



California ISO

2024-2025 Transmission Planning Process - Policy & Economic Preliminary Assessment and Study Updates

Stakeholder Meeting

November 13, 2024

Housekeeping Reminders

- Stakeholder calls and meetings related to Transmission Planning are not recorded.
 - Given the expectation that documentation from these calls will be referred to in subsequent regulatory proceedings, we address written questions through written comments, and enable more informal dialogue at the call itself.
 - Minutes are not generated from these calls, however, written responses are provided to all submitted comments.
- Calls are structured to stimulate an honest dialogue and engage different perspectives.
- Please keep comments professional and respectful.

Instructions for raising your hand to ask a question

- Open the Participant and Chat panels from the bottom right.
- If you are connected to audio through your computer or used the “call me” option, select the raise hand icon  located at the bottom of the participant panel.
 - **-Note:** *3 only works if you dialed into the meeting.
- Please remember to state your name and affiliation before making your comment.
- If you need technical assistance during the meeting, please send a chat to the event producer.
- You may also send your question via chat to either Yelena Kopylov-Alford or to all panelists.

2024-2025 Transmission Planning Process Stakeholder Call – Agenda

Topic	Presenter
Overview	Andrew Rivera
Reliability <\$50 Million Project Recommendation - North	Preethi Rondla
Reliability <\$50 Million Project Recommendation - South	Rene Romo de Santos
Preliminary Results of Economic Analysis	Yi Zhang
MIC Expansion Requests	Catalin Micsa
Preliminary Policy Assessment Introduction - Preliminary Results of SCE and GLW areas - Preliminary Results for SDG&E area - Preliminary Results for PG&E area	Meng Zhang - Rene Romo de Santos, Anuj Hiray, Amanda Wong, Meng Zhang - Luba Kravchuk - Lindsey Thomas
Wrap-up	Yelena Kopylov-Alford



Introduction and Overview

Preliminary Reliability Assessment Results

Andrew Rivera

Transmission Planning Specialist

2024-2025 Transmission Planning Process Stakeholder Meeting

November 13, 2024

2024-2025 Transmission Planning Process

January 2024

Phase 1 – Develop detailed study plan

State and federal policy

CEC - Demand forecasts

CPUC - Resource forecasts and common assumptions with procurement processes

Other issues or concerns

April 2024

Phase 2 - Sequential technical studies

- Reliability analysis
 - Renewable (policy-driven) analysis
 - Economic analysis
- Publish comprehensive transmission plan with recommended projects

May 2024

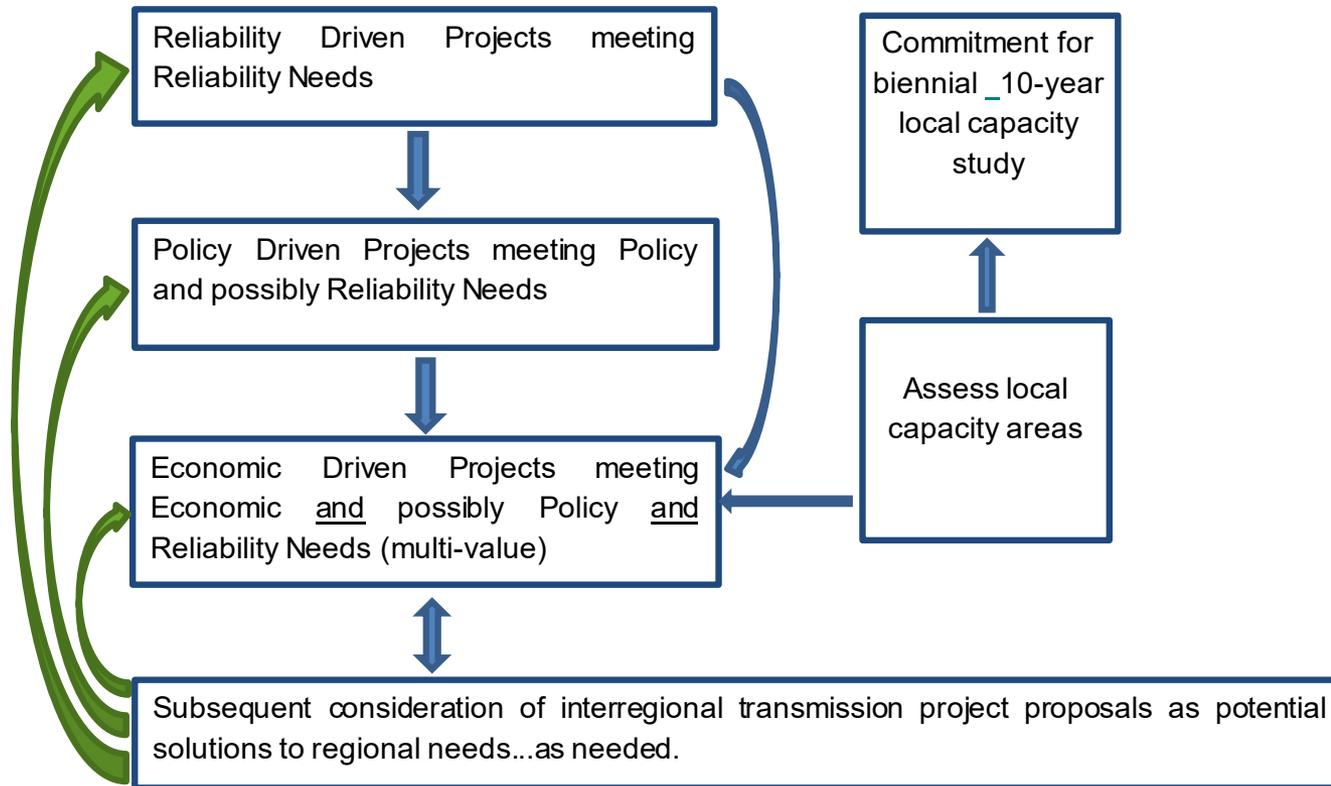
Phase 3 Procurement

CAISO Board for approval of transmission plan

2024-2025 Transmission Plan Milestones

- Draft Study Plan posted on February 21
- Stakeholder meeting on Draft Study Plan on February 28
 - Comments to be submitted by March 13
- Final Study Plan to be posted in April
- Preliminary reliability study results to be posted on August 15
- Stakeholder meeting on September 23 and 24
 - Comments to be submitted by October 8
- Request window closes October 15
- Preliminary policy and economic study results on November 13
 - Comments to be submitted by November 27
- Long-Term LCR Study Stakeholder Meeting December 9
- Draft transmission plan to be posted on March 31, 2025
- Stakeholder meeting in April 2025
 - Comments to be submitted within two weeks after stakeholder meeting
- Revised draft for approval at May 2025 Board of Governor meeting

Studies are coordinated as a part of the transmission planning process



2024-2025 Transmission Planning Process Reliability Assessment - Update

- ISO recommended projects have two paths for approval:
 - For management approval, reliability projects less than \$50 million can be presented at November stakeholder session
 - For Board of Governor approval of reliability projects over \$50 million and projects not presented for management approval, are included in draft plan to be issued for stakeholder comments by March 31, 2025
- Final reliability results were posted October 31, 2024.

2024 Request Window Submissions

Project Name	Submitter	Review of Submission
Cortina #3 60 kV Reconductoring Project	PG&E	May be considered as a reliability alternative
Gold Hill-El Dorado Reinforcement Project	PG&E	May be considered as a reliability alternative
Jefferson-Stanford 60 kV Menlo to SLAC Tap Recabling Project	PG&E	May be considered as a reliability alternative
Konocti-Eagle Rock 60 kV Reconductoring Project	PG&E	May be considered as a reliability alternative
Metcalf Substation 500/230kV Transformer Bank Addition	PG&E	May be considered as a reliability alternative
Moraga 230/115 kV Transformer Addition Project	PG&E	May be considered as a reliability alternative
North Oakland Reinforcement Project	PG&E	May be considered as a reliability alternative
Pittsburg-Kirker 115kV Line Section Limiting Elements Upgrade Project	PG&E	May be considered as a reliability alternative
San Mateo 230/115 kV Transformer Bank Addition Project	PG&E	May be considered as a reliability alternative
San Miguel New 70 kV Line Project	PG&E	May be considered as a reliability alternative
Sobrante 230 kV Bus Upgrade Project	PG&E	May be considered as a reliability alternative
South Bay 115 kV System Reinforcement Project (Conceptual)	PG&E	Submission incomplete: Conceptual and no confirmed alternative
South Oakland Reinforcement Project (Conceptual)	PG&E	Submission incomplete: Conceptual and no confirmed alternative
Vaca Dixon-Davis Area Reinforcement Project	PG&E	May be considered as a reliability alternative
West Fresno 115 kV Voltage Support Project	PG&E	May be considered as a reliability alternative

2024 Request Window Submissions

Project Name	Submitter	Review of Submission
Alamitos 230 kV SCD Upgrade	SCE	May be considered as a reliability alternative
Control 115/55 kV B-Banks Replacement	SCE	May be considered as a reliability alternative
Coolwater Second A-Bank and Lines Relocation	SCE	May be considered as a reliability alternative
Coolwater to Ivanpah 115 kV Line Rebuild	SCE	May be considered as a reliability alternative
Julian Hinds-Mirage 230 kV Advanced Reconductor	SCE	May be considered as a reliability alternative
Kramer-Coolwater 115 kV line Looping into Tortilla 115 kV Substation	SCE	May be considered as a reliability alternative
Magunden-Springville No. 2 230 kV Advanced Reconductor	SCE	Does not meet a reliability need identified by the CAISO in this TPP cycle. Therefore it will not be considered as a reliability solution in the development of the transmission plan. However, it may be considered in the policy and economic analysis.
Moorpark-Santa Clara #1 230 kV Advanced Reconductor	SCE	May be considered as a reliability alternative
Moorpark-Santa Clara #2 230 kV Advanced Reconductor	SCE	May be considered as a reliability alternative
New Kramer 230/115 kV A-Bank (Third A-Bank)	SCE	May be considered as a reliability alternative
Pardee-Santa Clara 230 kV Advanced Reconductor	SCE	May be considered as a reliability alternative
Pardee-Vincent No. 2 230 kV Line Upgrade	SCE	May be considered as a reliability alternative
Santa Clara-Vincent 230 kV Advanced Reconductor	SCE	May be considered as a reliability alternative
Serrano 230 kV GIS Bus Split	SCE	May be considered as a reliability alternative
Serrano 500 kV SCD Mitigation	SCE	May be considered as a reliability alternative
Tortilla 115 kV Capacitor Replacement	SCE	May be considered as a reliability alternative

2024 Request Window Submissions

Project Name	Submitter	Review of Submission
Coronado Island Reliability Reinforcement	SDG&E	May be considered as a reliability alternative
Downtown Reliability Reinforcement	SDG&E	May be considered as a reliability alternative
TL623C Reconductor	SDG&E	May be considered as a reliability alternative
TL6966 Reconductor	SDG&E	May be considered as a reliability alternative
Osprey Data Center	VEA	May be considered as a reliability alternative
Ames-Adobe Creek-Palo Alto 115 kV Line	City of Palo Alto	May be considered as a reliability alternative
Warnerville-Newark Transmission Expansion	City and County of San Francisco	May be considered as a reliability alternative
Origin Plain Transmission Project	Origin Plain Infrastructure, LLC	Does not meet a reliability need identified by the CAISO in this TPP cycle. Therefore it will not be considered as a reliability solution in the development of the transmission plan. However, it may be considered as a policy and economic solution.
Pelicans Jaw RAS	SB Energy	May be considered as a reliability alternative
TBC Oakland link	NextEra Energy Transmission	May be considered as a reliability alternative
Pacific Transmission Expansion Project (PTEP)	Zglobal	May be considered as a reliability alternative
Kern-Southland Energy Link (K-SEL)	Kern-Southland Energy Link LLC (Grid United and Plains All American)	Merchant project submission
Del Amo – El Nido 230kV Underground Line	Grid United and Plains All American	Merchant project submission

Comments

- Comments due by end of day November 27, 2024
- Submit comments through the ISO's commenting tool, using the template provided on the process webpage:
- <https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/2024-2025-Transmission-planning-process>



California ISO

2024-2025 Transmission Planning Process
PG&E Area
Less than \$50 Million Project Approvals and
Project for Concurrence

Preethi Rondla

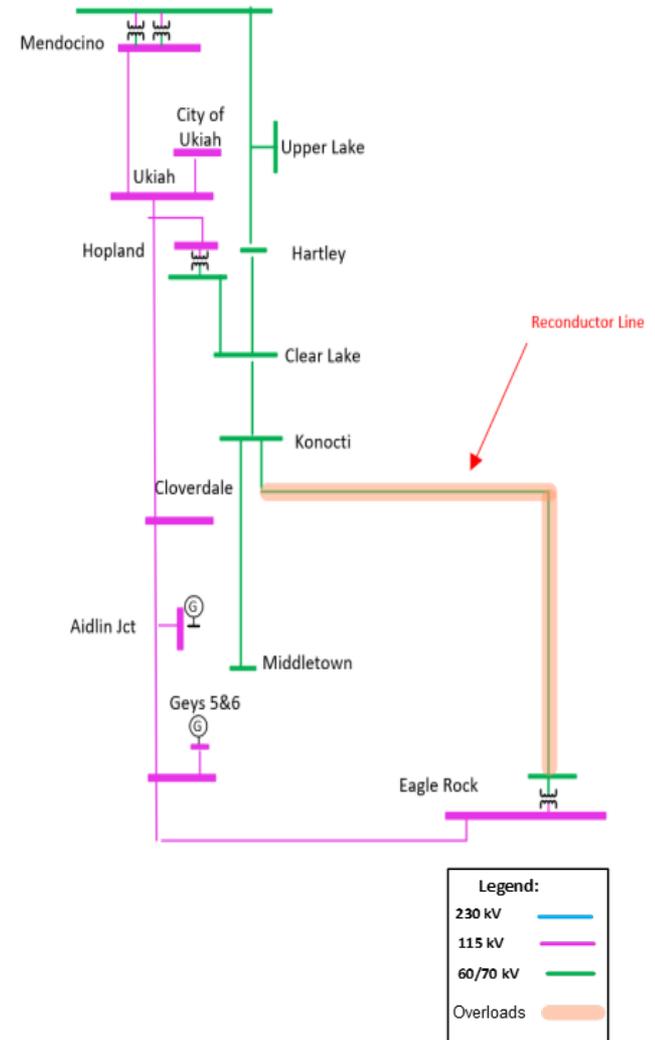
Regional Transmission Engineer Lead

2024-2025 Transmission Planning Process Stakeholder Meeting

November 13, 2024

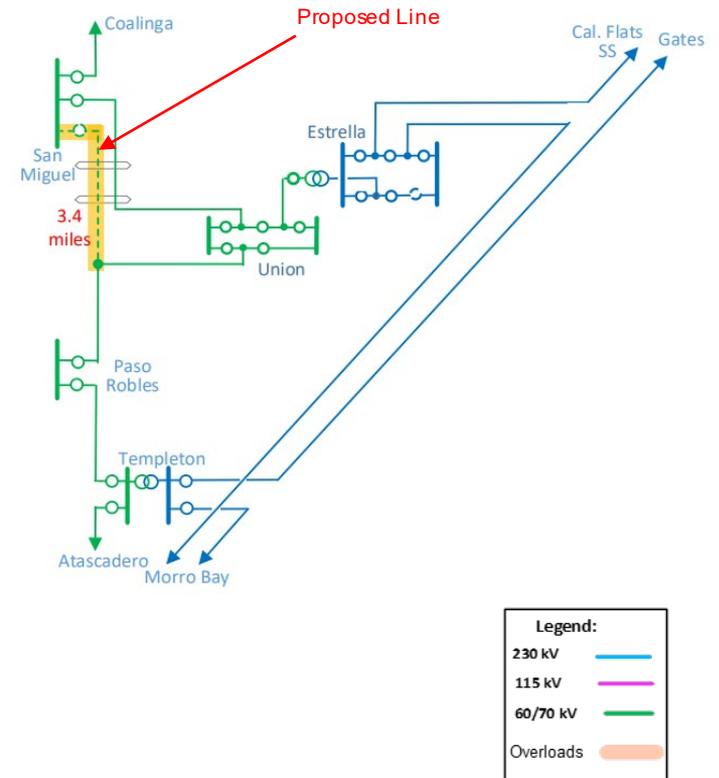
Konocti – Eagle Rock 60 kV Line Reconductoring (North Coast North Bay)

