Agenda
Unified Planning Assumptions & Study Plan

Isabella Nicosia
Stakeholder Engagement and Policy Specialist

2021-2022 Transmission Planning Process Stakeholder Meeting
February 25, 2021

2021-2022 Transmission Planning Process Stakeholder Meeting - Agenda

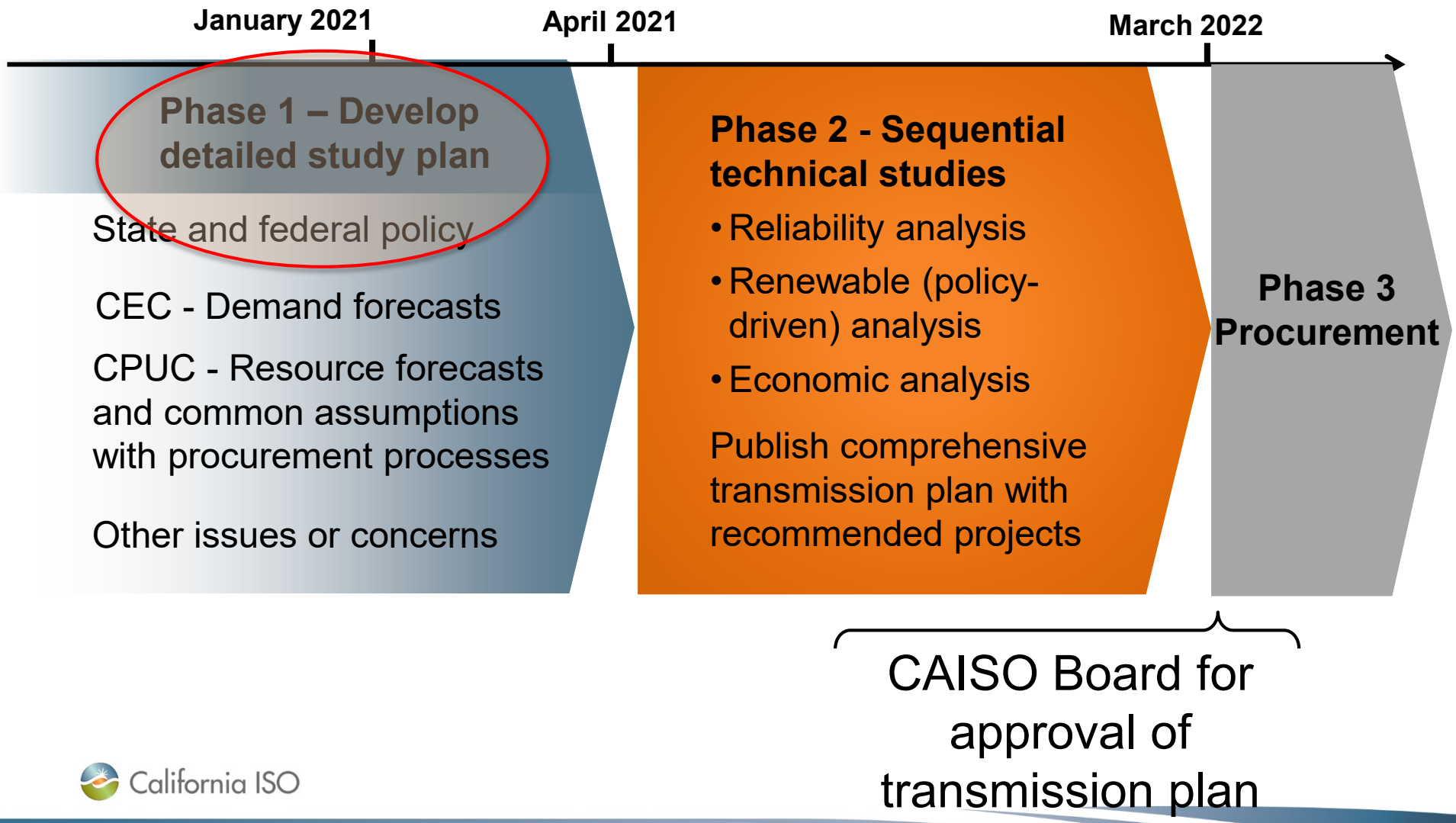
Topic	Presenter
Introduction	Isabella Nicosia
Overview & Key Issues	Jeff Billinton
Reliability Assessment	Abhishek Singh
Policy Assessment	Nebiyu Yimer
Economic Assessment	Yi Zhang
Wildfire Assessment	Robert Sparks
Frequency Response	Ebrahim Rahimi
Wrap-up & Next Steps	Isabella Nicosia

Overview
Unified Planning Assumptions & Study Plan

Jeff Billinton
Director, Transmission Infrastructure Planning

2021-2022 Transmission Planning Process Stakeholder Meeting
February 25, 2021

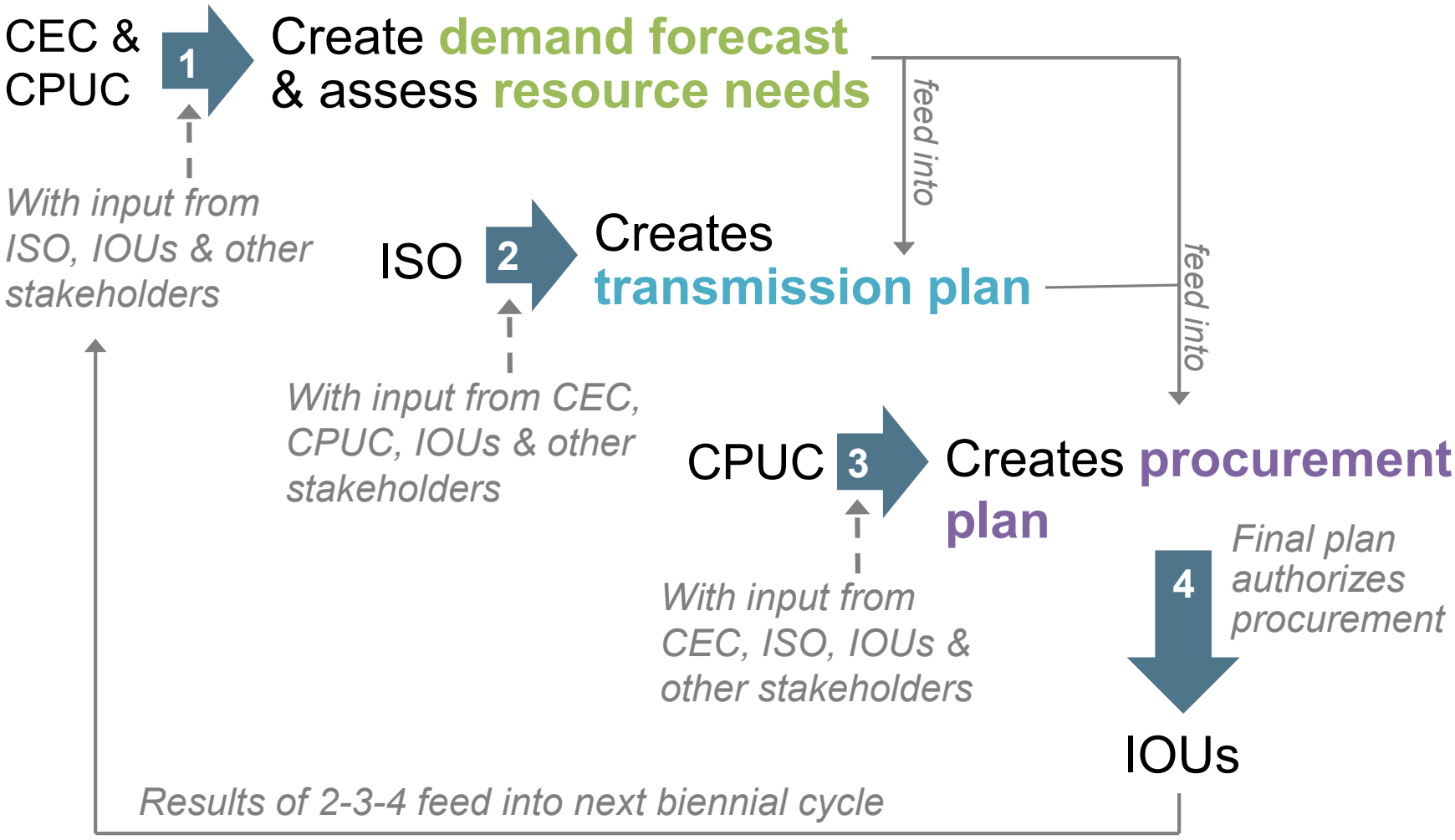
2021-2022 Transmission Planning Process



2021-2022 Transmission Plan Milestones

- Draft Study Plan posted on February 18
- Stakeholder meeting on Draft Study Plan on February 25
- Comments to be submitted by March 11
- Final Study Plan to be posted on March 31
- Preliminary reliability study results to be posted on August 13
- Stakeholder meeting on September 27 and 28
- Comments to be submitted by October 12
- Request window closes October 15
- Preliminary policy and economic study results on November 18
- Comments to be submitted by December 6
- Draft transmission plan to be posted on January 31, 2022
- Stakeholder meeting in February
- Comments to be submitted within two weeks after stakeholder meeting
- Revised draft for approval at March Board of Governor meeting

