airports)
		• CEC Core Land-Use Screen:
		  • Protected areas
		  • Farmland
		  • Habitats
		  • Endangered species

In-State Transmission Updates

Modeling of Trout Canyon-Lugo 500 kV

- When transmission upgrades get approved by CAISO in the TPP, the default approach is to update the RESOLVE model to "sink" those projects' costs by forcing in approved upgrades
- Given the approval of the Trout Canyon-Lugo 500 kV transmission line to address the Lugo-Victorville Area Constraint, the following updates are made:
  - Starting in 2035, the available TPD behind this constraint is augmented by 5,410 MW, as confirmed in the Working Group
  - The approved project's estimated cost of $1.685 B has been added to RESOLVE's non-optimized costs
- Since RESOLVE may determine additional OOS resources delivered to East of Pisgah are cost-effective, an additional tranche of transmission upgrades has been introduced to provide additional headroom:
  - Cost: $1.685 B * 1.25x = **$2.106 B**
  - First Available Year: **2037** (available in the 10-year plan)
  - Incremental Capability: **5,410 MW**
- No other updates will be made in RESOLVE; changes to TPD estimates and constraint boundaries due to Trout Canyon-Lugo are studied in the 27-28 TPP Busbar Mapping Analysis

In-State Transmission Updates

New Arizona Solar TPD Constraint

- RESOLVE's system-level transmission constraints are sourced from CAISO's 2024 Transmission Capability Estimates Whitepaper, developed specifically for the CPUC IRP process
  - RESOLVE analysis for the 27-28 TPP was substantially complete before the 2026 Whitepaper was published
- In the 26-27 TPP RESOLVE analysis, large volumes of solar were selected in the SDGE Arizona Study Area, exceeding the available transmission capability
- A new constraint has been added to more accurately represent deliverability limitations in this area:
  - RESOLVE and the busbar mapping process will now include the **Hoodoo Wash–North Gila and Palo Verde–Colorado River Deliverability Constraint**, affecting resources mapped to Hassayampa, Hoodoo Wash, and Palo Verde, to appropriately restrict the selection of solar resources and reflect real-world transmission limits in this corridor
- The headroom of the constraint is 4 GW, further limited by existing resources at these busbars, and no upgrade is modeled to alleviate this transmission constraint

In-State Transmission Updates

RESOLVE PGE<>SCE Transmission Upgrade Tranches

- The Working Group identified that a Path 26 upgrade studied in isolation (which was introduced as an upgrade tranche in the 26-27 TPP RESOLVE analysis) would not provide significant congestion reduction, as Path 15 would remain constrained
  - Revised Tranche 1 reflects a new Windhub to Tesla 500 kV line, as studied in the 25-26 TPP, providing an incremental 2,500 MW of transfer capacity
  - Revised Tranche 2 reflects additional Path 26/15 reinforcements, as well as an extension to Lugo
- RESOLVE may select each tranche sequentially, if they are found to be cost-optimal, on top of the existing PGE<>SCE transmission capability (3,000 MW from SCE to PGE, 4,000 MW from PGE to SCE)

Tranche #	Incremental Upgrade (MW)	Total Upgrade (MW)	Total Path Rating (MW)	Cost of Tranche (2024 $)	Levelized Cost ($/kW-yr)[1]	First Available Year	Description	Source
Tranche 1 (Path 26/15)	2,500	2,500	5,500 (SCE to PGE) 6,500 (PGE to SCE)	$3,187 M	$100	**2037**	New Windhub to Tesla line (Alternative 6 from the 25-26 TPP Congestion Economic Study[2])	CAISO 25-26 TPP[2]
Tranche 2 (Path 26/15 + Extension)	3,000	5,500	8,500 (SCE to PGE) 9,500 (PGE to SCE)	$6,090 M	$158	**2040**	Path 15 upgrade (Alternative 8 from the 23-24 TPP Congestion Economic Study[3]) Two new Vincent to Midway 500 kV lines[4] New Lugo to Vincent 500 kV line[4]	CAISO 23-24 TPP[3] CAISO per-unit cost guide[4]

1 Real 2024$; assumes a 7.80% CRF
2 https://stakeholdercenter.caiso.com/InitiativeDocuments/Board-Approved-2025-2026-Transmission-Plan.pdf
3 https://www.caiso.com/documents/appendix-g-board-approved-2023-2024-transmission-plan.pdf
4 https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/20-Year-transmission-outlook-2023-2024

Baseline and Contracted Resources

Baseline Reconciliation

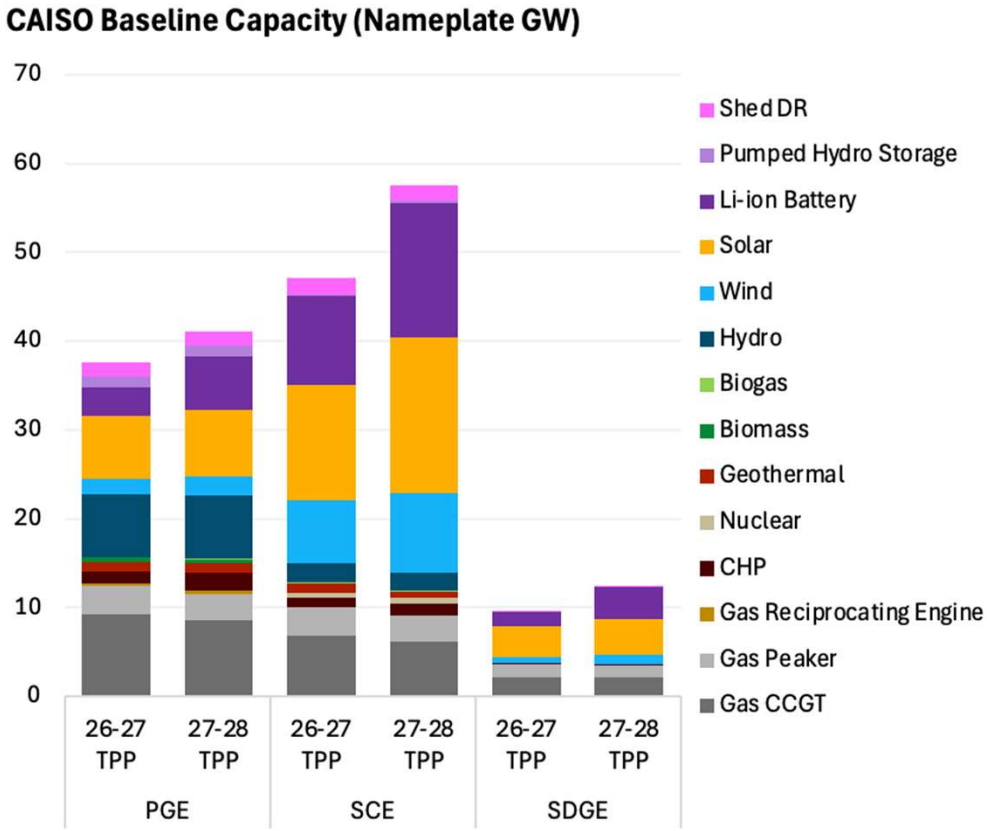
Defining the Baseline

- The resource baseline is an input to both RESOLVE and SERVM, and includes both online and in-development resources for both CAISO and non-CAISO zones
  - **Online**: Units already built and operating, net of scheduled retirements
  - **In-Development**: Units with approved contracts and/or under construction
- The baseline does not include **candidate** resources, which can be selected by RESOLVE as new additions
- The baseline is constructed from multiple sources:
  - Online CAISO: CAISO Master Generating Capability List (MGC)[1] and the CAISO Retirement and Mothball List[2]
  - In-Development CAISO: CAISO Generator Interconnection Resource ID Report (GIRR)[3]
  - Non-CAISO (external): WECC Anchor Data Set (ADS)[4]
- In previous TPPs, in-development resources were sourced from LSE filings; by updating to CAISO GIRR, the threshold for inclusion in the baseline is stricter than in previous years

1 http://oasis.caiso.com/mrioasis/logon.do; 2 https://www.caiso.com/Documents/AnnouncedResourceRetirement-MothballListPosted-051321.html#:~:text=The%20California%20ISO%20has%20posted%20an%20updated%20list.The%20list%20includes%20all%20resources%2C%20regardless%20of%20size.;
3 https://www.caiso.com/documents/new-generator-interconnection-resource-id-report-083023.html;
4 https://www.wecc.org/program-areas/reliability-planning-performance-analysis/reliability-modeling/anchor-data-set-ads

Baseline Resources

- The resource baseline was updated to reflect online and in-development resources for both CAISO and non-CAISO zones as of September 2025
- Key changes for the 27-28 TPP include:
  - Several GW of new resources coming online or beginning development
  - In-development resource data source changed from LSE Filings to CAISO Generator Interconnection Resource ID Report (GIRR), representing higher-confidence units only
    - A handful of units on the previous baseline were not on the GIRR and dropped from the baseline (e.g. delayed projects, and/or projects with COD 2028 or later)
    - Incremental contracts from LSE filings are included in RESOLVE minimum builds instead
  - Re-assignment of CHP and non-CHP gas units based on CEC and EIA data[1]



1 CAISO CHP is forced to phaseout from 2036-2040; this is done as a post-processing step to generator list data.

RESOLVE Minimum Builds for LSE Contracts

- While the IRP baseline (existing and in-development units) used in RESOLVE and SERVM is updated every ~2 years, LSEs are consistently contracting new resources; minimum builds allow these more recent contracts to be reflected in modeling
- "Development" contracts incremental to the baseline found in the June 2025 IRP Compliance Filings-are forced-in to RESOLVE as minimum builds

PG&E Minimum Builds (MW)

Technology	2028	2030	2032
Geothermal	144	184	184
Biomass	3	3	3
Solar	528	648	758
Battery Storage (4-hr)	1,988	2,148	2,258
Battery Storage (8-hr)	94	94	94
Location-Constrained Storage	-	-	-

SCE Minimum Builds (MW)

Technology	2028	2030	2032
Geothermal	459	526	550
Biomass	-	-	-
Solar	1,454	1,519	1,519
Battery Storage (4-hr)	3,048	3,321	3,321
Battery Storage (8-hr)	726	951	951
Location-Constrained Storage	-	200	200

SDG&E Minimum Builds (MW)

Technology	2028	2030	2032
Geothermal	26	66	66
Biomass	-	-	-
Solar	23	23	23
Battery Storage (4-hr)	39	39	39
Battery Storage (8-hr)	-	-	-
Location-Constrained Storage	-	-	-

Baseline Reconciliation

Baseline Reconciliation

Baseline Reconciliation Methodology

- Staff perform a reconciliation to account for resources that are incremental to the modeling baseline and/or the transmission constraints baseline, to ensure that resource amounts and transmission utilization are properly accounted
  - This process also identifies in-development resources to align with in mapping
- The reconciliation process focuses on matching resources across datasets, standardizing key attributes (e.g., technology, capacity, online date), and resolving conflicts or discrepancies
- Staff crosswalk data from CAISO, E3, and CPUC sources, verifying facility-level details and addressing inconsistent naming conventions or missing fields
- The reconciled dataset serves to resolve discrepancies among the resource baselines used in upstream processes (e.g., the modeling baseline and the transmission constraints baseline), ensuring that busbar mapping is performed with a consistent accounting of existing and in-development resources
- This clean baseline can also be re-used in downstream analyses, including cost and siting evaluations, commercial interest filters, and transmission planning input
- In collaboration with the commercial interest analysis, contracted projects are subtracted from the CAISO interconnection queue to avoid double-counting of new versus existing capacity

Baseline Reconciliation

Data Sources for Baseline Reconciliation

Name and Link	Vintage	Description
RESOLVE/SERVM Baseline	Sept 2025	Recently calibrated across E3 team and CPUC's Energy Resource Modeling team, a complete list of generators and operating characteristics used in RESOLVE.
Resource Data Template (RDT) Error Checking, Aggregation and Reallocation Tool (RECART) LSE Filings	June 2025	Utility-provided filings listing contracted capacities across generators, used for tracking LSE procurement and various Energy Division efforts.
CAISO Interconnection Queue	May 2026	CAISO dataset mapping interconnection queue numbers to resource IDs, enabling tracking of project progression into market operations.
CAISO Master Generating Capability List	May 2026	Official CAISO list of generating and storage resources used for resource accounting.

- RECART is an internal tool that compiles energy and capacity under contract, contracted resources by technology type and LSE, identifies errors, and aggregates new resources that were in development or planned future purchases.

Baseline Reconciliation Details and Results

- For each data source, a cleaned and filtered list of resource names and/or IDs is used to identify matching resources across different datasets.
  - January 1st, 2024 cut-off online date, to ensure that projects with reported CODs within one year of the online date used in CAISO Transmission Capability Estimates White Paper (1/1/2025) are re-verified as part of the analysis.
  - In-development and online resources only.
- Matches between data sources are performed using formula-based matches and by manually identifying matches.
  - Units that have matches across one or multiple datasets are aligned and "linked."
  - Units that do not have matches across any datasets are still retained in the resource list.
- A list is developed with all unique resources across the RESOLVE/ERM Baseline, LSE Filings, CAISO Interconnection Queue, and the CAISO Master Generating Capability List.
- For each resource in each data source, relevant data is pulled: ResID, queue number, POI/substation, contracted online date, resource type, deliverability, and resource capacity.
- To reconcile the resource baseline with the commercial interest datasets, resources identified in both the RECART LSE Filings and the interconnection queues are flagged.
  - The contracted capacities of these resources are subtracted from the nameplate capacities in the CAISO IX Queue to ensure no double-counting in the commercial interest criteria analysis.
- Results are posted to the CPUC IRP website alongside Busbar Mapping results.

Load Forecast for 27-28 TPP

Single Forecast Set Agreement and Use of 2024 IEPR

- The staff of the joint agencies and California ISO have agreed that for the CPUC's Integrated Resource Plan (IRP) and bulk system transmission planning process (TPP), California ISO TPP economic, policy, and bulk system studies for the 2027-2028 TPP will use an IRP portfolio from CPUC based on the 2024 IEPR planning forecast. [1]

1 Single Forecast Set Agreement can be found here: https://efiling.energy.ca.gov/GetDocument.aspx?tn=269506&DocumentContentId=106596

Summary of Changes from the 2024 to 2025 IEPR

- The 2025 IEPR forecast[1] has an **overall decrease in electrification (buildings and transportation) reflecting recent policy rollbacks/headwinds**
  - Reductions in electric vehicles and building electrification due to policy rollbacks
  - Increase in energy efficiency, largely driven by building codes (Title 24) and programs
- The decrease in electrification loads is partially offset by **forecasted growth in data centers**
- In the 2025 IEPR Planning Scenario, **peaks and annual load decrease** compared to the aggressive 2024 IEPR, and are **similar to 2023 IEPR levels**
- The 2025 IEPR Planning Scenario remains **summer-peaking through the entire forecast horizon**, unlike the previous two vintages (winter managed peaks in the 2040s), primarily due to a decrease in forecasted building electrification

1 Any analysis in this deck that utilizes the 2025 IEPR excludes known loads.

Changes from 2024 to 2025 IEPR by Load Modifier

Component	Policy Impacts and Changes from 2024 IEPR	Impact
Baseline	Economic indicators forecast (GDP, population, housing, etc.)	Decrease in load
Climate Impacts	Minor updates to climate-driven load impacts	negligible
Baseline Electric Vehicles (EVs)	Repeal of IRA tax credits[1]	Decrease in load
Policy-Driven (AATE) EVs	Repeal of EPA Waiver[2]	**Decrease in load**
Energy Efficiency (AAEE)	Repeal of IRA tax credits[1]; DOE Efficiency Standards[3]; Increased Title 24 impacts[5]	**Decrease in load**
Building Electrification (AAFS)	Withdrawal of CARB State Implementation Plan (SIP)[4]; Repeal of IRA tax credits[1]; DOE Efficiency Standards[3]; Increased Title 24 impacts[5]	**Decrease in load**
Data Centers	Updated application data and weighting for uncertainty[5]	**Increase in load**
BTM Storage Losses	Repeal of IRA tax credits[1]; higher long-term new housing forecast[5]	Negligible (on net)
BTM Solar	Repeal of IRA tax credits[1]; higher long-term new housing forecast[5]	Increase in load (near-term) Decrease in load (long-term)
Known Loads	*New Load Modifier, aggregated within Baseline (Local Reliability + Known Loads scenario only, **not used in the Planning Scenario nor the 27-28 TPP**), representing distribution-level interconnection requests*[5]	**Known loads are not included in the 27-28 TPP**

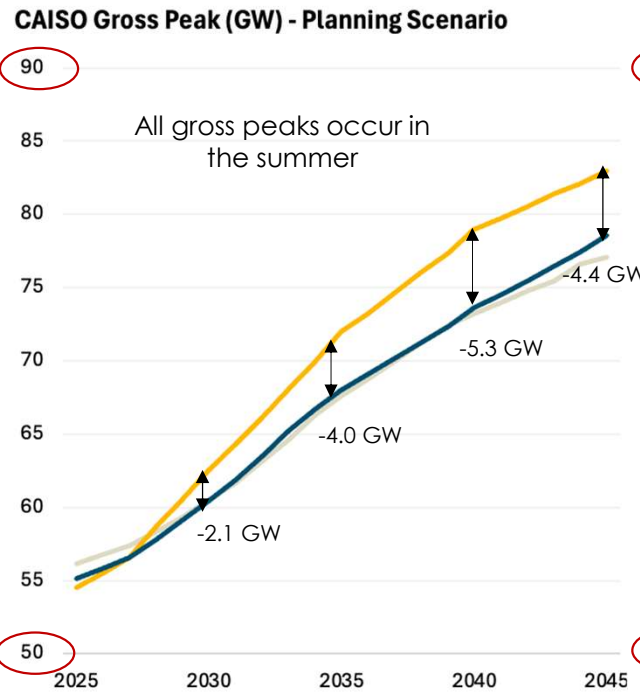
Largest drivers of change

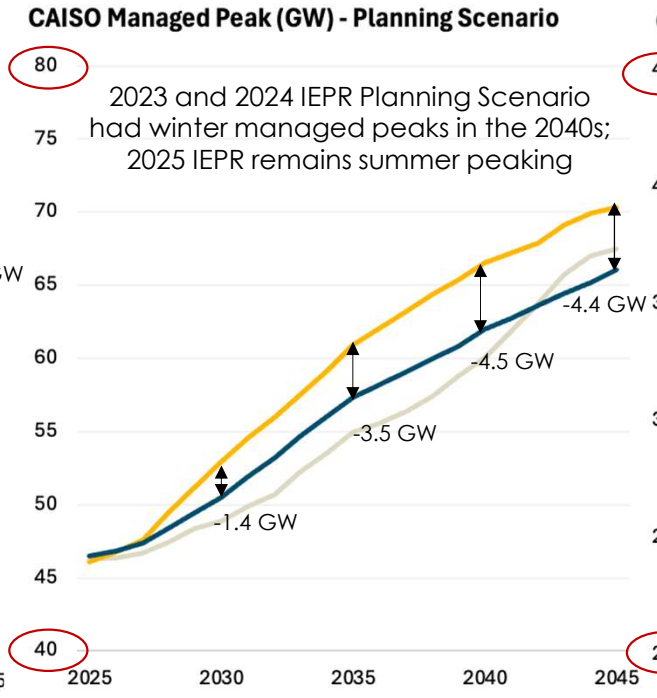
Tariff impacts are excluded from IEPR due to large uncertainty!