- Reliability Assessment Need
 - NERC Category P2-1 starting 2029
- Project Submitter
 - PG&E
- Project Scope
 - Reconductor Konocti – Eagle Rock 60 kV Line
 - Upgrade any limiting component to achieve full conductor capacity.
- Project Cost
 - \$16.2M - \$32.5M
- Alternatives Considered
 - **Status Quo**. Not recommended because it does not mitigate violations and expected capacity constraints.
 - **Energy Storage**. Not recommended due to potential substation costs and insufficient line capacity to accommodate more power flow.
 - **Flow Control Device**. Not recommended as it causes overloads on other nearby lines.
- Estimated In-service Date
 - 2030 or earlier
- Recommendation
 - Approval



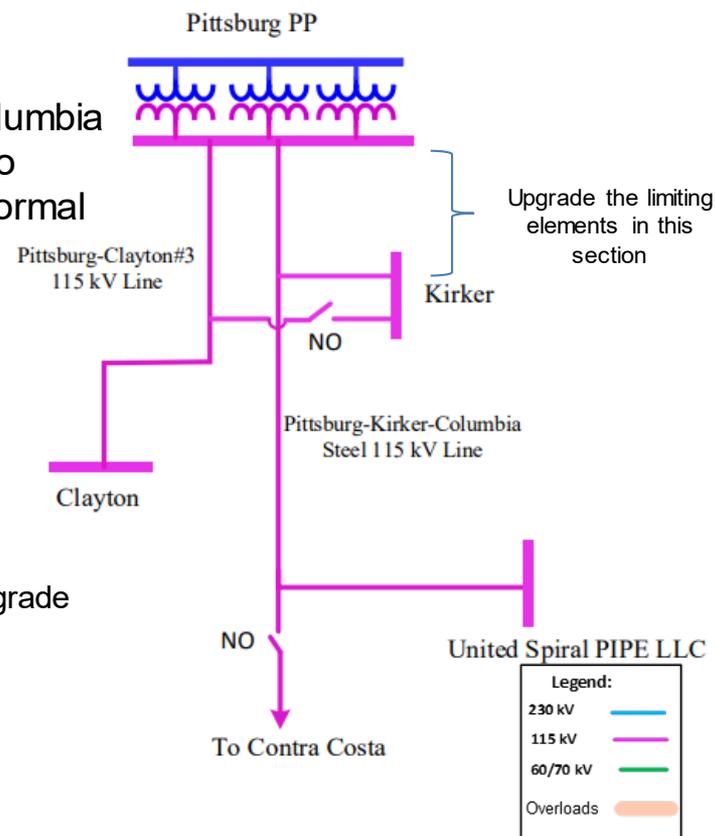
San Miguel New 70kV Line Project (Los Padres)

- Reliability Assessment Need
 - NERC Category P1 induced low voltage starting near term.
- Project Submitter
 - PG&E
- Project Scope
 - Build new 70kV line from the loop-in point on the future Union-Paso Robles 70 kV line to San Miguel Substation.
 - Minimum summer emergency rating of 1048A is required for new line section.
- Project Cost
 - \$15.5M - \$30M
- Alternatives Considered
 - **Status Quo**. Not recommended because it does not mitigate NERC TPL P1 violations.
 - **Voltage Support** at San Miguel. Not recommended despite comparable cost (\$11.5M - \$22M) because limited load serving capacity provided, which is insufficient for projected load growth.
 - **Flow Control Device**. Not recommended because system is radial after the loss of San Miguel-Union 70kV line.
 - **Energy Storage**. Not recommended because deliverability is not available at San Miguel and Coalinga-San Miguel 70kV line having insufficient capacity to accommodate additional power flow caused by adding energy storage.
- Estimated In-service Date
 - May 2032 or earlier
- Recommendation
 - Approval



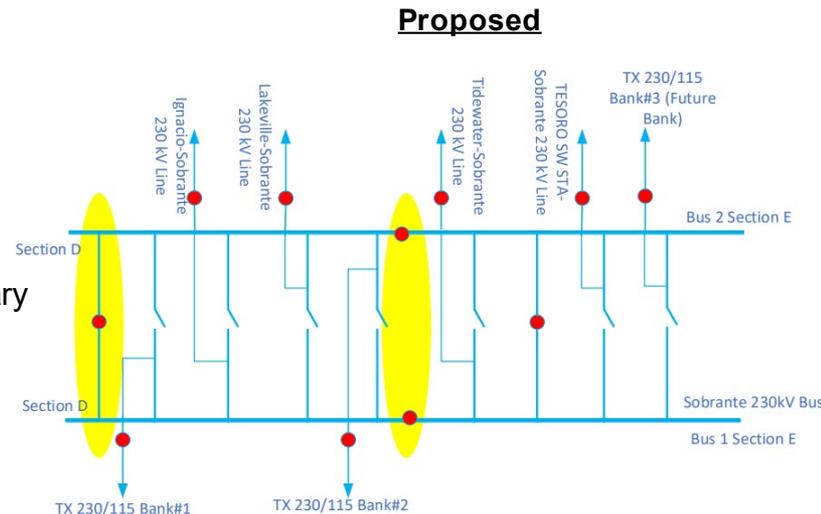
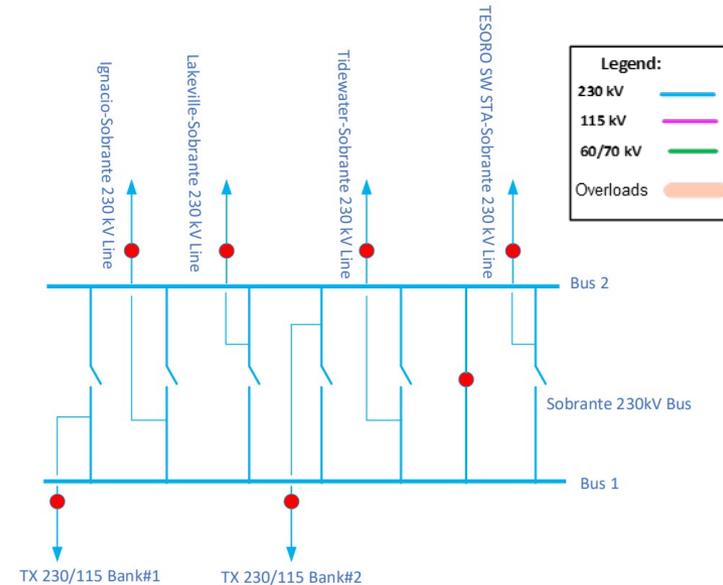
Pittsburg-Kirker 115kV Line Section Limiting Elements Upgrade Project (Greater Bay Area)

- Reliability Assessment Need
 - NERC Category P0 starting 2026.
 - Load increase
- Project Submitter
 - PG&E
- Project Scope
 - Upgrade the limiting elements on the Pittsburg-Kirker-Columbia Steel 115 kV transmission line (Pittsburg-Kirker section) to achieve the full conductor rating of 1126 Amps summer normal rating.
- Project Cost
 - \$0.1 M - \$0.2 M
- Alternatives Considered
 - **Status quo.** Not recommended due to potential criteria violations.
 - **Power Flow Control Device.** Not applicable for radial systems
 - **RAS.** Cost is higher than the limiting elements upgrade
 - **BESS.** Interconnection cost is higher than the limiting elements upgrade alternative
- Estimated In-service Date
 - 2028 or earlier
- Recommendation
 - Approval



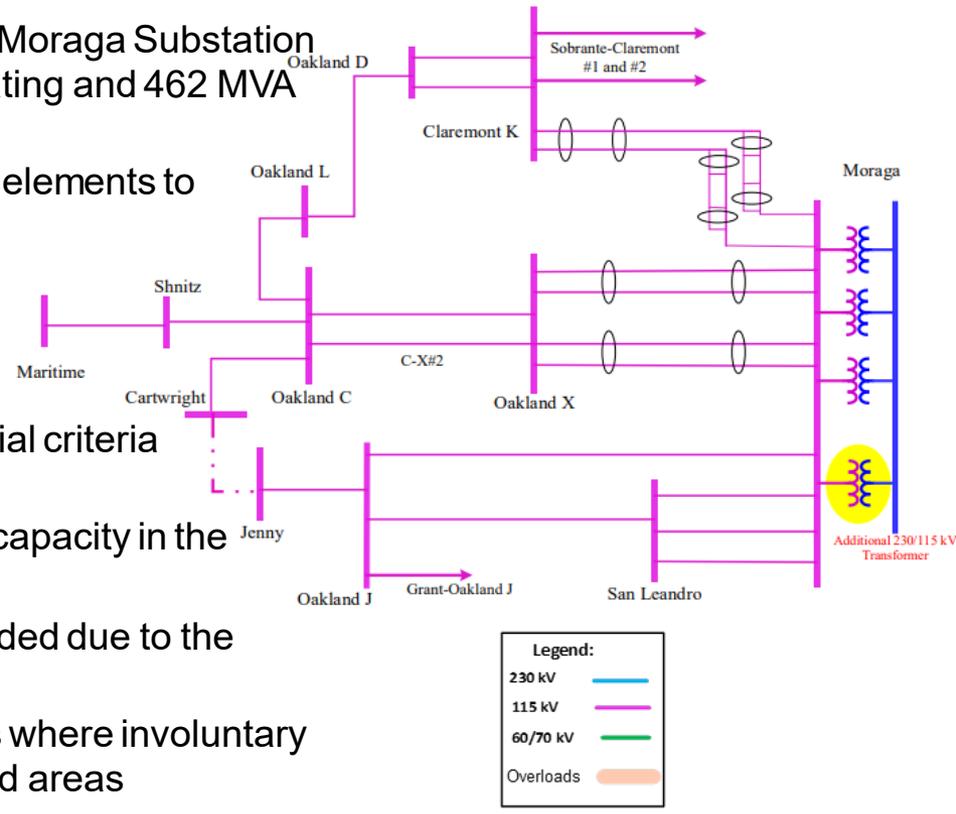
Sobrante 230 kV Bus Upgrade Project (Greater Bay Area) Existing

- Reliability Assessment Need
 - NERC Category P2-4 starting 2034.
 - Load increase
- Project Submitter
 - PG&E
- Project Scope
 - Expand Sobrante 230 kV bus and split to two sections, section D and section E by adding two sectionalizing breakers and one bus-tie breaker.
- Project Cost
 - \$7.5 M - \$15 M
- Alternatives Considered
 - **Status quo.** Not recommended due to potential criteria violations.
 - **BESS.** Not recommended due to insufficient capacity in the charging window.
 - **Power Flow Control Device.** Not recommended due to the multiple power flow controllers required
 - **RAS.** Not applicable per ISO RAS Guidelines where involuntary load tripping is not allowed in high density load areas
- Estimated In-service Date: 2033 or earlier
- Recommendation: Approval



Moraga 230/115 kV Transformer Bank Addition Project (Greater Bay Area)

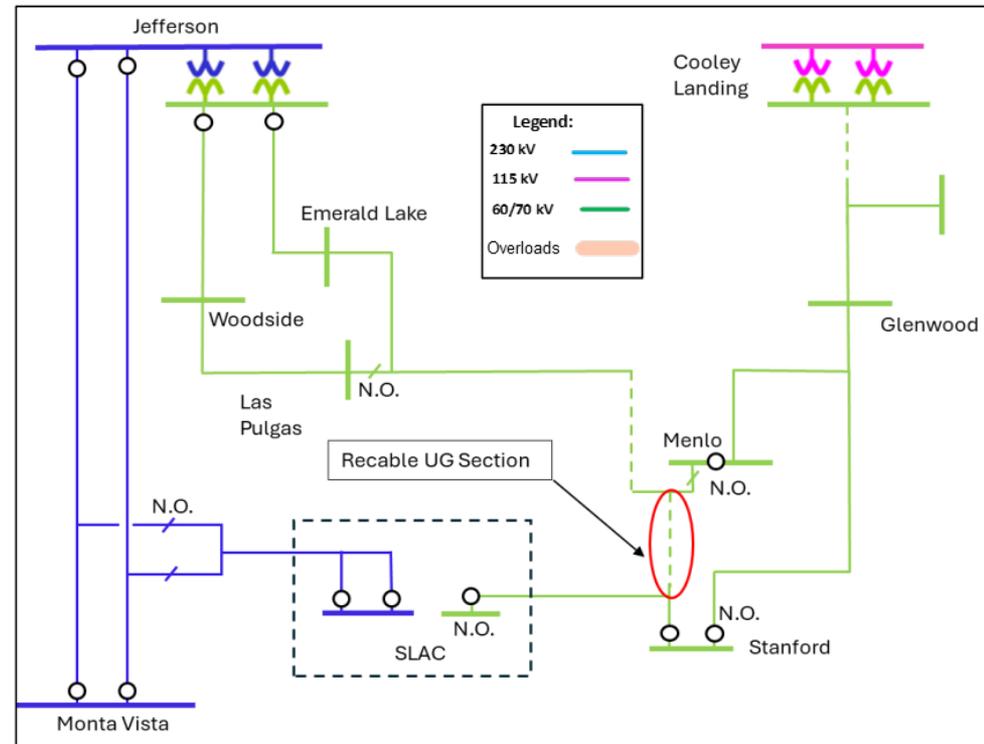
- Reliability Assessment Need
 - NERC Category P2 and P6 starting 2026.
 - Load increase
- Project Submitter
 - PG&E
- Project Scope
 - Install a new 230/115 kV transformer bank at Moraga Substation with minimum 420 MVA for summer normal rating and 462 MVA for summer emergency rating.
 - Upgrade Moraga 115 kV bus and any limiting elements to achieve full bank capacity
- Project Cost
 - \$20 M - \$40 M
- Alternatives Considered
 - **Status quo.** Not recommended due to potential criteria violations.
 - **BESS.** Not recommended due to insufficient capacity in the charging window.
 - **PowerFlow Control Device.** Not recommended due to the multiple power flow controllers required
 - **RAS.** Not applicable per ISO RAS Guidelines where involuntary load tripping is not allowed in high density load areas
- Estimated In-service Date
 - 2031 or earlier
- Recommendation
 - Approval



Jefferson-Stanford 60 kV Recabling Project (Greater Bay Area)

- Reliability Assessment Need
 - Potential NERC category P0 based on real-time non-coincident load at Stanford.
- Project Submitter
 - PG&E
- Project Scope
 1. Temporary overhead shoo-fly transmission line to bypass existing underground cable section.
 2. Replace 0.9 mile of existing 800 kcmil AL underground cable with larger size.
 3. Upgrade limiting electrical equipment as necessary to achieve full cable capacity.
- Project Cost: \$20.0 M - \$40.0 M
- Alternatives Considered
 - **Status quo.** Not recommended due to potential criteria violations.
 - **Replace UG cable with OH line.** Not recommended for potential violations on city ordinance and local opposition.
 - **Power Flow Control Device.** Not applicable for radial systems
 - **RAS.** Not applicable as it's a P0 issue.
 - **BESS.** Not feasible to install at the Stanford substation, the university campus, or the nearby residential area due to the limited land availability.