Planning and procurement overview

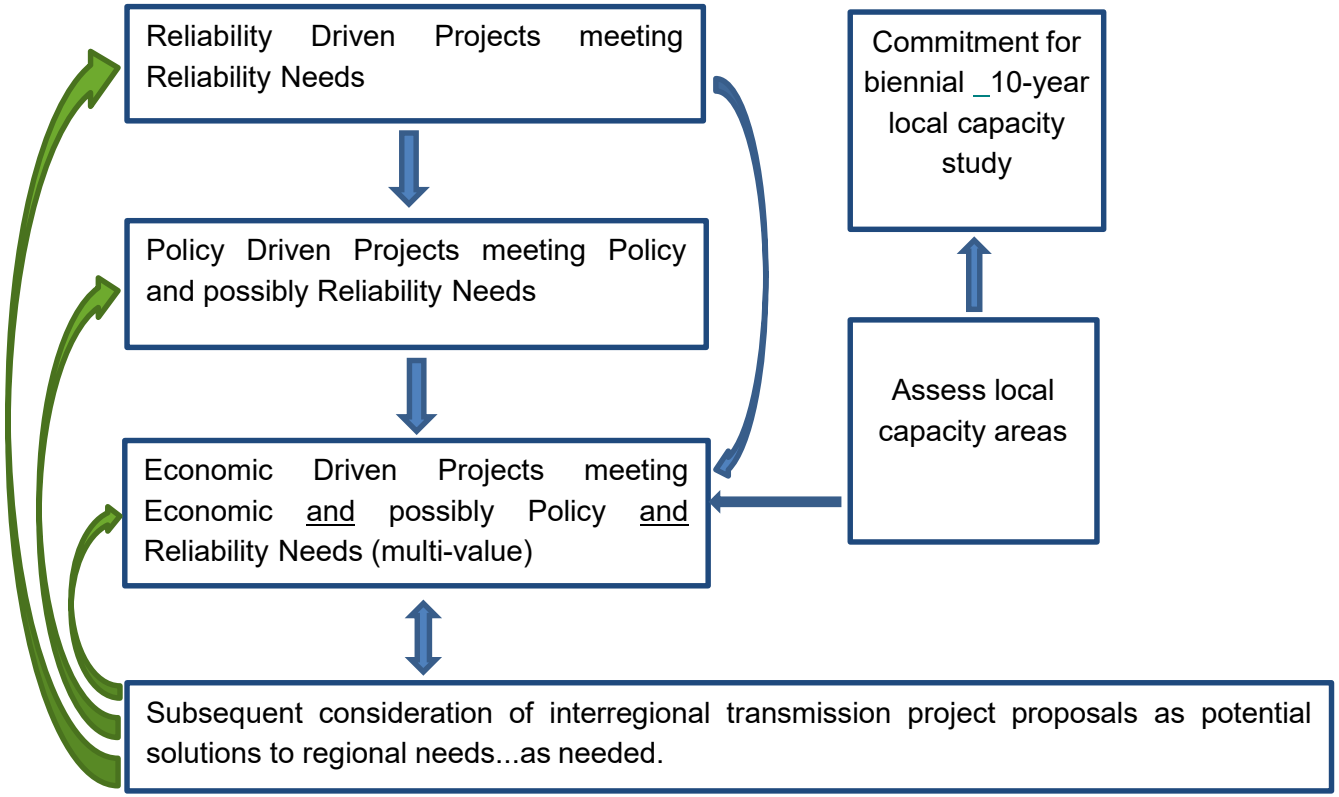


California ISO

Key Issues in 2021-2022 Transmission Plan Cycle:

- CAISO will incorporate renewable portfolios from the CPUC
  - Baseline portfolio
    - Reliability, Policy and Economic Assessments
  - Sensitivity portfolios
    - Policy Assessment

Studies are coordinated as a part of the transmission planning process



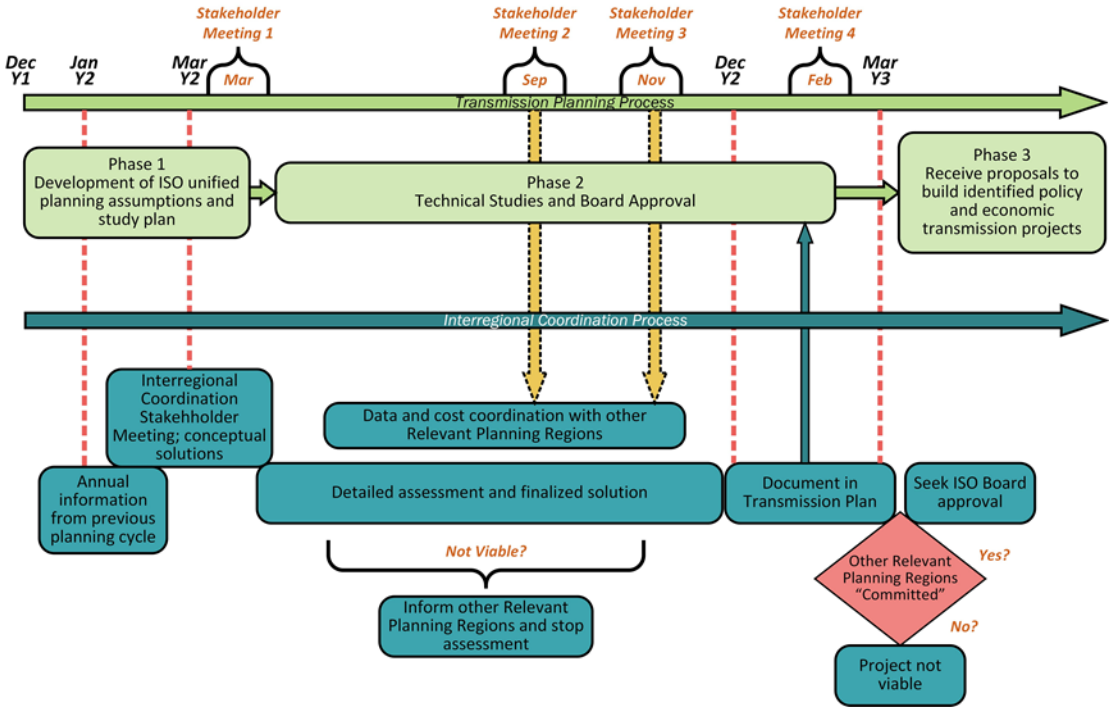
2021-2022 Transmission Plan Study Plan

- Reliability Assessment to identify reliability-driven needs
- Policy Assessment to identify policy-driven needs
- Economic Planning Study to identify needed economically-driven elements
- Interregional Transmission Planning Process
  - In year two (odd year) of 2 year planning cycle
- Other Studies
  - Long-term Congestion Revenue Rights
  - Frequency response
  - Flexible deliverable capacity
    - Considering biennial assessment
  - Wildfire Assessment – Southern California

Interregional Transmission Coordination - Year 2 of 2

- Participate in a western planning regions' stakeholder meeting; and
- Based on the assessment of ITP in the previous year's TPP cycle, the CAISO determines whether to further evaluate the project during the odd year of the planning cycle. The 2020-2021 TPP did not identify a need for any of the ITP's submitted to the CAISO during its open window. As such, no further consideration of the ITPs will occur during the 2021-2022 TPP.

Year 1 (Even Year) - Interregional Coordination Process



http://www.caiso.com/planning/Pages/InterregionalTransmissionCoordination/default.aspx

Study Information

- Final Study Plan will be posted on 2020-2021 transmission planning process webpage on March 31st
  http://www.caiso.com/planning/Pages/TransmissionPlanning/2020-2021TransmissionPlanningProcess.aspx

- Base cases will be posted on the Market Participant Portal (MPP)
  - For reliability assessment in Q3

- Market notices will be posted in the Daily Briefings to notify stakeholders of meetings and any relevant information
  http://www.caiso.com/dailybriefing/Pages/default.aspx

Stakeholder comments

- Stakeholders requested to submit comments to: regionaltransmission@caiso.com
  - Economic study requests are to be submitted with comments.

- Stakeholder comments are to be submitted within two weeks after stakeholder meetings: **by March 11**

- CAISO will post comments and responses on website

Reliability Assessment
Unified Planning Assumptions & Study Plan

Abhishek Singh

2021-2022 Transmission Planning Process Stakeholder Meeting
February 25, 2021

Planning Assumptions

- Reliability Standards and Criteria
  - California ISO Planning Standards
  - NERC Reliability Criteria
    - TPL-001-5
      - Modified category P5 & R2.4.5 will not be implemented in this cycle
    - NUC-001-3
  - WECC Regional Criteria
    - TPL-001-WECC-CRT-3.2

Planning Assumptions
(continued)

- Study Horizon
  - 10 years planning horizon
    - near-term: 2023 to 2026
    - longer-term: 2027 to 2031

- Study Years
    - near-term: 2023 and 2026
    - longer-term: 2031

Study Areas

- **Northern Area - Bulk**
- **PG&E Local Areas:**
  - Humboldt area
  - North Coast and North Bay area
  - North Valley area
  - Central Valley area
  - Greater Bay area:
  - Greater Fresno area;
  - Kern area;
  - Central Coast and Los Padres areas.
- **Southern Area – Bulk**
- **SCE local areas:**
  - Tehachapi and Big Creek Corridor
  - North of Lugo area
  - East of Lugo area;
  - Eastern area; and
  - Metro area
- **SDG&E area**
  - Bulk transmission
  - Sub-transmission
- **Valley Electric Association area**
- **ISO combined bulk system**

Use of Past Studies

- CAISO will continue to evaluate areas known to have no major changes compared to assumptions made in prior planning cycles for potential use of past studies. (TPL-R2.6)
- At a high level, the process will include three major steps :
  - Data collection
  - Evaluation of data change
  - Drawing conclusions based on judgment and evaluation collection
- Data collection and evaluation of extent of change will include following major categories:
  - Transmission data
  - Generation data
  - Load data
  - Applicable standards

Transmission Assumptions

- Transmission Projects
  - Transmission projects that the CAISO has approved will be modeled in the study base case
  - Canceled and on-hold projects will not be modeled
- Reactive Resources
  - Existing and planned reactive power resources will be modeled
- Protection Systems
  - Existing and planned RAS, safety nets, UVLS & UFLS will be modeled
  - Continue to include RAS models and work with PTOs to obtain remaining RAS models.
- Control Devices
  - Existing and Planned control devices will be modeled in the studies

Load Forecast Assumptions
Energy and Demand Forecast

- California Energy Demand Updated Forecast 2020-2031 adopted by California Energy Commission (CEC) on January 25, 2021 will be used:
  - Using the Mid Baseline LSE and Balancing Authority Forecast spreadsheets
  - Additional Achievable Energy Efficiency (AAEE)
    - Consistent with CEC 2020 IEPR
    - Mid AAEE will be used for system-wide studies
    - Low AAEE will be used for local studies
  - CEC forecast information is available on the CEC website at:

https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=20-IEPR-03

Load Forecast Assumptions
Energy and Demand Forecast (continued)

- Load forecasts to be used for each of the reliability assessment studies.
  - 1-in-10 weather year, mid demand baseline case with low AAEE load forecasts will be used in PG&E, SCE, SDG&E, and VEA local area studies including the studies for the local capacity requirement (LCR) areas
  - 1-in-5 weather year, mid demand baseline case with mid AAEE load forecast will be used for bulk system studies

Load Forecast Assumptions

Methodologies to Derive Bus Level Forecast

- The CEC load forecast is generally provided for the larger areas and does not provide the granularity down to the bus-level which is necessary in the base cases for the reliability assessment

- The local area load forecast are developed at the bus-level by the participating transmission owners (PTOs) .