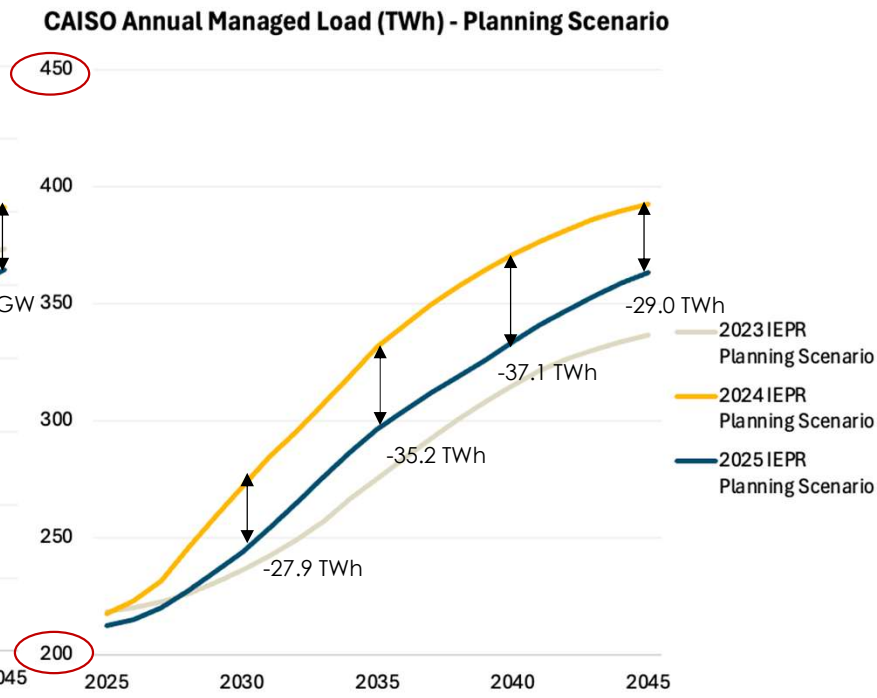
1 https://www.congress.gov/bill/119th-congress/house-bill/1/text
2 https://calmatters.org/environment/2025/05/california-electric-car-mandate-senate-revoke-waiver/
3 https://www.energy.gov/articles/doe-finalizes-efficiency-standards-water-heaters-save-americans-over-7-billion-household
4 https://ww2.arb.ca.gov/sites/default/files/2025-08/09-11---2025%20Joint%20Meeting%20Building%20Decarbonization%20Memo.pdf
5 https://www.energy.ca.gov/event/workshop/2025-11/iepr-commissioner-workshop-load-modifier-energy-demand-forecast-results

IEPR Load Forecast Changes by Year

- Differences from 2024 to 2025 IEPR shown







Excludes impacts of BTM CHP phaseout (2036-2040) implemented in IRP modeling

RESOLVE Results: 27-28 TPP Recommended Base Case Portfolio

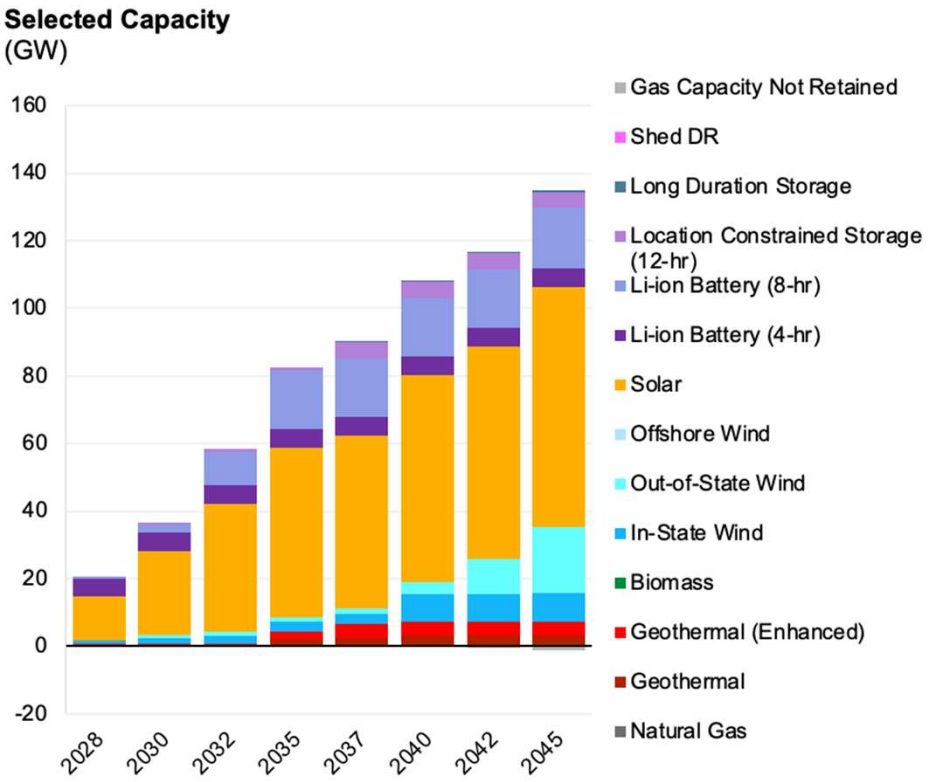
Recommended 27-28 TPP Base Case Overview

- The recommended base case makes two significant changes to policy assumptions from the 26-27 TPP base case:
  - **Modifies the near-term GHG target, from 30 MMT to 38 MMT in 2030, and from 25 MMT to 30 MMT in 2035**
  - **Offshore wind is not included in the portfolio since it is no longer forced into RESOLVE as a minimum build, unlike in the previous three TPP cycles.**
- Similar to the 26-27 TPP, the 27-28 TPP base case includes a partial buildout of the maximum procurement volumes considered in the Commission's need determination analysis pursuant to D.24-08-064, related to Assembly Bill (AB) 1373
- CAISO's study of these portfolios focuses on model years that are 10 and 15 years in the future (i.e. 2037 and 2042), though CPUC staff also model intermediate and near-term years

27-28 TPP Recommended Base Case

Portfolio Summary

- Geothermal (both conventional and enhanced) is selected as it becomes available for reliability value and high-capacity factor, GHG-free energy
  - Most geothermal potential is selected by 2037 to capture tax credits before they expire
- Relatively small amounts of onshore wind are selected by the mid-2030s, then scale up rapidly in the 2040s
  - Transmission constraints limit in-state wind selection in the mid-2030s
  - Most out-of-state wind is not available until 2042 due to long transmission lead times required for deliverability
- Solar and storage (primarily 8-hr) are the scalable resources to meet GHG reduction and reliability needs, especially mid-2030s
  - As alternative resources become available starting in the mid-2030s, solar and storage build rates slow into the 2040s
- No offshore wind is selected
- No multi-day storage is selected above forced-in partial AB 1373 amounts; RESOLVE exceeds AB 1373 amounts of geothermal and location-constrained (12-hr) storage
- Small amounts of gas capacity with high fixed costs are not retained



27-28 TPP Recommended Base Case

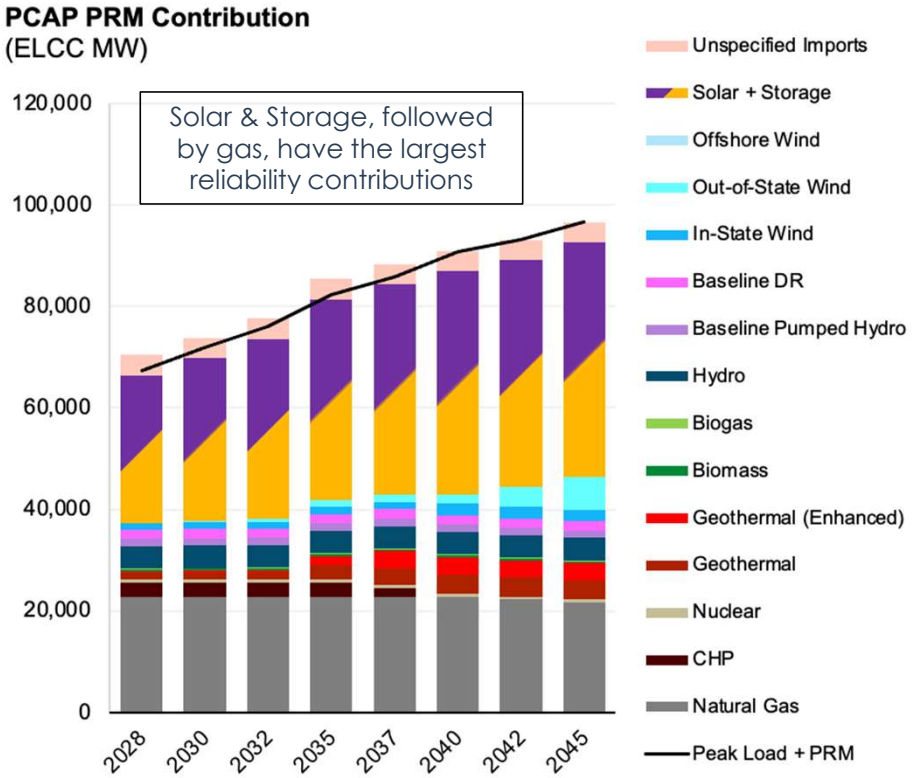
Selected Builds

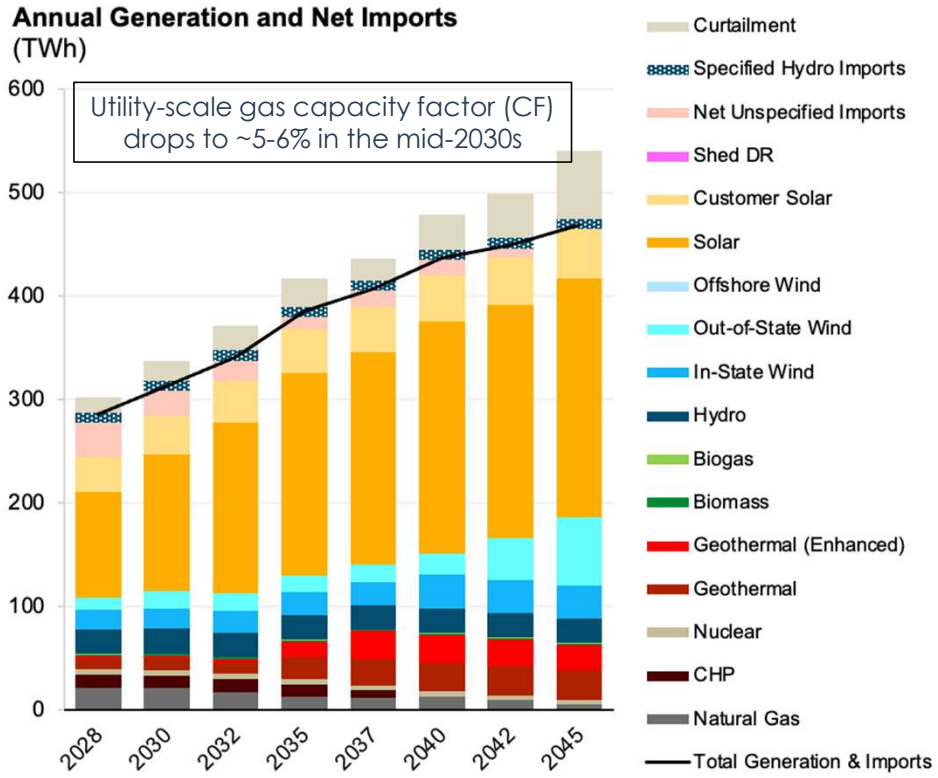
Resource Type (cumulative GW)	2028	2030	2032	2035	2037	2040	2042	2045
Natural Gas	-	-	-	-	-	-	-	-
Geothermal	0.2	0.3	0.3	1.9	2.5	3	3	3
Geothermal (Enhanced)	0.4	0.4	0.5	2.3	4.1	4.2	4.2	4.2
Biomass	0	0	0	0	0	0	0	0
In-State Wind	1.2	1.7	2.1	2.9	2.9	8.3	8.3	8.7
Out-of-State Wind	-	0.9	1.5	1.5	1.5	3.6	10.3	19.5
Offshore Wind	-	-	-	-	-	-	-	-
Solar	13	24.7	37.8	50.1	51.2	61	62.8	71
Li-ion Battery (4-hr)	5.1	5.5	5.6	5.6	5.6	5.6	5.6	5.6
Li-ion Battery (8-hr)	0.8	2.5	9.8	17.1	17.4	17.4	17.4	17.8
Location Constrained Storage (12-hr)	-	0.5	0.9	1.2	4.7	4.7	4.7	4.7
Generic Storage (12-hr)	-	-	-	-	-	-	-	-
Generic Storage (24-hr)	-	-	-	-	0	0	0	0
Generic Storage (100-hr)	-	-	-	-	0.5	0.5	0.5	0.5
Shed DR	-	-	-	-	-	-	-	-
Gas Capacity Not Retained	-	-	-	-	-	-	-0.6	-1.2

Represents new resources (nameplate GW), both LSE planned and RESOLVE selected, above the IRP Modeling Baseline; Note: RESOLVE build exceeds AB 1373 amounts of geothermal and location-constrained (12-hr) storage

27-28 TPP Recommended Base Case

Reliability and Energy Mix

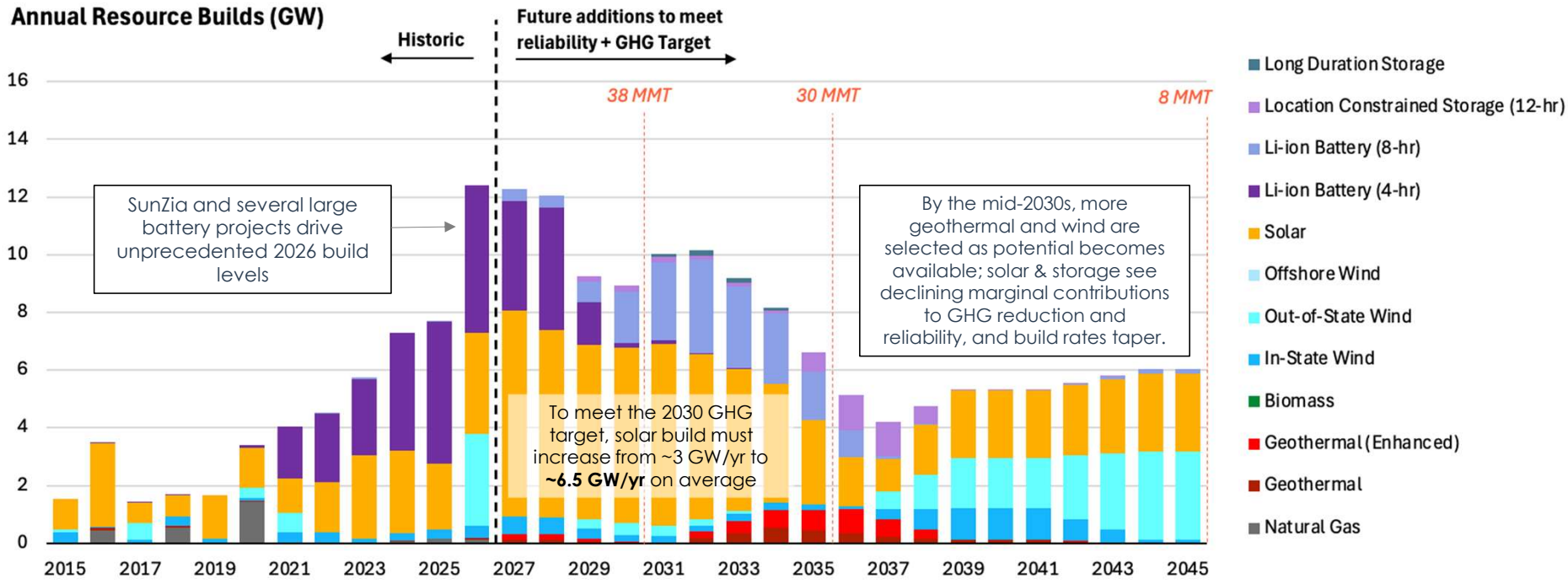




27-28 TPP Recommended Base Case

Resource Build Rate

- ***The 2030 and 2035 GHG targets, combined with limited geothermal and wind availability through the mid-2030s, drive high solar and storage build rates in the near-term***

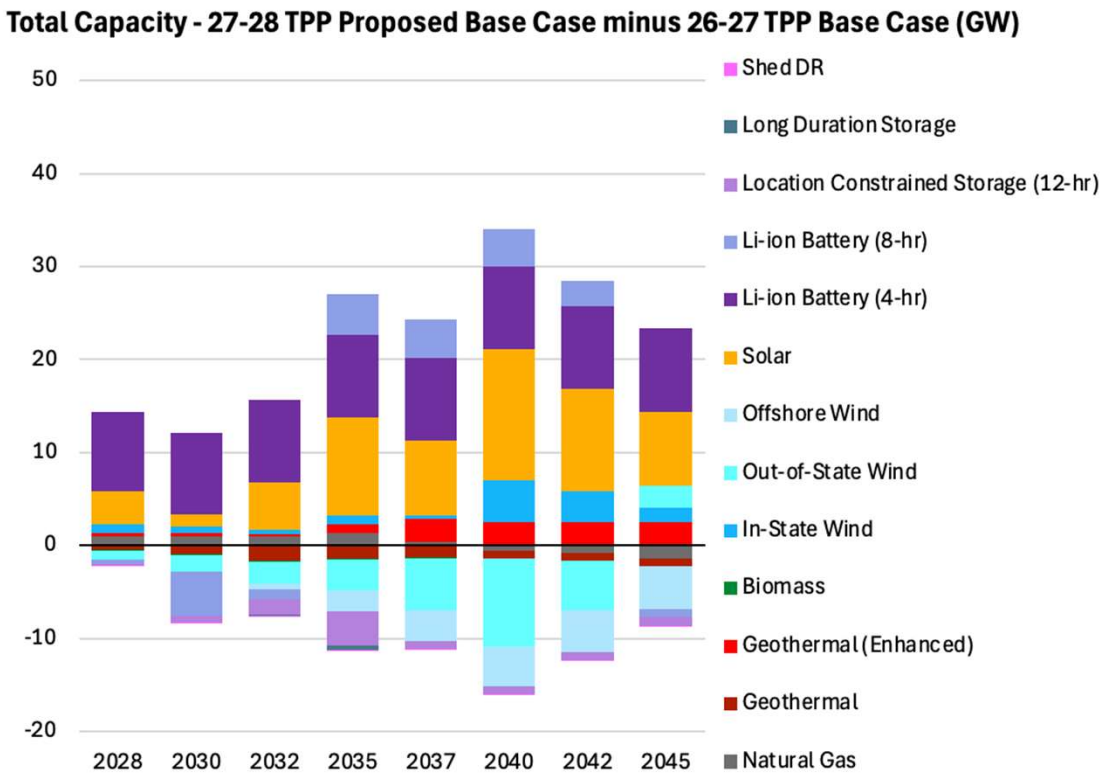


Builds are interpolated and smoothed between model years; 2026 build is a combination of resources already online this year and resources with high-confidence online dates later in the year provided by CAISO

27-28 TPP Recommended Base Case

Total Capacity Comparison with 26-27 TPP Base Case

- Differences from the 26-27 TPP are driven by:
  - **Delayed availability of long lead time resources** (geothermal, wind) in the near-term, particularly out-of-state wind
  - Offshore wind no longer forced into the base case
  - Significant additions of 4-hr batteries in the baseline, reflecting recent LSE contracting
  - Smaller impacts from other input updates (new solar profiles with lower cf, incorporation of forced outage rates for SERVM-RESOLVE calibration)
- A net increase in geothermal (additional EGS) is selected by 2037
- By 2045, differences in onshore wind builds with 26-27 TPP are relatively small



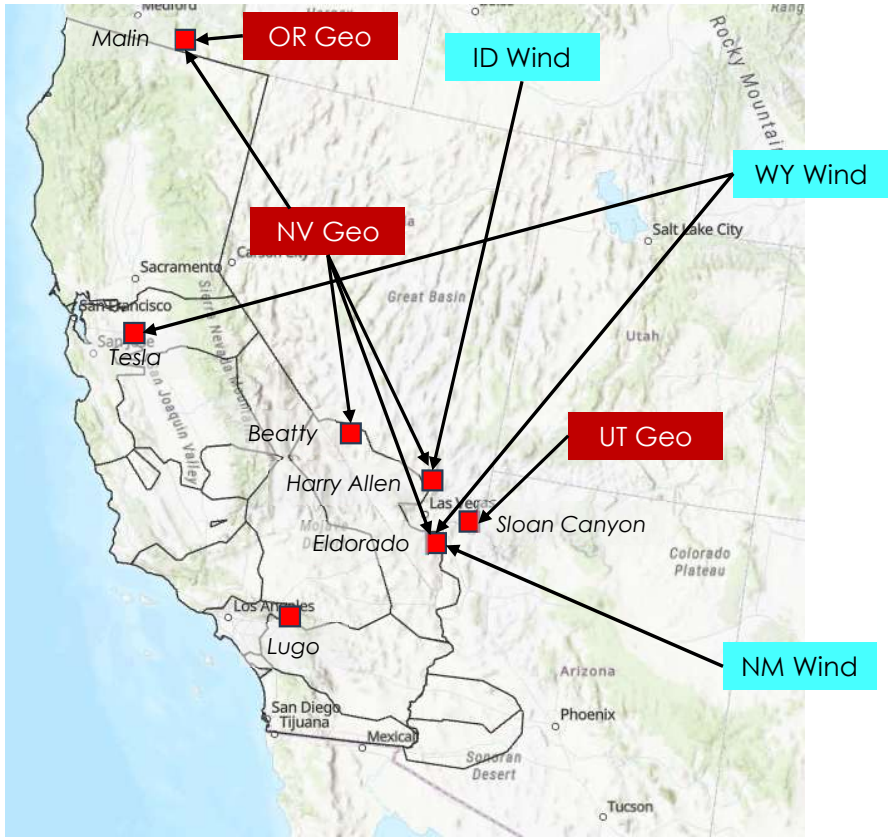
26-27 TPP results interpolated between model years where necessary; natural gas differences include both utility-scale and CHP

27-28 TPP Recommended Base Case

Out-of-State Resource Tie-in Locations

- **Multiple points of interconnection accommodate either wind or geothermal**; allocating TPD at these locations can mitigate risk if either wind or geothermal projects do not materialize
- High West, TransWest, and SWIP-N all utilized by RESOLVE; new HVDC transmission lines are selected for generic New Mexico and Wyoming wind
- **Several out-of-state resources compete for Tx headroom in the Harry Allen/Sloan Canyon/Eldorado area**, delaying Idaho wind (SWIP-N) selection to 2040; the second Trout Canyon Lugo upgrade relieves some of this
  - Nevada Geothermal split into four alternative pathways to help alleviate this competition
- Wyoming **wind delivered north of Path 15/26 (Tesla) is selected at a higher transmission cost** compared to transmission paths delivering south of Path 15/26
- Several GW of additional out-of-state wind are selected by RESOLVE in 2045, interconnecting at Lugo and Eldorado

Major Transmission Pathways Selected by 2042



Officially selected transmission upgrades are determined by the CAISO Transmission Plan; Selections of less than 100 MW not shown