- Estimated In-service Date
 - 2029 or earlier
- Recommendation
 - Approval





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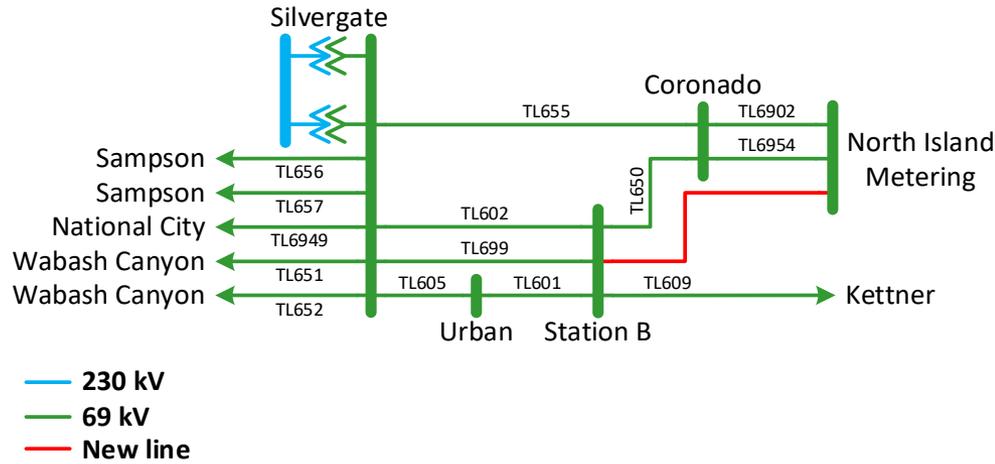
2024-2025 Transmission Planning Process
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Rene Romo de Santos
Regional Transmission Engineer Lead

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Coronado Island Reliability Reinforcement Phase I

- Reliability Assessment Need
 - This project was proposed as a reliability transmission solution to address NERC Category P1 contingencies, starting 2028, driven by the additional US Navy load.
- Project Submitter
 - SDG&E
- Project Scope
 - Build a new underground 69 kV line from Station B to North Island Metering
- Estimated Project Cost
 - \$42M
- Estimated In-service Date
 - Q3 2027
- Alternatives Considered
 - Build a new underground 69 kV line from Bay Boulevard to North Island Metering. Cost ~\$300-400M. ISD 2032
 - Energy Storage.** Not applicable due to energy storage charging limitations.
 - Flow Control Device.** Not applicable since Coronado Island load is radial and only served by two 69 kV lines.
 - RAS.** Not applicable per ISO RAS Guidelines where involuntary load tripping is not allowed due to critical US Navy load.
- Recommendation
 - Approval





California ISO

Preliminary Economic Assessment Results

Yi Zhang

Sr. Advisor, Transmission Infrastructure Planning

2024-2025 Transmission Planning Process Stakeholder Meeting

November 13, 2024

Outline of the presentation

- 2034 Base portfolio PCM preliminary results
- 2039 Base portfolio PCM preliminary results
- 2039 Sensitivity portfolio (high gas retirement) PCM preliminary results
- Economic study requests and preliminary high priority study areas

2034 Base portfolio preliminary PCM results

2034 Base portfolio preliminary PCM – congestion

Area or branch group	Total Congestion Cost (\$M)	Total Congestion Hours (Hrs)
Path 15 Corridor	232.81	5,725
PG&E Moss Landing-Las Aguilas 230 kV	199.37	2,582
Path 26 corridor	189.00	4,388
SWIP North	32.49	429
Path 65 PDCI	23.29	1,622
SCE Northern	21.62	1,976
SCE Metro	19.13	231
East of Pispah	14.56	1,226
PG&E North Valley 230 kV	12.99	1,689
SDG&E/CFE	8.94	1,295
SCE North of Lugo	8.00	4,403
Path 42	5.77	405
PG&E Kern 230kV	3.74	723
PG&E GBA	3.67	1,111
SCE Antelope 66kV	3.54	1,287
SDG&E 230 kV	3.50	643
SDG&E Bulk	3.43	369
Path 41 Sylmar transformer	2.78	203
COI Corridor	1.07	61
PG&E Sierra	0.99	258
Path 46 WOR	0.78	33
PG&E Fresno 115 kV	0.67	69
Path 25 PACW-PG&E 115 kV	0.19	10
SCE Eastern	0.16	29
SDG&E Northern 69 kV	0.10	661
SCE Lugo - Vincent 500 kV	0.05	9
PG&E Fresno 230 kV	0.03	32
Moenkope - Eldorado 500 kV	0.01	4

Path 15 corridor congestion

Constraints Name	Cost Forward (\$K)	Duration Forward (Hrs)	Cost Backward (\$K)	Duration Backward (Hrs)	Costs Total (\$K)	Duration Total (Hrs)
PANOCHÉ-GATES E 230 kV line, subject to PG&E N-2 Gates-Gregg and Gates-McCall 230 kV	0	0	77,068	1,402	77,068	1,402
P15 Midway-LosBanos	51,407	677	0	0	51,407	677
QUINTO_SS-LOSBANOS 230 kV line, subject to PG&E N-1 LosBanos-Tesla 500kV	0	0	27,198	645	27,198	645
PANOCHÉ-GATES E 230 kV line, subject to PG&E N-2 LB-Gates and LB-Midway 500 kV	0	0	18,101	784	18,101	784
TESLA E-WESTLEY 230 kV line #1	0	0	17,045	581	17,045	581
MANNING-MN_MW_21 500 kV line #2	0	0	7,641	395	7,641	395
LOSBANOS-LB_MN_21 500 kV line #2	0	0	5,678	57	5,678	57
GT_MW_11-MIDWAY 500 kV line #1	0	0	5,232	246	5,232	246
GATES-GT_MW_11 500 kV line #1	0	0	5,098	179	5,098	179
LOSBANOS-LB_MN_11 500 kV line #1	0	0	3,970	89	3,970	89
MANNING-MN_GT_11 500 kV line #1	0	0	3,905	120	3,905	120
MN_MW_23-MIDWAY 500 kV line #2	0	0	3,433	143	3,433	143
PANOCHÉ-GATES E 230 kV line, subject to PG&E N-2 Mustang-Gates #1 and #2 230 kV	0	0	1,813	148	1,813	148
PANOCHÉ-GATES E 230 kV line, subject to PG&E N-1 Panoche-Gates #1 230 kV	0	0	1,510	186	1,510	186
MN_GT_11-GATES 500 kV line #1	0	0	1,462	15	1,462	15
TESLA-LOSBANOS 500 kV line, subject to PG&E N-1 LosBanos-Tracy 500 kV	0	0	1,314	10	1,314	10
TESLA-LOSBANOS 500 kV line #1	0	0	673	6	673	6
MN_MW_21-MN_MW_22 500 kV line #2	0	0	230	34	230	34
MN_MW_22-MN_MW_23 500 kV line #2	0	0	32	8	32	8

- Path 15 corridor congestion occurs when the flow is from south to north
- Path 15 corridor congestion increased compared with the last TPP results mainly due to high volume of CPUC portfolio resources in the Fresno/Kern

Path 15 corridor congestion occurrence patterns

Path 15

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	0	0	0	0	0	0	0	0	5	10	14	14	15	14	11	13	1	0	0	0	2	2	1	1
Feb	0	0	0	0	0	0	0	1	8	10	7	7	6	7	6	5	4	0	0	0	1	1	4	0
Mar	0	0	0	0	0	0	0	5	9	12	13	16	15	16	13	12	5	0	0	0	1	1	0	0
Apr	0	0	0	0	0	0	2	2	3	6	5	6	4	1	2	2	2	0	0	0	0	0	0	0
May	0	0	0	0	0	0	1	5	4	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	3	2	5	4	3	6	7	3	1	0	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	5	8	10	9	8	9	7	6	5	1	1	0	2	1	2	1	1	1
Dec	4	3	1	1	1	0	4	17	19	24	19	20	20	18	13	6	5	6	7	8	7	8	6	6

Quinto – Los Banos under Los Banos – Tesla 500 kV N-1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	0	0	0	0	0	0	0	0	0	5	7	8	6	6	4	2	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	8	18	10	11	12	9	7	7	2	0	0	0	0	0	1	0
Mar	0	0	0	0	0	0	0	3	12	17	14	13	16	14	10	7	1	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	1	3	5	7	8	6	3	6	3	2	2	0	0	0	0	1	1	1
May	0	0	0	0	0	0	3	3	1	2	3	3	3	0	0	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	3	2	3	3	3	6	4	4	5	5	4	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1	0	0	0	0	0	0
Aug	0	0	0	0	0	0	1	1	0	0	1	0	0	2	4	0	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	1	4	9	12	11	9	7	8	8	9	1	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	12	11	8	11	10	11	13	12	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	4	16	19	18	14	12	6	2	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	3	6	9	7	6	3	0	0	0	0	0	0	0	0	0

Panoche – Gates under Gates – Gregg and Gates – McCall N-2

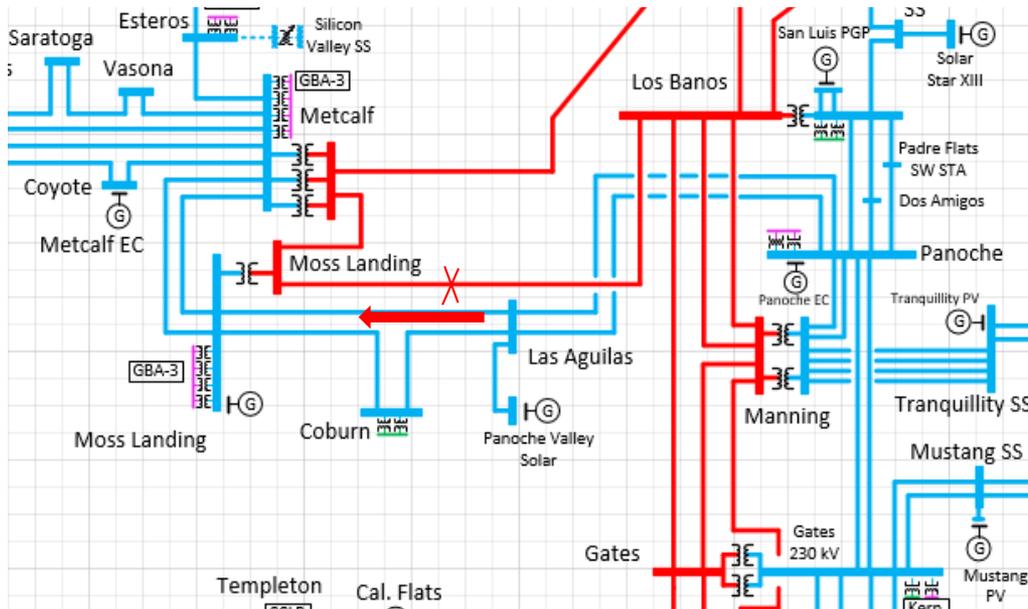
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	0	0	0	0	0	0	0	0	6	12	15	18	17	18	17	13	0	0	0	0	0	1	0	0
Feb	0	0	0	0	0	0	0	1	17	21	25	23	23	23	22	18	4	0	0	0	0	0	1	0
Mar	0	0	0	0	0	0	0	10	17	18	18	20	17	21	19	14	7	0	0	0	1	0	0	0
Apr	0	0	0	0	0	0	0	2	5	4	8	11	9	10	9	7	2	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	4	7	8	8	7	9	8	8	5	5	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	1	4	9	9	9	9	8	7	10	14	13	3	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	1	4	4	4	2	3	5	5	5	3	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	3	12	15	14	15	13	11	14	9	3	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	4	20	19	19	18	20	19	20	16	2	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	10	19	24	23	25	20	20	5	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	3	16	22	23	22	19	17	17	11	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	7	15	18	18	19	18	13	6	0	0	0	0	1	0	0	0

Tesla – Westley 230 kV

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	4	8	6	6	3	3	3	3	2	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	2	7	14	15	10	10	10	9	6	4	2	2	0	0	0	0	0	0
Jun	0	0	0	0	0	0	2	3	3	5	4	6	5	3	3	6	11	5	0	0	0	0	2	1
Jul	0	0	0	0	0	0	0	1	2	1	3	4	6	8	11	12	8	4	1	5	5	1	0	0
Aug	0	0	0	0	0	0	0	3	5	9	8	7	6	11	11	5	4	4	7	6	3	0	0	0
Sep	0	0	0	0	0	0	0	4	11	13	12	11	11	6	11	16	3	1	1	4	4	0	0	0
Oct	0	0	0	0	0	0	0	1	17	24	26	18	10	8	7	3	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0

PG&E Mosslanding – Las Aguilas 230 kV congestion under 500 kV N-1

Constraints Name	Costs (\$K)	Duration (Hrs)	From Bus Name	From Bus ID	To Bus Name	To Bus ID	CKT
MOSSLNSW-LASAGLSRCTR 230 kV line, subject to PG&E N-1 Moss Landing-LosBanos 500 kV	199,368	2,582	MOSSLNSW	30755	LASAGLSRCTR	30798	1



- Congestion happened under the N-1 contingency of the Moss Landing – Los Banos 500 kV line, when flow direction is from Las Aguilas to Moss Landing

PG&E Mosslanding – Las Aguilas 230 kV congestion under 500 kV N-1

- Congestion significantly increased compared with the last TPP results, mainly due to high volume of CPUC portfolio resources in the Fresno/Kern areas
- Congestion was observed in every month of the year, and mostly in solar hours

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	0	0	0	0	0	0	0	0	0	1	5	6	8	7	6	5	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	8	15	13	15	21	21	21	16	3	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	3	15	15	19	18	18	21	19	15	9	0	0	0	0	0	0	0
Apr	2	1	1	1	2	1	16	25	26	24	24	24	24	26	24	24	21	7	1	2	3	6	11	8
May	1	0	1	1	1	2	22	28	28	30	30	29	29	28	26	24	18	6	0	1	1	5	8	8
Jun	0	1	0	0	0	7	29	27	28	29	29	28	27	29	27	25	24	15	3	1	3	6	13	16
Jul	0	0	1	0	0	0	19	25	29	28	29	28	28	26	28	28	22	12	0	0	0	0	0	0
Aug	0	0	0	0	0	0	7	29	30	31	31	31	31	31	30	28	21	4	0	0	0	1	1	2
Sep	0	1	0	0	0	0	2	25	29	29	29	29	29	29	29	29	16	0	0	0	3	2	0	2
Oct	0	0	0	0	0	0	0	9	23	26	28	28	29	27	26	24	0	0	0	2	2	3	0	1
Nov	0	0	0	0	0	0	0	0	6	12	13	14	16	15	13	5	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	3	5	9	10	9	6	3	0	0	0	0	0	0	0	0

Path 26 Corridor congestion

Constraints Name	Cost Forward (\$K)	Duration Forward (Hrs)	Cost Backward (\$K)	Duration Backward (Hrs)	Costs Total (\$K)	Duration Total (Hrs)
Midway – Whirlwind 500 kV line, subject to SCE N-2 Midway-Vincent 500 kV	7,356	287	162,084	3,250	169,440	3,537
Midway – Whirlwind 500 kV line	0	0	18,973	787	18,973	787
Midway -VINCENT 500 kV line #2	305	27	0	0	305	27
Midway – Whirlwind 500 kV line, subject to SCE N-1 Midway-Vincent #2 500kV	35	16	230	10	265	26
Midway - Vincent #1 500 kV line, subject to SCE N-1 Midway-Vincent #2 500kV	8	3	0	0	8	3
P26 Northern-Southern California	3	7	0	0	3	7
Midway - VINCENT 500 kV line #1	1	1	0	0	1	1

- Congestion mainly occurred when flow is from south to north
 - S. CA battery discharging in evening contributes to night time congestion
 - S. CA wind also contributes to night time congestion
- Majority of Path 26 corridor congestion occurred on Midway – Whirlwind 500 kV line
 - Summer normal rating of PG&E’s section
 - 4-hour emergency rating also used
 - 30-minute emergency rating could be applicable to mitigate the congestion under N-2 contingency, but congestion may shift to normal rating binding or to Path 26 path rating binding

Path 26 corridor congestion patterns

Midway – Whirlwind congestion occurrences under N-2 contingency when flow is from south to north