- Descriptions of the methodologies used by each of the PTOs to derive bus-level load forecasts using CEC data as a starting point are included in the draft Study Plan.

Load Forecast Assumptions

BTM-PV, BTM-Storage and AAEE

- Similar to previous cycles, BTM-PV will be modeled explicitly in the 2021-2022 TPP base cases.
  - Amount of the BTM-PV to be modeled will be based on 2020 IEPR data.
  - Location to model BTM-PV will be identified based on location of existing BTM-PV, information from PTO on future growth and BTM-PV capacity by forecast climate zone information from CEC.
  - Output of the BTM-PV will be selected based on the time of day of the study using the end-use load and PV shapes for the day selected.
  - Composite load model CMPLDWG will be used to model the BTM-PV. DER_A model will be used for dynamic representation of BTM-PV.
- BTM-storage will not be modeled explicitly in 2021-2022 TPP base cases due to limitation within the GE PSLF tool to model more than one distributed resources behind each load and lack of locational information.
- AAEE will be modeled using the CEC provided bus-bar allocations and will be modeled as negative load.

Supply Side Assumptions - Continued coordination with CPUC Integrated Resource Planning (IRP)

- CPUC Proposed Decision:
  https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M366/K426/366426300.PDF
  - Base portfolio (for Reliability, Policy and Economic Assessment)

- **Base portfolio** modeling assumptions to be used in 2021-2022 TPP:
  - CPUC Staff Report: Modeling Assumptions for the 2021-2022 TPP
    ftp://ftp.cpuc.ca.gov/energy/modeling/Modeling_Assumptions_2021_22_TPP_Final.pdf

Generation Assumptions

- New Generation Modeling
  - Level 1: Under construction (for Years 1-5 study case with applicable in-service dates)
  - Level 2: Regulatory approval but not yet under construction (i.e., having Power Purchase Agreement approved by the CPUC or other regulatory agencies with applicable in-service dates for Year 5)
  - Level 3: CPUC Base Portfolio generation, or planned resources in the IRP (for entity outside of California) for the 10-year study case (or for 6-10 year case with applicable in-service dates)
- Retired generation is modeled offline and disconnected in appropriate study years

Generation Assumptions

Distribution connected resources modeling

- Behind-the-meter generators: Model explicitly as component of load
- In-front-of-the-meter with resource ID: Model as individual generator
- In-front-of-the-meter without resource ID: Model as individual generator if >10 MW, aggregate <10 MW same technology

Generation Assumptions

Generation Retirements

- Nuclear Retirements
  - Diablo Canyon will be modeled off-line based on the OTC compliance date
- Once Through Cooled Retirements
  - Separate slide below for OTC assumptions
- Renewable and Hydro Retirements
  - Assumes these resource types stay online unless there is an announced retirement date.
- Other Retirements
  - Resources 40 years or older will not be assumed to be retired by default.

Generation Assumptions

OTC Generation

- Modeling based on the SWRCB's compliance schedule with the following exceptions:
  - Generating units that are repowered, replaced or have firm plans to connect to acceptable cooling technology
  - Generating units that have been approved for compliance schedule extension to meet CAISO system capacity need for 2021-2023 timeframe
  - Generating units with approved Track 2 mitigation plan

Generation Assumptions

CEC permitted resources or CPUC-approved long-term procurement resources (Thermal and Solar Thermal)

PTO Area	Project	Capacity (MW)	Expected In-service Date
SCE	Huntington Beach Energy Project Unit 6 (CCGT)	644	2020
	Alamitos Energy Center Unit 8 (CCGT)	640	2020

These projects have received PPTA approvals from the CPUC as part of Long Term Procurement Plan (LTPP) process.

Preferred Resources

- Demand Response
  - Long-term transmission expansion studies may utilize fast-response DR and slow-response PDR if it can be dispatched pre-contingency.
  - DR that can be relied upon participates, and is dispatched from, the ISO market in sufficiently less than 30 minutes (implies that programs may need 20 minutes response time to allow for other transmission operator activities) from when it is called upon
  - DR capacity will be allocated to bus-bar using the method defined in D.12-12-010, or specific bus-bar allocations provided by the IOUs.
  - The DR capacity amounts will be modeled offline in the initial reliability study cases and will be used as potential mitigation in those planning areas where reliability concerns are identified.

Preferred Resources

- Energy Storage
  - Existing, under construction and/or approved procurement status energy storage projects.
  - Behind-the-meter energy storage will be netted to load due to tool limitation

Major Path Flows and Interchange

Northern area (PG&E system) assessment

Path	Transfer Capability/SOL (MW)	Scenario in which Path will be stressed
Path 26 (N-S)	4,000	Summer Peak
PDCI (N-S)	3,220	
Path 66 (N-S)	4,800	
Path 15 (N-S)	-5,400	Spring Off Peak
Path 26 (N-S_	-3,000	
Path 66 (N-S)	-3,675	Winter Peak

Southern area (SCE & SDG&E system) assessment

Path	Transfer Capability/SOL (MW)	Near-Term Target Flows (MW)	Scenario in which Path will be stressed, if applicable
Path 26 (N-S)	4,000	4,000	Summer Peak
Path 26 (N-S)	3,000	0 to 3,000	Spring Off Peak
PDCI (N-S)	3220	3220	Summer Peak
West of River (WOR)	11,200	5,000 to 11,200	Summer Peak
East of River (EOR)	10,100	4,000 to 10,100	Summer Peak
San Diego Import	2765~3565	2,400 to 3,500	Summer Peak
SCIT	17,870	15,000 to 17,870	Summer Peak
Path 45 (N-S)	600	0 to 408	Summer Peak
Path 45 (S-N)	800	0 to 300	Spring Off Peak

Study Scenarios - *Base Scenarios*

Study Area	Near-term Planning Horizon		Long-term Planning Horizon
	2023	2026	2031
Northern California (PG&E) Bulk System	Summer Peak Spring Off-Peak	Summer Peak Spring Off-Peak	Summer Peak, Spring Off-Peak, Winter Off-Peak
Humboldt	Summer Peak, Winter Peak Spring Off-Peak	Summer Peak, Winter Peak Spring Off-Peak	Summer Peak Winter Peak
North Coast and North Bay	Summer Peak, Winter Peak Spring Off-Peak	Summer Peak, Winter Peak Spring Off-Peak	Summer Peak Winter peak
North Valley	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak
Central Valley	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak
Greater Bay Area	Summer Peak, Winter peak - (SF & Peninsula), Spring Off-Peak	Summer Peak, Winter peak - (SF & Peninsula), Spring Off-Peak	Summer Peak, Winter peak - (SF Only)
Greater Fresno	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak
Kern	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak
Central Coast & Los Padres	Summer Peak, Winter Peak Spring Off-Peak	Summer Peak, Winter Peak Spring Off-Peak	Summer Peak Winter Peak
Southern California Bulk Transmission System	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak
SCE Metro Area	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak
SCE Northern Area	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak
SCE North of Lugo Area	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak
SCE East of Lugo Area	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak
SCE Eastern Area	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak
SDG&E main transmission	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak
SDG&E sub-transmission	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak
Valley Electric Association	Summer Peak, Spring Off-Peak	Summer Peak, Spring Off-Peak	Summer Peak

Study Scenarios - *Baseline Scenarios Definition and Renewable Dispatch for System-wide Cases*

PTO	Scenario	Day/Time			BTM-PV			Transmission Connected PV			Transmission Connected Wind			% of managed peak load		
		2023	2026	2031	2023	2026	2031	2023	2026	2031	2023	2026	2031	2023	2026	2031
PG&E	Summer Peak	7/27 HE 18	See CAISO	See CAISO	21%	See CAISO	See CAISO	10%	See CAISO	See CAISO	62%	See CAISO	See CAISO	100%	See CAISO	See CAISO
PG&E	Spring Off Peak	4/26 HE 20	See CAISO	See CAISO	0%	See CAISO	See CAISO	0%	See CAISO	See CAISO	55%	See CAISO	See CAISO	71%	See CAISO	See CAISO
PG&E	Winter Off peak	N/A	N/A	11/9 HE 5	N/A	N/A	0%	N/A	N/A	0%	N/A	N/A	12%	N/A	N/A	44%
PG&E	Winter peak	12/11 HE 19	12/14 HE 19	12/9 HE 19	0%	0%	0%	0%	0%	0%	13%	13%	13%	75%	76%	77%
SCE	Summer Peak	9/5 HE 16	9/1 HE 16	9/3 HE 19	46%	46%	0%	51%	51%	0%	20%	20%	40%	100%	100%	100%
SCE	Spring Off Peak	4/26 HE 20	See CAISO	See CAISO	0%	See CAISO	See CAISO	0%	See CAISO	See CAISO	48%	See CAISO	See CAISO	65%	See CAISO	See CAISO
SDG&E	Summer Peak	9/6 HE 19	9/2 HE 19	9/4 HE 19	0%	0%	0%	0%	0%	0%	33%	33%	33%	100%	100%	100%
SDG&E	Spring Off Peak	5/23 HE 20	See CAISO	See CAISO	0%	See CAISO	N/A	0%	See CAISO	N/A	68%	See CAISO	N/A	75%	See CAISO	N/A
VEA	Summer Peak	9/5 HE 16	9/1 HE 16	9/3 HE 19	N/A	N/A	N/A	51%	51%	0%	N/A	N/A	N/A	100%	100%	100%
VEA	Spring Off Peak	4/26 HE 20	See CAISO	See CAISO	N/A	N/A	N/A	0%	See CAISO	See CAISO	N/A	N/A	N/A	65%	See CAISO	See CAISO

PTO	Scenario	Day/Time			BTM-PV			Transmission Connected PV			Transmission Connected Wind			% of non-coincident PTO managed peak load		
					PGE	SCE	SDGE	PGE	SCE	SDGE	PGE	SCE	SDGE	PGE	SCE	SDGE
CAISO	2031 Summer Peak	9/3 HE 19	6%	0%	0%	0%	0%	0%	42%	40%	33%	96%	100%	98%	9/3 HE 19	6%
	2031 Spring Off Peak	4/7 HE 13	79%	80%	85%	92%	94%	95%	20%	34%	30%	18%	19%	9%	4/7 HE 13	79%
	2026 Summer Peak	9/1 HE 19	6%	0%	0%	0%	0%	0%	42%	40%	33%	95%	99%	98%	9/1 HE 19	6%
	2026 Spring Off Peak	4/5 HE 13	79%	79%	86%	92%	94%	95%	20%	34%	30%	24%	23%	13%	4/5 HE 13	79%