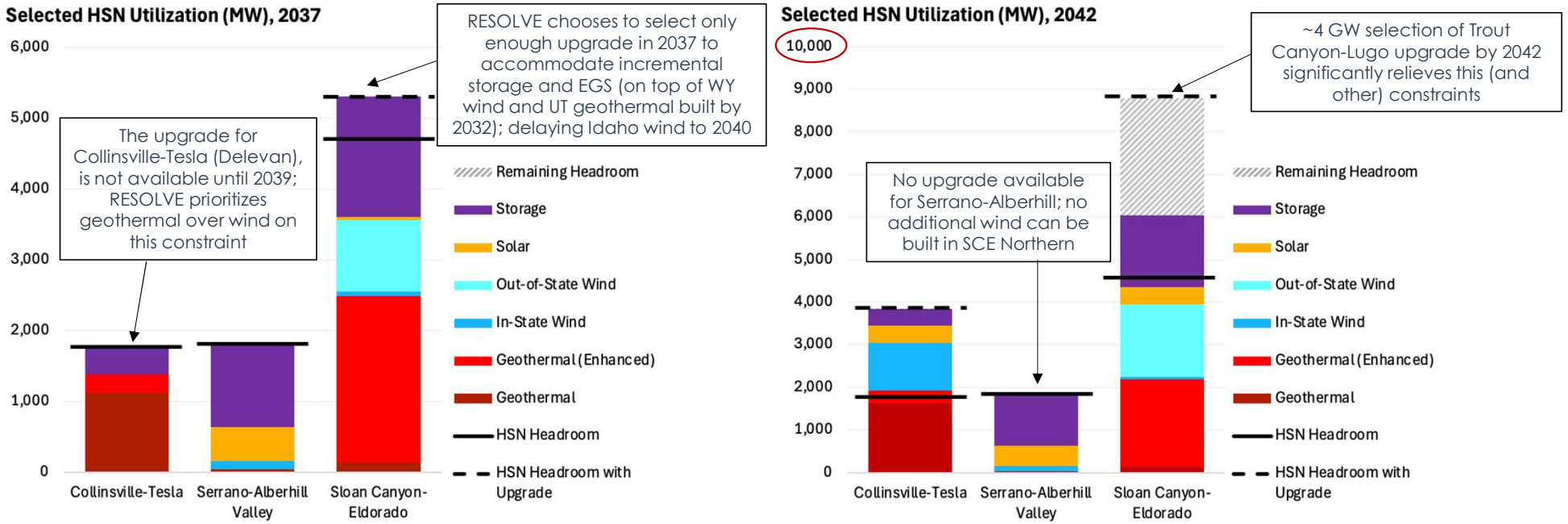
Transmission Constraint Impacts on Wind

- Although all in-state wind potential becomes available by 2035, much of it is not selected in the 10-year timeframe (2037) due to binding transmission constraints, driven by competition from near-term solar and storage and/or geothermal resources also becoming available by 2035
  - This also impacts Idaho Wind utilizing SWIP-N
- By 2042, most of the wind potential is selected as additional transmission upgrades become available

Wind Resource	Selected by 2037	Remaining potential in 2037	Binding transmission constraints	Additional built by 2042?
PG&E GBA	247 MW	-	n/a	n/a
PG&E Kern	3 MW	242 MW	multiple	Yes, on generic transmission
PG&E NGBA	762 MW	1,131 MW	Collinsville – Tesla 500kV and Carberry – Round Mtn 230kV	Yes, with upgrade
PG&E Northeast CA	-	1,015 MW	Collinsville – Tesla 500kV	Yes, with upgrade
SCE Eastern	467 MW	352 MW	Serrano – Alberhill Valley Area	No – no upgrade available
SCE EOP	255 MW	-	n/a	n/a
SCE NOL	-	1,243 MW	multiple	No – upgrades not available or very expensive
SCE Northern	700 MW	1,733 MW	multiple	Yes, with upgrade
SDG&E Imperial	456 MW	467 MW	East of Miguel	Yes, tx headroom increases due to approved upgrades
SDG&E Baja California	-	1,958 MW	East of Miguel	Yes, tx headroom increases due to approved upgrades
SCE Idaho (out-of-state)	-	1,100 MW	Sloan Canyon – Eldorado Area	Yes, with upgrade

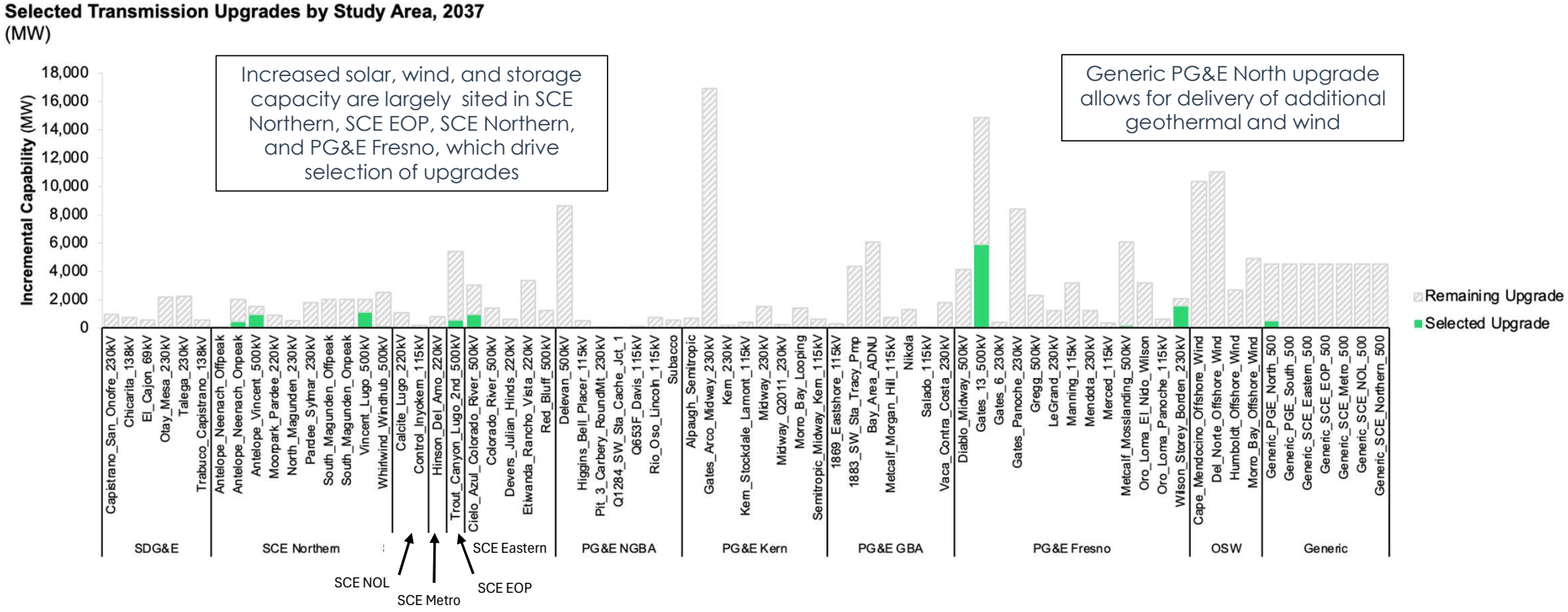
Example Binding Transmission Constraints Impacting Wind

- These examples impact PG&E NGBA, SCE Northern, and SDG&E Imperial/Baja CA; little to no headroom is available to accommodate wind in 2037
- In some cases (e.g. Sloan Canyon-Eldorado), transmission upgrades are available in 2037, but RESOLVE prioritizes other resources (primarily geothermal before tax credits expire) before selecting upgrades to allow for more wind build in the 2040s



27-28 TPP Recommended Base Case

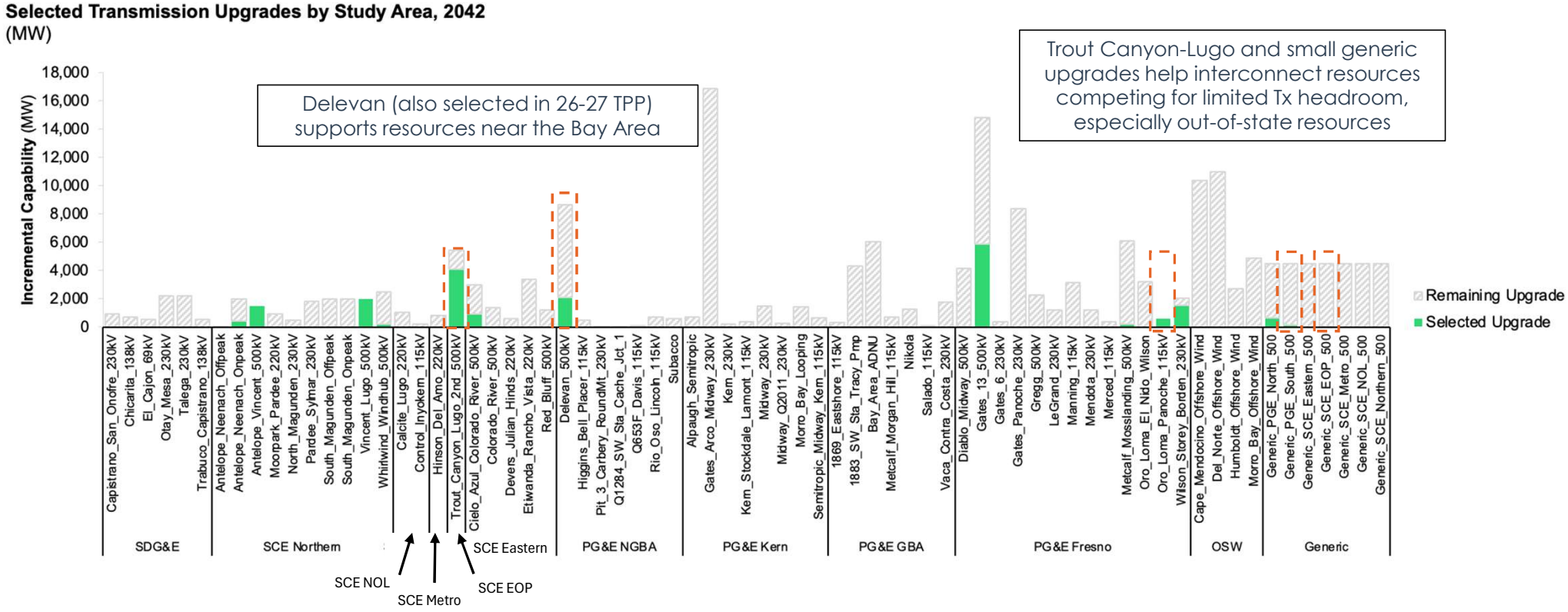
RESOLVE-Selected Transmission Upgrades (2037)



Officially selected transmission upgrades are determined by the CAISO Transmission Plan

27-28 TPP Recommended Base Case

RESOLVE-Selected Transmission Upgrades (2042)



Officially selected transmission upgrades are determined by the CAISO Transmission Plan

RESOLVE-Selected Transmission Upgrades – Changes from 26-27 TPP (2036/2037)

- **~6 GW additional capacity expansion supporting transmission upgrades** selected in the 10-year outlook, at an additional cost of $0.4 Billion ($37 Million/yr), primarily to procure in-state solar and storage resources

Constraint	Upgrade	Study Area	Cost ($/kW-yr)	27-28 TPP (2037)	26-27 TPP (2036)	27-28 TPP MW	26-27 TPP MW
Antelope-Vincent Area Deliverability Constraint	Antelope Vincent 500kV	SCE Northern	$0.82	✓	✗	961	0
Windmaster-Delta pumps 230 kV line	Bay Area ADNU	PG&E GBA	$6.41	✓	✗	31	0
DCRT Area Deliverability Constraint	Cielo Azul Colorado River 500kV	SCE Eastern	$14.31	✓	✗	955	0
Diablo-Gates 500 kV line	Diablo Midway 500kV	PG&E Fresno	$18.65	✓	✗	48	0
	Generic PGE North 500		$41.20	✓	✗	500	0
Metcalf-Mosslanding 500kV	Metcalf Mosslanding 500kV	PG&E Fresno	$3.05	✓	✗	190	0
Vincent-Lugo Area Deliverability Constraint	Vincent Lugo 500kV	SCE Northern	$3.98	✓	✗	1093	0
Windhub Area Deliverability Constraint	Whirlwind Windhub 500kV	SCE Northern	$22.69	✓	✗	137	0
Borden-Storey #1 230kV line	Wilson Storey Borden 230kV	PG&E Fresno	$2.26	✓	✗	1536	0
Lugo – Victorville Area Deliverability Constraint	Trout Canyon Lugo 2nd 500kV	SCE EOP	$33.67	✓	**Not available**	579	n/a
Control to Inyokern constraint	Control Inyokern 115kV	SCE NOL	$163.97	✗	✓	0	186
Morro Bay Offshore Wind Constraint	Morro Bay Offshore Wind	Offshore Wind	$2.09	✗	✓	0	2924

Officially selected transmission upgrades are determined by the CAISO Transmission Plan;
Only upgrades selected in one case and not the other are shown; upgrades selected in different MW amounts omitted

RESOLVE-Selected Transmission Upgrades – Changes from 26-27 TPP (2041/2042)

- **~10 GW additional transmission upgrades** selected, though there are **net incremental savings due to the removal of offshore wind**

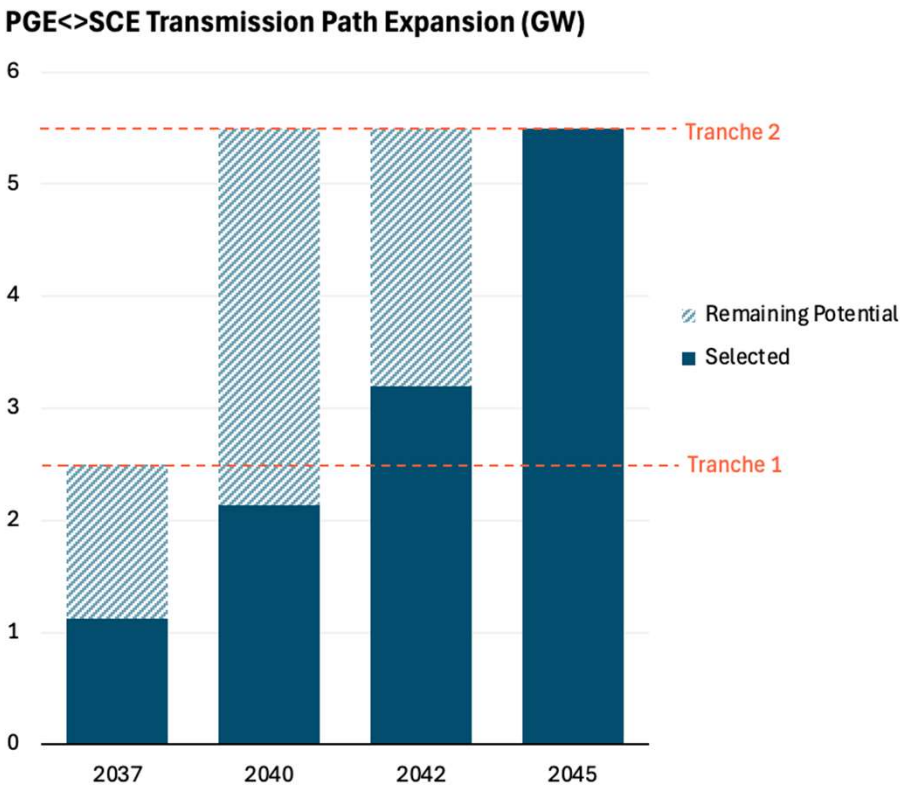
Constraint	Upgrade	Study Area	Cost ($/kW-yr)	27-28 TPP (2037)	26-27 TPP (2036)	27-28 TPP MW	26-27 TPP MW
Antelope-Vincent Area Deliverability Constraint	Antelope Vincent 500kV	SCE Northern	$0.82	✓	✗	1500	0
Windmaster-Delta pumps 230 kV line	Bay Area ADNU	PG&E GBA	$6.41	✓	✗	31	0
DCRT Area Deliverability Constraint	Cielo Azul Colorado River 500kV	SCE Eastern	$14.31	✓	✗	955	0
Diablo-Gates 500 kV line	Diablo Midway 500kV	PG&E Fresno	$18.65	✓	✗	48	0
	Generic PGE North 500		$41.20	✓	✗	642	0
	Generic PGE South 500		$41.20	✓	✗	125	0
	Generic SCE EOP 500		$41.20	✓	✗	39	0
Metcalf-Mosslanding 500kV	Metcalf Mosslanding 500kV	PG&E Fresno	$3.05	✓	✗	190	0
Panoche-Oro Loma 115kV Line	Oro Loma Panoche 115kV	PG&E Fresno	$0.00	✓	✗	588	0
Vincent-Lugo Area Deliverability Constraint	Vincent Lugo 500kV	SCE Northern	$3.98	✓	✗	2000	0
Windhub Area Deliverability Constraint	Whirlwind Windhub 500kV	SCE Northern	$22.69	✓	✗	222	0
Lugo – Victorville Area Deliverability Constraint	Trout Canyon Lugo 2nd 500kV	SCE EOP	$33.67	✗	Not available	4092	n/a
Control to Inyokern constraint	Control Inyokern 115kV	SCE NOL	$163.97	✗	✓	0	186
Etiwanda-Rancho Vista Area Deliverability Constraint	Etiwanda Rancho Vista 220kV	SCE Eastern	$2.46	✗	✓	0	709
Humboldt Bay Offshore Wind Constraint	Humboldt Offshore Wind	Offshore Wind	$120.06	✗	✓	0	1607
Morro Bay Offshore Wind Constraint	Morro Bay Offshore Wind	Offshore Wind	$2.09	✗	✓	0	2924

Officially selected transmission upgrades are determined by the CAISO Transmission Plan;
Only upgrades selected in one case and not the other are shown; upgrades selected in different MW amounts omitted

27-28 TPP Recommended Base Case

PG&E-SCE Transmission Path Expansion

- Path 26/Path 15 expansion(s) are selected primarily to increase import capacity into PG&E
- Path expansion is selected by RESOLVE as soon as it becomes available in 2037, with the full first tranche built by 2042
- The second tranche selected in full by 2045, more than doubling the transmission capacity
- In the 26-27 TPP base case, 1 GW expansion was selected by 2036, but less was selected than the 27-28 TPP in the longer term (no additional selection by 2041, ~3.7 GW total by 2045)



Officially selected transmission upgrades are determined by the CAISO Transmission Plan

RESOLVE Results:
2025 IEPR Load Forecast Sensitivity

38 MMT by 2030, 30 MMT by 2035, No Offshore Wind

2025 IEPR Sensitivity

2025 IEPR Case Overview

- The 2025 IEPR reflects more recent policy, including an **overall decrease in electrification (buildings and transportation) reflecting recent policy rollbacks/headwinds**
  - The decrease in electrification loads is partially offset by forecasted growth in data centers
- For the planning scenario, the 2025 IEPR **peaks and annual load decrease** compared to the larger 2024 IEPR, but are **similar to 2023 IEPR levels**
  - *2024 IEPR loads are likely not realistic under current policy*

2037

Load Forecast	Gross Peak (GW)[1]	Managed Peak (GW)	Annual Load (TWh)
2024 IEPR	74.7	63.2	349.8
2025 IEPR	70.2 -4.5 (6.0%)	59.1 -4.1 (6.5%)	311.9 -29.9 (8.5%)

2042

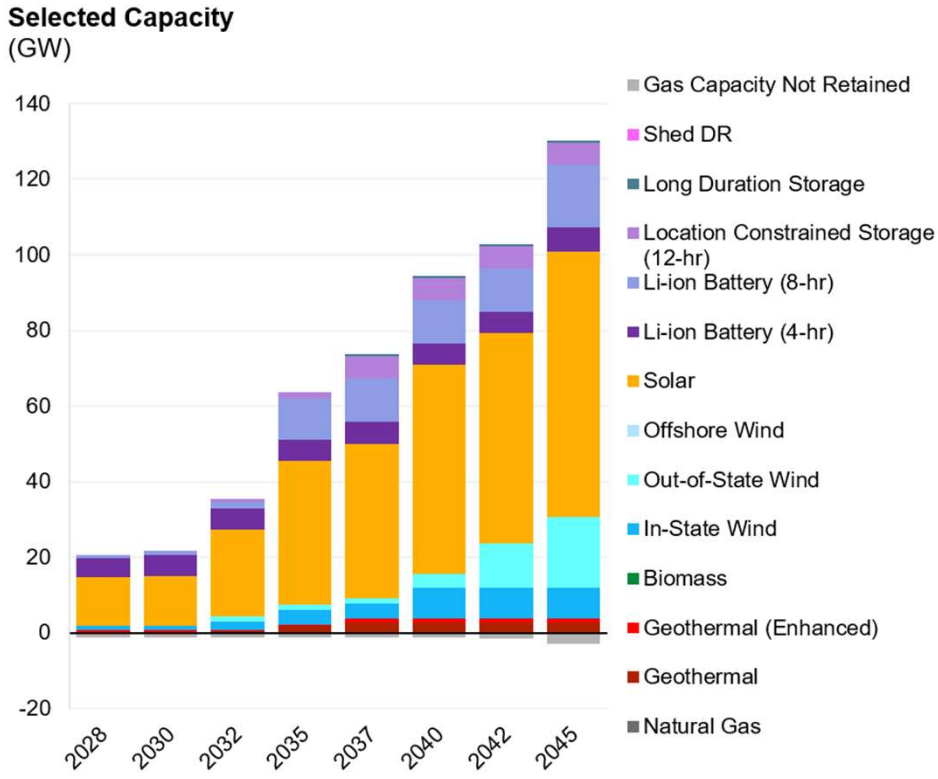
Load Forecast	Gross Peak (GW)[1]	Managed Peak (GW)	Annual Load (TWh)
2024 IEPR	80.5	67.9	381.6
2025 IEPR	75.4 -5.1 (6.3%)	63.6 -4.3 (6.3%)	347.4 -34.2 (9.0%)