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	11	6	8	6	7	5	4	21	28	26	26	21	19	21	20	21	22	19	21	28	28	28	27	30
Feb	4	3	3	1	3	0	1	16	14	11	8	6	5	4	4	7	7	18	20	21	22	24	25	25
Mar	13	14	12	12	10	10	16	27	27	25	23	19	18	18	18	19	18	22	24	25	28	28	28	27
Apr	5	5	4	3	7	7	14	18	17	16	14	16	16	15	19	16	11	2	11	18	19	21	21	21
May	5	3	3	4	3	9	8	7	7	6	4	6	5	7	5	1	1	0	11	17	14	16	14	14
Jun	2	3	1	2	2	3	7	6	5	4	4	4	3	3	2	2	2	1	5	11	19	16	15	16
Jul	2	1	0	0	1	4	6	5	4	4	3	4	3	3	1	2	4	3	7	11	14	10	10	9
Aug	0	1	0	0	0	2	17	5	2	2	2	2	2	1	0	0	0	3	6	9	14	15	13	15
Sep	4	1	0	0	1	1	14	11	1	1	1	1	1	1	1	0	7	11	12	15	14	14	14	15
Oct	5	6	6	7	7	3	12	18	3	1	1	0	0	0	1	3	10	14	13	14	14	14	18	18
Nov	17	15	14	14	13	12	13	27	27	23	18	16	15	15	15	20	29	24	26	27	28	28	29	29
Dec	8	7	4	5	5	3	2	15	23	22	21	19	19	19	17	17	24	18	22	24	22	27	25	27

Midway – Whirlwind congestion occurrences under normal condition flow from south to north

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr	13	13	11	9	9	10	6	3	5	4	3	2	2	0	1	6	5	3	4	6	6	13	7	7
May	2	2	1	1	2	1	6	6	7	6	5	5	2	3	3	3	1	2	7	10	15	21	21	14
Jun	1	1	1	1	1	2	2	5	5	3	1	1	1	2	4	4	5	4	16	20	23	27	26	18
Jul	0	0	0	0	0	0	0	2	3	2	1	1	0	2	2	5	6	10	9	10	16	14	11	7
Aug	0	0	0	0	0	0	1	6	2	0	0	0	2	2	2	5	4	8	7	10	14	13	12	6
Sep	0	0	0	0	0	0	0	2	3	0	0	0	0	1	1	3	1	3	5	11	14	12	10	5
Oct	0	0	0	0	0	0	0	2	4	1	2	3	1	1	1	2	3	2	4	5	8	7	4	3
Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Midway – Whirlwind congestion occurrences under N-2 contingency when flow is from north to south

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0
May	0	0	0	0	0	0	0	0	0	0	4	6	9	6	7	10	7	5	0	0	0	0	0	0
Jun	1	0	2	2	1	0	0	0	1	1	3	2	4	6	8	5	3	2	0	0	0	0	0	0
Jul	0	0	0	1	0	1	1	9	13	17	17	17	15	14	12	5	3	0	2	0	0	0	1	0
Aug	0	0	0	0	0	0	0	2	4	8	7	6	6	6	1	0	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0	2	3	3	3	3	3	2	0	1	2	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SWIP North congestion

- Flow is south to north (Robinson Summit to Midpoint), and mainly happened in solar hours, which is coincident with the solar generation surplus in California and other southwest regions

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	2	2	2	2	2	1	2	2	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	1	3	5	5	6	5	4	5	4	3	0	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	1	1	2	2	2	3	5	3	0	0	0	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	2	3	5	7	6	3	1	1	0	0	0	0	0	0	0	0	0	0
Jul	0	0	0	0	0	0	3	4	3	3	4	3	2	0	0	0	0	0	0	0	0	0	0	0
Aug	0	0	0	0	0	2	5	6	5	5	6	8	8	6	2	0	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	3	9	13	12	10	11	11	10	10	5	0	0	0	0	0	0	0	0	0
Oct	0	0	0	0	0	1	11	14	15	15	14	13	13	13	7	1	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	3	2	1	1	1	2	2	2	0	0	0	0	0	0	0	0	0	0
Dec	0	0	1	1	1	1	0	1	3	3	3	3	3	2	2	1	0	0	0	0	0	0	0	0

- Out-of-state geothermal generators, which were mapped close to the Robinson Summit substation, in the CPUC portfolio also contributed to the congestion

SCE Northern area congestion

Constraints Name	Cost Forward (\$K)	Duration Forward (Hrs)	Cost Backward (\$K)	Duration Backward (Hrs)	Costs Total (\$K)	Duration Total (Hrs)
WINDHUB_A 230/13.8 kV transformer #1	15,053	788	0	0	15,053	788
VINCNT2-WINDSTAR1 230 kV line #1	0	0	3,568	533	3,568	533
PARDEE-VINCENT 230 kV line #2	0	0	1,466	216	1,466	216
VINCENT-vincen1i 500 kV line, subject to SCE N-1 Vincent Transformer 500 kV #4	963	126	0	0	963	126
WINDHUB_A 230/13.8 kV transformer #2	256	34	0	0	256	34
VINCNT2-vincen1i 230 kV line, subject to SCE N-1 Vincent Transformer 500 kV #4	0	0	164	25	164	25
MAGUNDEN-ANTELOPE 230 kV line #1	0	0	110	169	110	169
PARDEE-S.CLARA 230 kV line, subject to SCE N-2 MOORPARK-SCLARA #1 and #2 230 kV	14	58	0	0	14	58
VINCNT2-S.CLARA 230 kV line, subject to SCE N-2 MOORPARK-SCLARA #1 and #2 230 kV	14	10	0	0	14	10
MAGUNDEN-VESTAL 230 kV line, subject to SCE N-1 Magunden-Vestal #1 230kV	6	16	0	0	6	16
PARDEE-SYLMAR220 230 kV line, subject to SCE N-1 Sylmar-Pardee 230kV	0	0	2	1	2	1

Most of SCE Northern area congestion are local issues related to portfolio resource busbar mapping

SCE Metro congestion

Constraints Name	Cost Forward (\$K)	Duration Forward (Hrs)	Cost Backward (\$K)	Duration Backward (Hrs)	Costs Total (\$K)	Duration Total (Hrs)
LCIENEGA-LA FRESA 230 kV line, subject to SCE N-2 La Fresa-El Nido #3 and #4 230 kV	0	0	19,127	228	19,127	228

- SCE Metro congestion was observed mainly on the La Cienega – La Fresa 230 kV line under the N-2 contingency of the La Fresa – El Nido 230 kV lines when the flow is from La Fresa to La Cienega
- There is a LCR sub area that including load on El Nido and La Cienega buses
- Thermal generator retirement inside this sub area aggravated the congestion

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Jan	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	1	3	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0
Mar	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	3	1	1	1	1	0
Apr	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	3	1	0	0	0
May	0	0	0	0	0	0	0	0	1	1	1	1	0	1	1	3	2	1	2	3	5	3	0	0
Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	6	3	4	10	6	1	0	0
Jul	0	0	0	0	0	0	0	2	0	1	3	7	1	1	6	3	0	0	1	1	0	2	0	0
Aug	0	0	0	0	0	0	0	1	1	0	2	4	2	6	3	4	7	2	1	0	0	0	0	0
Sep	0	0	0	0	0	0	0	2	2	0	0	0	4	6	6	12	6	0	1	1	1	0	0	0
Oct	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	0
Nov	1	1	1	1	1	1	1	4	4	2	0	0	0	0	0	0	1	0	0	0	0	1	1	1
Dec	0	0	0	0	0	0	1	2	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0

East of Pisgah congestion

Constraints Name	Cost Forward (\$K)	Duration Forward (Hrs)	Cost Backward (\$K)	Duration Backward (Hrs)	Costs Total (\$K)	Duration Total (Hrs)
ELDORDO-MCCULLGH 500 kV line, subject to SCE N-1 Eldorado-Lugo 500 kV with RAS	8,331	918	0	0	8,331	918
LUGO-VICTORVL 500 kV line, subject to SCE N-1 Eldorado-Lugo 500 kV with RAS	0	0	3,468	37	3,468	37
P61 Lugo-Victorville 500 kV Line	1,293	18	419	84	1,711	102
SLOAN_CYN_5-ELDORDO 500 kV line #1	588	55	0	0	588	55
ELDORDO-MCCULLGH 500 kV line, subject to SCE N-1 Lugo-Mohave 500 kV	387	48	0	0	387	48
ELDORDO-MCCULLGH 500 kV line, subject to SCE N-1 Eldorado-Mohave 500 kV	24	6	0	0	24	6
GAMEBIRD-GAMEBIRD 230 kV line, subject to VEA N-2 Pahrump-Gamebird 230 kV no RAS	0	0	18	30	18	30
IVANPAH-MTN PASS 115 kV line #1	15	28	0	0	15	28
ELDORDO-MCCULLGH 500 kV line, subject to SCE N-1 Eldorado-Moenkopi 500 kV	12	2	0	0	12	2

Gridliance/VEA area portfolio resource capacity in the 2034 base portfolio is about 2000 MW less than the 2035 base portfolio that was studied in the last TPP

This preliminary PCM did not model any Eldorado – McCullough 500 kV short circuit duty mitigation

SDG&E area congestion

Constraints Name	Cost Forward (\$K)	Duration Forward (Hrs)	Cost Backward (\$K)	Duration Backward (Hrs)	Costs Total (\$K)	Duration Total (Hrs)
P45 SDG&E-CFE	6,806	1,070	1,669	127	8,475	1,197
ECO 500/500kV transformer #1	0	0	3,421	353	3,421	353
SILVERGT-BAY BLVD 230 kV line, subject to SDGE N-2 Miguel-Mission 230 kV #1 and #2	0	0	1,714	122	1,714	122
SANLUSRY-S.ONOFRE 230 kV line, subject to SDGE N-2 SLR-SO 230 kV #2 and #3 with RAS	0	0	1,563	311	1,563	311
OTAYMESA-TJI-230 230kV line #1	0	0	396	64	396	64
SILVERGT-OLD TOWN 230 kV line, subject to SDGE N-1 Silvergate-OldTown-Mission 230kV no RAS	120	27	0	0	120	27
SANLUSRY-OCEAN RANCH 69 kV line, subject to SDGE N-2 EN-SLR and EN-SLR-PEN 230 kV with RAS	89	527	0	0	89	527
SILVERGT-OLDTWNTP 230 kV line, subject to SDGE N-1 Silvergate-OldTown 230kV no RAS	73	46	0	0	73	46
IMPRLVLY-IV PFC1 230 kV line, subject to SDGE N-2 Sycamore-OtayMesa-Miguel and BayBlvd-OtayMesa-Miguel 230kV	0	0	61	25	61	25
TALEGA-S.ONOFRE 230 kV line #1	0	0	34	137	34	137
ESCNDIDO-VC69_TP 69 kV line, subject to SDGE N-2 EN-SLR and EN-SLR-PEN 230 kV with RAS	0	0	8	79	8	79
IV PFC1 230/230kV transformer #1	7	8	0	0	7	8
ECO 230/500kV transformer #1	5	16	0	0	5	16
LILAC-PALA 69 kV line, subject to SDGE N-2 EN-SLR and EN-SLR-PEN 230 kV with RAS	2	55	0	0	2	55
IV PFC1 230/230kV transformer #2	2	1	0	0	2	1

- ECO transformer congestion is attributed to the portfolio resources that were mapped on the low voltage buses of ECO substation
- San Luis Rey – S.Onofre congestion was observed when the flow is from S. Onofre to San Luis Rey as the IV - North of SONGS upgrade was

PG&E North Valley area congestion

Constraints Name	Cost Forward (\$K)	Duration Forward (Hrs)	Cost Backward (\$K)	Duration Backward (Hrs)	Costs Total (\$K)	Duration Total (Hrs)
BRNY_FST_JCT-PIT 1 230 kV line, subject to PG&E N-1 Carberry-RM with HR SPS	0	0	5,596	477	5,596	477
CARBERY-ROUND MT 230 kV line #1	2,432	192	0	0	2,432	192
CARBERY-ROUND MT 230 kV line, subject to PG&E N-1 Pit-Cottonwood 230 kV with HR SPS	1,520	165	0	0	1,520	165
CORTINA-VACA-DIX 230 kV line, subject to PG&E N-1 Delevn-Cortina 230 kV	1,295	590	0	0	1,295	590
CARBERY-ROUND MT 230 kV line, subject to PG&E N-2 Pit-CotwdF and CotwdE-RM 230 kV with HR SPS	1,185	124	0	0	1,185	124
COTWD_F2-BRNY_FST_JCT 230 kV line, subject to PG&E N-1 Carberry-RM with HR SPS	0	0	931	114	931	114
COTWD_E-ROUND MT 230 kV line, subject to PG&E N-1 RoundMtn Xfmr 500 kV	0	0	13	2	13	2
CORTINA-VACA-DIX 230 kV line, subject to PG&E N-2 LoganCR-Delevn and Delevn-Cortina 230 kV	12	20	0	0	12	20
PIT 7JT2-ROUND MT 230 kV line #1	9	5	0	0	9	5

CPUC portfolio resources in the PG&E North Valley area are the main driver of the congestion in this area

PG&E Fresno and Kern area congestion

Constraints Name	Cost Forward (\$K)	Duration Forward (Hrs)	Cost Backward (\$K)	Duration Backward (Hrs)	Costs Total (\$K)	Duration Total (Hrs)
GATES D-CALFLATSSS 230 kV line #1	0	0	3,738	714	3,738	714
SANGER-MCCALL 115 kV line #3	0	0	380	34	380	34
KINGSBURGD-CONTADNA 115 kV line #1	0	0	252	19	252	19
HERNDON-CHLDHOSP_JCT 115 kV line #1	35	12	0	0	35	12
GREGG-HENTAP1 230 kV line, subject to PG&E N-1 Wilson-Warnerville 230kV	0	0	14	6	14	6
MCMULLN1-KEARNEY 230 kV line, subject to PG&E N-2 Mustang-Gates#1 and #2 230 kV	8	10	0	0	8	10
GREGG-HENTAP1 230 kV line #1	0	0	4	8	4	8
GREGG-HENTAP1 230 kV line, subject to PG&E N-1 Gregg-Borden #1 230kV	0	0	1	1	1	1
GATES D-TEMPLETN 230 kV line #1	0	0	1	5	1	5
HENTAP1-MUSTANGSS 230 kV line #1	0	0	1	6	1	6
ARCO-MIDWAY-E 230 kV line #1	0	0	0	4	0	4
LPRNJCTSS-GWFHANFORDSS 115 kV line #1	0	1	0	0	0	1
GWFHANFORDSS-CONTADNA 115 kV line #1	0	2	0	0	0	2
SLATE-MUSTANG3N4 230 kV line #1	0	1	0	0	0	1
HENRETTA-LPRNJCTSS 115 kV line #1	0	1	0	0	0	1

PG&E Bay area congestion

Constraints Name	Cost Forward (\$K)	Duration Forward (Hrs)	Cost Backward (\$K)	Duration Backward (Hrs)	Costs Total (\$K)	Duration Total (Hrs)
E. SHORE-SANMATEO 230 kV line, subject to PG&E N-2 Newark-Ravenswood 230kV and Tesla-Ravenswood 230kV	2,176	233	0	0	2,176	233
USWP-JRW_JCT-CAYETANO 230 kV line, subject to PG&E N-2 C.Costa-Moraga 230 kV	852	49	0	0	852	49
LS ESTRS 230/230 kV transformer #1	534	816	0	0	534	816
EIGHT MI-STAGG-J1 230 kV line, subject to PG&E N-1 EightMiles-TeslaE 230kV	58	4	0	0	58	4
LS PSTAS-NEWARK D 230 kV line, subject to PG&E N-2 C.Costa-Moraga 230 kV	25	4	0	0	25	4
C.COSTAPPE-BDLSWSTA 230 kV line#1	0	0	20	1	20	1
DELTAPMP-SANDHLWJCT 230 kV line#1	0	0	11	4	11	4