Study Scenarios - *Sensitivity Studies*

Sensitivity Study	Near-term Planning Horizon	
	2023	2026
Summer Peak with high CEC forecasted load	-	PG&E Bulk PG&E Local Areas Southern California Bulk SCE Local Areas SDG&E Main
Off peak with heavy renewable output and minimum gas generation commitment	PG&E Bulk PG&E Local Areas Southern California Bulk SCE Local Areas SDG&E Main	-
Summer Peak with heavy renewable output and minimum gas generation commitment	PG&E Bulk PG&E Local Areas Southern California Bulk SCE Local Areas SDG&E Main	-
Summer Peak with forecasted load addition	VEA Area	VEA Area
Summer Off peak with heavy renewable output	-	VEA Area

Study Scenarios - *Sensitivity Scenario Definitions and Renewable Generation Dispatch*

PTO	Scenario	Starting Baseline Case	BTM-PV		Transmission Connected PV		Transmission Connected Wind		Comment
			Baseline	Sensitivity	Baseline	Sensitivity	Baseline	Sensitivity	
PG&E	Summer Peak with heavy renewable output and minimum gas generation commitment	2023 Summer Peak	21%	99%	10%	99%	62%	62%	Solar and wind dispatch increased to 20% exceedance values
	Off peak with heavy renewable output and minimum gas generation commitment	2023 Spring Off-peak	0%	99%	0%	99%	20%	64%	Solar and wind dispatch increased to average of 20% exceedance values
	Summer Peak with high CEC forecasted load	2026 Summer Peak	6%	6%	0%	0%	42%	42%	Load increased by turning off AAEE
SCE	Summer Peak with heavy renewable output and minimum gas generation commitment	2023 Summer Peak	46%	91%	51%	99%	20%	67%	Solar and wind dispatch increased to 20% exceedance values
	Off peak with heavy renewable output and minimum gas generation commitment	2023 Spring Off-peak	0%	91%	0%	99%	48%	67%	Solar and wind dispatch increased to 20% exceedance values
	Summer Peak with high CEC forecasted load	2026 Summer Peak	6%	6%	0%	0%	40%	40%	Load increased per CEC high load scenario
SDG&E	Summer Peak with heavy renewable output and minimum gas generation commitment	2023 Summer Peak	0%	96%	0%	96%	33%	51%	Solar and wind dispatches increased to 20% exceedance values
	Off peak with heavy renewable output and minimum gas generation commitment	2023 Spring Off-peak	0%	96%	0%	96%	68%	51%	Solar and wind dispatches increased to 20% exceedance values with net load unchanged at certain % of summer peak
	Summer Peak with high CEC forecasted load	2026 Summer Peak	0%	0%	0%	0%	33%	33%	Load increased per CEC high load scenario
VEA	Summer Peak with forecasted load addition	2023 Summer Peak			51%	51%			Load increase reflect future load service request
	Off-peak with heavy renewable output	2026 Spring Off-peak			0%	96%			Modeled active GIDAP projects in the queue
	Summer Peak with forecasted load addition	2026 Summer Peak			21%	21%			Load increase reflect future load service request

Study Base Cases

- WECC base cases will be used as the starting point to represent the rest of WECC

Study Year	Season	WECC Base Case	Year Published
2023	Summer Peak	2023 Heavy Summer 3	11/25/2020
	Winter Peak	2022-23 Heavy Winter 2	6/19/2020
	Spring Off-Peak	2021 Heavy Spring 1	4/3/2020
2026	Summer Peak	2026 Heavy Summer 2	7/31/2020
	Winter Peak	2025-26 Heavy Winter 2	9/1/2020
	Spring Off-Peak	2024 Light Spring 1	5/1/2020
2031	Summer Peak	2031 Heavy Summer 1	10/19/2020

Contingencies

- **Normal conditions (P0)**

- **Single contingency (Category P1)**
  - The assessment will consider all possible Category P1 contingencies based upon the following:
    - Loss of one generator (P1.1)
    - Loss of one transmission circuit (P1.2)
    - Loss of one transformer (P1.3)
    - Loss of one shunt device (P1.4)
    - Loss of a single pole of DC lines (P1.5)

- **Single contingency (Category P2)**
  - The assessment will consider all possible Category P2 contingencies based upon the following:
    - Loss of one transmission circuit without a fault (P2.1)
    - Loss of one bus section (P2.2)
    - Loss of one breaker (internal fault) (non-bus-tie-breaker) (P2.3)
    - Loss of one breaker (internal fault) (bus-tie-breaker) (P2.4)

Contingencies
(continued)

- **Multiple contingency (Category P3)**
  - The assessment will consider the Category P3 contingencies with the loss of a *generator unit* followed by system adjustments and the loss of the following:
    - Loss of one generator (P3.1)
    - Loss of one transmission circuit (P3.2)
    - Loss of one transformer (P3.3)
    - Loss of one shunt device (P3.4)
    - Loss of a single pole of DC lines (P3.5)

- **Multiple contingency (Category P4)**
  - The assessment will consider the Category P4 contingencies with the loss of multiple elements caused by a stuck breaker (non-bus-tie-breaker for P4.1-P4.5) attempting to clear a fault on one of the following:
    - Loss of one generator (P4.1)
    - Loss of one transmission circuit (P4.2)
    - Loss of one transformer (P4.3)
    - Loss of one shunt device (P4.4)
    - Loss of one bus section (P4.5)
    - Loss of a bus-tie-breaker (P4.6)

Contingencies
(continued)

- **Multiple contingency (Category P5)**
  - The assessment will consider the Category P5 contingencies with delayed fault clearing due to the failure of a non-redundant component of protection system protecting the faulted element to operate as designed, for one of the following:
    - Loss of one generator (P5.1)
    - Loss of one transmission circuit (P5.2)
    - Loss of one transformer (P5.3)
    - Loss of one shunt device (P5.4)
    - Loss of one bus section (P5.5)
- **Multiple contingency (Category P6)**
  - The assessment will consider the Category P6 contingencies with the loss of two or more (non-generator unit) elements with system adjustment between them, which produce the more severe system results.
- **Multiple contingency (Category P7)**
  - The assessment will consider the Category P7 contingencies for the loss of a common structure as follows:
    - Any two adjacent circuits on common structure14 (P7.1)
    - Loss of a bipolar DC lines (P7.2)

Contingency Analysis
(continued)

- **Extreme contingencies (TPL-001-5)**
  - As a part of the planning assessment the ISO assesses Extreme Event contingencies;
    - Analysis will be included in TPP if requirements drive the need for mitigation plan.

Technical Studies

- The planning assessment will consist of:
  - Power Flow Contingency Analysis
  - Post Transient Analysis
    - Post Transient Thermal Analysis
    - Post Transient Voltage Stability Analysis
      - Post Transient Voltage Deviation Analysis
      - Voltage Stability and Reactive Power Margin Analysis
  - Transient Stability Analysis

Corrective Action Plans

- ISO will identify the need for any transmission additions or upgrades required to ensure System reliability consistent with all Applicable Reliability Criteria and CAISO Planning Standards.
  - ISO in coordination with PTO and other Market Participants, shall consider lower cost alternatives to the construction of transmission additions or upgrades, such as:
    - acceleration or expansion of existing projects,
    - demand-side management,
    - special protection systems,
    - generation curtailment,
    - interruptible loads,
    - storage facilities; or
    - reactive support

Policy-driven Assessment
Unified Planning Assumptions & Study Plan

Nebiyu Yimer
Senior Advisor, Regional Transmission South

2021-2022 Transmission Planning Process Stakeholder Meeting
February 25, 2021

Agenda

- Policy-driven assessment objectives and methodology
- Description of portfolios transmitted by the CPUC
- Additional guidance from the CPUC