[1] Gross Peak = Managed Peak + BTM PV + BTM Storage

2025 IEPR Sensitivity

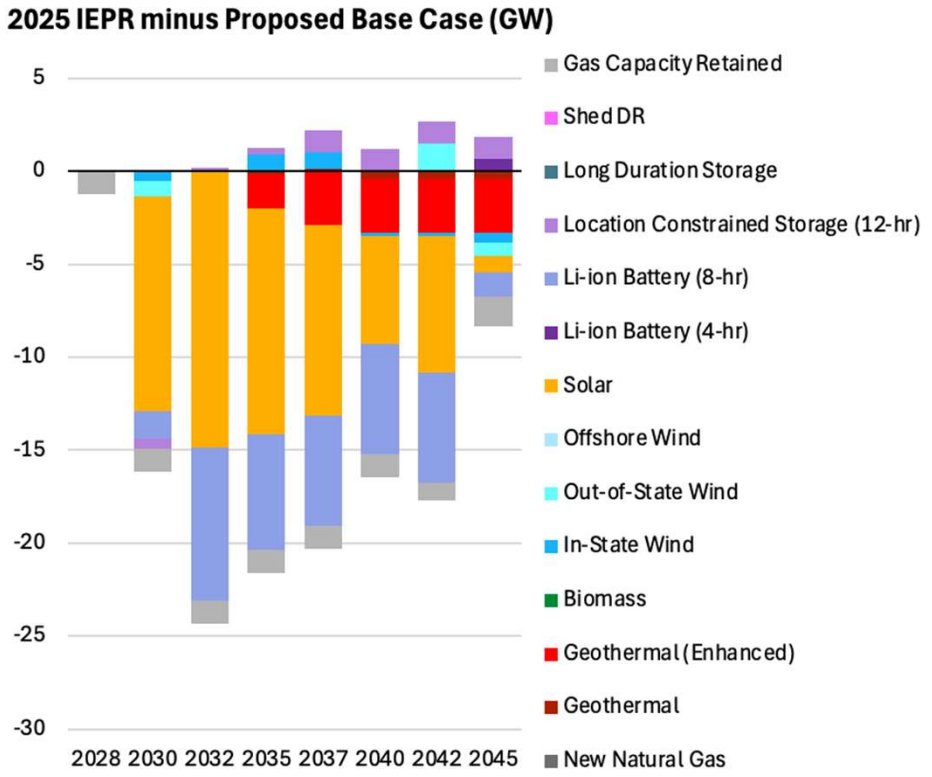
Portfolio Summary

- Geothermal (both conventional and enhanced) is selected as it becomes available for reliability value and high-capacity factor, GHG-free energy
  - Most geothermal potential is selected by 2037 to capture tax credits before they expire
- Relatively small amounts of onshore wind are selected by the mid-2030s, then scale up rapidly in the 2040s
  - Transmission constraints limit in-state wind selection in the mid-2030s
  - Most out-of-state wind is not available until 2042 due to long transmission lead times required for deliverability
- Solar and storage (especially 8-hr) are the scalable resources to meet GHG reduction and reliability, especially through 2035
  - As alternative resources become available starting in the mid-2030s, storage build rates slow into the 2040s though solar continues to scale (lower load means solar is less saturated by 2035)
- No offshore wind is selected, as lower-cost GHG-free resources are available
- Small amounts of gas capacity with high fixed costs are not retained early on, with additional non-retention in 2045



Total Capacity Comparison with Recommended Base Case

- Using the 2025 IEPR forecast reduces near-term solar and 8-hr storage builds through 2042, reaching a maximum of ~15 GW avoided solar and ~8 GW avoided storage in 2032
- ~3 GW less enhanced geothermal is selected under the lower load forecast
- Small shifts in long duration storage; onshore wind slightly accelerated to 2035 (in-state) and 2042 (out-of-state) with less competition for transmission headroom
- Less gas capacity is retained, and the first gas not retained occurs earlier (2028 instead of 2042)



2025 IEPR Sensitivity

System Cost Comparison with Recommended Base Case

RESOLVE-Optimized Costs ($MM in 2024$)

Case	2028	2030	2032	2035	2037	2040	2042	2045	NPV
Recommended Base Case	$13,316	$16,667	$20,080	$25,190	$27,746	$30,420	$32,378	$40,287	*$421,454*
2025 IEPR Sensitivity (Cost delta) (% change[1])	$11,594 -$1,722 (13%)	$13,223 -$3,444 (21%)	$15,905 -$4,175 (21%)	$19,718 -$5,471 (22%)	$22,158 -$5,587 (20%)	$24,798 -$5,622 (19%)	$27,083 -$5,295 (16%)	$35,763 -$4,524 (11%)	*$356,875* *-$64,579* *(15%)*

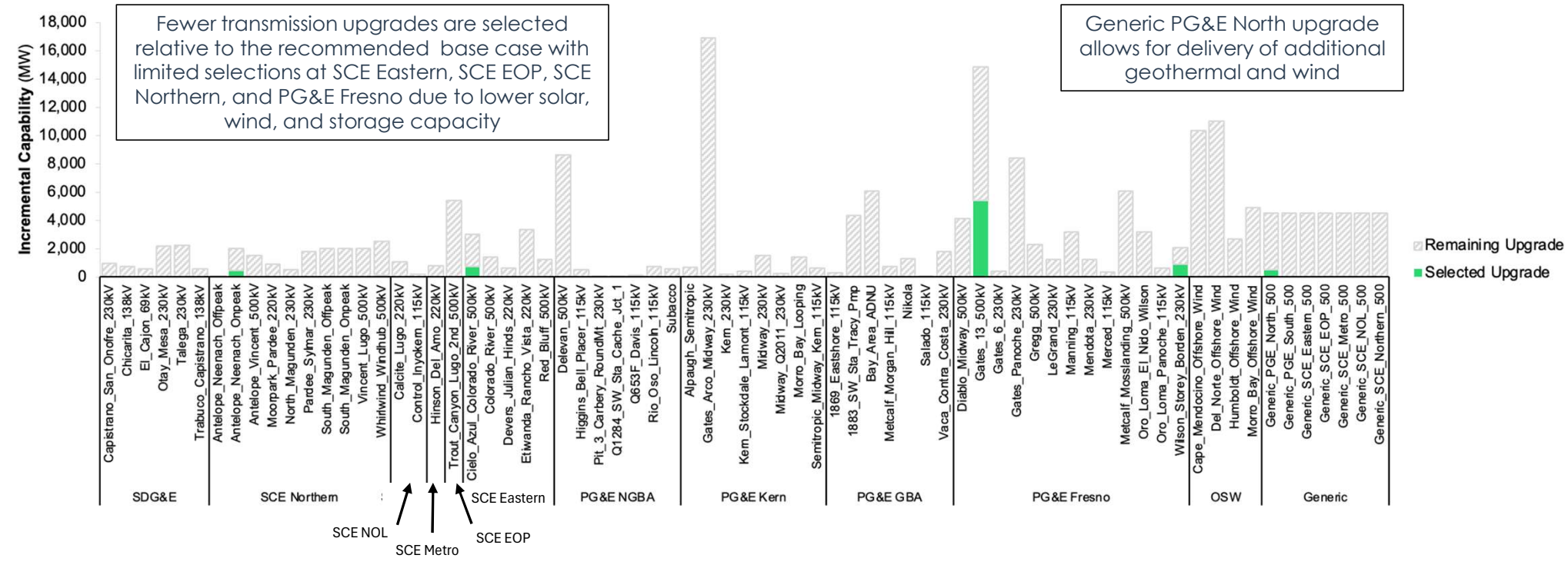
- With lower load under the 2025 IEPR load forecast, costs are significantly lower, reaching ~$5 Billion/yr less starting in 2035

[1] RESOLVE-optimized costs account for ~15-30% of total system costs (increasing over time); non-optimized baseline generation, transmission, and distribution make up the rest of the revenue requirement

2025 IEPR Sensitivity

RESOLVE-Selected Transmission Upgrades (2037)

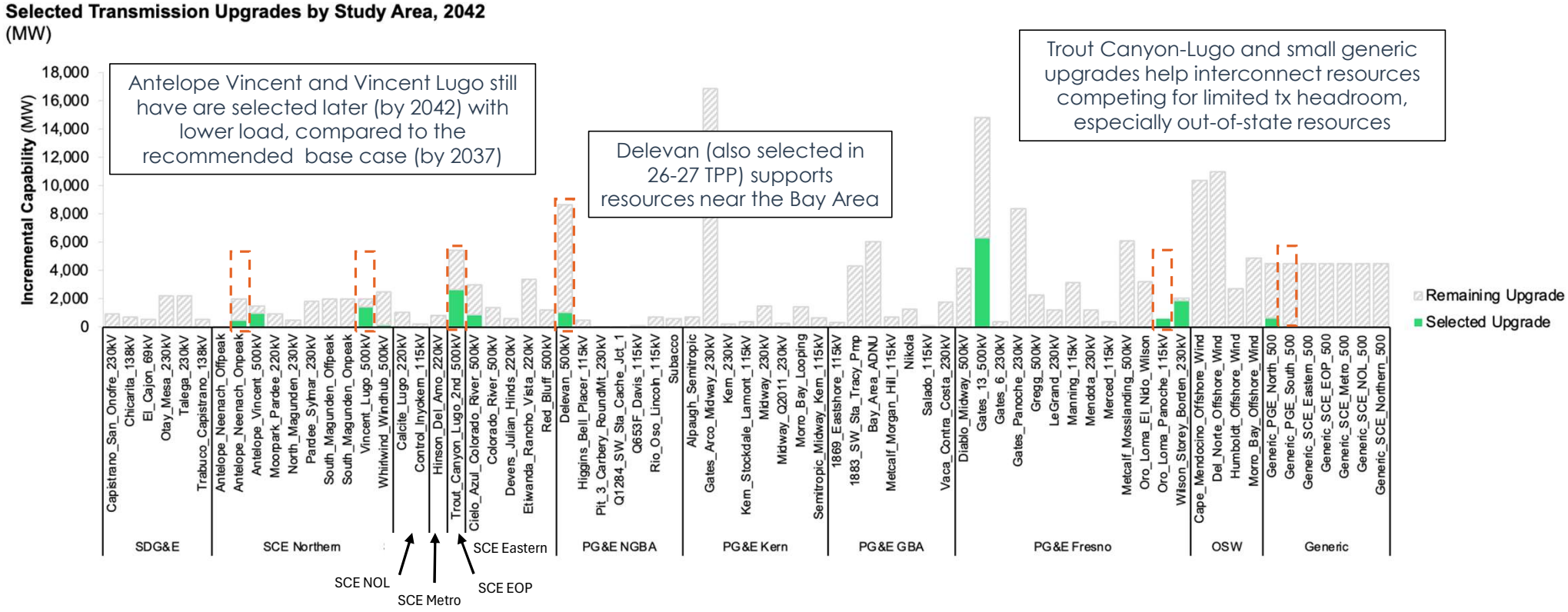
Selected Transmission Upgrades by Study Area, 2037
(MW)



Officially selected transmission upgrades are determined by the CAISO Transmission Plan

2025 IEPR Sensitivity

RESOLVE-Selected Transmission Upgrades (2042)



Officially selected transmission upgrades are determined by the CAISO Transmission Plan

RESOLVE-Selected Transmission Upgrades – Changes from Recommended Base Case (2037)

- **~3 GW net fewer transmission upgrades** selected by 2037, with a net cost reduction of ~$0.3 Billion (~$26 Million/yr), driven by lower load

Constraint	Upgrade	Study Area	Cost ($/kW-yr)	2025 IEPR	Recommended Base Case	2025 IEPR MW	Recommended Base Case MW
Antelope-Vincent Area Deliverability Constraint	Antelope Vincent 500kV	SCE Northern	$0.82	✗	✓	0	961
Diablo-Gates 500 kV line	Diablo Midway 500kV	PG&E Fresno	$18.65	✗	✓	0	48
Metcalf-Mosslanding 500kV	Metcalf Mosslanding 500kV	PG&E Fresno	$3.05	✗	✓	0	190
Lugo – Victorville Area Deliverability Constraint	Trout Canyon Lugo 2nd 500kV	SCE EOP	$33.67	✗	✓	0	579
Vincent-Lugo Area Deliverability Constraint	Vincent Lugo 500kV	SCE Northern	$3.98	✗	✓	0	1093

Officially selected transmission upgrades are determined by the CAISO Transmission Plan;
Only upgrades selected in one case and not the other are shown; upgrades selected in different MW amounts omitted

RESOLVE-Selected Transmission Upgrades – Changes from Recommended Base Case (2042)

- ~0.3 GW net fewer transmission upgrades selected by 2042, with a net cost reduction of less than $0.1 Billion (~$3 Million/yr), driven by lower load
- **This result indicates the majority of upgrades selected by 2042 in the recommended base case are robust to lower load**

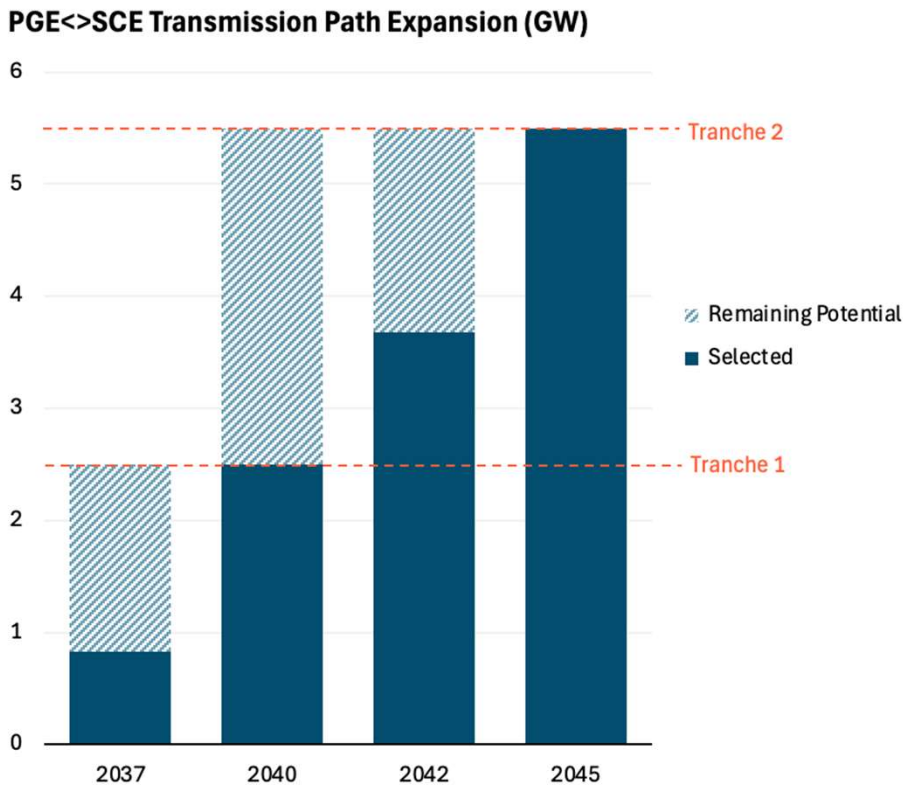
Constraint	Upgrade	Study Area	Cost ($/kW-yr)	2025 IEPR	Recommended Base Case	2025 IEPR MW	Recommended Base Case MW
Diablo-Gates 500 kV line	Diablo Midway 500kV	PG&E Fresno	$18.65	✗	✓	0	48
	Generic SCE EOP 500		$41.20	✗	✓	0	39
Metcalf-Mosslanding 500kV	Metcalf Mosslanding 500kV	PG&E Fresno	$3.05	✗	✓	0	190

Officially selected transmission upgrades are determined by the CAISO Transmission Plan;
Only upgrades selected in one case and not the other are shown; upgrades selected in different MW amounts omitted

2025 IEPR Sensitivity

PG&E-SCE Transmission Path Expansion

- Path 26/Path 15 expansion(s) are selected primarily to increase import capacity into PG&E
- Path expansion is selected by RESOLVE as soon as it becomes available in 2037, with the full first tranche built by 2040
- The second tranche selected in full by 2045, more than doubling the transmission capacity



Officially selected transmission upgrades are determined by the CAISO Transmission Plan

RESOLVE Results: Limited Out-of-State (OOS) Resource Sensitivity

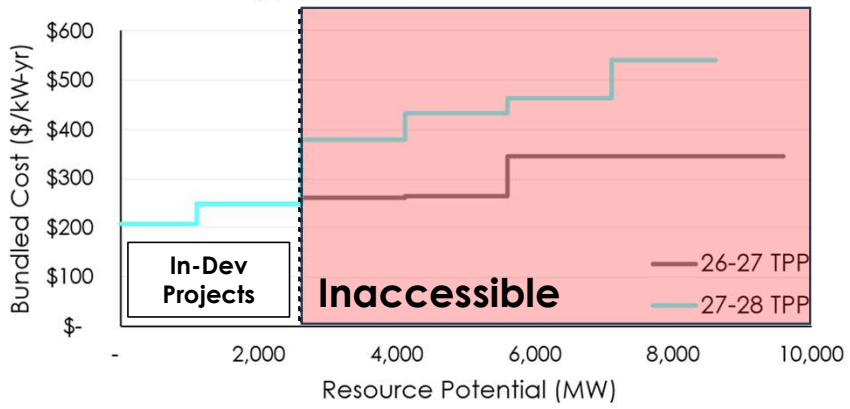
38 MMT by 2030, 30 MMT by 2035, No Offshore Wind

Limited OOS Sensitivity

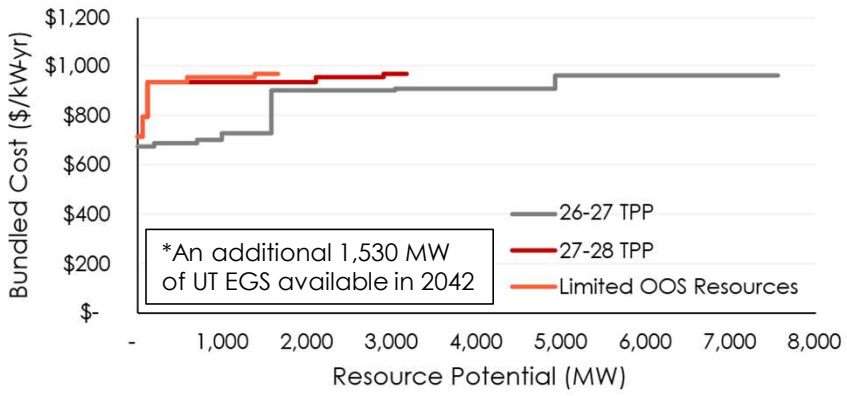
Limited OOS Resources Case Overview

- **Generic transmission lines that could deliver non-CAISO resources are assumed to be unavailable**
  - Out-of-state wind options are limited to ID wind on SWIP-N and WY wind on TransWest Express
  - Out-of-state geothermal options are limited to NV and UT geothermal contracts from LSE filings, projects identified in the NEVP interconnection queue, and 1,070 MW of NV EGS that could utilize capacity on SWIP-N or Greenlink West
  - High West (up to 2 GW of UT EGS) is made available in 2042 only
  - Transmission solutions to deliver in-state wind and geothermal resources in the Hilltop area are not modeled

Out-of-State Wind Supply Curve, 2037



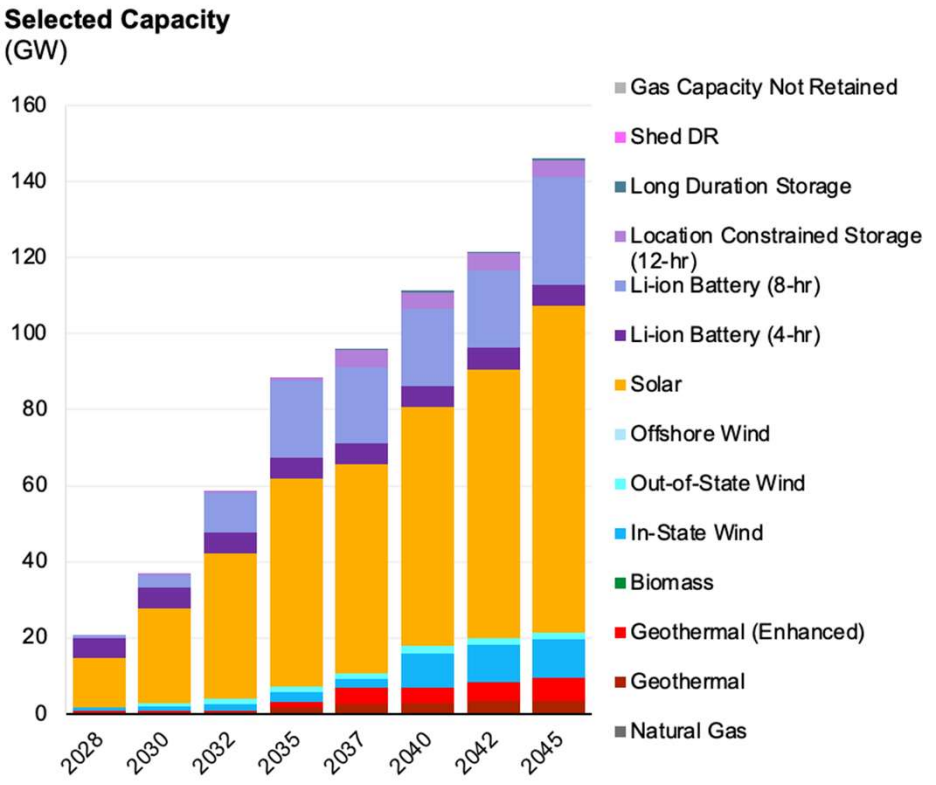
Out-of-State Geothermal and EGS Supply Curve, 2032