Renewable curtailment in the 2034 Base portfolio PCM

Renewable zone	Generation (GWh)	Curtailment (GWh)	Total potential (GWh)	Curtailment Ratio
SCE Northern	31,305	1,210	32,516	3.72%
SCE Eastern	20,205	256	20,461	1.25%
PG&E Fresno	15,024	3,313	18,337	18.07%
SDG&E Eastern and Bulk	14,239	385	14,624	2.63%
OSW-Diablo	14,056	78	14,134	0.55%
East of Pisgah	12,860	489	13,349	3.67%
PG&E Central Valley	11,161	328	11,488	2.85%
OOS W-WY	10,813	416	11,229	3.71%
SCE North of Lugo	10,675	369	11,044	3.34%
OOS W-SunZia	8,404	1,154	9,558	12.07%
NM	4,797	1,905	6,702	28.42%
PG&E Kern	5,970	404	6,375	6.34%
OSW-Humboldt	4,724	28	4,752	0.59%
PG&E Central Coast	4,085	287	4,372	6.56%
PG&E North Valley	3,431	83	3,515	2.37%
OOS W-ID	2,808	132	2,939	4.48%
AZ	1,973	780	2,753	28.33%
SCE Metro	2,176	65	2,241	2.90%
IID	1,407	3	1,410	0.21%
PG&E Greater Bay Area	1,223	33	1,256	2.67%
San Diego	713	3	716	0.43%
NW	555	27	582	4.69%
SMUD	394	14	408	3.42%
PG&E North Coast	391	6	397	1.54%
NV	337	39	376	10.45%
Total	183,796	11,811	195,607	6.04%

- Overall curtailment amount reduced from the last TPP cycle's results, mainly due to load growth and battery capacity increase

2039 Base portfolio preliminary PCM results

2039 Base portfolio preliminary PCM – congestion

Area or branch group	Total Congestion Cost (\$M)	Total Congestion Hours (Hrs)
PG&E Moss Landing-Las Aguilas 230 kV	407.59	3,932
Path 15 Corridor	203.31	5,611
Path 26 Corridor	139.54	4,021
SCE Metro	85.32	1,617
SCE Northern	79.26	4,130
East of Pisgah	51.66	3,311
SWIP North	38.40	483
SCE North of Lugo	24.46	6,206
PG&E GBA	15.98	1,651
Path 65 PDCI	15.86	1,358
SDG&E/CFE	15.11	1,798
SDG&E 230 kV	11.50	1,329
PG&E North Valley 230 kV	11.23	1,247
PG&E Fresno 115 kV	10.98	513
Path 41 Sylmar transformer	10.65	404
Path 42	10.38	506
SCE Eastern	8.61	247
Path 46 WOR	8.57	179
SCE Antelope 66kV	7.35	1,815
PG&E MorroBay 230 kV	6.62	905
PG&E Kern 230kV	5.41	1,017
SDG&E Bulk	3.72	427
PG&E Sierra	2.10	447
COI Corridor	1.56	50
PG&E Fresno 230 kV	0.44	205
Moenkope - Eldorado 500 kV	0.43	18
Path 25 PACW-PG&E 115 kV	0.39	36
PG&E Tesla 230 kV	0.11	5
PG&E Tesla-Metcalf 500kV	0.06	4
PG&E Collinsville corridor	0.06	12
SDG&E Northern 69 kV	0.04	208
SCE Vincent-MiraLoma 500kV	0.03	2
SCE Lugo - Vincent 500 kV	0.03	11
PG&E VacaDixon 230kV	0.01	2

Comparison between 2034 and 2039 Base portfolio PCM congestion results

Area or Branch Group	Congestion Cost (\$M) 2034 Base	Congestion Cost (\$M) 2039 Base	Change in Congestion Cost \$M
PG&E Moss Landing-Las Aguilas 230 kV	199.37	407.59	208.22
SCE Metro	19.13	85.32	66.19
SCE Northern	21.62	79.26	57.64
East of Pisgah	14.56	51.66	37.11
SCE North of Lugo	8.00	24.46	16.46
PG&E GBA	3.67	15.98	12.31
PG&E Fresno 115 kV	0.67	10.98	10.32
SCE Eastern	0.16	8.61	8.45
SDG&E 230 kV	3.50	11.50	7.99
Path 41 Sylmar transformer	2.78	10.65	7.88
Path 46 WOR	0.78	8.57	7.79
PG&E MorroBay 230 kV	0.00	6.62	6.62
SDG&E/CFE	8.94	15.11	6.17
Path 42	5.77	10.38	4.62
SCE Antelope 66kV	3.54	7.35	3.81
SWIP North	32.49	38.40	5.91
PG&E Kern 230kV	3.74	5.41	1.67
PG&E Sierra	0.99	2.10	1.11
PG&E North Valley 230 kV	12.99	11.23	-1.76
Path 65 PDCI	23.29	15.86	-7.42
Path 26 Corridor	189.00	139.54	-49.46
Path 15 Corridor	232.81	203.31	-29.50

- Changes in the CPUC portfolio resource assumption are the main drivers of the congestion changes from 2034 to 2039, notably
 - Humboldt Bay offshore wind increased
 - Additional 1500 MW of Wyoming wind in the 2039 Base portfolio was assumed to be directly delivered at the Tesla 500 kV bus
 - Gridliance/VEA area solar and battery increased
- Changes in load forecast also contributed to the congestion changes
 - Load modifiers (BTM PV, AAEE, AATE, and AAFS) significantly increased in the 2039 forecast

Renewable curtailment in the 2039 Base portfolio PCM

Renewable zone	Generation (GWh)	Curtailment (GWh)	Total potential (GWh)	Curtailment Ratio
SCE Northern	33,470	1,359	34,828	3.90%
SCE Eastern	23,791	391	24,182	1.62%
PG&E Fresno	18,055	5,461	23,516	23.22%
East of Pisgah	17,404	491	17,896	2.75%
PG&E Central Valley	17,272	396	17,668	2.24%
OOS W-SunZia	13,747	2,113	15,860	13.32%
SDG&E Eastern and Bulk	15,046	431	15,477	2.78%
OSW-Diablo	14,109	25	14,134	0.18%
SCE North of Lugo	12,292	503	12,795	3.93%
OOS W-WY	11,186	410	11,596	3.54%
PG&E Kern	9,848	453	10,301	4.40%
OSW-Humboldt	8,189	14	8,203	0.17%
NM	4,535	2,166	6,702	32.32%
OOS W-Tesla	5,752	46	5,798	0.80%
PG&E Central Coast	4,660	538	5,198	10.35%
PG&E North Valley	4,512	80	4,592	1.73%
SCE Metro	3,028	87	3,115	2.81%
OOS W-ID	2,829	110	2,939	3.76%
OOS W-NW	1,903	900	2,802	32.10%
AZ	1,861	891	2,753	32.38%
IID	1,409	0	1,410	0.03%
PG&E Greater Bay Area	1,244	12	1,256	0.99%
San Diego	714	2	716	0.25%
NW	561	21	582	3.64%
SMUD	399	9	408	2.30%
PG&E North Coast	395	2	397	0.49%
NV	335	42	376	11.05%
PG&E North Bay	59	1	60	1.16%
Total	228,617	16,956	245,573	6.90%

- The overall curtailment ratio in the 2039 Base portfolio PCM is similar to the 2034 Base portfolio PCM results, as both load and battery capacity increased along with the renewable capacity increase

2039 Sensitivity portfolio (high gas retirement) preliminary PCM results

2039 Sensitivity portfolio preliminary PCM – congestion

Area	Total Congestion Cost (\$M)	Total Congestion Hours (Hrs)
PG&E Moss Landing-Las Aguilas 230 kV	485.66	4,209
Path 26 Corridor	445.62	7,210
Path 15 Corridor	183.53	5,060
East of Pisgah	86.52	3,008
SCE Metro	76.38	1,910
SCE North of Lugo	73.67	9,624
SDG&E Bulk	62.30	1,947
Path 65 PDCI	61.50	3,273
Path 41 Sylmar transformer	50.70	801
SDG&E/CFE	32.93	2,597
SCE Northern	32.13	3,621
SWIP North	31.33	408
PG&E GBA	29.29	2,038
PG&E North Valley 230 kV	12.99	1,363
PG&E MorroBay 230 kV	9.25	1,224
SDG&E 230 kV	9.11	915
SCE Eastern	7.55	156
Path 46 WOR	7.25	122
PG&E Sierra	5.75	1,093
PG&E Fresno 115 kV	5.37	463
COI Corridor	2.99	70
SCE Antelope 66kV	2.49	1,001
Moenkope - Eldorado 500 kV	1.07	25
PG&E Fresno 230 kV	0.86	237
Path 25 PACW-PG&E 115 kV	0.53	39
Path 49 EOR	0.22	1
Path 42	0.21	99
PG&E Kern 230kV	0.17	465
PG&E Collinsville corridor	0.13	9
SCE Lugo - Vincent 500 kV	0.09	33
SDG&E Northern 69 kV	0.08	228
PG&E Tesla 230 kV	0.03	13
PG&E Tesla-Metcalf 500 kV	0.02	1

Comparison between 2039 Base and Sensitivity portfolios PCM congestion results

Area or Branch Group	Congestion Cost (\$M) 2039 Base	Congestion Cost (\$M) 2039 Sensitivity	Change in Congestion Cost \$M
Path 26 Corridor	139.54	445.62	306.08
PG&E Moss Landing-Las Aguilas 230 kV	407.59	485.66	78.06
SCE North of Lugo	24.46	73.67	49.21
Path 41 Sylmar transformer	10.65	50.70	40.04
East of Pisgah	51.66	86.52	34.85
Path 65 PDCI	15.86	61.50	45.63
SDG&E/CFE	15.11	32.93	17.82
PG&E GBA	15.98	29.29	13.30
PG&E Sierra	2.10	5.75	3.65
PG&E MorroBay 230 kV	6.62	9.25	2.63
PG&E North Valley 230 kV	11.23	12.99	1.76
SCE Eastern	8.61	7.55	-1.06
Path 46 WOR	8.57	7.25	-1.32
SDG&E 230 kV	11.50	9.11	-2.39
SCE Antelope 66kV	7.35	2.49	-4.86
SWIP North	38.40	31.33	-7.07
PG&E Kern 230kV	5.41	0.17	-5.24
PG&E Fresno 115 kV	10.98	5.37	-5.61
SCE Metro	85.32	76.38	-8.93
Path 42	10.38	0.21	-10.17
Path 15 Corridor	203.31	183.53	-19.77
SCE Northern	79.26	32.13	-47.12

- Resource assumption and mapping changes are the main reason of the changes of congestion in the 2039 sensitivity portfolio PCM
- Renewable and battery in the SCE, SDG&E and Gridliance/VEA areas increased, and off shore wind were removed from the portfolio
 - which contributed to the increase of congestion in these areas and the Path 26 corridor
- The addition of generic resources at the Vincent 230 kV helped to reduce Vincent transformer (SCE Northern) congestion
- The increase of Fresno solar capacity aggravated the Moss Landing – Las Aguilas congestion

Renewable curtailment in the 2039 Sensitivity portfolio PCM

Renewable zone	Generation (GWh)	Curtailment (GWh)	Total potential (GWh)	Curtailment Ratio
SCE Northern	39,603	3,440	43,043	7.99%
SCE Eastern	30,902	257	31,159	0.82%
PG&E Fresno	21,314	4,604	25,917	17.76%
SDG&E Eastern and Bulk	21,114	767	21,880	3.50%
East of Pisgah	20,968	557	21,525	2.59%
SCE North of Lugo	13,910	1,703	15,612	10.91%
OOS W-SunZia	11,816	1,667	13,483	12.36%
PG&E Central Valley	13,057	138	13,194	1.04%
OOS W-WY	11,197	399	11,596	3.44%
PG&E Kern	10,372	54	10,425	0.51%
NM	4,742	1,960	6,702	29.24%
PG&E North Valley	5,347	5	5,352	0.09%
PG&E Central Coast	4,784	141	4,925	2.86%
SCE Metro	4,292	145	4,437	3.28%
OOS W-ID	2,871	68	2,939	2.32%
AZ	1,933	820	2,753	29.79%
IID	1,410	0	1,410	0.00%
PG&E Greater Bay Area	1,269	1	1,270	0.06%
San Diego	714	2	716	0.29%
NW	579	4	582	0.61%
SMUD	408	0	408	0.11%
PG&E North Coast	397	0	397	0.03%
NV	342	34	376	9.08%
PG&E North Bay	60	0	60	0.00%
PG&E Humboldt	12	0	12	0.00%
Total	223,410	16,764	240,174	6.98%

- Curtailment ratio in the 2039 Sensitivity portfolio PCM is similar to the ratio in the 2039 Base portfolio PCM
 - Total amount of renewable capacity increased, but also more gas generators retired
- Resource allocation in some local areas may aggravate congestion and curtailment, for example, resources at Calcite in the SCE North of Lugo area were curtailed due to congestion on the Calcite-Lugo 230 kV line

Next Steps

Economic planning study requests received

No.	Study Request	Submitted By	Location
1	Pacific Transmission Expansion Project (PTE)	California Western Grid Development, LLC	Northern/Southern California
2	New 500 kV line from Colorado River - Red Bluff - Devers - Mira Loma	EDF Renewables North America	Southern California
3	Upgrades on PG&E 500 kV lines to add new circuits on segments • Los Banos-Gates 500kV • Gates-Midway 500kV • Tesla-Los Banos 500kV • Gates-Diablo 500kV	EDF Renewables North America	Northern California
4	New 500 kV line from Midway to Gregg and Gregg to Table Mountain	EDF Renewables North America	Northern California
5	Third Red Bluff transformer	EDF Renewables North America	Southern California
6	230 kV Red Bluff tap to Buck Blvd - J. Hinds	EDF Renewables North America	Southern California
7	Third Devers transformer	EDF Renewables North America	Southern California
8	Fourth Whirlwind transformer	EDF Renewables North America	Southern California
9	Temporary reconfiguration solutions to relieve Devers 500/230 kV transformer congestion	EDF Renewables North America	Southern California
10	Monarch 500 kV Transmission Project associated with the Fresno County solar plus storage projects in the WAPA SNR queue	Golden State Clean Energy, LLC (“GSCE”)	Northern California
11	Del Amo to El Nido Underground HVDC Line project	Grid United LLC	Southern California
12	Del Amo to El Nido Underground 230 kV AC Line project	Grid United LLC	Southern California
13	Kern-Southland Energy Link (K-SEL) project (Midway – Pardee – El Nido HVDC)	Kern-Southland Energy Link LLC	Southern California
14	Sloan Canyon- Mead	GridLiance West	Southern Nevada
15	GLW Upsize to Sagebrush	GridLiance West	Southern Nevada
16	Mead- Mohave	GridLiance West	Southern Nevada
17	GLW Upsize to Esmeralda	GridLiance West	Southern Nevada

Preliminary list of high priority study areas to receive detailed consideration

- Preliminary high priority study areas were proposed based on the preliminary production cost simulation results for the base portfolio and the economic study requests:
 - PG&E Mosslanding - Las Aguilas 230 kV congestion
 - Path 15 corridor congestion
 - Path 26 corridor congestion
 - SCE Metro congestion
 - GridLiance/VEA area and SCE East of Pisgah area congestion
- The list may change with considering stakeholder comments and detailed planning study results

Next steps of PCM simulation and economic assessment

- Continue to develop and enhance the CAISO Planning PCM, including but not limited to
 - Incorporating applicable WECC 2034 ADS PCM updates
 - Updating transmission constraints identified in the reliability and policy studies
 - Incorporating transmission upgrades to be recommended for approval in this TPP cycle
- Conduct economic assessment for identified high priority upgrades or studies



2024 MIC Expansion Requests

Catalin Micsa

Senior Advisor, Transmission Infrastructure Planning

2024-2025 Transmission Planning Process Stakeholder Meeting

November 13, 2024

2024 Valid MIC expansion requests

No.	Requestor Name	Intertie Name (Scheduling Point)	MW quantity	Resource type
1-2	Southern California Edison	BLYTHE_ITC (BLYTHE161)	22.7	Hydro
3	Clean Power Alliance	IPPDCADLN_ITC (IPP & IPPUTAH)	33	Geothermal
4		MEAD_ITC (MEAD230)	118.95	Wind
5-6	Valley Electric Association	MEAD_ITC (MEAD230)	24	Hydro
7			90	Solar/Battery
8	California Community Power	SUMMIT_ITC (SUMMIT120)	18	Geothermal
		MERCHANT_ITC (ELDORADO230) Back-up		
9		IID-SDGE_ITC (IMLY2)	107	
		IID-SCE_ITC (MIR2) Back-up		
10	SILVERPK_ITC (SILVERPEAK55)	13		
11	Ava Community Energy	PALOVRDE_ITC (PWEST)	99.13	Wind
12			42.5	Solar/Battery
13	San Diego Community Power	ELDORADO_ITC (WILLOWBEACH)	20.22	Wind
14-15		PALOVRDE_ITC (PWEST)	79.70	
16		IID-SCE_ITC (MIR2)	145.5	Solar/Battery
17		IID-SDGE_ITC (IMLY2)	35	
18		BLYTHE_ITC (BLYTHE161)	160	

Not all MIC expansion requests trigger an actual need for expansion

- First the CAISO checks if these resources were included in the base portfolio in order to avoid duplicate entries.
- Second the CAISO calculates if a MIC expansion is needed (see methodology in RR BPM section 6.1.3.5).
- If MIC expansion is needed, the increase in MIC needs to be modeled and tested through deliverability studies
 - NQC deliverability study (if applicable in year one)
 - TPP deliverability study
 - GIP deliverability study
- One or multiple of these studies can limit the deliverability and therefore the MIC expansion.