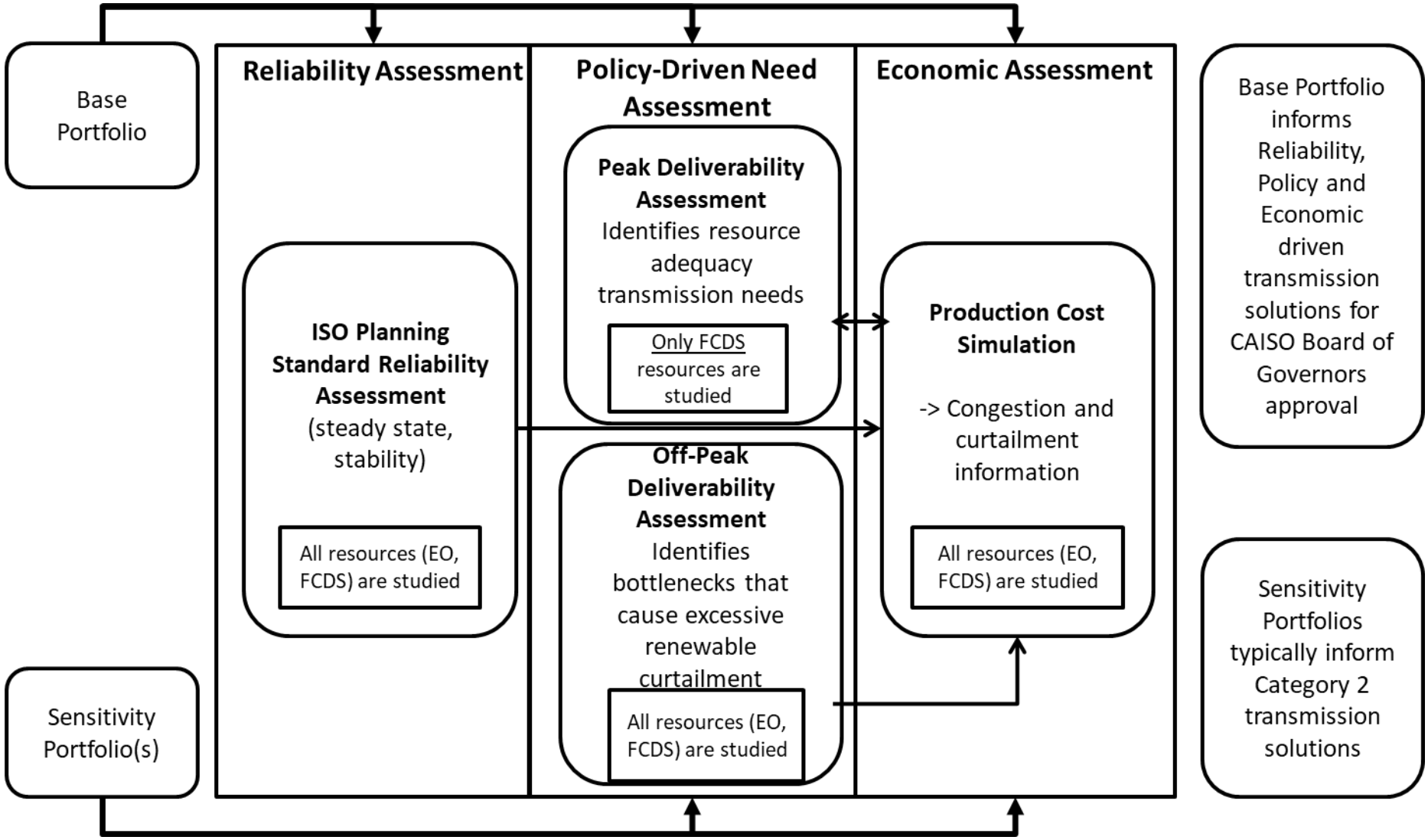
Agenda

- Policy-driven assessment objectives and methodology
- Description of portfolios transmitted by the CPUC
- Additional guidance from the CPUC

Objectives and methodology

- Overarching objective is to ensure alignment between resource planning (CPUC) and transmission planning (CAISO)
- Deliverability assessment (on-peak) supports deliverability of FCDS resources selected to meet resource adequacy needs
- Production cost simulation supports the economic delivery of renewable energy over the course of all hours of the year
- Reliability assessment and off-peak deliverability assessment are used to identify constraints for further evaluation using production cost simulation
- Assessment is used to identify transmission upgrades or other solutions needed to achieve objectives
- Transmission capability estimates used by CPUC in resource planning will be updated as part of the current TPP

Overview of the policy-driven assessment



California ISO

Agenda

- Policy-driven assessment objectives and methodology
- Description of portfolios transmitted by the CPUC
- Additional guidance from the CPUC

CPUC portfolio documentation for the 2021-2022 TPP

- CPUC decision transferring the portfolios:
  https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M366/K426/366426300.PDF

- Modeling Assumptions for the 2021-2022 Transmission Planning Process
  ftp://ftp.cpuc.ca.gov/energy/modeling/Modeling_Assumptions_2021_22_TPP_Final.pdf

- Final busbar mapping results for non-battery resources for the base and sensitivity portfolios
  https://caenergy.databasin.org/documents/documents/a618da529cd346dfa5bec12148161b71/

- Final busbar mapping results for battery storage for the base and sensitivity portfolios
  ftp://ftp.cpuc.ca.gov/energy/modeling/Battery_Mapping_Dashboard_All_Portfolios_Final.xlsx

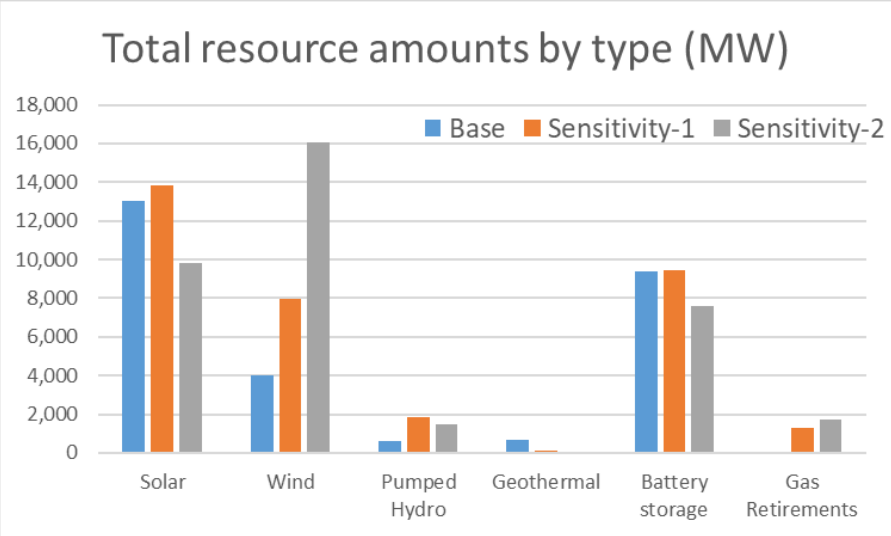
- Retirement list for the policy-driven sensitivity
  ftp://ftp.cpuc.ca.gov/energy/modeling/Retirement_List_for_Sensitivity_Portfolios.xlsx

The CPUC transmitted a base portfolio and two sensitivity portfolios for the 2021-2022 TPP

- Base Portfolio – Portfolio based on 46 MMT GHG target to be used to determine transmission investments needed
- Sensitivity-1 Portfolio – Portfolio based on 38 MMT GHG target
- Sensitivity-2 Portfolio– Offshore Wind (OSW) Portfolio based on 30 MMT GHG target intended to test the transmission needs associated with offshore wind
- CPUC provided the portfolios complete with mapping at the substation bus level for both generation and battery storage resources
- The current base portfolio includes significantly more renewables and storage resources than the base portfolio studied in the 2020-2021 TPP

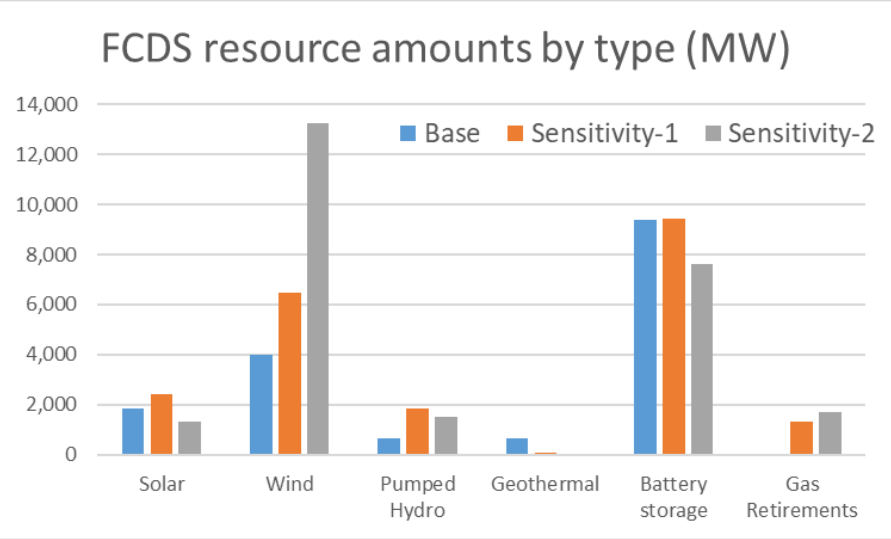
Total and FC generic resource mix in the three portfolios

Total (FC+EO) generic resource additions and retirements (MW)			
	Base	Sensitivity-1	Sensitivity-2
Solar	13,044	13,817	9,807
Wind	4,005	7,955	16,039
Pumped Hydro	627	1,843	1,495
Geothermal	651	105	0
Battery storage	9,368	9,447	7,604
Gas Retirements	0	1,319	1,718
Total (FC+EO)	**27,695**	**31,848**	**33,227**



FC generic resource additions and retirements (MW)			
	Base	Sensitivity-1	Sensitivity-2
Solar	1,832	2,422	1,332
Wind	3,971	6,451	13,250
Pumped Hydro	627	1,843	1,495
Geothermal	651	57	0
Battery storage	9,368	9,447	7,604
Gas Retirements	0	1,319	1,718
Total FC	**16,448**	**18,901**	**21,963**

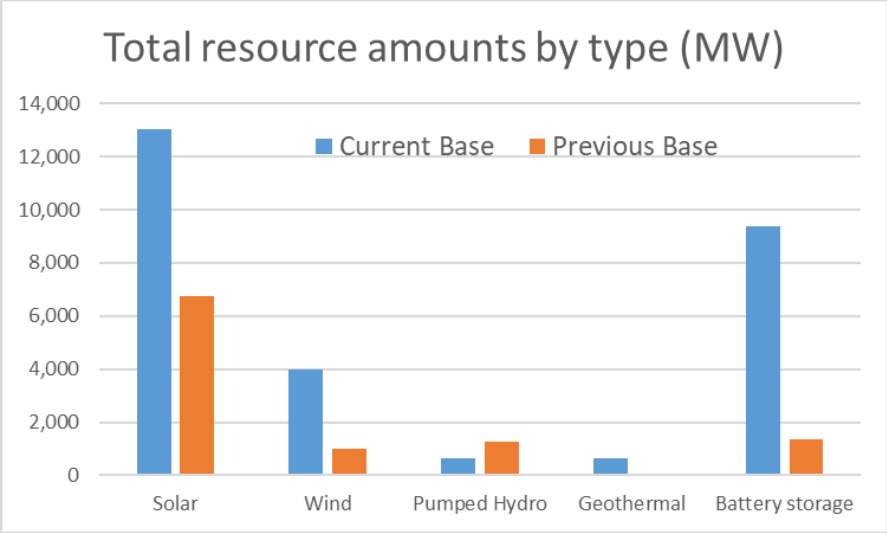
Note: The FCDS solar amount shown is adjusted to reflect the transfer of the FCDS status for some solar resources to co-located battery storage