Limited OOS Sensitivity

Portfolio Summary

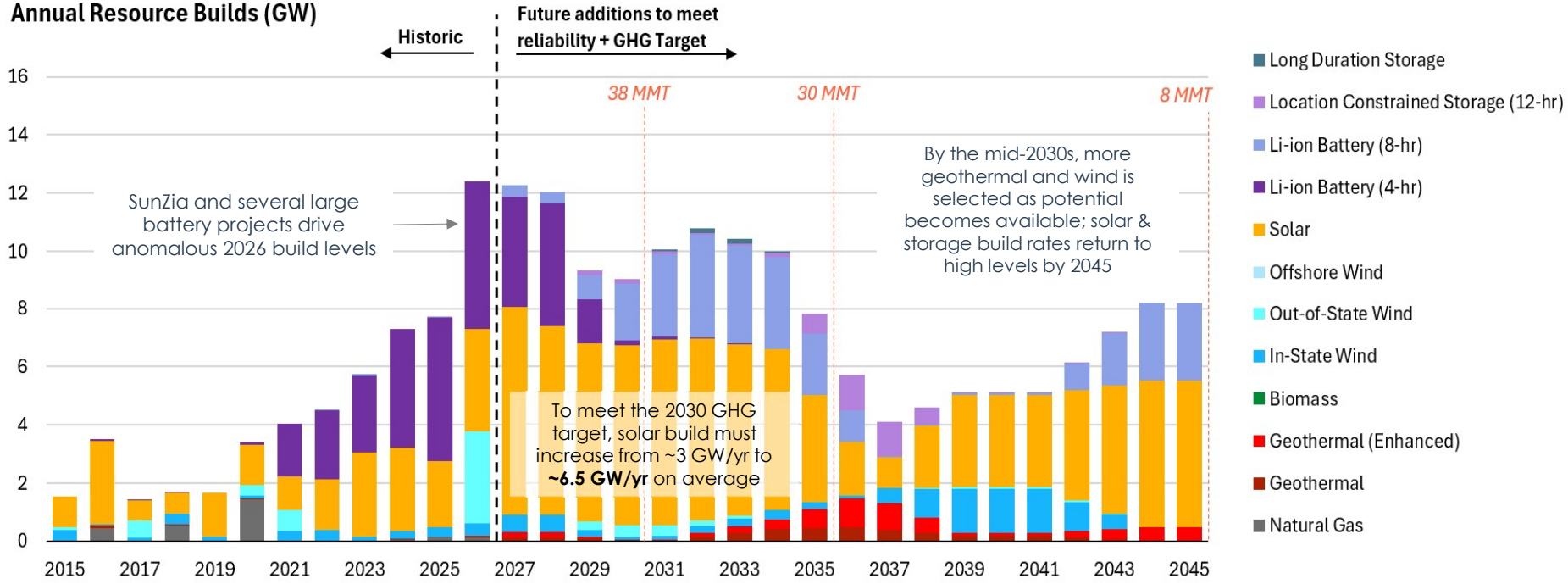
- Similar to the recommended base case, geothermal (both conventional and enhanced) is selected for reliability value and high-capacity factor, GHG-free energy
  - Most geothermal potential is selected by 2037 to capture tax credits before they expire
- Relatively small amounts of onshore wind are selected by the mid-2030s, then scale up rapidly in the 2040s
  - Transmission constraints limit in-state wind selection in the mid-2030s
- Solar and storage (especially 8-hr) are the scalable resources to meet GHG reduction and reliability, especially through 2035
  - As alternative resources become available starting in the mid-2030s, storage build rates slow until 2045
  - Solar continues to scale rapidly though 2045 in the absence of most out-of-state resources, even as it becomes heavily saturated
- No offshore wind is optimally selected, as lower-cost GHG-free resources are available in-state
- All gas capacity is retained
- **Greatly reduced amounts of out-of-state wind and geothermal resources are selected for the portfolio**



Limited OOS Sensitivity

Resource Build Rate

- The 2030 and 2035 GHG targets, combined with limited geothermal and wind availability through the mid-2030s, drive high solar and storage build rates in the near-term; limited out-of-state resource potential drives continued high build rates in the long-term

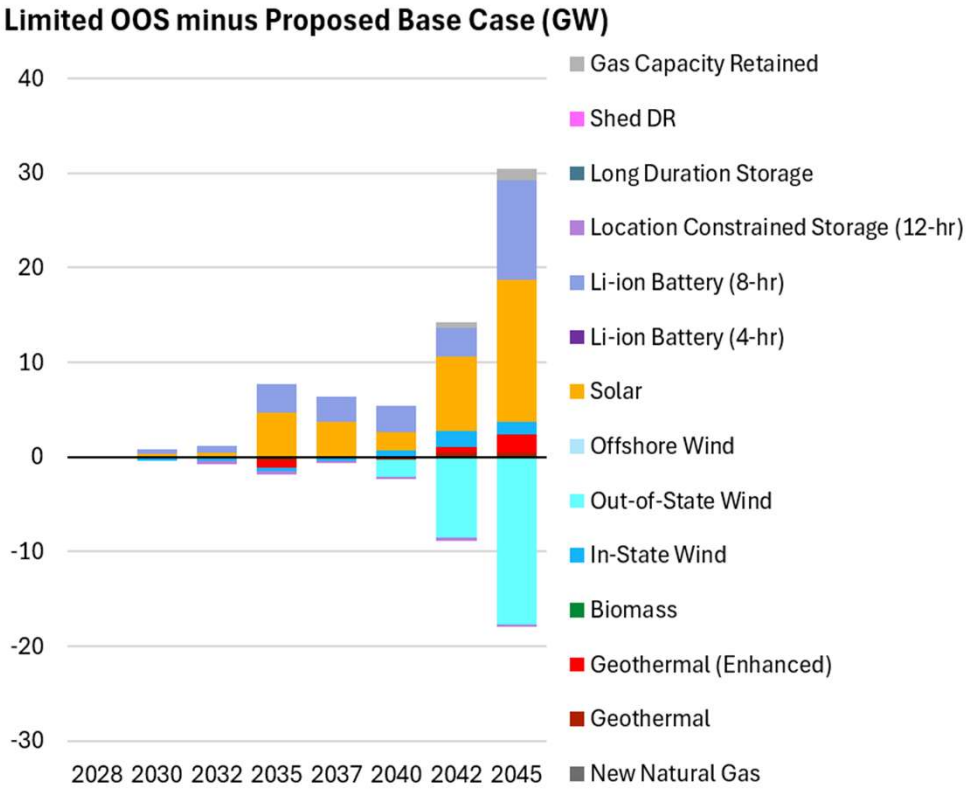


Builds are interpolated and smoothed between model years; 2026 build is a combination of resources already online this year and resources with high-confidence online dates later in the year provided by CAISO

Limited OOS Sensitivity

Total Capacity Comparison with Recommended Base Case

- Differences grow starting in 2035, when out-of-state resources become available in the recommended base case
- Out-of-state resources are primarily replaced by solar and storage, plus smaller amounts in-state wind and EGS
  - An additional ~15 GW of solar and ~10 GW of storage are needed by 2045
- In-state EGS is selected to replace out-of-state EGS and some out-of-state wind
- All gas capacity is retained



System Cost Comparison with Recommended Base Case

RESOLVE-Optimized Costs ($MM in 2024$)

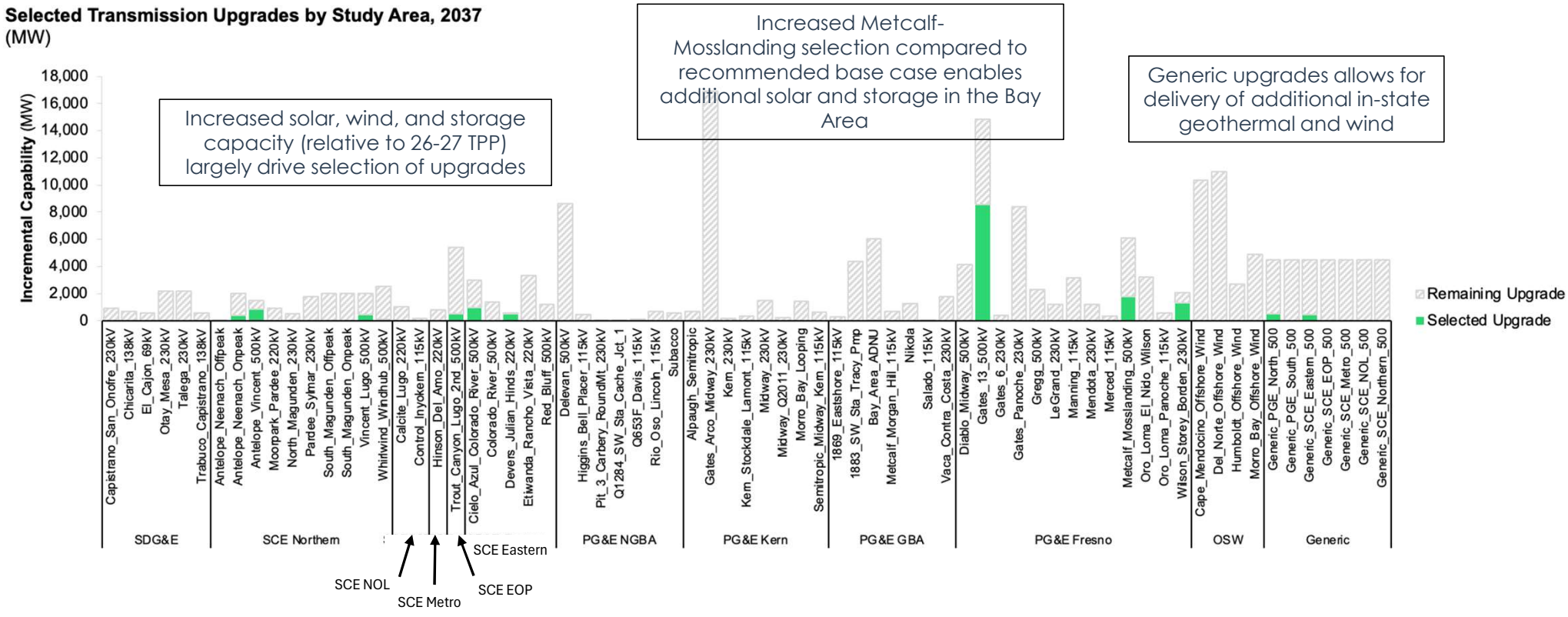
Case	2028	2030	2032	2035	2037	2040	2042	2045	NPV
Recommended Base Case	$13,316	$16,667	$20,080	$25,190	$27,746	$30,420	$32,378	$40,287	*$421,454*
Limited OOS Sensitivity (Cost delta) (% change[1])	$13,322 +$6 (<0.1%)	$16,663 -$4 (<0.1%)	$20,086 +$6 (<0.1%)	$25,529 +$339 (1.3%)	$28,389 +$643 (2.3%)	$30,654 +$234 (0.8%)	$33,328 +$950 (2.9%)	$42,176 +$1,889 (4.7%)	*$433,652* *+$12,198* *(2.9%)*

- Limited out-of-state resource availability results in **increased costs of ~$1Billion/yr by 2042**, and growing thereafter

[1] RESOLVE-optimized costs account for ~15-30% of total system costs (increasing over time); non-optimized baseline generation, transmission, and distribution make up the rest of the revenue requirement

Limited OOS Sensitivity

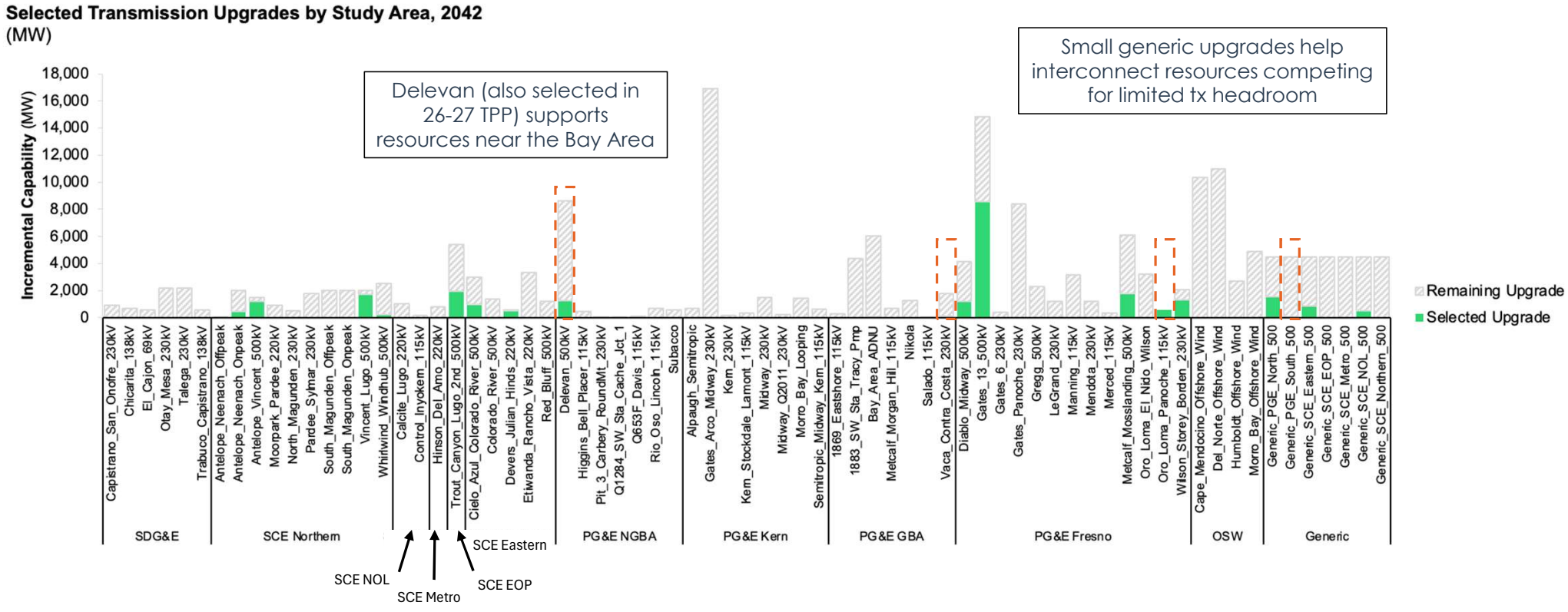
RESOLVE-Selected Transmission Upgrades (2037)



Officially selected transmission upgrades are determined by the CAISO Transmission Plan

Limited OOS Sensitivity

RESOLVE-Selected Transmission Upgrades (2042)



Officially selected transmission upgrades are determined by the CAISO Transmission Plan

RESOLVE-Selected Transmission Upgrades – Changes from Recommended Base Case (2037)

- **~1 GW net additional transmission upgrades are selected to accommodate in-state resources** by 2037, with a net cost increase of ~$1.3 Billion (~$125 Million/yr)

Constraint	Upgrade	Study Area	Cost ($/kW-yr)	Limited OOS	Recommended Base Case	Limited OOS MW	Recommended Base Case MW
Eagle Mountain Area Deliverability Constraint	Devers Julian Hinds 220kV	SCE Eastern	$182.62	✓	✗	535	0
	Generic SCE Eastern 500		$61.80	✓	✗	437	0

Officially selected transmission upgrades are determined by the CAISO Transmission Plan;
Only upgrades selected in one case and not the other are shown; upgrades selected in different MW amounts omitted

RESOLVE-Selected Transmission Upgrades – Changes from Recommended Base Case (2042)

- **~2 GW net additional transmission upgrades** selected by 2042, at an additional cost of ~$1.9Billion (~$175 Million/yr) to accommodate additional in-state resources

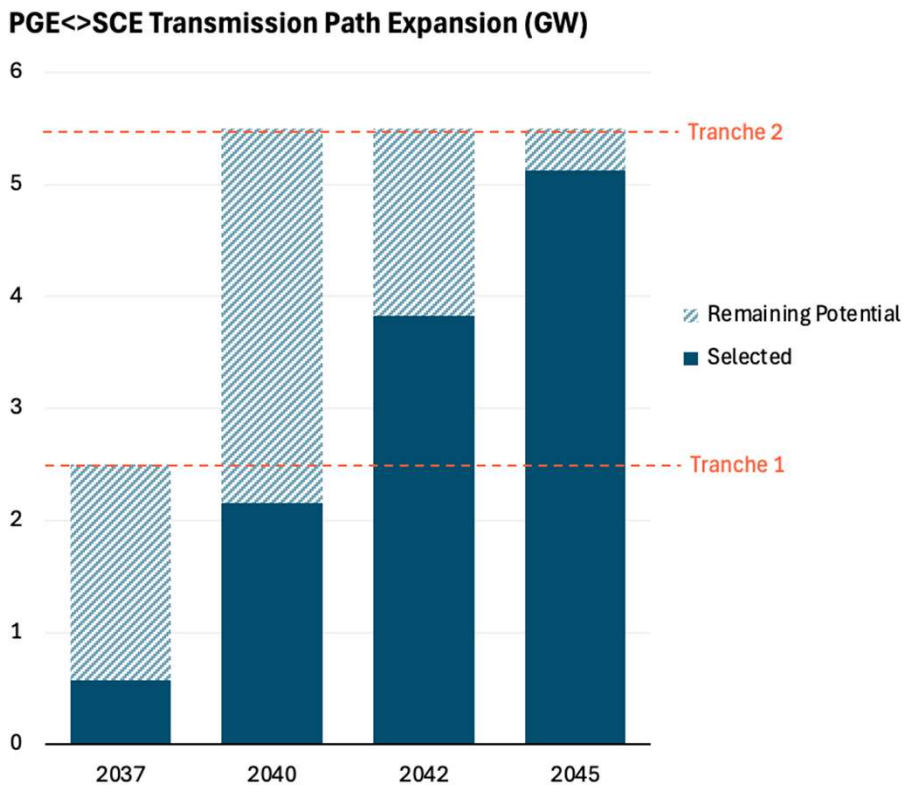
Constraint	Upgrade	Study Area	Cost ($/kW-yr)	Limited OOS	Recommended Base Case	Limited OOS MW	Recommended Base Case MW
Eagle Mountain Area Deliverability Constraint	Devers Julian Hinds 220kV	SCE Eastern	$182.62	✓	✗	535	0
	Generic SCE Eastern 500		$61.80	✓	✗	862	0
	Generic SCE NOL 500		$41.20	✓	✗	489	0
Birds Landing-Contra Costa 230kV Line	Vaca Contra Costa 230kV	PG&E GBA	$36.74	✓	✗	134	0
	Generic SCE EOP 500		$41.20	✗	✓	0	39

Officially selected transmission upgrades are determined by the CAISO Transmission Plan;
Only upgrades selected in one case and not the other are shown; upgrades selected in different MW amounts omitted

Limited OOS Sensitivity

PG&E-SCE Transmission Path Expansion

- Path 26/Path 15 expansion(s) are selected primarily to increase import capacity into PG&E
- Path expansion is selected by RESOLVE as soon as it becomes available in 2037, with the full first tranche built by 2042
  - Limited out-of-state resources drives ~1 GW additional selection by 2042, though other years remain similar to the recommended base case
- Most of the second tranche is selected by 2045, more than doubling the transmission capacity



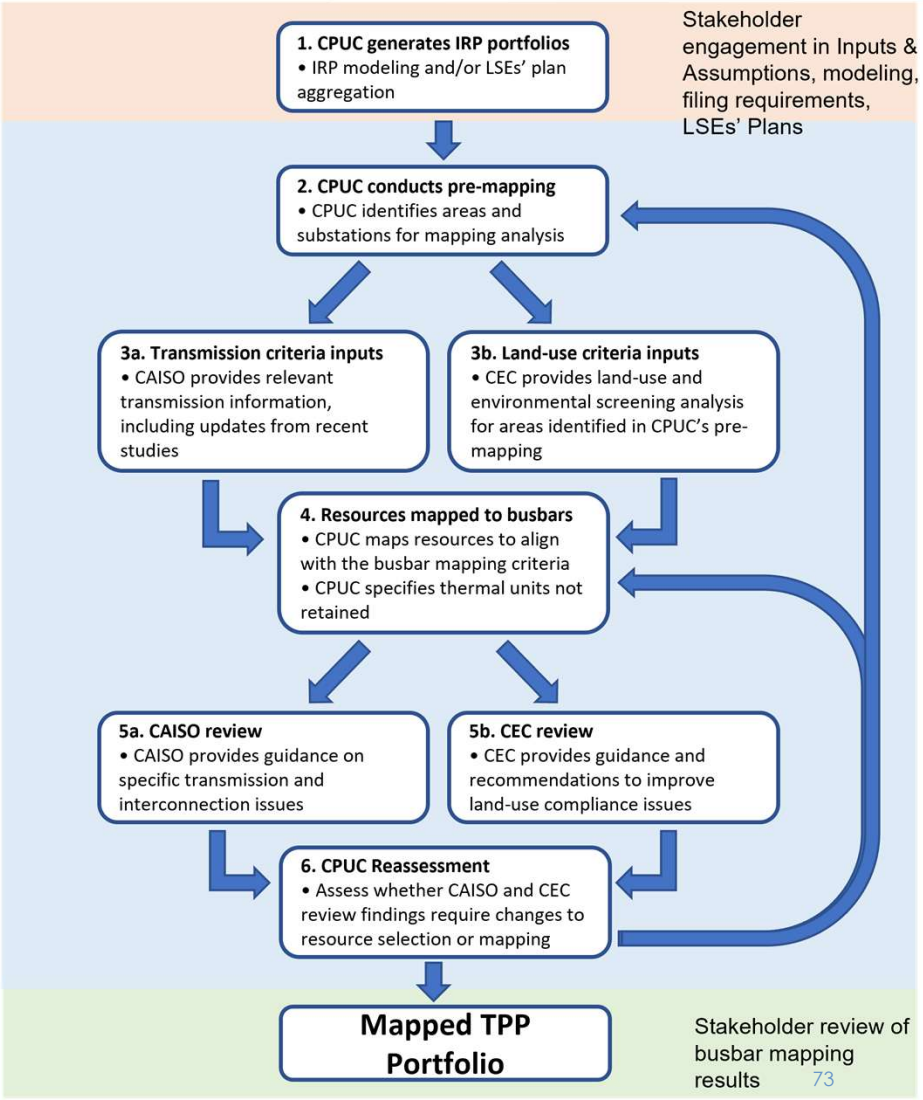
Officially selected transmission upgrades are determined by the CAISO Transmission Plan

Busbar Mapping Methodology

Busbar Mapping Process

- Busbar Mapping can be viewed as a sequence of steps involving CPUC, CEC, and CAISO staff providing inputs and expertise at various stages.
  - CEC staff provide land-use and environmental information, data analysis, and implications assessment.
  - CAISO staff provide similar info for transmission and interconnection topics.
  - CPUC staff apply analysis and information to conduct the mapping itself and coordinates the information transfers.
- Overall process is an iterative effort that requires several rounds of the mapping process
- Goals of the mapping process:
  - Identify plausible locations for portfolio resources that align with CPUC policy requirements, maintain reliability, and minimize cost to ratepayers.
  - Align mapped resources to the extent feasible with the guiding principles and the mapping priorities of each criteria.