Assessment of valid 2024 MIC expansion requests

No.	Requestor Name	Intertie Name (Scheduling Point)	MW Quantity	Triggers Expansion	Comments
1-2	Southern California Edison	BLYTHE_ITC (BLYTHE161)	22.7	Yes	Partial
3	Clean Power Alliance	IPPDCADLN_ITC (IPP & IPPUTAH)	33	In CPUC portfolio	
4		MEAD_ITC (MEAD230)	118.95		
5-6	Valley Electric Association	MEAD_ITC (MEAD230)	24	Yes	Full
7			90		
8	California Community Power	SUMMIT_ITC (SUMMIT120)	18	In CPUC portfolio	Active as back-up location only
9		MERCHANT_ITC (ELDORADO230) Back-up IID-SDGE_ITC (IMLY2)			107
		IID-SCE_ITC (MIR2) Back-up	Active as back-up location only		
		SILVERPK_ITC (SILVERPEAK55)			
10		13			
11	Ava Community Energy	PALOVRDE_ITC (PWEST)	99.13	In CPUC portfolio	No need for expansion
12			42.5	No	
13	San Diego Community Power	ELDORADO_ITC (WILLOWBEACH)	20.22	In CPUC portfolio	
14		PALOVRDE_ITC (PWEST)	20.22		
15			59.48		
16		IID-SCE_ITC (MIR2)	145.5		
17		IID-SDGE_ITC (IMLY2)	35	Yes	Full
18		BLYTHE_ITC (BLYTHE161)	160	Yes	Full

2024 MIC Expansion Requests Being Assessed (not already part of the CPUC portfolio)

No.	Requestor Name	Intertie Name (Scheduling Point)	MW quantity	Resource type
1-2	Southern California Edison	BLYTHE_ITC (BLYTHE161)	8	Hydro
3-4	Valley Electric Association	MEAD_ITC (MEAD 230)	24	Hydro
5			90	Hybrid (Solar/Battery)
6-7	California Community Power	SUMMIT_ITC (SUMMIT120) *	18	Geothermal
		SILVERPK_ITC (SILVERPEAK55) **	13	Geothermal
8-9	San Diego Community Power	IID-SDGE_ITC (ILY2)	35	Hybrid (Solar/Battery)
		BLYTHE_ITC (BLYTHE161)	160	Hybrid (Solar/Battery)

* = As back-up locations only – main delivery point included as MEAD_ITC (MEAD230) and part of the CPUC portfolio.

** = As back-up locations only – main delivery point included as MONAIPPDC_ITC (MDWP) and part of the CPUC portfolio.

2025 NQC Deliverability Study Results For MIC Expansion Requests Being Assessed

Intertie Name (Scheduling Point)	Status	Comments:
BLYTHE_ITC (BLTHE161)	Pass	Temporary expansion included in 2025 MIC.
MEAD_ITC (MEAD 230)	Pass	Includes both CPUC portfolio and MIC expansion requests. Temporary expansion included in 2025 MIC.

- Only applicable to MIC expansion request across RA year 2025
- Permanent expansion depends on the TPP and GIP deliverability study results

TPP Deliverability Study Results

For MIC Expansion Requests Being Assessed

Intertie Name (Scheduling Point)	Status	Comments:
BLYTHE_ITC (BLYTHE161)	FAIL	For potential increase see mitigation for Lugo-Victorville constraint.
IID-SDGE_ITC (IVLY2)	PASS	Subject to various mitigations already in place.
MEAD_ITC (MEAD 230)	FAIL	Part included in the CPUC portfolio. For potential increase see mitigation for Eldorado-McCullough and Lugo-Victorville constraints.
SILVERPK_BG (SILVERPEAK55)	FAIL	Used as back-up only. For potential increase see mitigation for Control-Inyokern 115 kV lines (Control-Silver Peak) and Lugo-Victor #1 & #2 230 kV lines constraints.
SUMMIT_ITC (SUMMIT120)	TBD	Used as back-up only. Evaluation in progress. A higher amount in last cycle failed behind Drum-Higgins and PG&E 500 kV constraints.



Policy-driven Deliverability Assessment Preliminary Results

Transmission Infrastructure Planning

*2024-2025 Transmission Planning Process Stakeholder Meeting
November 13, 2024*

Introduction

- The 2024-2025 TPP policy-driven deliverability assessment is based on the base and high gas retirement sensitivity portfolios transmitted by CPUC for the years 2034 and 2039
 - Base Portfolio is based on a 25 MMT GHG target by 2035 and the 2022 CEC demand forecast utilizing the additional transportation electrification (ATE) assumptions
 - Sensitivity Portfolio is based on the same GHG target and load forecast intended to identify the transmission needs associated with 15.9 GW of natural gas retirements by 2039
- MIC expansion requests are also assessed as part of the studies
- The deliverability assessment consists of on-peak assessment (HSN and SSN) and Off-peak assessment

Introduction – Cont'd

- Alternatives considered to address on-peak deliverability constraints
 - RAS or other operating solutions
 - Reducing generic battery-storage where applicable
 - Transmission upgrade alternatives (HSN)
 - Transmission upgrade alternatives if they provide sufficient economic benefits (SSN)
- Alternatives considered to address off-peak deliverability constraints if constraint is not addressed by reducing thermal generation output to zero, dispatching existing energy storage in charging mode and reducing imports
 - RAS or other operating solutions
 - Dispatch portfolio energy storage in charging mode
 - Transmission upgrade alternatives if they provide sufficient economic benefits

Base and Sensitivity Portfolios by Resource Type

Resource Type	2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	8,501	10,715	19,216	10,878	19,608	30,486	21,324	30,614	51,938
Wind – In State	5,203	921	6,123	6,103	921	7,023	4,885	855	5,739
Wind – Out-of-State	6,096	0	6,096	9,096	0	9,096	7,066	0	7,066
Wind - Offshore	3,855	0	3,855	4,531	0	4,531	0	0	0
Li Battery – 4 hr	18,951	468	19,419	18,227	468	18,695	13,047	468	13,515
Li Battery – 8 hr	1,618	0	1,618	7,115	0	7,115	15,612	0	15,612
Long Duration Energy Storage (LDES)	1,030	0	1,030	1,080	0	1,080	3,680	0	3,680
Geothermal	1,969	0	1,969	1,969	0	1,969	5,089	0	5,089
Biomass/Biogas	171	0	171	171	0	171	22	0	22
Distributed Solar	260	0	260	283	0	283	335	0	335
Net Dependable Gas Capacity not Retained	(3,448)	0	(3,448)	(4,418)	0	(4,418)	(12,274)	0	(12,274)
Total	44,206	12,104	56,309	55,035	20,997	76,031	58,786	31,937	90,722

Portfolio Adjustments Based On CPUC Guidance

- Unaccounted for TPD allocation modeled (MW)

			TPD in key MIC regions unaccounted for by mapped resources (MWs)		
CAISO Study Area	Substation	Voltage	2034 Base	2039 Base	2039 Sensitivity
SCE Eastern Study Area	Alberhill	500	500	500	500
SCE Eastern Study Area	Cielo Azul	500	590	90	499
East of Pisgah Study Area	Eldorado	230	250	-	-
East of Pisgah Study Area	Mohave	500	1,020	1,020	1,240
East of Pisgah Study Area	Trout Canyon	230	1,000	527	975
Total			3,360	2,137	3,214

Portfolio Adjustments Based On CPUC Guidance

- Additional in-development resources modeled by PTO based on projects status

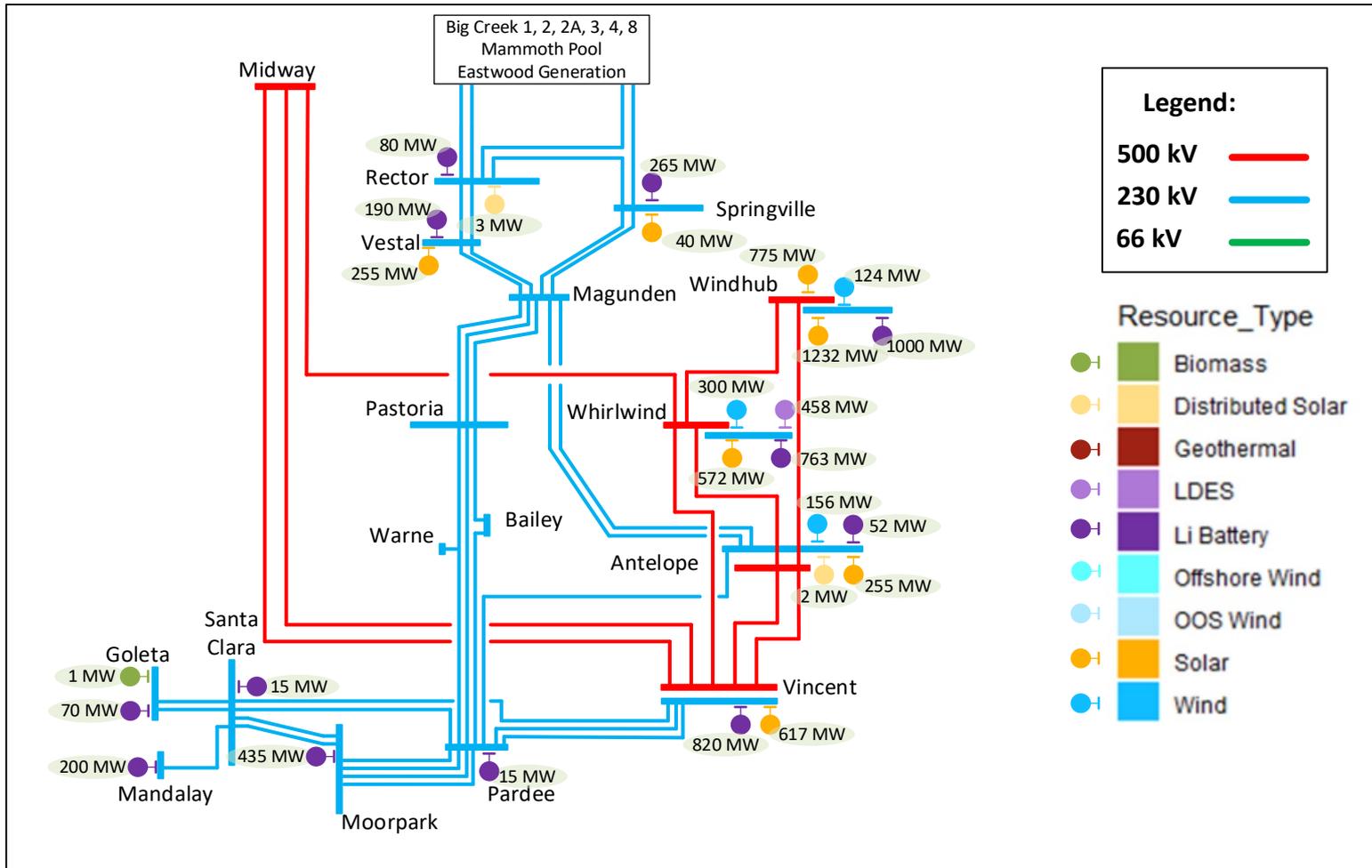
				2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
Transmission Area	Substation	Voltage	Resource Type	FCDS (MW)	EODS (MW)	Total (MW)	FCDS (MW)	EODS (MW)	Total (MW)	FCDS (MW)	EODS (MW)	Total (MW)
SCE Northern Area	Windhub	230	Li Battery	375	-	375	125	-	125	250	-	250
SCE Northern Area	Windhub	230	Solar	-	400	400	-	-	-	-	-	-
SCE Northern Area	Windhub	66	Solar	20	-	20	20	-	20	20	-	20
SCE Northern Area	Rector	66	Li Battery	80	-	80	80	-	80	80	-	80
SCE Northern Area	Springville	66	Solar	-	40	40	-	40	40	-	40	40
SCE Northern Area	Springville	66	Li Battery	40	-	40	40	-	40	40	-	40
SCE NOL Area	Coolwater	115	Li Battery	8	-	8	8	-	8	28	-	28
SCE NOL Area	Inyokern	115	Li Battery	46	-	46	46	-	46	46	-	46
SCE NOL Area	Victor	115	Solar	-	27	27	-	27	27	-	27	27
SCE Eastern Area	Red Bluff	230	Li Battery	-	468	468	-	468	468	-	468	468
SCE Metro Area	Alamitos	230	Li Battery	84	-	84	84	-	84	84	-	84
				653	935	1,588	403	535	938	548	535	1,083

SCE Northern Interconnection Area

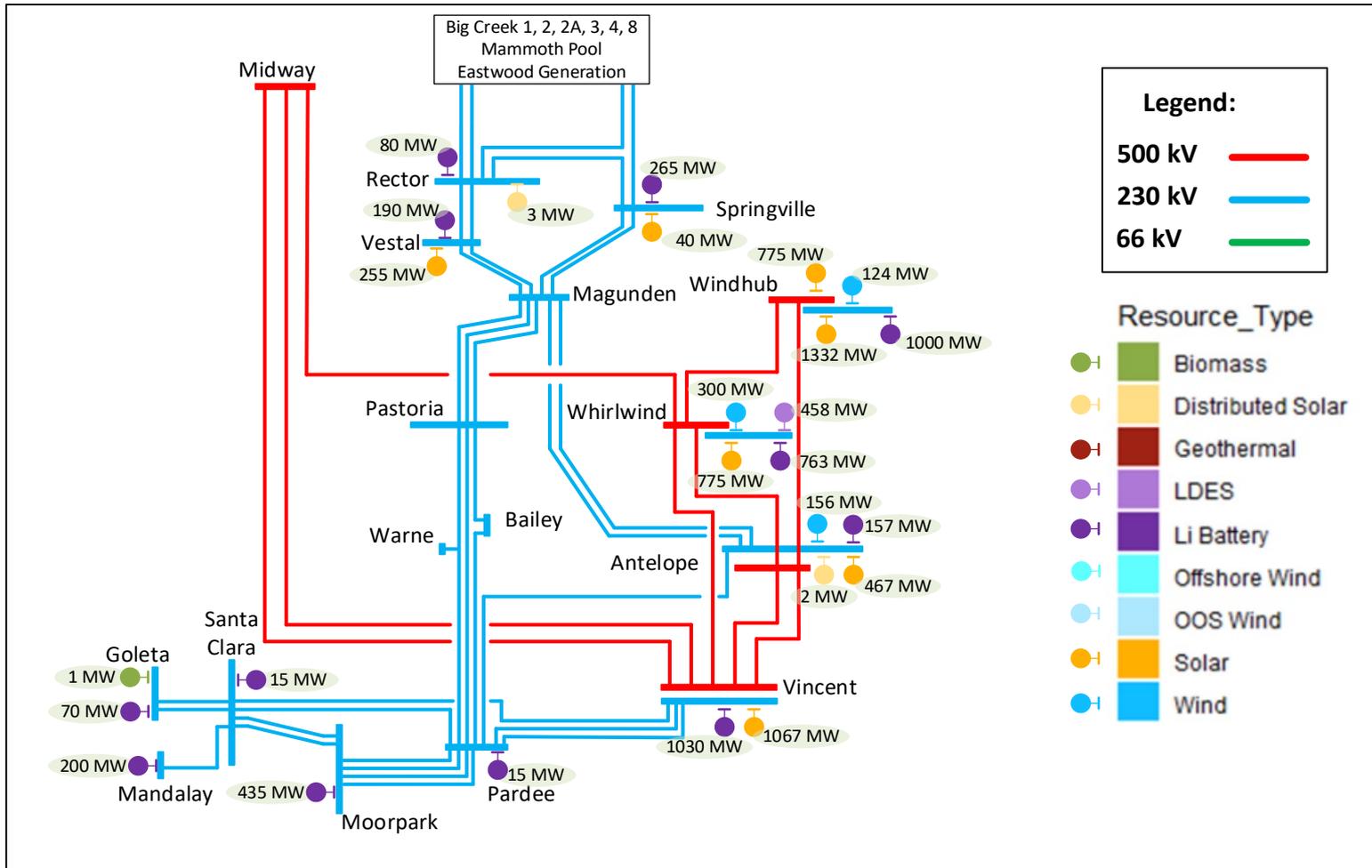
SCE Northern Interconnection Area Portfolio Summary