Comparison of current and previous TPP base portfolios

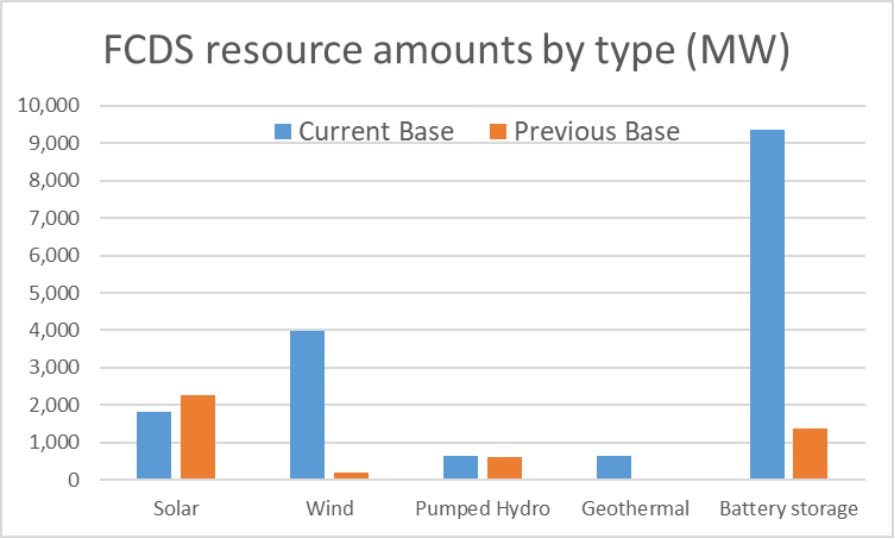
Total (FC+EO) generic resource additions and retirements (MW)		
	Current Base	Previous Base
Solar	13,044	6,763
Wind	4,005	992
Pumped Hydro	627	1,256
Geothermal	651	0
Battery storage	9,368	1,376
Gas Retirements	0	0
Total (FC+EO)	**27,695**	**10,387**

Note: Battery storage amount shown for previous TPP base case is 4-hour equivalent



FC generic resource additions and retirements (MW)		
	Current Base	Previous Base
Solar	1,832	2,273
Wind	3,971	188
Pumped Hydro	627	604
Geothermal	651	0
Battery storage	9,368	1,376
Gas Retirements	0	0
Total FC	**16,448**	**4,441**

- The FCDS solar amount shown is adjusted to reflect the transfer of the FCDS status for some solar resources to co-located battery storage
- Battery storage amount shown for previous TPP base case is 4-hour equivalent



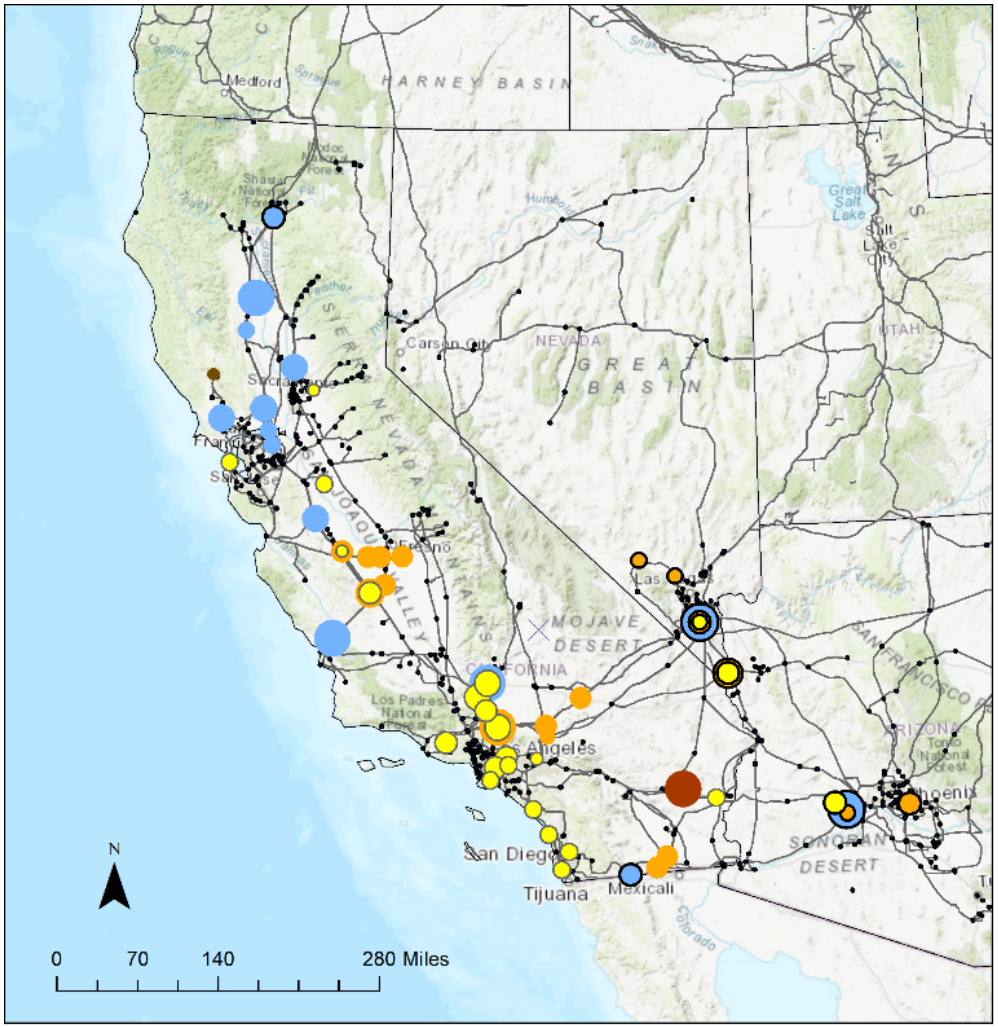
Total (EO + FC) non-battery resources by location

RESOLVE Resource	Tx Deliv. Zone	Base	Sensitivity-1	Sensitivity-2
Arizona_Solar	SCADSNV-Riverside_Palm_Springs	2352	1,580	1,910
Carrizo_Wind	SPGE-Kern_Greater_Carrizo-Carrizo	187	287	287
Central_Valley_North_Los_Banos_Wind	Central_Valley_North_Los_Banos-SPGE	173	173	173
Greater_Imperial_Solar	Greater_Imperial-SCADSNV	548	1,148	1,148
Humboldt_Wind	Sacramento_River-Humboldt	34	34	34
Kern_Greater_Carrizo_Solar	SPGE-Kern_Greater_Carrizo	700	801	-
Kern_Greater_Carrizo_Wind	SPGE-Kern_Greater_Carrizo	20	20	20
Mountain_Pass_El_Dorado_Solar	Mountain_Pass_El_Dorado	248	248	248
North_Victor_Solar	North_Victor-Greater_Kramer	300	300	300
Northern_California_Ex_Wind	Sacramento_River	767	767	767
Pisgah_Solar	Pisgah-Greater_Kramer	201	201	201
Sacramento_River_Solar	Sacramento_River		231	-
SCADSNV_Solar	SCADSNV	568	740	410
Solano_Geothermal	Solano-Sacramento_River	51	105	-
Solano_Solar	Solano-Sacramento_River		622	-
Solano_Wind	Solano-Sacramento_River	462	462	462
Southern_Nevada_Solar	SCADSNV-GLW_VEA	2024	182	182
Southern_Nevada_Wind	SCADSNV-GLW_VEA		442	442
Tehachapi_Solar	Tehachapi	4680	5,676	4,680
Tehachapi_Wind	Tehachapi	275	275	275
Westlands_Solar	Central_Valley_North_Los_Banos-SPGE	1423	2,088	728
Pumped Hydro Storage	Pumped Hydro (Lee Lake)	627	500	500
Pumped Hydro Storage	Pumped Hydro (Sycamore canyon)		500	500
Pumped Hydro Storage	Pumped Hydro Storage (Red Bluff)		843	495
Baja_California_Wind	Greater_Imperial-SCADSNV	495	495	495
Greater_Imperial_Geothermal	Greater_Imperial-SCADSNV	600		-
New_Mexico_Wind	SCADSNV-Riverside_Palm_Springs		1,500	1,500
Wyoming_Wind	SCADSNV-Mountain_Pass_El_Dorado	1062	1,500	1,500
NW_Ext_Tx_Wind	Sacramento_River	530	1,500	1,500
SW_Ext_Tx_Wind	SCADSNV-Riverside_Palm_Springs		500	234
Diablo_Canyon_Offshore_Wind	N/A			4,419
Humboldt_Bay_Offshore_Wind	N/A			1,607
Morro_Bay_Offshore_Wind	N/A			2,324
	Total	**18,327**	**23,720**	**27,341**

Battery resources by location (MW)

Substation Name	Tx Deliv. Zone	Base	Sensitivity 1	Sensitivity 2
ANTELOPE 230KV	Tehachapi	575	575	575
PANOCHE	SPGE_Z1_Westlands	99	99	-
WHEELER RIDGE	SPGE_Z2_KernAndGreaterCarrizo	-	16	-
ARCO	SPGE_Z2_KernAndGreaterCarrizo	-	19	-
MIDWAY 230KV	SPGE_Z2_KernAndGreaterCarrizo	-	18	-
BIRDS LANDING	Norcal_Z4_Solano	5	-	-
GATES 230KV	SPGE_Z1_Westlands	136	136	-
DELANEY	SCADSNV_Z4_RiversideAndPalmSprings	426	331	-
VINCENT	Tehachapi	809	941	748
WINDHUB	Tehachapi	1,008	1,081	860
WHIRLWIND 230KV	Tehachapi	1,645	1,198	953
GATES 500KV	SPGE_Z1_Westlands	341	341	655
VICTOR	GK_Z3_NorthOfVictor	50	50	50
HASSAYAMPA	SCADSNV_Z4_RiversideAndPalmSprings	269	53	-
MOHAVE 500KV	SCADSNV_Z5_SCADSNV	228	369	98
CALCITE	GK_Z4_Pisgah	126	126	126
INNOVATION	SCADSNV_Z2_GLW_VEA	123	36	36
ELDORADO 230KV	SCADSNV_Z1_EldoradoAndMtnPass	75	75	75
ELDORADO 500KV	SCADSNV_Z5_SCADSNV	149	149	149
RED BLUFF	SCADSNV_Z4_RiversideAndPalmSprings	-	278	-
COLORADO RIVER	SCADSNV_Z4_RiversideAndPalmSprings	-	278	-
CRAZY EYES	SCADSNV_Z2_GLW_VEA	125	100	100
GOLD HILL	NorCalOutsideTxConstraintZones	59	59	59
MARTIN	NorCalOutsideTxConstraintZones	250	250	250
WALNUT	TehachapiOutsideTxConstraintZones	200	200	200
HINSON	TehachapiOutsideTxConstraintZones	200	200	200
ETIWANDA	KramerInyoOutsideTxConstraintZones	101	101	101
LAGUNA BELL	TehachapiOutsideTxConstraintZones	500	500	500
WALNUT	TehachapiOutsideTxConstraintZones	200	200	200
SILVERGATE	GreaterImpOutsideTxConstraintZones	200	200	200
MOORPARK	TehachapiOutsideTxConstraintZones	500	500	500
ESCONDIDO	GreaterImpOutsideTxConstraintZones	50	50	50
SYCAMORE CANYON	GreaterImpOutsideTxConstraintZones	300	300	300
TALEGA 138KV	GreaterImpOutsideTxConstraintZones	200	200	200
TRABUCO 138KV	GreaterImpOutsideTxConstraintZones	250	250	250
ENCINA 138KV	GreaterImpOutsideTxConstraintZones	160	160	160
KEARNY	GreaterImpOutsideTxConstraintZones	10	10	10
	Total	**9,368**	**9,447**	**7,604**