Methodology addresses these steps



Busbar Mapping Methodology

- **Busbar Mapping Methodology:** Methodology document states guiding principles, establishes mapping criteria, and outlines the iterative inter-agency mapping process.
  - Current Mapping Methodology for the 27-28 TPP.
- **Updates included in Current Methodology:** Staff implemented a number of updates this cycle. Those updates included:
  - Revisions to the way substation upgrades influence the interconnection criteria alignment
  - The incorporation of permitting data in the commercial interest criteria
  - Revisions to the gas non-retention logic
  - A new methodology for land use and environmental evaluation of pumped storage hydroelectric resources (PSH) which calculates a weighted average of project-specific and landscape-level data
  - A new methodology for land use and environmental evaluation of enhanced geothermal systems (EGS) resources
  - A methodology for avoiding double-counting of resource potential near substations
  - We refer interested parties to this webinar from June 2026 for more information on methodology updates
- **Future Methodology updates:** Staff anticipate conducting more updates to the methodology for the next cycle

Mapping Criteria Overview

- The mapping Methodology, used since the 24-25 TPP portfolios, has the busbar mapping criteria organized into seven categories:
    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. Environmental (societal) and community impact factors
    6. Commercial & development interest
    7. Consistency with prior TPP portfolios
- Staff rank criteria alignment using a five-level scale to summarize mapped resources' alignment with the various criteria priorities.
    - Not all criteria screens use all five levels of alignment.

Level 1	Level 2	Level 3	Level 4	Level 5
Strong compliance with criteria; alignment with criteria's prioritized conditions	Mostly favorable compliance with criteria; not fully aligned with priorities but not near to triggering unfavorable criteria	Mixed compliance with criteria; little alignment with priorities; potential alignment with conditions criteria seek to limit or avoid	Some noncompliance with criteria; some alignment with conditions criteria seeks to limit or avoid	Significant noncompliance with criteria; no alignment with stated criteria; meets conditions criteria seek to limit or avoid

Criteria 1: System Level Transmission Capacity

System Level Tx Capability Criteria Analysis

- Mapped resources should abide by the estimated system level transmission constraints, triggering only those upgrades which are determined to be cost-effective or necessary to meet policy and reliability requirements.
- Mapping uses information from the most current CAISO White Paper Transmission Capability Estimates for use in the CPUC's Resource Planning Process.
  - Includes substations and constraint info, including approved upgrades from recent TPPs.
- Analysis incorporates on-peak and off-peak limits and identified upgrades for CAISO transmission constraints
  - Actual constraints (binding amounts identified in CAISO studies) and Default constraints (non-binding limits – largest amount CAISO has studied)
- Identify mapped OOS resources as utilizing existing Maximum Import Capability (MIC) or require MIC expansion

Base Case (2041) Tx Constraint Exceedances		Constraint's White Paper		Calculated Largest On-peak (HSN) Exceedance	Calculated Off-peak Exceedance	White Paper Upgrade Info	
CAISO Zone	Constraint Name	On-Peak Capability (MW)	Off-Peak Capability (MW)			Capability Increase (MW)	Estimated Cost (millions)
PGE North of Greater Bay Area	Collinsville – Tesla 500 kV line	3,379	7,706	**(3,002)**	None	8,645	$2,852

Flags without (left) and with (right) upgrades

CAISO Study Area	Substation	Voltage	Resource Type	FCDS (or 4-hr for Battery)	EODS (or 8-hr for Battery)	Total	FCDS (or 4-hr for Battery)	EODS (or 8-hr for Battery)	Total	FCDS (or 4-hr for Battery)	EODS (or 8-hr for Battery)	Total	FCDS Alignment pre-upgrades	Final FCDS Alignment w/ Upgrade	EODS Alignment pre-upgrades	Final EODS Alignment w/ Upgrade
PG&E NGBA	Bridgeville	115	Geothermal	185	-	185	-	-	-	185	-	185	5	2	1	1
PG&E NGBA	Cloverdale	115	Geothermal	112	-	112	4	-	4	108	-	108	5	2	1	1
PG&E NGBA	Eagle Rock	115	Geothermal	7	-	7	7	-	7	-	-	-	5	2	1	1

Table: 26-27 TPP non-compliance flags determined from transmission constraints utilization calculations

Transmission Capability – Calculating Tx Utilization

- *Multi-step process to calculate transmission utilization within a constraint.*
  1. 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.
  2. Calculate transmission utilization of each resource type for each transmission use scenario.
  3. Sum across all resources for each constraint and comparing to existing transmission capacity.
  4. Assess exceedances and if any CAISO identified upgrades could alleviate the exceedances.
- Rely on CAISO Local Capacity Requirement studies to aide in storage and resource mapping in local areas.

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	-

- Tables show the 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 2: Substation Level Interconnection Viability

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.
- Initial mapping analysis includes only:
  - Distance from substation for in-CAISO solar, onshore wind, and geothermal resources.
  - Interconnection voltage analysis for in-CAISO solar, onshore wind, and storage resources.

Criteria Alignment levels for Distance to interconnection

	Wind &Geothermal		Solar	
Level	**< 200 MW**	**200 MW or more**	**< 400 MW**	**400 MW or more**
1	<10 mi	<10 mi	<5 mi	<10 mi
2	<15 mi	<20 mi	<10 mi	<15 mi
3	<20 mi	<30 mi	<15 mi	<20 mi
4	<30 mi	>30 mi	<20 mi	<30 mi
5	>30 mi	-	>20 mi	>30 mi

	Interconnection Substation Voltage			
Level	**Less than 100 kV**	**100 - 200 kV**	**230 or 345 kV**	**500 kV**
1	-	<50 MW	>200 MW & <1,500 MW	>400 MW & <3,000 MW
2	-	<100 MW	>50 MW & <2,000 MW	>200 MW & <3,000 MW
3	<50 MW	<200 MW	>50 MW & <3,000 MW	>200 MW & <4,000 MW
4	<100 MW	<400 MW	>3,000 MW	<200 MW or >4,000 MW
5	>100 MW	>400 MW	<50 MW	<100 MW

Substation-level Interconnection Criteria: Potential Updates to Interconnection Criteria

- Last cycle, the interconnection criteria was expanded to integrate PTO feedback and per-unit cost guide data to estimate the economic feasibility to interconnect at individual busbars.
- For the 27-28 TPP, this expanded criteria was enhanced as follows:
  - Sent data requests to 12 PTOs, we received detailed responses from GLW, SCE, and SDG&E
  - Consistent interconnection data being collected for uniform data processing across busbars
  - Requests to the PTOs included more busbars
  - Based on PTO feedback, the busbar upgrade need was identified, and the corresponding cost was estimated
  - The interconnection upgrade cost criterion dynamically scores each busbar based on the $/kW cost of the required upgrade as a function of how much capacity is mapped there, benchmarked against empirically-derived thresholds specific to each PTO, voltage class, and upgrade type.
  - Busbars are rewarded for either avoiding upgrade cost triggers entirely or mapping enough capacity to utilize the upgrade efficiently, and penalized for partial placements that drive up the per-MW cost of the required upgrade.

Updated Criteria Thresholds

- The criteria alignment score for a busbar is dynamically updated based on the mapped capacity. For example, as more capacity is mapped to a busbar, the $/kW cost of the upgrade decreases so the criteria alignment score of that busbar improves as utilization increases.
- Score thresholds are unique to each PTO, voltage class, and upgrade type combination, reflecting real differences in upgrade costs.
- A busbar that requires no upgrade scores a 1 by default; a busbar where mapped capacity exceeds the upgrade's implied limit scores a 5 regardless of cost

Example: PGE, New Substation

Voltage	Score 1		Score 2	Score 3	Score 4	Score 5
	Mapped capacity = 0 MW	$/kW < Threshold A	Threshold A ≤ $/kW < Threshold B	Threshold B ≤ $/kW < Threshold C	Threshold C ≤ $/kW < Threshold D	Threshold D ≤ $/kW OR Mapped capacity > limit
115 kV *Cap: 100 MW*	No upgrade cost	$468/kW	$624/kW	$936/kW	$1,871/kW	≥$1,871/kW
230 kV *Cap: 1,500 MW*	No upgrade cost	$38/kW	$51/kW	$76/kW	$152/kW	≥$152/kW
500 kV *Cap: 3,000 MW*	No upgrade cost	$64/kW	$85/kW	$128/kW	$256/kW	≥$256/kW

Thresholds A, B, C, and D correspond to the $/kW cost of the upgrade at 80%, 60%, 40%, and 20% utilization of the implied capacity limit, respectively.

Criteria 3: Land-Use Implications and Feasibility

Land-Use Implications and Feasibility Criteria

- This criteria serves 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.
- CEC Core Land-use Screen: key screen that combines the broader land-use and environmental datasets to provide an overall potential implications impact.
- Staff will also use the following datasets as screens for the land-use criteria:
  - CEC parcelization model screen,
  - CEC Cropland Index Model screen,
  - Critically Overdrafted Groundwater Basins, and
  - High Fire Threat Areas.

Criteria 4: Environmental (Conservation and Biological) Impact

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.

Criteria 5: Community and Environmental (Societal) Impact

Community and Environmental (Societal) Impact Factors

- These criteria prioritize 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 include:
  - Proximity to disadvantaged communities as identified by CalEnviroScreens 4.0[1].
  - Located in a $PM_{2.5}$ or Ozone EPA[2] non-attainment zone.
  - Proximity to fossil-fueled generator (particularly those identified through the Thermal Retirement Assumptions).
  - Located in an IRA Energy Community[3]
  - Located in an LCR area (incorporated into transmission analysis criteria).

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

[1] SB 535 Disadvantaged Communities - OEHHA (This map was last updated in May 2024 with additional tribal lands based on consultations that occurred in 2023 and 2024.)
[2] PM 2.5 (2012) and Ozone Non-Attainment Area Shapefiles - Green Book GIS Download | US EPA
[3] IRA: IRA Energy Community Data Layers - Submissions - EDX (4/3/2024)

Criteria 6: Commercial Development Interest

Commercial Interest

Commercial Interest Criteria

The Commercial Interest Criteria aligns mapped resources with locations of commercial interest and identifies locations where misalignment occurs to ensure that differences are supported by strong rationale.

When mapped resources **exceed** the amount of commercial interest:

- Level 1 alignment:
  - Mapped resources align with in-development resources and commercial interest with TPD, an executed IA or projects that have completed permitting and entered an interconnection queue.
- Level 2 alignment:
  - Mapped resource amounts exceed the amount of commercial interest with TPD, an executed IA, or projects that have completed permitting and entered an interconnection queue
- Level 3 alignment:
  - Mapped resource amounts exceed the amount of higher confidence commercial interest
- Level 4 alignment:
  - Mapped resource amounts exceed the total amount of commercial interest
- Level 5 alignment:
  - There is no commercial interest at the substation where resources are mapped.

When the mapped resources **are less than** the various amounts of commercial interest:

- Level 1 alignment:
  - Amount mapped is significantly less than only the total commercial interest
- Level 2 alignment:
  - Amount mapped is less than higher confidence commercial interest by a to be specified MW amount
- Level 3 alignment:
  - Amount mapped is less than the amount of commercial interest with TPD, an executed IA, or projects that have completed permitting and entered the queue by a to be specified amount
- Level 4 alignment:
  - Amount mapped is significantly less than the amount of commercial interest with TPD, an executed IA, or projects that have completed permitting and entered the queue by a to be specified amount
- Level 5 alignment:
  - Amount mapped is less than the amount of identified in-development and contracted resources

Updates to the Commercial Interest Criteria in the 27-28 TPP

- Due to FERC approval of CAISO's interconnection queue reform plan in 2024, Staff has incorporated a broader set of supplemental data into the commercial interest criteria for the 2027-2028 TPP.
- Additional data sources now considered:
  - The BLM (Bureau of Land Management) permit application queue (NEPA), used to identify developer interest on federal lands.[1,2]
  - The CEQA (California Environmental Quality Act) permit application queue, which tracks early-stage project applications on non-federal lands in California.[3]
- The projects with first priority in the "higher confidence" commercial interest category are projects that have been assigned transmission plan deliverability (TPD) by the CAISO, or resources that have an executed interconnection agreement, or projects that have completed CEQA and NEPA documentation and have entered the queue.
- Projects that have executed interconnection agreements (IAs), or have completed Phase II in the CAISO interconnection queue, or are in the process of CEQA and NEPA documentation and have entered the queue have the next level of priority within the "higher confidence" category, followed by resources identified in LSE plans but not yet contracted.

[1] *BLM NEPA Register:* https://eplanning.blm.gov/eplanning-ui/home
[2] *BLM CA Renewable Energy Projects, BLM GIS Hub:* https://gbp-blm-egis.hub.arcgis.com/maps/BLM-EGIS::blm-ca-renewable-energy-projects/about
[3] *CEQANet:* https://ceqanet.lci.ca.gov/Search/Advanced

Criteria 7: Consistency with Prior TPP Portfolios

Alignment with prior TPP portfolios

- Mapping should be relatively consistent with prior years.
  - The Base Case is compared to base cases of prior years and similar sensitivity portfolios.
  - Sensitivity Portfolios are compared to similar issue-focused portfolios of prior years.
- Goal is to avoid significant changes to the resource portfolio that could drive different transmission system impacts from those studied by CAISO in prior years' TPPs, unless clear reasons with explicit justification are provided.
- Following working group discussions, larger deviations can be tolerated if they are estimated to not significantly affect transmission implications.

Criteria	Comparative Point(s)		Level 1	Level 2	Level 3	Level 4	Level 5
Consistency with prior TPP Portfolios	**Previous TPP portfolios mapped resources**	**MW amounts mapped**	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

Gas Capacity Not Retained

Gas Capacity Not Retained

Mapping Methodology for Modeled Gas Non-Retention

- Portfolios can include two types of gas non-retentions:
  - Policy-driven non-retentions that are forced into RESOLVE and do not appear as RESOLVE-selected resources
  - RESOLVE-selected capacity not retained due to RESOLVE's economic costs optimization
- RESOLVE only identifies the aggregate amount of gas capacity not retained, but individual units need to be specified for the TPP studies. To identify which units to model as offline, staff implement a scoring criteria to develop a prioritized ranking of units to model as not retained:
- Environmental/Community Factors:
  1. Proximity to Disadvantaged communities (DACs): Units in or near a DAC receive higher score
  2. Emission info and non-attainment zones: Units in Ozone and PM2.5 non-attainment areas receive higher score and units with higher per MWh NO_X and SO_2 emissions per available EIA data receive higher score
- Performance-Related Factors:
  3. Age of plant: Older units receive higher score
  4. Heat Rate: Plants with highest heat rate (by plant type) receive highest score/priority
- Local Reliability factor:
  5. CAISO LCR study info: Units with lower effectiveness factors receive higher score
- In these selections, the CPUC is seeking to identify transmission needs and impacts of potential plant non-retentions. **The CPUC is not directing specific gas generators to retire via these studies.**

Gas Capacity Not Retained

Prioritizing Existing Gas Generators for Non-Retention

- For each unit type (CCGT, Peaker), scores are calculated for six impact factors across three categories
- The average score across all factors within each category is computed; a weighted sum is then taken to get the unit's total score
- Units will be identified for non-retention in descending score order, up to the total amount (MW) not retained by RESOLVE
  - Exemptions are made for units built or repowered in the last ten years, units with high (>15%) Local Effectiveness Factors, and CCGT units suitable for CCS retrofitting
- The volume of Li-ion batteries that could replace gas capacity on a 1-for-1 MW basis within each LCR area are taken from the 2031 CAISO Long-Term Local Capacity Technical Report[2]

Low Priority ← → High Priority

Environmental / Community Factors (50%)				
NAA	Outside			Inside
DAC	> 10 mi	< 10 mi	< 5 mi	Inside
NOx + SOx	Normalized scoring – prioritize high emitters			

Performance-Related Factors (25%)	
Age	Normalized scoring – prioritize older units
Heat Rate	Normalized scoring – prioritize inefficient units

Local Reliability Factor (25%)	
LEF[1]	Normalized scoring – prioritize low LEF units

[1] *Units that do not have a reported LEF are assumed to receive the mean score for this factor*
[2] *https://stakeholdercenter.caiso.com/InitiativeDocuments/Final-2031-Long-Term-Local-Capacity-Technical-Report.pdf*

Updates to the Gas Capacity Not Retained Criteria

- The three impact factor categories (Environmental/Community, Performance, and Local Reliability) and their respective weights in the final scoring of existing gas plants, are consistent with the 2026-2027 TPP
- To score each individual factor, the data has been normalized (continuously) over the range [1,4], replacing the quartile binning used in previous cycles
  - The age threshold for non-retention exemption has been set to 10 years
  - The effectiveness factor threshold for non-retention exemption has been set to 15%
  - Units missing data for a given factor (including data from the 2031 Long-Term LCT Study) are assigned the mean score of 2.5
- Staff analysis identified CCGT units suitable for CCS retrofits; those units have been excluded from non-retention
- Major maintenance data from EIA Form 860 is no longer used to adjust the plant age used for the Performance Factor

Gas Capacity Not Retained

Candidates for CCS Technology Retrofits

- For the 27-28 TPP, existing gas facilities that have a higher likelihood of retrofitting with CCS technology will be excluded from non-retention in the busbar mapping process, irrespective of their score in the Gas Capacity Not Retained workbook
- Likelihood is based on factors including:
  - Proximity to carbon storage facilities in the Class VI permitting process as identified by storage operators
  - Publicized information on completed front-end engineering design studies
  - An academic study from Stanford[1] cited in the docket
  - Publicized development memoranda of understanding
  - Unit-specific citation available in the proceeding
- Unit scoring is available for parties to review in the Gas Capacity Not Retained Workbook

Facility	Size
Delta Energy Center	880 MW
Elk Hills Combined Cycle	552 MW
Gateway Generating Station	585 MW
High Desert Power Project	850 MW
La Paloma Generating Plant	1,066 MW
Lodi Energy Center	303 MW
Los Esteros Energy Facility	310 MW
Los Medanos Energy Center	580 MW
Metcalf Energy Center	597 MW
Moss Landing Power Blocks	1,020 MW
Pastoria Energy Facility	799 MW
Russell City Energy Center	615 MW
Sunrise Power Project	586 MW
Tracy Combined Cycle	336 MW

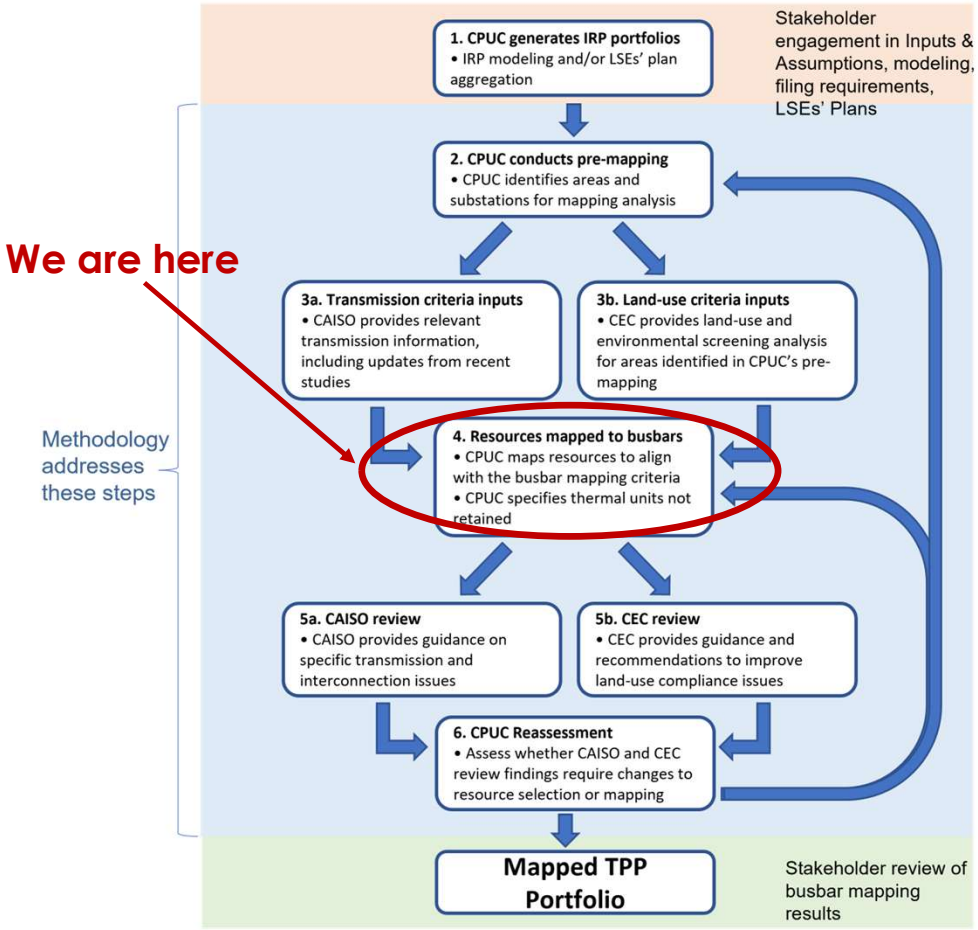
[1] https://sccs.stanford.edu/california-projects/opportunities-and-challenges-for-CCS-in-California

In-state Land-use and Environmental Analysis (CEC Presentation)