Resource Type	2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	1,653	2,093	3,746	1,654	3,057	4,711	3,259	5,107	8,366
Wind – In State	564	16	580	564	16	580	514	16	530
Wind – Out-of-State	0	0	0	0	0	0	0	0	0
Wind - Offshore	0	0	0	0	0	0	0	0	0
Li Battery – 4 hr	3,735	0	3,735	3,485	0	3,485	2,610	0	2,610
Li Battery – 8 hr	170	0	170	734	0	734	2,294	0	2,294
Long Duration Energy Storage (LDES)	458	0	458	458	0	458	500	0	500
Geothermal	0	0	0	0	0	0	0	0	0
Biomass/Biogas	1	0	1	1	0	1	0	0	0
Distributed Solar	5	0	5	5	0	5	8	0	8
Total	6,586	2,109	8,695	6,901	3,073	9,974	9,185	5,123	14,308

2034 Base Portfolio: SCE Northern Area



2039 Base Portfolio: SCE Northern Area



2034 Base Portfolio On-Peak SCE Northern Area Deliverability Constraints

Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
Windhub #1 or #2 500/230 kV transformer*	Windhub #1 or #2 500/230 kV transformer	HSN	135
Whirlwind #1, #3 or #4 500/230 kV transformer	Whirlwind #1, #3 or #4 500/230 kV transformer	SSN	102
Midway–Whirlwind 500 kV line (PG&E segment)	Base Case	SSN	106

* Depending on which Windhub 230 kV bus, Bus A or Bus B, generic portfolio resources are mapped to, could overload Banks #3 and #4 500/230 kV transformers.

2034 Base Portfolio On-Peak Windhub #1 & #2 500/230 kV transformers Constraint Summary

Affected transmission zones		Tehachapi area – Windhub 230 kV Bus A
Portfolio resources behind the constraint (Installed FCDS capacity)		1373 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		1016 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		621 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		752 MW
Mitigation Options	RAS	Existing Windhub AA Bank CRAS
	Reduce generic battery storage (MW)	Not needed
	Transmission upgrade including cost	Not needed
Recommended Mitigation		Existing Windhub AA Bank CRAS

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Whirlwind 500/230 kV transformers Constraint Summary

Affected transmission zones		Tehachapi area – Whirlwind 230 kV
Portfolio resources behind the constraint (Installed FCDS capacity)		1848 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		758 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1742 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		106 MW
Mitigation Options	RAS	Planned Whirlwind AA Bank CRAS
	Reduce generic battery storage (MW)	Not needed
	Transmission upgrade including cost	Not needed
Recommended Mitigation		Planned Whirlwind AA Bank CRAS

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Midway–Whirlwind 500 kV line Constraint Summary

Affected transmission zones		Tehachapi and North of Magunden areas
Portfolio resources behind the constraint (Installed FCDS capacity)		5165 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		2838 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		4735 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		430 MW
Mitigation Options	RAS	Not applicable for P0 overload
	Reduce generic battery storage (MW)	Not sufficient
	Transmission upgrade including cost	<ol style="list-style-type: none"> 1. Bypass the series capacitor of the Midway–Whirlwind 500 kV line (No cost) 2. Upgrade Midway – Whirlwind 500 kV line (PGE segment normal rating) (No cost) 3. Upgrade Midway – Whirlwind 500 kV line (Cost TBD) 4. PTEP (\$1.89-\$2.32 B)
Recommended Mitigation*		TBD

* The final recommendation will be coordinated with the reliability and economic assessments

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio Off-Peak SCE Northern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)
Windhub #1 or #2 500/230 kV transformer*	Windhub #1 or #2 500/230 kV transformer	140
Midway–Whirlwind 500 kV line (PG&E segment)	Base Case	119

* Depending on which Windhub 230 kV bus, Bus A or Bus B, generic portfolio resources are mapped to, could overload Banks #3 and #4 500/230 kV transformers.

2034 Base Portfolio Off-Peak Windhub #1 & #2 500/230 kV transformers Constraint Summary

Affected renewable transmission zones		Tehachapi area – Windhub 230 kV Bus A
Portfolio solar and wind resources behind the constraint		1382 MW
Portfolio energy storage behind the constraint		1016 MW
Renewable curtailment without mitigation		728 MW
Mitigation Options:	Portfolio ES (in charging mode)*	572 MW
	RAS	Existing Windhub AA Bank CRAS
	Transmission upgrades	Not needed
Recommended Mitigation		Existing Windhub AA Bank CRAS

* The Portfolio energy storage (in charging mode) amount is the amount needed to mitigate the constraint after baseline battery storage is fully utilized.

2034 Base Portfolio Off-Peak Midway–Whirlwind 500 kV line Constraint Summary

Affected renewable transmission zones		Tehachapi and North of Magunden areas
Portfolio solar and wind resources behind the constraint		3755 MW
Portfolio energy storage behind the constraint		3202 MW
Renewable curtailment without mitigation		1258 MW
Mitigation Options:	Portfolio ES (in charging mode)*	0 MW
	RAS	Not applicable for P0 overload
	Transmission upgrades	<ol style="list-style-type: none"> 1. Bypass the series capacitor of the Midway–Whirlwind 500 kV line 2. Upgrade Midway – Whirlwind 500 kV line (PGE segment normal rating) 3. Upgrade Midway – Whirlwind 500 kV line 4. PTEP
Recommended Mitigation**		TBD

* The Portfolio energy storage (in charging mode) amount is the amount needed to mitigate the constraint after baseline battery storage is fully utilized.

** The final recommendation will be coordinated with the reliability and economic assessments

2039 On-Peak SCE Northern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Windhub #1 or #2 500/230 kV transformer*	Windhub #1 or #2 500/230 kV transformer	135	136
Windhub constraint	Antelope-Windhub and Whirlwind-Windhub 500 kV lines	< 100	102

* Depending on which Windhub 230 kV bus, Bus A or Bus B, generic portfolio resources are mapped to, could overload Banks #3 and #4 500/230 kV transformers.

2039 On-Peak Windhub #1 & #2 500/230 kV transformers Constraint Summary

Affected transmission zones		Tehachapi area – Windhub 230 kV Bus A	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		1368 MW	
Portfolio battery storage behind the constraint (Installed FCDS capacity)		1012 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		623 MW	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		745 MW	
Mitigation Options	RAS	Existing Windhub AA Bank CRAS	
	Reduce generic battery storage (MW)	Not needed	
	Transmission upgrade including cost	Not needed	
Recommended Mitigation		Existing Windhub AA Bank CRAS	

Affected interties	N/A	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Windhub Area Constraint Summary

Affected transmission zones		Tehachapi area – Windhub	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		2142 MW	2338 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		1012 MW	1154 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		2142 MW	2273 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		0 MW	65 MW
Mitigation Options	RAS	Not applicable	
	Reduce generic battery storage (MW)	Not needed	Relocate at least 65 MW of generic storage
	Transmission upgrade including cost	Not needed	New Whirlwind-Windhub 500 kV line (\$612 M)
Recommended Mitigation		Not needed	Relocate at least 65 MW of generic storage

Affected interties	N/A	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

SCE Northern On-Peak Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Windhub #1 & #2 500/230 kV transformers	2034 Base	1373	1016	621	752	Existing Windhub AA Bank CRAS
	2039 Base	1368	1012	623	745	
	2039 Sensitivity	1368	1012	623	745	
Whirlwind #1, #3 or #4 500/230 kV transformer	2034 Base	1848	758	1742	106	Planned Whirlwind AA Bank CRAS
Midway–Whirlwind 500 kV line	2034 Base	5165	2838	4735	430	TBD
Windhub Area	2039 Sensitivity	2338	1154	2273	65	Relocate generic portfolio storage

SCE Metro Interconnection Area

SCE Metro Interconnection Area Portfolio Summary

Resource Type	2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	0	0	0	0	0	0	0	0	0
Wind – In State	0	0	0	0	0	0	0	0	0
Wind – Out-of-State	0	0	0	0	0	0	0	0	0
Wind - Offshore	0	0	0	0	0	0	0	0	0
Li Battery – 4 hr	1,879	0	1,879	1,929	0	1,929	979	0	979
Li Battery – 8 hr	167	0	167	447	0	447	1,292	0	1,292
Long Duration Energy Storage (LDES)	0	0	0	0	0	0	0	0	0
Geothermal	0	0	0	0	0	0	0	0	0
Biomass/Biogas	6	0	6	6	0	6	6	0	6
Distributed Solar	27	0	27	34	0	34	40	0	40
Total	2,078	0	2,078	2,415	0	2,415	2,316	0	2,316

SCE Metro area Constraints Summary

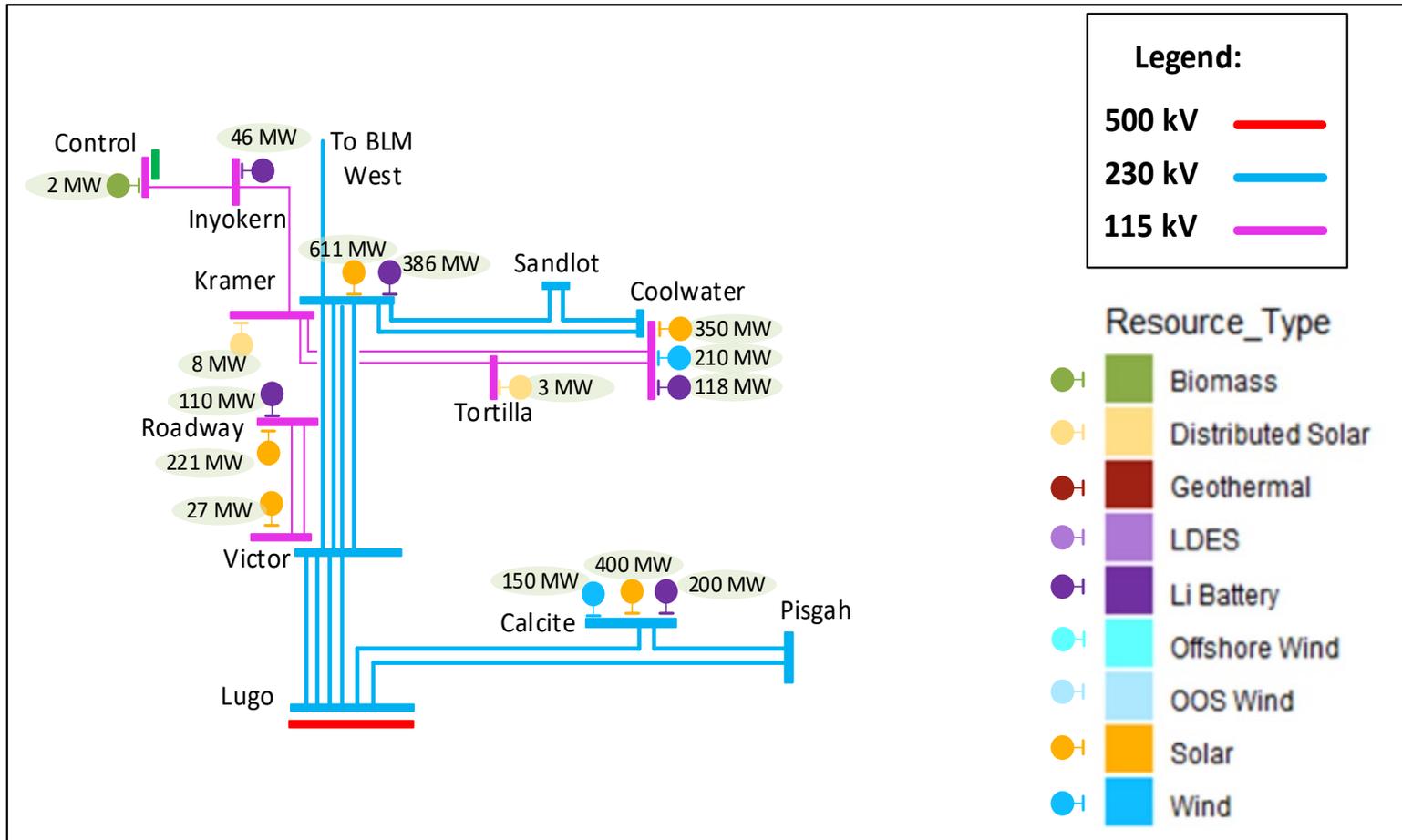
- The following cases were studied:
 - 2034 Peak HSN
 - 2034 Peak SSN
 - 2034 Off-Peak
 - 2039 Peak HSN
 - 2039 Peak Sensitivity (High Gas Retirement)
- No constraints were identified.