Map of busbar mapping results for the base portfolio



38 MMT Round 3 adj

Solar MW (Fully Deliverable)

- 0 - 21
- 22 - 59
- 60 - 410
- 411 - 667
- 668 - 1053

Wind MW FD (Fully Deliverable)

- 0 - 30
- 31 - 241
- 242 - 530
- 531 - 945
- 946 - 1500

Geothermal MW (Fully Deliverable)

- 0
- 1 - 57

Battery MW

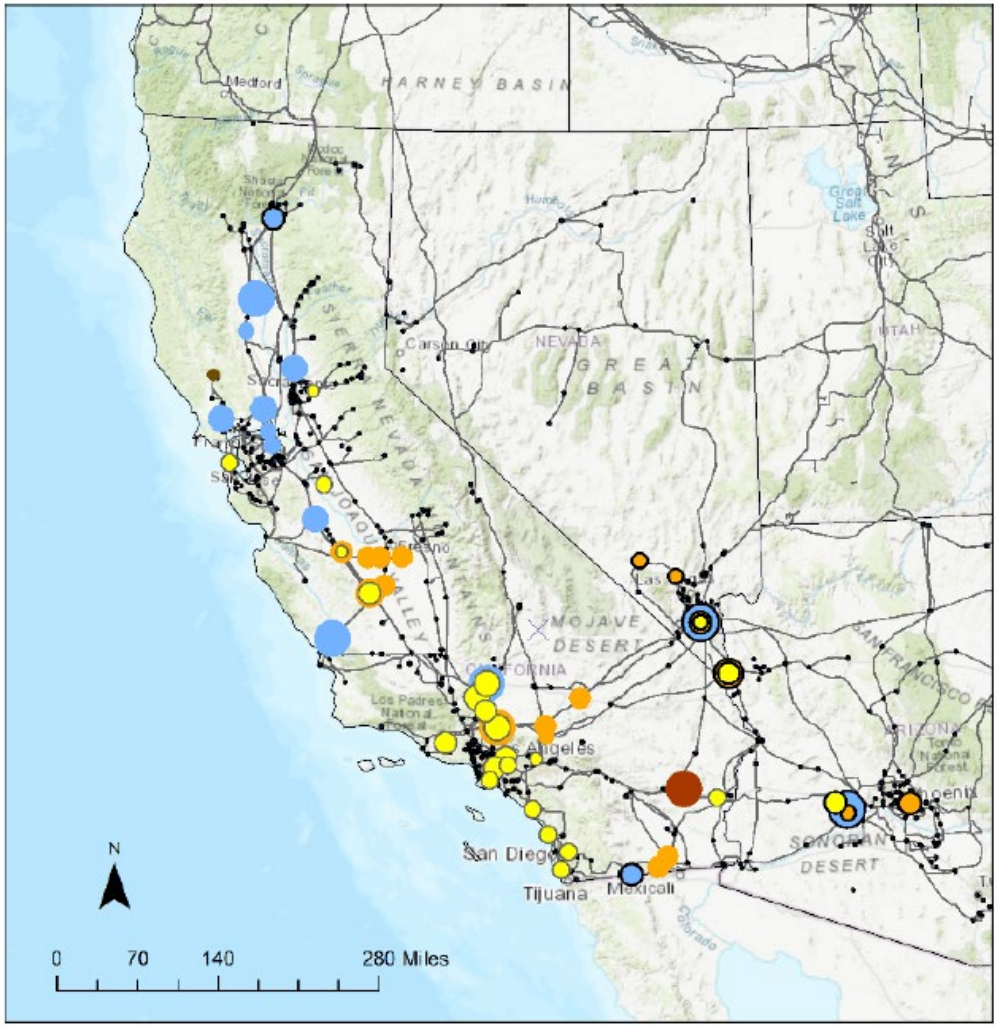
- 0 - 51
- 52 - 126
- 127 - 300
- 301 - 809
- 810 - 1645

Pumped Hydro MW

- 0
- 1 - 1343

- Substations 161kV Plus
- Electric transmission lines

Map of busbar mapping results for the 38 MMT Sensitivity



38 MMT Round 3 adj

Solar MW (Fully Deliverable)

- 0 - 21
- 22 - 59
- 60 - 410
- 411 - 667
- 668 - 1053

Wind MW FD (Fully Deliverable)

- 0 - 30
- 31 - 241
- 242 - 530
- 531 - 945
- 946 - 1500

Geothermal MW (Fully Deliverable)

- 0
- 1 - 57

Battery MW

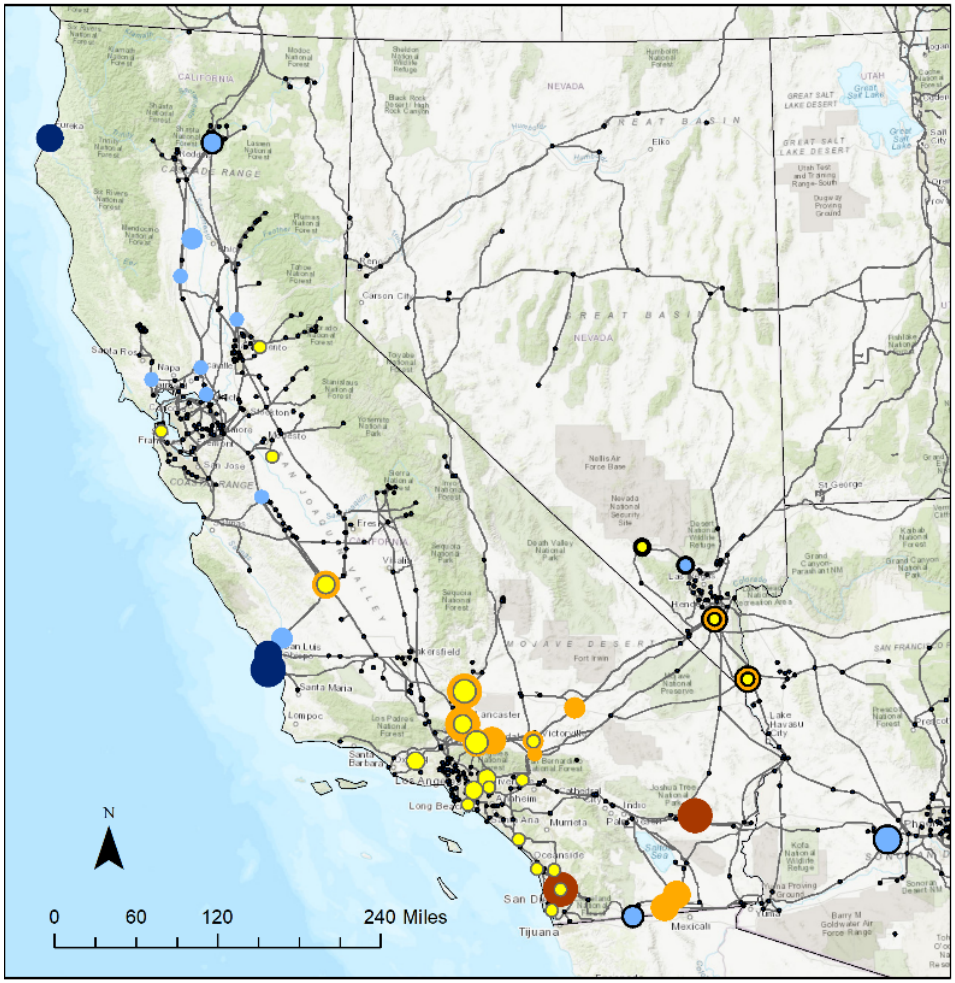
- 0 - 51
- 52 - 126
- 127 - 300
- 301 - 809
- 810 - 1645

Pumped Hydro MW

- 0
- 1 - 1343

- Substations 161kV Plus
- Electric transmission lines

Map of busbar mapping results for the OSW Sensitivity



Solar MW (Fully Deliverable)

- 0 - 14
- 15 - 47
- 48 - 300
- 301 - 852
- 853 - 1045

Wind MW FD (Fully Deliverable)

- 0 - 30
- 31 - 194
- 195 - 587
- 588 - 2324
- 2325 - 4419

Battery MW

- 0 - 30
- 31 - 400
- 401 - 655
- 656 - 941

Offshore Wind MW

- 0 - 30
- 31 - 194
- 195 - 587
- 588 - 2324
- 2325 - 4419

Pumped Hydro MW

- 0
- 1 - 905

- Substations 161kV Plus
- Electric transmission lines

Agenda

- Policy-driven assessment objectives and methodology
- Description of portfolios transmitted by the CPUC
- Additional guidance from the CPUC

Additional guidance from the CPUC

- Due to the uncertainty of the transmission implication of the injection point of the 1062 MW OOS wind resource in the base portfolio, it will be studied with Palo Verde and Eldorado as alternative injection points
- The CAISO should consult with CPUC before moving forward with any new policy-driven transmission needs associated specifically with storage mapping in this planning cycle
- CPUC staff would expect to coordinate with CAISO to enable small adjustments in the CPUC's mapping of storage resources to allow for the inclusion of storage resources that are identified as mitigation for transmission issues in CAISO's 2020-2021 TPP

Additional guidance from the CPUC - OSW Portfolio

- The expected product would include the cost of upgrading transmission to accommodate the 8.3 GW OSW in the portfolio with the potential to increase to up to 21.1 GW

- The CAISO is to conduct an outlook assessment for 21.2 GW of OSW to ensure potential transmission development for early offshore wind resources is “least regrets”