Preliminary Mapping Results

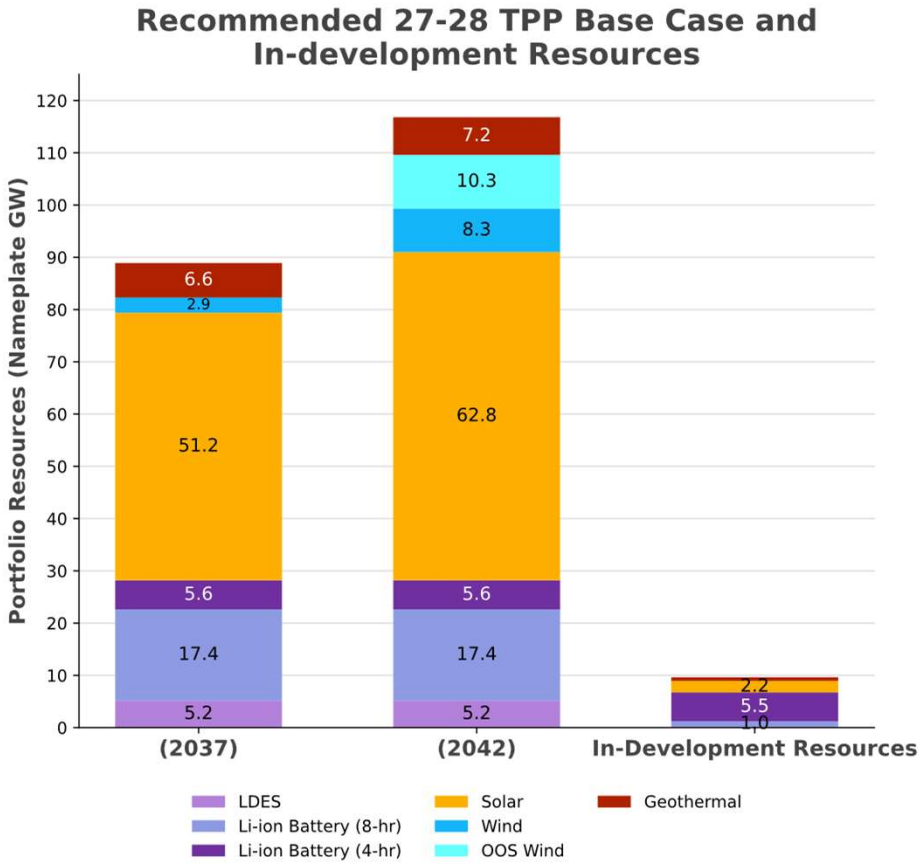
Preliminary Mapping – Point in the mapping process

- These are first draft mapping results of the base case portfolio
  - These results are undergoing review by the busbar mapping group and typically undergo several rounds of remapping.
- During the review and additional rounds of mapping, staff will work to
  - Assess the locations with non-alignments for potential remapping,
  - Conduct further analysis for interconnection information, commercial interest, environmental impacts, and import details for out-of-state resources,
  - Optimize existing transmission and effective upgrade utilization, and
  - Incorporate stakeholder feedback.
- This section will be a high-level overview of these initial mapping results
  - Full mapping details are in the mapping dashboard at the CPUC webpage: [Assumptions for the 2027-2028 TPP]



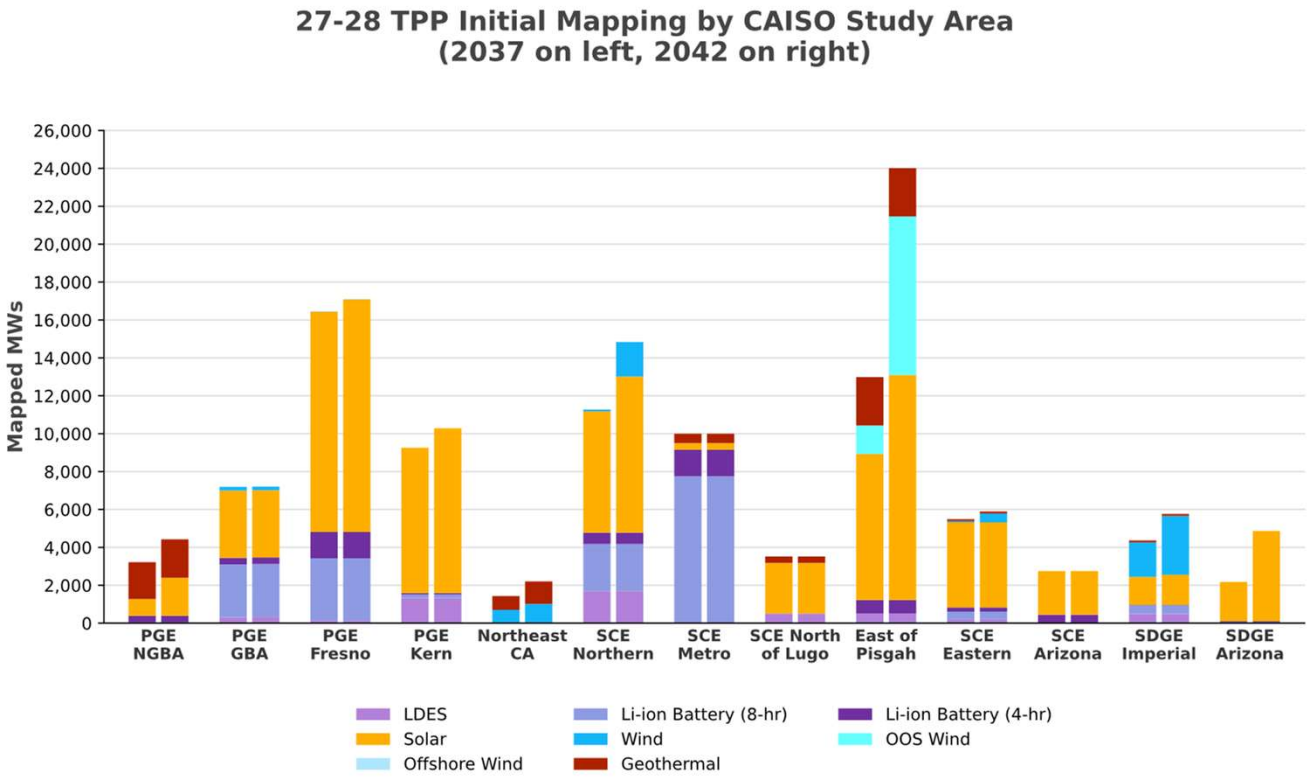
Preliminary Mapping – Baseline Reconciliation & In-development Resources

- Staff identified nearly 10 GW of in-development resources not in the IRP modeling baseline.
  - These incremental resources were mapped faithfully at their interconnection points and at their reported capacities.
- Note that in this cycle there were more incremental 4-hr batteries than in the selected portfolio.
  - To address this issue:
    - All in-dev 4-hr batteries were mapped.
    - No selected 4-hr batteries were mapped.
    - Half the delta between the in-dev 4-hr and the selected 4-hr was subtracted from selected 8-hr.
    - E.x.
      - If 100MW selected 4-hr, 120MW in-dev 4-hr, 100MW selected 8-hr ---> 120MW would be mapped 4-hr, 90MW would be mapped 8-hr (90=100-[120-100]/2).
  - This approach is consistent with what was done in the 26-27 TPP for the same issue and accounts for the delta between the mapped and selected portfolios.



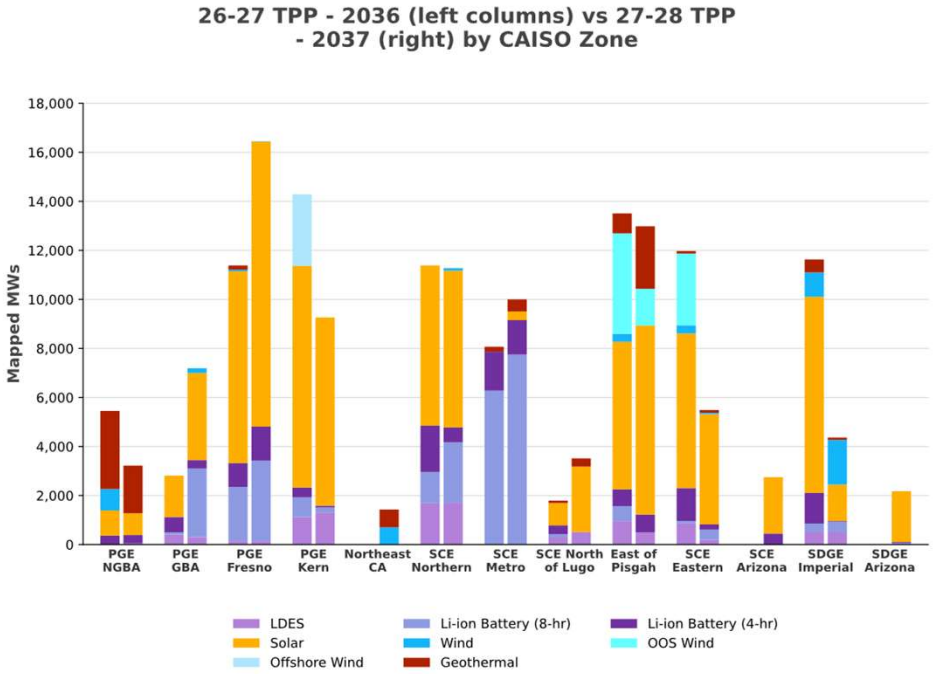
Preliminary Mapping Results Summary by CAISO study area

- Chart depicts the 2037 and 2042 initial mapping results by CAISO transmission study area.
- Out-of-CAISO resources are included at the substation nearest to their likely import point.
  - More detail on these assumed intertie points can be found on "Out-of-CAISO_Summary" tab in the Base Case Dashboard.



Preliminary Mapping Recommended Base Case (2037): Consistency with 26-27 TPP Base Case (2036)

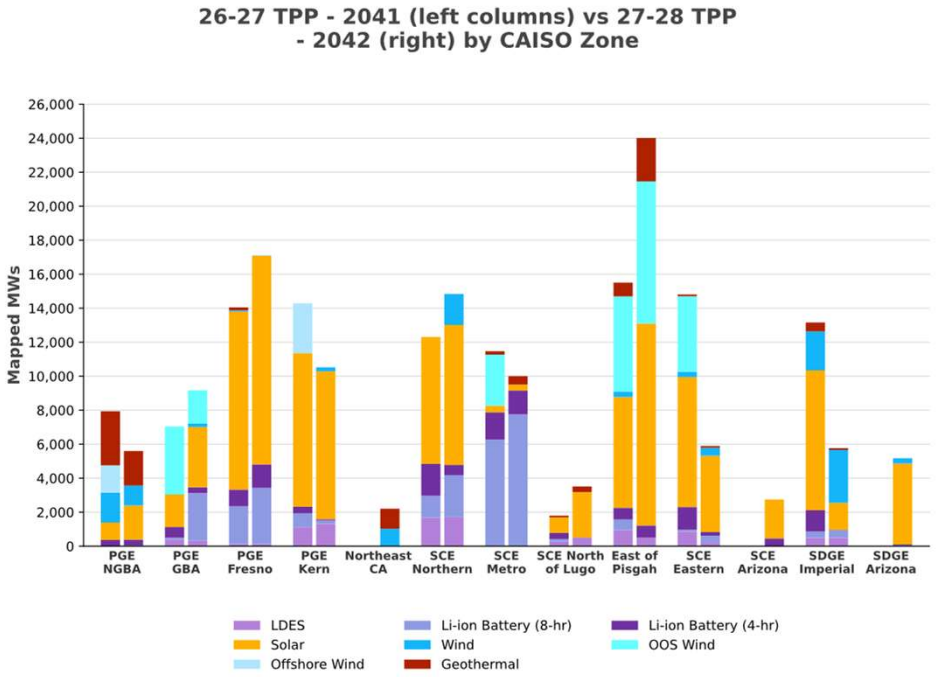
- Chart depicts the 2037 mapping results by CAISO transmission study zone compared to the 26-27 TPP (2036) mapped resources.
- 2037 portfolio size is ~91 GW, compared to ~92 GW in 26-27 TPP base case's 2036 portfolio.
- Increased granularity showing Northeast CA, SCE Arizona, SDGE Arizona as study zones in RESOLVE.
- More detail on this can be found in the "Summary_ byCAISO_zone" tab in the Base Case Dashboard



Left Column for each area is the 26-27 TPP (2036) amounts; Right Column is the initial 27-28 TPP (2037) amounts.

Preliminary Mapping Recommended Base Case (2042): Consistency with 26-27 TPP Base Case (2041)

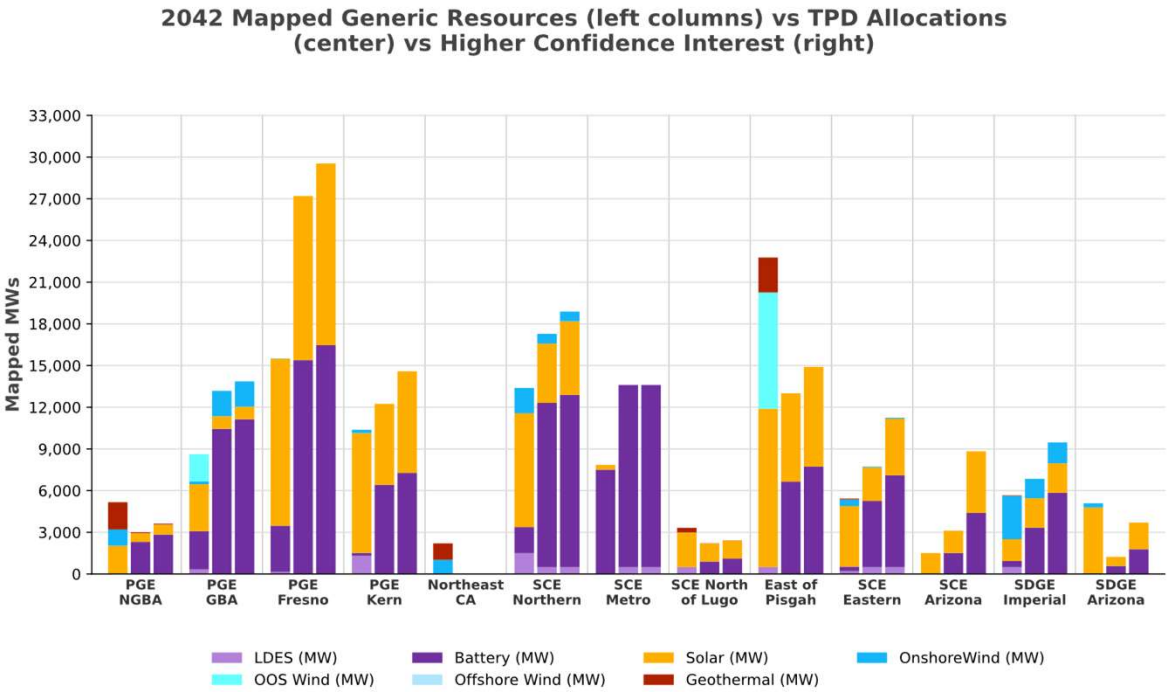
- Chart depicts the 2042 mapping results by CAISO transmission study zone compared to the 26-27 TPP (2041) mapped resources.
- 2042 portfolio size is ~117 GW, compared to ~112 GW in 26-27 TPP base case's 2041 portfolio.
- More detail on this can be found in the "Summary_ byCAISO_zone" tab in the Base Case Dashboard



Left Column for each area is the 26-27 TPP (2041) amounts; Right Column is the initial 27-28 TPP (2042) amounts.

Commercial Development Interest Alignment

- Chart below shows the 2042 mapped generic resources by CAISO study area compared to Transmission Plan Deliverability (TPD) Allocations compared to higher confidence commercial interest
  - Key divergence with commercial interest in nearly all regions is large amount of storage (high confidence interest) compared to amount in the portfolio and mapped.
  - Whereas there is less wind and geothermal in the interconnection queues than in the portfolio.
- More detail on commercial development interest can be found on the "CI_Analysis" tab in the Base Case Dashboard.



Land-Use and Env. Impacts Alignment – Solar (MWs)

- Chart depicts the 2042 mapping results for utility-scale solar by CAISO transmission study zone alignment with the Core Land-use Screen and other land-use criteria.
  - For OOS resources only the Core Land-Use Screen is available using the WECC dataset rather than the Core Screen, thus total numbers in certain areas may not add up to the full amount mapped.
  - Additionally, amounts include baseline resources included in calculations.

2042 Portfolio Mapping	Core Land-use Screen Criteria Alignment				Parcelization Criteria Alignment - Highest Flag				Cropland Index Criteria Alignment - Highest Flag				Overdrafted Groundwater Basin		Fire Threat Criteria Alignment - Highest Flag			
Solar	1 or 2	3	4	5	1 or 2	3	4	5	1 or 2	3	4	5	In	Out	1 or 2	3	4	5
PGE Kern	3,561	5,136	-	-	8,697	-	-	-	5,645	3,053	-	-	-	8,697	8,094	604	-	-
SCE Metro	337	-	-	14	-	111	-	226	337	-	-	-	-	351	81	270	-	-
SCE Eastern	1,239	2,371	882	-	2,261	2,230	-	-	3,610	-	882	-	-	4,492	2,261	1,203	-	1,027
PGE GBA	1,409	158	1,981	-	3,543	-	-	-	1,563	1,981	-	-	-	3,548	1,098	2,357	-	93
PGE Fresno	9,652	370	2,249	-	12,271	-	-	-	10,022	2,249	-	-	-	12,271	8,978	3,294	-	-
SDGE Imperial	325	1,258	-	-	1,170	290	15	108	433	1,150	-	-	-	1,591	1,438	-	-	153
SCE Northern	6,432	1,787	-	-	769	362	870	6,218	8,219	-	-	-	-	8,239	5,715	2,312	-	212
PGE NGBA	884	1,121	-	-	1,968	38	-	-	2,005	-	-	-	-	2,005	1,379	518	-	108
SCE NOL	1,010	700	960	-	506	3	700	487	1,696	-	-	-	-	2,670	2,670	-	-	-
SCE EOP	4,542	7,338	-	-	-	-	-	-	-	-	-	-	-	11,880	11,880	-	-	-
SCE Arizona	2,300	-	-	-	-	-	-	-	-	-	-	-	-	2,300	2,300	-	-	-
SDGE Arizona	4,261	500	-	-	-	-	-	-	-	-	-	-	-	4,761	4,761	-	-	-
Northeast CA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**35,953**	**20,739**	**6,072**	**14**	**31,186**	**3,034**	**1,586**	**7,039**	**33,530**	**8,433**	**882**	**-**	**-**	**62,806**	**50,655**	**10,558**	**-**	**1,593**

Environmental Impacts Alignment – Solar (MWs)

- Chart depicts the 2042 mapping results by CAISO transmission study zone alignment with the various Environmental (Conservation and Biodiversity) criteria.

2042 Portfolio Mapping	ACE Connectivity Criteria Alignment - Highest Flag				ACE Biodiversity Criteria Alignment - Highest Flag				ACE Irreplaceability Criteria Alignment - Highest Flag				All ACE Criteria Alignment - Highest Flag				Intactness Criteria Alignment - Highest Flag				Wetlands Criteria Alignment - Highest Flag			
Solar	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**
PGE Kern	8,499	198	-	-	8,697	-	-	-	8,697	-	-	-	8,276	421	-	-	8,697	-	-	-	8,697	-	-	-
SCE Metro	337	-	-	-	337	-	-	-	337	-	-	-	226	111	-	-	337	-	-	-	337	-	-	-
SCE Eastern	4,492	-	-	-	4,492	-	-	-	4,492	-	-	-	3,812	680	-	-	4,492	-	-	-	4,492	-	-	-
PGE GBA	3,385	158	-	-	3,543	-	-	-	3,542	1	-	-	3,002	542	-	-	3,543	-	-	-	3,543	-	-	-
PGE Fresno	12,242	29	-	-	12,271	-	-	-	12,271	-	-	-	9,993	2,279	-	-	12,271	-	-	-	12,271	-	-	-
SDGE Imperial	1,583	-	-	-	1,582	-	2	-	1,582	2	-	-	1,458	123	2	-	1,583	-	-	-	1,583	-	-	-
SCE Northern	8,219	-	-	-	8,219	-	-	-	8,219	-	-	-	5,930	2,289	-	-	8,219	-	-	-	8,219	-	-	-
PGE NGBA	2,005	-	-	-	2,005	-	-	-	1,992	13	-	-	1,840	166	-	-	2,005	-	-	-	2,005	-	-	-
SCE NOL	1,693	3	-	-	1,696	-	-	-	1,696	-	-	-	1,693	3	-	-	996	700	-	-	1,696	-	-	-
SCE EOP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCE Arizona	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SDGE Arizona	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeast CA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**42,457**	**388**	**-**	**-**	**42,843**	**-**	**2**	**-**	**42,829**	**16**	**-**	**-**	**36,229**	**6,614**	**2**	**-**	**42,145**	**700**	**-**	**-**	**42,845**	**-**	**-**	**-**

Land-Use and Env. Impacts Alignment – Wind (MWs)

- Chart depicts the 2042 mapping results by CAISO transmission study zone alignment with the various Land-use and Environmental Impacts criteria.
  - OOS resources use WECC Risk Class 3

2042 Portfolio Mapping	Core Land-use Screen Criteria Alignment				Overdrafted Groundwater Basin		Fire Threat Criteria Alignment - Highest Flag				Intactness Criteria Alignment - Highest Flag				Wetlands Criteria Alignment - Highest Flag			
Wind	**1 or 2**	**3**	**4**	**5**	**In**	**Out**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**
PGE Kern	-	-	30	307			-	-	-	337	-	30	258	49	288	-	-	49
SCE Metro	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
SCE Eastern	60	-	-	-			-	60	-	-	60	-	-	-	60	-	-	-
PGE GBA	-	-	-	1,966			-	-	-	1,966	-	-	-	1,966	-	-	-	1,966
PGE Fresno	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
SDGE Imperial	193	37	163	2,716			216	-	2,206	688	258	135	511	2,206	393	511	-	2,206
SCE Northern	1,188	716	-	-			425	1,184	252	44	1,904	-	-	-	1,904	-	-	-
PGE NGBA	19	-	12	1,111			1,013	-	-	158	31	47	252	812	330	-	51	761
SCE NOL	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
SCE EOP	-	-	-	5,759			5,759	-	-	2,600	-	-	-	-	-	-	-	-
SCE Arizona	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-	-
SDGE Arizona	-	-	-	305			305	-	-	-	-	-	-	-	-	-	-	-
Northeast CA	-	315	-	700			-	-	-	1,015	-	315	700	-	1,015	-	-	-
Total	**1,459**	**1,068**	**205**	**12,864**	**-**	**-**	**7,717**	**1,244**	**2,457**	**6,807**	**2,252**	**527**	**1,721**	**5,032**	**3,990**	**511**	**51**	**4,981**

Environmental Impacts Alignment - Wind (MWs)

- Further focus on land use/environmental impacts on for potential mapping adjustments:
  - PG&E, especially in North of Greater Bay Area and Kern (Wind)
  - SCE EOP (Wind)
  - SCE Northern (Solar)
- Stakeholders should note at this stage busbar mapping has not yet been finalized.

2042 Portfolio Mapping	ACE Connectivity Criteria Alignment - Highest Flag				ACE Biodiversity Criteria Alignment - Highest Flag				ACE Irreplaceability Criteria Alignment - Highest Flag				All ACE Criteria Alignment - Highest Flag			
Wind	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**	**1 or 2**	**3**	**4**	**5**
PGE Kern	30	27	-	280	288	-	-	49	288	-	-	49	-	57	-	280
SCE Metro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCE Eastern	60	-	-	-	60	-	-	-	60	-	-	-	60	-	-	-
PGE GBA	-	-	-	1,966	-	-	-	1,966	-	-	-	1,966	-	-	-	1,966
PGE Fresno	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SDGE Imperial	393	511	-	2,206	365	539	-	2,206	365	28	511	2,206	365	28	511	2,206
SCE Northern	1,904	-	-	-	1,904	-	-	-	1,904	-	-	-	1,096	808	-	-
PGE NGBA	78	252	-	812	78	303	-	761	78	303	-	761	19	59	252	812
SCE NOL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCE EOP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCE Arizona	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SDGE Arizona	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northeast CA	315	700	-	-	1,015	-	-	-	1,015	-	-	-	315	700	-	-
Total	**2,780**	**1,490**	**-**	**5,263**	**3,710**	**841**	**-**	**4,981**	**3,710**	**331**	**511**	**4,981**	**1,854**	**1,652**	**763**	**5,263**

Transmission Constraint Exceedances Impacts (2037)

- Chart depicts the CAISO Tx constraint exceedances calculated from the 2037 initial mapping.
  - 17 exceedances in total
- For comparison, RESOLVE modelling triggered 13 new partial transmission upgrades.
- Key areas of exceedances:
  - SCE EOP
  - Key out-of-CAISO import areas: SCE Eastern area connection to IID and North of Lugo area
- Several exceedances triggered with in-development resources.

Recommended Base Case Tx Constraint Exceedances, 2037						
			FCDS Resources Mapped		FCDS Upgrade Info	
CAISO Study Area	Constraint Name	On-Peak Capability (MW)	FCDS (HSN) Mapped Resources (MW)	FCDS Exceedance	Capability Increase (MW)	Estimated Cost (millions)
SCE Northern	Windhub Area Deliverability Constraint	775	2,967	2,192	2500	612
SCE Northern	Moorpark-Pardee Area Deliverability Constraint	849	850	1	900	600
SCE NOL	Control to Inyokern Constraint	0	21	21	186	329
SCE NOL	Calcite to Lugo Area Constraint	541	345	(196)	1046	239
SCE Eastern	Colorado River 500/230 kV Area Deliverability Constraint	346	476	130	1370	67
SCE Eastern	DCRT Area Deliverability Constraint	1850	2,934	1,084	3000	463
SCE Eastern	Devers-Red Bluff Area Deliverability Constraint	4903	9,739	4,836	N/A	N/A
SCE Eastern	Eagle Mountain Area Deliverability Constraint	0	106	106	600	1182
SCE Eastern	Serrano-Alberhill-Valley Area Deliverability Constraint	5581	9,967	4,386	N/A	N/A
SCE EOP	Sloan Canyon - Eldorado Area Constraint	3153	7,354	4,201	1180	N/A
SCE EOP	Lugo – Victorville Area Deliverability Constraint	3259	16,712	13,453	5410	N/A
SCE EOP	Eldorado - McCullough Constraint	4773	9,048	4,275	1180	N/A
SDGE	Chicarita 138 kV Deliverability Constraints	224	300	76	700	100
SDGE	Silvergate-Old Town 230 kV Deliverability Constraints	1276	3,467	2,191	N/A	N/A
PGE GBA	Bellota Area Constraint	0	211	211	196	18
PGE Fresno	Gregg 230 kV Area Constraint	0	163	163	1302	3
PGE Kern	Gates-Arco-Midway 230 kV Area Constraint	1568	2,749	1,181	7067	270

N/A = information not currently available

Transmission Constraint Exceedances Impacts (2042)

- Chart depicts the Tx constraint exceedances calculated from the 2042 initial mapping.
  - 21 exceedances in total
- For comparison, RESOLVE modeling triggered 17 new full or partial transmission upgrades
- 2042 mapping increases the exceedances of the 2037 results and expands the number exceedances
- Exceedances will be further assessed by working group.
  - Small exceedances may not result in upgrades or have resources that likely can be remapped.

Recommended Base Case Tx Constraint Exceedances, 2042						
			FCDS Resources Mapped		FCDS Upgrade Info	
CAISO Study Area	Constraint Name	On-Peak Capability (MW)	FCDS (HSN) Mapped Resources (MW)	FCDS Exceedance	Capability Increase (MW)	Estimated Cost (millions)
SCE Northern	Vincent-Lugo Area Deliverability Constraint	7030	12,512	5,482	1500	86
SCE Northern	Windhub Area Deliverability Constraint	775	3,469	2,694	2500	612
SCE Northern	Moorpark-Pardee Area Deliverability Constraint	849	850	1	900	600
SCE NOL	Control to Inyokern Constraint	0	21	21	186	329
SCE NOL	Calcite to Lugo Area Constraint	541	345	(196)	1046	239
SCE Eastern	Colorado River 500/230 kV Area Deliverability Constraint	346	476	130	1370	67
SCE Eastern	DCRT Area Deliverability Constraint	1850	2,934	1,084	3000	463
SCE Eastern	Devers-Red Bluff Area Deliverability Constraint	4903	11,480	6,577	N/A	N/A
SCE Eastern	Eagle Mountain Area Deliverability Constraint	0	106	106	600	1182
SCE Eastern	Mira Loma-Mesa Area Deliverability Constraint	20763	45,545	24,782	N/A	N/A
SCE Eastern	Serrano-Alberhill-Valley Area Deliverability Constraint	5581	10,374	4,793	N/A	N/A
SCE EOP	GLW - VEA Area Deliverability Constraints	3706	5,679	1,973	853	N/A
SCE EOP	Sloan Canyon - Eldorado Area Constraint	3153	10,743	7,590	1180	N/A
SCE EOP	Lugo – Victorville Area Deliverability Constraint	3259	28,665	25,406	5410	N/A
SCE EOP	Eldorado - McCullough Constraint	4773	19,216	14,443	1180	N/A
SDGE	Chicarita 138 kV Deliverability Constraints	224	300	76	700	100
SDGE	Silvergate-Old Town 230 kV Deliverability Constraints	1276	4,621	3,345	N/A	N/A
PGE NGBA	Collinsville-Tesla 500 kV Area Constraint	4198	6,170	1,972	1599	122
PGE GBA	Bellota Area Constraint	0	211	211	196	18
PGE Fresno	Gregg 230 kV Area Constraint	0	163	163	1302	3
PGE Kern	Gates-Arco-Midway 230 kV Area Constraint	1568	2,799	1,231	7067	270

N/A = information not currently available

Study area focus – North of GB and GB Areas

- Summary of initial mapping to the two Northern California study areas
  - Includes comparison of 26-27 TPP to current 27-28 TPP
- Key mapping considerations working group continues to assess:
  - Wind resources land-use implications
  - Geothermal mapping contributing to exceedances
- Notes:
  - Wyoming wind mapped as interconnecting in 2042 to the Tesla area
  - OOS NF EGS and geothermal interconnecting to the Malin substation

PG&E North of Greater Bay				
PGE NGBA	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	2,309	2,394	2,277	2,277
Biomass	3	3	-	-
Wind	-	1,171	-	605
Offshore Wind	-	-	-	1,607
Distributed Solar	-	-	18	18
Solar	886	2,005	1,278	1,278
Li-ion Battery 4-hr	344	344	363	363
Li-ion Battery 8-hr	-	-	-	-
LDES	45	45	-	-
Total (MW)	**3,587**	**5,962**	**3,935**	**6,147**
PG&E Greater Bay				
PGE GBA	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	-	-	-	-
Biomass	3	3	-	-
Wind	-	2,160	-	4,000
Offshore Wind	-	-	-	-
Distributed Solar	-	-	10	10
Solar	886	3,548	1,440	1,670
Li-ion Battery 4-hr	344	344	628	628
Li-ion Battery 8-hr	-	2,794	96	96
LDES	45	326	400	400
Total (MW)	**1,278**	**9,174**	**2,574**	**6,804**

Study area focus – PG&E Fresno & Kern Areas

- Summary of initial mapping to the two Central California study areas
  - Includes comparison to 26-27 TPP
- Key mapping considerations working group continues to assess:
  - Commercial interest alignment for amount of solar
  - Interactions with the Valley Clean Infrastructure Plan and Westlands Water District Interconnection Queue

PG&E Fresno				
PGE Fresno	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	-	-	170	170
Biomass	-	-	-	-
Wind	14	14	69	69
Offshore Wind	-	-	-	-
Distributed Solar	-	-	34	34
Solar	11,625	12,271	7,813	10,398
Li-ion Battery 4-hr	1,387	1,387	980	980
Li-ion Battery 8-hr	3,283	3,283	2,205	2,205
LDES	140	140	140	140
Total (MW)	**16,449**	**17,095**	**11,410**	**13,995**
PG&E Kern				
PGE Kern	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	-	-	-	-
Biomass	-	-	-	-
Wind	-	242	-	-
Offshore Wind	-	-	2,924	2,924
Distributed Solar	-	-	19	19
Solar	7,674	8,697	9,035	9,110
Li-ion Battery 4-hr	73	73	398	398
Li-ion Battery 8-hr	200	200	805	805
LDES	1,312	1,312	1,122	1,122
Total (MW)	**9,260**	**10,525**	**14,303**	**14,378**

Study area focus – Northeast California

- Summary of initial mapping to Northeast California
  - Includes comparison to 26-27 TPP
- Key mapping considerations working group continues to assess:
  - Wind in NE California on the 10-year timeframe that has been mapped for several previous cycles, at Madeline and Leavitt substations
  - Locations of conventional Geothermal, Deep EGS, and NF EGS, currently mapped to Hilltop substation

Northeast CA				
Northeast CA	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	726	1,187	909	909
Biomass	-	-	-	-
Wind	700	1,015	873	1,148
Offshore Wind	-	-	-	-
Distributed Solar	-	-	-	-
Solar	-	-	-	-
Li-ion Battery 4-hr	-	-	-	-
Li-ion Battery 8-hr	-	-	-	-
LDES	-	-	-	-
Total (MW)	**1,426**	**2,202**	**1,782**	**2,057**

Study area focus – SCE Northern & Metro Areas

- Summary of initial mapping to the SCE Northern and Metro study areas
  - Includes comparison to 26-27 TPP
- Key mapping considerations working group continues to assess:
  - High volume of 8-hr battery added mapped to Metro area, consistent with last year
  - Large amounts of generic FCDS solar being selected in SCE Northern, consistent with last year
- Notes:
  - In-development geothermal in SCE Metro at Lugo
  - Mapped quantities are not indicative of geographically-targeted procurement needs

SCE Northern Area				
SCE Northern	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	-	-	-	-
Biomass	-	-	-	-
Wind	100	1,821	-	-
Offshore Wind	-	-	-	-
Distributed Solar	-	-	21	21
Solar	6,394	8,239	6,540	7,466
Li-ion Battery 4-hr	603	603	1,884	1,884
Li-ion Battery 8-hr	2,469	2,469	1,280	1,280
LDES	1,705	1,705	1,680	1,680
Total (MW)	**11,270**	**14,837**	**11,405**	**12,331**
SCE Metro				
SCE Metro	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	496	496	203	203
Biomass	-	-	-	-
Wind	-	-	-	3,000
Offshore Wind	-	-	-	-
Distributed Solar	-	-	5	5
Solar	351	351	720	1,120
Li-ion Battery 4-hr	1,405	1,405	1,589	1,589
Li-ion Battery 8-hr	7,747	7,747	6,277	6,277
LDES	-	-	-	-
Total (MW)	**9,999**	**9,999**	**8,793**	**12,193**

Study area focus – North of Lugo & East of Pisgah Areas

- Summary of initial mapping to the North of Lugo and East of Pisgah areas
  - Includes comparison to 26-27 TPP
- Key mapping issues working group continues to assess:
  - Transmission exceedances in both areas
  - Large quantities of OOS wind and geothermal resources leading to exceedances in EOP
- Notes:
  - OOS NF EGS connecting to Lugo in SCE NOL
  - 2 GW of NF EGS connecting at Sloan Canyon in EOP
  - OOS wind connecting at Eldorado and Harry Allen in EOP

SCE North of Lugo				
SCE NOL	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	337	337	100	100
Biomass	-	-	-	-
Wind	-	-	-	-
Offshore Wind	-	-	-	-
Distributed Solar	-	-	10	10
Solar	2,670	2,670	912	912
Li-ion Battery 4-hr	8	8	359	359
Li-ion Battery 8-hr	-	-	134	134
LDES	500	500	286	286
Total (MW)	**3,514**	**3,514**	**1,801**	**1,801**
East of Pisgah				
SCE EOP	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	2,552	2,552	815	815
Biomass	-	-	-	-
Wind	1,500	8,359	4,684	6,184
Offshore Wind	-	-	-	-
Distributed Solar	-	-	-	-
Solar	7,711	11,880	6,498	6,998
Li-ion Battery 4-hr	720	720	885	885
Li-ion Battery 8-hr	-	-	707	707
LDES	500	500	960	960
Total (MW)	**12,983**	**24,011**	**14,548**	**16,548**

Study area focus – SCE Eastern & SCE Arizona

- Summary of initial mapping to the SCE Eastern area
  - Includes comparison to 26-27 TPP
- Key mapping issues working group continues to assess:
  - RESOLVE selecting large amounts of solar at SCE Arizona and SCE Eastern subs (example: Cielo Azul)
  - Commercial interest alignment for large amount of higher confidence storage and solar
  - Exceedances are being driven by large quantities of OOS resources and in-development resources
- Notes:
  - Approximately 3 GW of OOS wind now in baseline at Palo Verde in SCE AZ

SCE Eastern				
SCE Eastern	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	106	106	100	100
Biomass	-	-	-	-
Wind	60	467	60	60
Offshore Wind	-	-	-	-
Distributed Solar	-	-	-	-
Solar	4,492	4,492	2,635	3,965
Li-ion Battery 4-hr	215	215	670	670
Li-ion Battery 8-hr	412	412	-	-
LDES	200	200	860	860
Total (MW)	**5,485**	**5,892**	**4,325**	**5,655**
SCE Arizona				
SCE Arizona	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	-	-	-	-
Biomass	-	-	-	-
Wind	-	-	2,936	4,436
Offshore Wind	-	-	-	-
Distributed Solar	-	-	-	-
Solar	2,300	2,300	2,475	2,475
Li-ion Battery 4-hr	450	450	472	472
Li-ion Battery 8-hr	-	-	-	-
LDES	-	-	-	-
Total (MW)	**2,750**	**2,750**	**5,883**	**7,383**

Study area focus – SDG&E & SDG&E Arizona

- Summary of initial mapping to SDG&E area
  - Includes comparison to 26-27 TPP
- Key mapping takeaways:
  - Solar has been remapped from SCE to relieve constraints, match high-quality commercial interest, and better align with last year's mapping
  - The Baja wind resources at ECO are mapped fully as well as projects at Suncrest-Ocotillo
  - LDES is mapped largely in accordance with last cycle's reservations, corresponding to known PSH and A-CAES projects
  - SDGE Imperial wind land use implications

SDG&E				
SDGE Imperial	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	100	100	530	530
Biomass	-	-	-	-
Wind	1,821	3,109	990	2,290
Offshore Wind	-	-	-	-
Distributed Solar	-	-	-	-
Solar	1,483	1,591	2,424	2,424
Li-ion Battery 4-hr	27	27	869	869
Li-ion Battery 8-hr	433	433	50	50
LDES	500	500	500	500
Total (MW)	**4,365**	**5,761**	**5,363**	**6,663**
SDGE Arizona				
SDGE Arizona	**Total Res**	**Total Res**	**26-27 TPP**	**26-27 TPP**
Resource Type	**2037**	**2042**	**2036**	**2041**
Geothermal	-	-	-	-
Biomass	-	-	-	-
Wind	-	305	-	-
Offshore Wind	-	-	-	-
Distributed Solar	-	-	-	-
Solar	2,070	4,761	5,576	5,806
Li-ion Battery 4-hr	43	43	383	383
Li-ion Battery 8-hr	61	61	307	307
LDES	-	-	-	-
Total (MW)	**2,173**	**5,169**	**6,265**	**6,495**

Mapping of the Recommended Sensitivity Portfolios

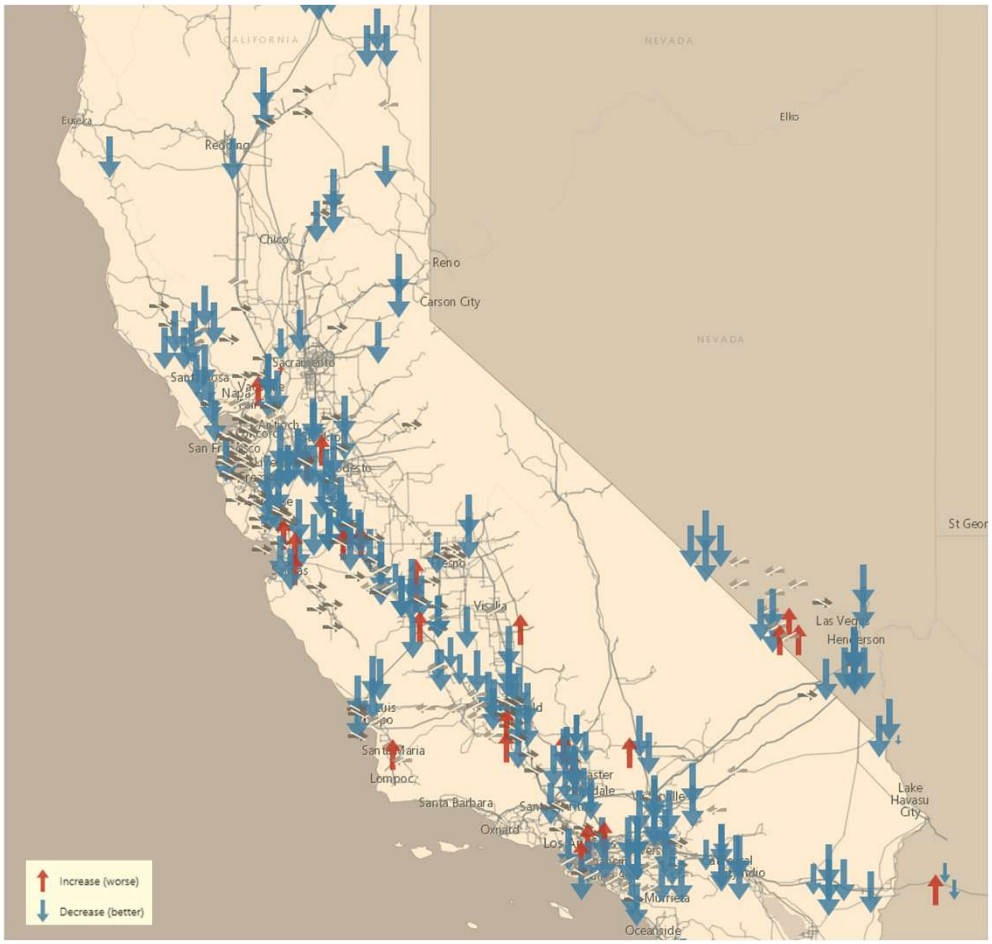
- Released mapping results are only for the base case portfolio
- Mapping of a sensitivity portfolio will be released with the Proposed Decision
  - Mapping is guided by base case mapping where resources align.
  - Same datasets and analysis will be applied.

Next Steps

- Busbar working group staff will continue to conduct mapping:
  - Use additional rounds of mapping to improve mapping alignment and incorporate additional data and feedback.
  - Conduct full mapping of a proposed sensitivity case.
- Comments received in response to August 31st, 2026 Ruling will inform possible portfolio changes.
- IRP staff are still in process of incorporating stakeholder feedback into the mapping efforts.
- Stakeholders have the opportunity to provide written comments on the initial mapping results by November 2nd, 2026 in response to the October 12th, 2026 Ruling.
- *Webinar slides* will be available at the **Assumptions for the 2027-2028 TPP** webpage.
- The webinar is being recorded; the recording and the webinar's Q&A will be posted online to the same webpage.

Input from Stakeholders

- Please weigh in on the Study Area Focus slides that focus on key mapping issues that the Busbar Mapping Working Group continues to assess.
- Staff continue to welcome input on more general process and accessibility improvement opportunities.



Internal GIS analysis tool: example here indicates the change in commercial interest criterion alignment, comparing the pre-mapped RESOLVE recommended base case with the preliminary mapping of the recommended base case

Thank You!

Please reach out to sierra.withers@cpuc.ca.gov or kaj.peterson@cpuc.ca.gov with any questions.