Economic Assessment
Unified Planning Assumptions & Study Plan

Yi Zhang
Senior Advisor, Transmission Infrastructure Planning

2021-2022 Transmission Planning Process Stakeholder Meeting
February 25, 2021

Economic planning study

- The CAISO economic planning study follows the CAISO tariff and Transmission Economic Assessment Methodology (TEAM) to do the following studies
  - Congestion analysis
  - Study request evaluations
  - Economic assessments

Production cost model (PCM)

- 2030 ADS PCM will be used as a starting point
  - WECC and planning regions continue to update the 2030 ADS PCM in 2021
  - The CAISO will use the latest available ADS PCM to start the 2021-2022 planning PCM development
- The unified planning assumptions will be used to update the CAISO system model in the PCM, consistent with the CAISO's TPP reliability study
  - Transmission topology
  - Generator assumptions for existing generators, renewable portfolio (CPUC Base Portfolio), energy storage, and retirement
  - CEC Load forecast for 2031
- Other model updates would be also needed through the PCM development and validation process
  - Will be discussed in future stakeholder meetings

Production cost simulation and congestion analysis

- Production cost simulations will be conducted using Hitachi-ABB GridView software on the CAISO's planning PCM

- Congestion analysis and renewable curtailment analysis will use the production cost simulation results
  - The analysis results will be considered in finalizing the selection of high priority areas, and in the policy study as well

Economic planning study requests

- Economic Planning Study Requests are to be submitted to the CAISO during the comment period of the draft Study Plan

- The CAISO will evaluate and consider the Economic Planning Study Requests as set out in section 24.3.4.1 of the CAISO Tariff

Selection of high priority areas for detailed study

- In the Study Plan phase of a planning cycle, the CAISO has carried all study requests forward as potential high priority study requests, which are mainly based on the previous cycle's congestion analysis
- The congestion results in the current cycle will be considered in finalizing the high priority areas, since changing circumstances may lead to more favorable results
- This approach gives more opportunity for the study requests to be considered, and can take into account the latest and most relevant information available

Economic assessment

- Economic benefit assessment is based on TEAM
  - Production cost benefit is assessed using production cost simulation results
  - Other benefits, such as capacity benefit, are assessed on a case by case basis
- Cost estimates are based on either per unit cost or study request submittal if available
- Total benefit and total cost (revenue requirement) are used in benefit-to-cost ratio calculation

Wildfire Mitigation Assessment of the SCE and SDG&E Areas Study Scope

Robert Sparks
Sr. Manager Regional Transmission - South

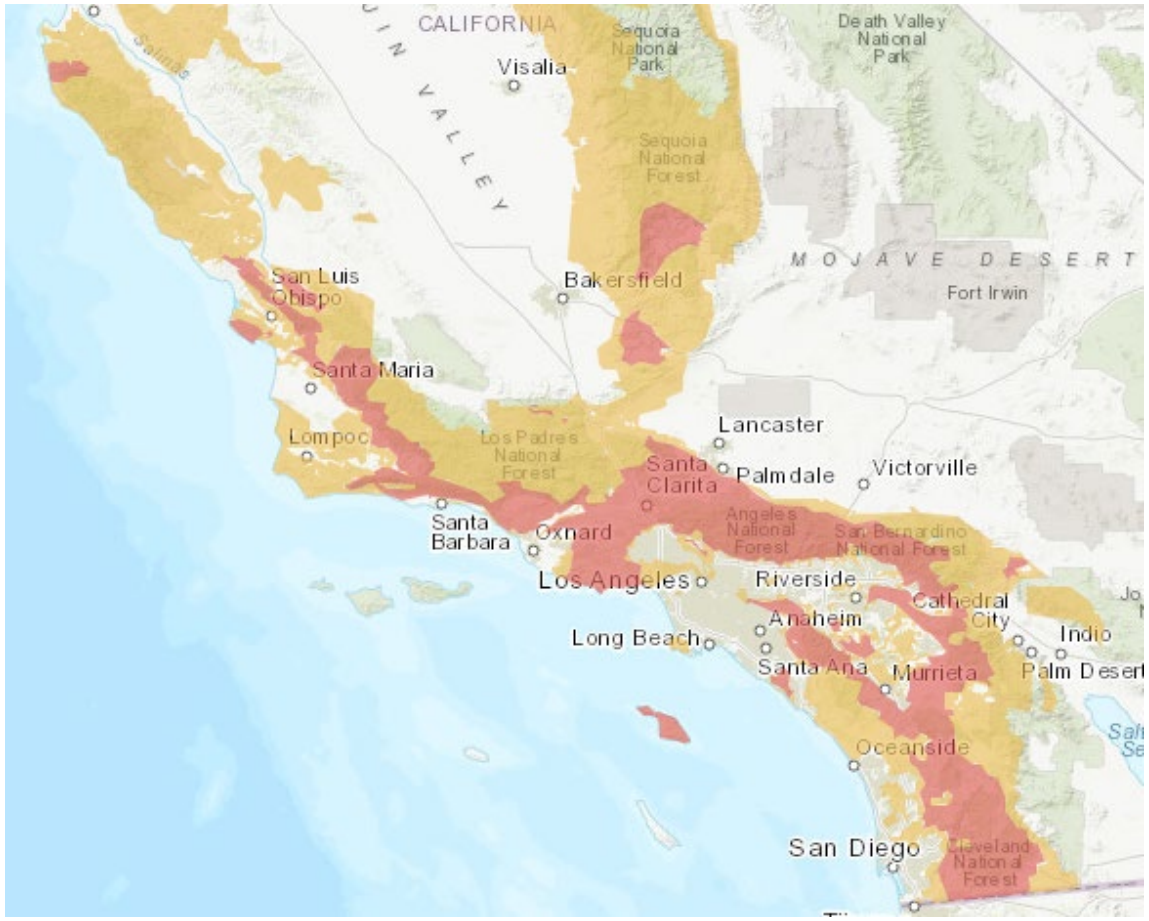
2021-2022 Transmission Planning Process Stakeholder Meeting
February 25, 2021

CAISO TPP Wildfire Mitigation Assessments

- The CAISO as part of the 2020-2021 TPP conducted studies to assess impact of various PSPS scenarios in the PG&E area
- As part of the 2021-2022 TPP the CAISO will conduct similar studies for the SCE, and SDG&E areas
  - to assess the potential risks of de-energizing CAISO-controlled facilities in High Fire Risk Area's (HFRA)

High Fire Risk Areas in Southern California (CPUC Fire Map)

- Tier 2-Elevated (gold)
- Tier 3-Extreme (red)



The assessment will begin with gathering wildfire related information

- GIS maps for HFRA with the transmission system overlay
- Identify transmission facilities within the different tiers of HFRA identified by the CPUC
- Develop scenarios with the facilities at risk de-energized

Scenario Development

- The CAISO will work with SCE and SDG&E to prioritize HFRAs that have been prone to past PSPS or wildfire events
- SCE and SDG&E will create scenarios that remove specific CAISO-controlled facilities from service
  - 1) pre-emptively de-energizing these facilities as part of a potential PSPS or
  - 2) losing these facilities as a forced outage due to uncontrollable events such as wildfire.

Assessment Steps

- Record the amount of load lost as a result of a radial system or an island created due to the facilities de-energized as part of the scenario
- Assess power flow system performance after modeling each scenario (P0 and P1 analysis)
- Determine the amount of load reduction needed to continue reliable operation of the system during each scenario

Mitigation Development

- Identify critical facilities
  - The critical facilities will be such that if excluded from the scope of PSPS scenario, will have significant impact on reducing risk in terms of load loss
- Work with SCE and SDG&E to evaluate mitigation options to be able to exclude these facilities from future PSPS events
- May also look into developing new upgrades
  - However, the PSPS scenarios are likely to be beyond the minimum requirements of NERC reliability standards and CAISO planning standards

Frequency Response Assessment
Unified Planning Assumptions & Study Plan

Ebrahim Rahimi

2021-2022 Transmission Planning Process Stakeholder Meeting

February 25, 2021

Background and Objective

- Historically, synchronous generators such as thermal and hydro units provided sufficient frequency response to the CAISO system to be able to meet the applicable standards.

- Currently (as of 2/17/2021), a total of 21.23 GW of Inverter Based Resources (IBRs) (wind, solar, storage) are connected to the CAISO grid and the total installed capacity is expected to reach 33 GW by year 2031

- Majority of the existing IBRs do not provide frequency response but FERC Order 842 requires that all IBRs that sign LGIA on or after 5/15/2018 to have frequency response capability.

- The objective of this study is to assess the CAISO system frequency response in years 2026 and 2031 and identify any potential performance issues

Study Models and Assumptions

- Overall study approach is similar to frequency response assessment performed in prior TPP cycles. However in this cycle:
  - The frequency response of the system both in year 2026 and year 2031 will be studied.
  - A review of the frequency response of individual units across CAISO system will be performed for number of NERC frequency events. The dynamic models in the study will be updated to correctly reflect the response provided by each unit.
  - Frequency response from IBRs (solar, wind, and storage) in the studies will be validated by review of historical data

Contingency and Monitored Parameters

- The trip of two fully dispatched Palo Verde units will be simulated and the following parameters under each scenario will be monitored:
  - System frequency including frequency nadir and settling frequency after primary frequency response
  - The total new IBR output
  - The total output of all other CAISO generators
  - The major path flows
  - Frequency response of the WECC and CAISO (MW/0.1 Hz)
  - Rate of Change of Frequency (ROCOF)

Study Scenarios

- Scenario 1: Frequency response from all IBRs in CAISO system will be switched off to establish a baseline.
- Scenario 2: Frequency response will be enabled for new BESS only.
- Scenario 3: Frequency response will be enabled for all new IBRs assuming 10% headroom.
- Scenario 4: Starting with Scenario 1 it will be assumed that the generator headroom in WECC case is set at spinning reserve.
- Scenario 5: Starting with Scenario 4, the frequency response of individual resources that did not respond to actual frequency events in the system will be switched off.

Next Steps
Unified Planning Assumptions & Study Plan

Isabella Nicosia
Stakeholder Engagement and Policy Specialist

2021-2022 Transmission Planning Process Stakeholder Meeting
February 25, 2021

2021-2022 Transmission Planning Process
Next Steps

- Stakeholders requested to submit comments to: regionaltransmission@caiso.com
  - Economic study requests are to be submitted with comments

- Stakeholder comments are to be submitted within two weeks after stakeholder meetings: **by March 11**

- CAISO will post comments and responses on website

- Final Study Plan will be posted on March 31