SCE North of Lugo (NOL) Interconnection Area

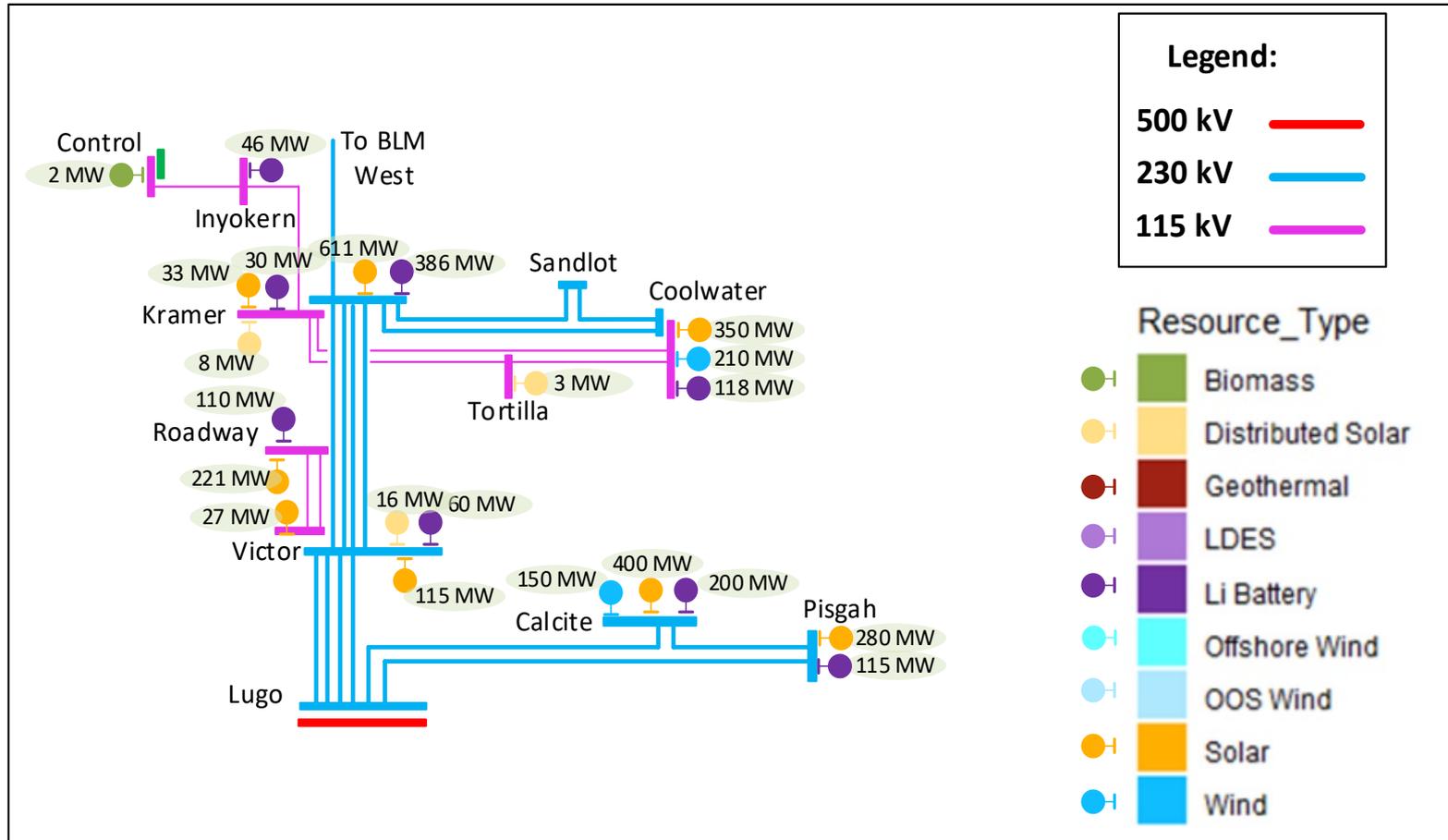
SCE North of Lugo Interconnection Area Portfolio Summary

Resource Type	2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	672	937	1,609	752	1,285	2,037	1,268	1,723	2,991
Wind – In State	310	50	360	310	50	360	310	50	360
Wind – Out-of-State	0	0	0	0	0	0	0	0	0
Wind - Offshore	0	0	0	0	0	0	0	0	0
Li Battery – 4 hr	770	0	770	800	0	800	435	0	435
Li Battery – 8 hr	90	0	90	265	0	265	683	0	683
Long Duration Energy Storage (LDES)	0	0	0	0	0	0	0	0	0
Geothermal	0	0	0	0	0	0	454	0	454
Biomass/Biogas	2	0	2	2	0	2	0	0	0
Distributed Solar	11	0	11	27	0	27	34	0	34
Total	1,855	987	2,842	2,156	1,335	3,491	3,184	1,773	4,957

2034 Base Portfolio: SCE North of Lugo Area



2039 Base Portfolio: SCE North of Lugo Area



2034 Base Portfolio On-Peak SCE North of Lugo Area Deliverability Constraints

Overloaded Facility	Contingency	Base Portfolio Overloading (%)	
		HSN	SSN
Coolwater 230/115 kV Tr.	Kramer–Coolwater & Kramer–Sandlot 230 kV lines	160	214
	Kramer–Coolwater & Sandlot–Coolwater 230 kV lines	144	147
Tortilla–Coolwater 115 kV	Kramer–Coolwater & Kramer–Sandlot 230 kV lines	124	142
Coolwater–Kramer 115 kV		128	157
Control–Inyokern Tap 115 kV	Control–Coso–Inyokern 115 kV line	109	105
Control–Silver Peak C 55kV	Control-Coso-Haiwee-Inyokern & Control-Haiwee-Inyokern 115 kV lines	138	157
Sandlot- Kramer #1 230kV line	Kramer – Coolwater #2 230kV line	101	133
Kramer – Coolwater #2 230kV line	Sandlot- Kramer #1 230kV line	101	125
Lugo- Victor #3 and #4 230 kV lines	Lugo- Victor #1 and #2 230 kV lines	102	124

2034 Base Portfolio On-Peak Coolwater 230/115kV transformer and Coolwater- Kramer 115 kV lines Constraint Summary

Affected transmission zones		NOL area
Portfolio resources behind the constraint (Installed FCDS capacity)		1,227 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		417 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		880 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		553 MW
Mitigation Options	RAS	Mohave Desert RAS
	Reduce generic battery storage (MW)	Not Needed
	Transmission upgrade including cost	Not Needed
Recommended Mitigation		Mohave Desert RAS

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

*North of Lugo local area load forecast is still under review

2034 Base Portfolio On-Peak Control-Inyokern 115kV lines Constraint Summary

Affected transmission zones		NOL area
Portfolio resources behind the constraint (Installed FCDS capacity)		55 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		22 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		33 MW
Mitigation Options	RAS	Bishop RAS
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	N/A
Recommended Mitigation		Bishop RAS + OP 7690

Affected interties	SILVERPK_BG
MIC expansion request MW behind constraint	13 MW
Deliverable MIC expansion request MW	0 MW

*North of Lugo local area load forecast is still under review

2034 Base Portfolio On-Peak Lugo-Victor #1 and #2 230kV lines Constraint Summary

Affected transmission zones		NOL area
Portfolio resources behind the constraint (Installed FCDS capacity)		3006 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		1229 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		2262 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1086 MW
Mitigation Options	RAS	HDPP RAS
	Reduce generic battery storage (MW)	Not Needed
	Transmission upgrade including cost	Not Needed
Recommended Mitigation		HDPP RAS

Affected interties	SILVERPK_BG
MIC expansion request MW behind constraint	13 MW
Deliverable MIC expansion request MW	0 MW

*North of Lugo local area load forecast is still under review

2034 Base Portfolio Off-Peak SCE North of Lugo Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)
Coolwater–Dunnside 115 kV line	Kramer–Coolwater & Kramer–Sandlot 230 kV Lines	184
Coolwater 230/115 kV Tr.		183
Coolwater–Kramer 115 kV line		182
Kramer 230/115 kV #1 & #2 Tr.		161
Tortilla–Kramer 115 kV line		159
Kramer–Sandlot #1 230 kV line	Kramer–Coolwater #2 230 kV line	140
Kramer–Coolwater #2 230 kV line	Kramer–Sandlot #1 230 kV line	133
Calcite–Pisgah 230 kV line	Calcite–Lugo 230 kV line	128
Lugo- Victor #3 and #4 230 kV lines	Lugo- Victor #1 and #2 230 kV lines	119

2034 Base Portfolio Off-Peak Kramer- Coolwater area 230/115 kV lines and transformer constraint summary

Affected renewable transmission zones		NOL area
Portfolio solar and wind resources behind the constraint		1062 MW
Portfolio energy storage behind the constraint		645 MW
Renewable curtailment without mitigation		364 MW
Mitigation Options:	Portfolio ES (in charging mode)*	0 MW
	RAS	Mojave Desert RAS
	Transmission upgrades	Not Needed
Recommended Mitigation		Mojave Desert RAS

* The Portfolio energy storage (in charging mode) amount is the amount needed to mitigate the constraint after baseline battery storage is fully utilized.

*North of Lugo local area load forecast is still under review

2034 Base Portfolio Off-Peak Lugo Calcite Constraint Summary

Affected renewable transmission zones		Calcite and Pisgah Substations
Portfolio solar and wind resources behind the constraint		550 MW
Portfolio energy storage behind the constraint		200 MW
Renewable curtailment without mitigation		86 MW
Mitigation Options:	Portfolio ES (in charging mode)*	0
	RAS	Planned Calcite CRAS
	Transmission upgrades	Not Needed
Recommended Mitigation		Planned Calcite CRAS

* The Portfolio energy storage (in charging mode) amount is the amount needed to mitigate the constraint after baseline battery storage is fully utilized.

*North of Lugo local area load forecast is still under review

2034 Base Portfolio Off-Peak Lugo Victor #1 and #2 230kV Constraint Summary

Affected renewable transmission zones		NOL area
Portfolio solar and wind resources behind the constraint		2406 MW
Portfolio energy storage behind the constraint		1480 MW
Renewable curtailment without mitigation		449 MW
Mitigation Options:	Portfolio ES (in charging mode)*	0 MW
	RAS	HDPP RAS
	Transmission upgrades	Not Needed
Recommended Mitigation		HDPP RAS

* The Portfolio energy storage (in charging mode) amount is the amount needed to mitigate the constraint after baseline battery storage is fully utilized.

*North of Lugo local area load forecast is still under review

2039 On-Peak SCE North of Lugo Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Coolwater–Kramer 115 kV	Kramer–Coolwater & Kramer–Sandlot 230 kV	129	123
Coolwater 230/115 kV Tr.		157	153
Tortilla–Coolwater 115 kV		126	115
Kramer 230/115 kV #1 & #2 Tr.		126	194
Tortilla–Kramer 115 kV		110	106
Control–Silver Peak 55kV line	Control-Coso-Haiwee-Inyokern & Control-Haiwee-Inyokern 115 kV lines	130	140
Calcite–Lugo 230 kV	Base case	101	105
Kramer- Inyokern 115kV	BLM West - Kramer 220kV & Kramer- Inyokern-Randsburg 115kV	NA	103
Calcite–Lugo 230 kV		101	106

2039 On-Peak Kramer- Coolwater area Constraint Summary

Affected transmission zones		NOL area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		916 MW	916 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		417 MW	417 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		765 MW	765 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		151 MW	151 MW
Mitigation Options	RAS	Mojave Desert RAS	Mojave Desert RAS
	Reduce generic battery storage (MW)	N/A	N/A
	Transmission upgrade including cost	Not Needed	Not Needed
Recommended Mitigation		Mojave Desert RAS	Mojave Desert RAS

Affected interties	None	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

*North of Lugo local area load forecast is still under review

2039 On-Peak Control- Inyokern 115kV lines Constraint Summary

Affected transmission zones		South of Control area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		55 MW	507 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0	0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		55 MW	55 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		0 MW	452 MW
Mitigation Options	RAS	Bishop RAS	Bishop RAS
	Reduce generic battery storage (MW)	N/A	N/A
	Transmission upgrade including cost	Not Needed	TBD
Recommended Mitigation		Bishop RAS + OP 7690	Discuss Upgrade Options with PTO

Affected interties	SILVERPK_BG	
	Base	Sensitivity
MIC expansion request MW behind constraint	13 MW	N/A
Deliverable MIC expansion request MW	0	N/A

*North of Lugo local area load forecast is still under review

2039 On-Peak Calcite- Lugo 230kV line Constraint Summary

Affected transmission zones		Calcite and Lugo Substation	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		1145	1725
Portfolio battery storage behind the constraint (Installed FCDS capacity)		315	295
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1115	1663
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		30	62
Mitigation Options	RAS	N/A	N/A
	Reduce generic battery storage (MW)	N/A	62 MW
	Transmission upgrade including cost	N/A	N/A
Recommended Mitigation		Discuss upgrade options with PTO	Discuss upgrade options with PTO

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

*North of Lugo local area load forecast is still under review

SCE North of Lugo On-Peak Constraints Summary

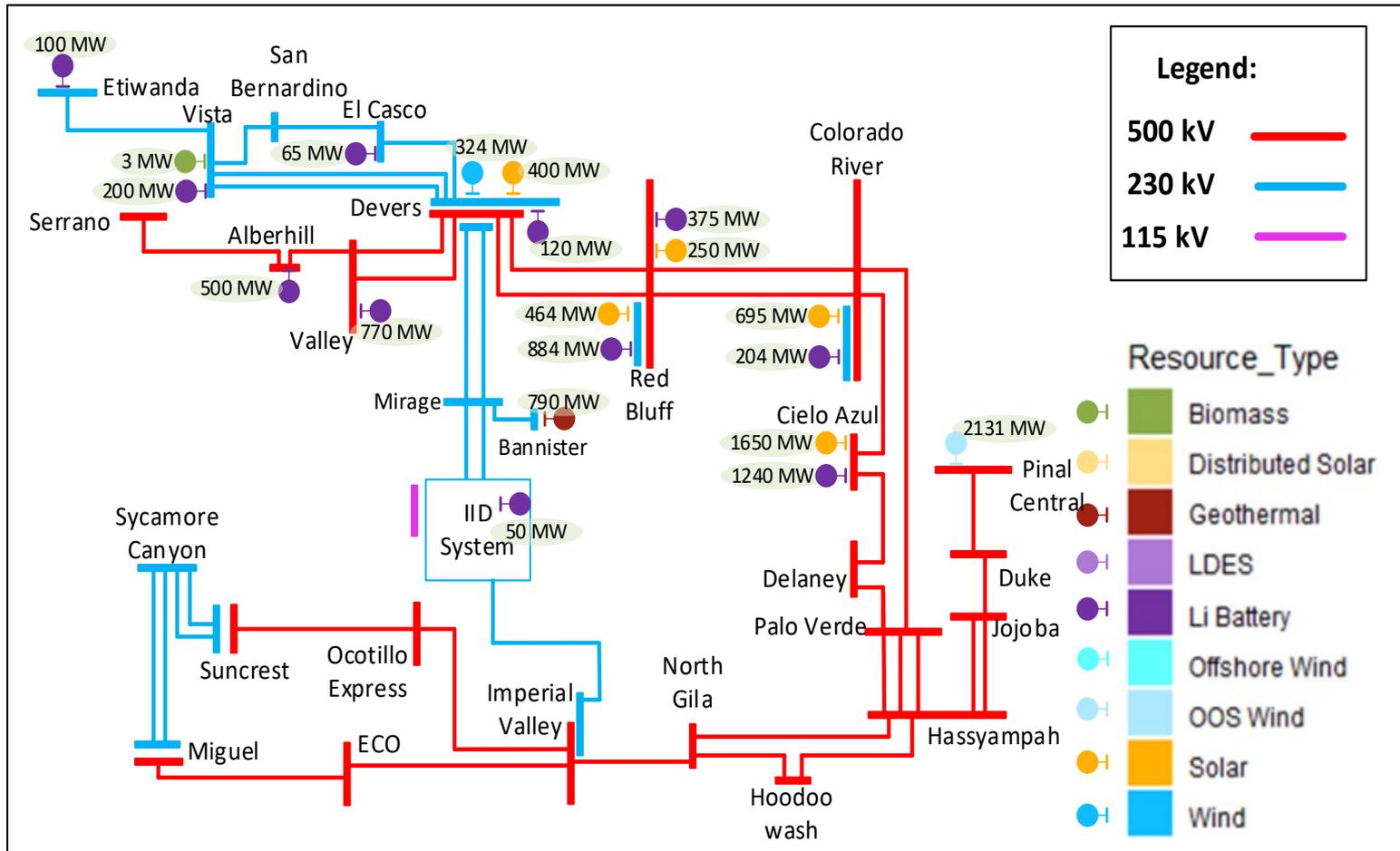
Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Coolwater 230kV/115kV transformer and Coolwater- Kramer 115kV lines	2034 Base	1,227	417	880	553	Mohave Desert RAS
	2039 Base	916	417	765	151	Mohave Desert RAS
	2039 Sensitivity	916	417	765	151	Mohave Desert RAS
Control- Inyokern 115kV lines	2034 Base	55	0	33	22	Bishop RAS + OP 7690
	2039 Base	55	0	55	0	Bishop RAS + OP 7690
	2039 Sensitivity	507	0	TBD	TBD	Discuss Upgrade Options with PTO
Lugo- Victor 230kV lines	2034 Base	3006	1229	2262	1931	HDPP RAS
	2039 Base	N/A	N/A	N/A	N/A	N/A
	2039 Sensitivity	N/A	N/A	N/A	N/A	N/A
Calcite- Lugo 230kV line	2034 Base	N/A	N/A	N/A	N/A	N/A
	2039 Base	1145	315	1115	30	Discuss Upgrade Options with PTO
	2039 Sensitivity	1725	295	1663	62	Discuss Upgrade Options with PTO

SCE Eastern Interconnection Area

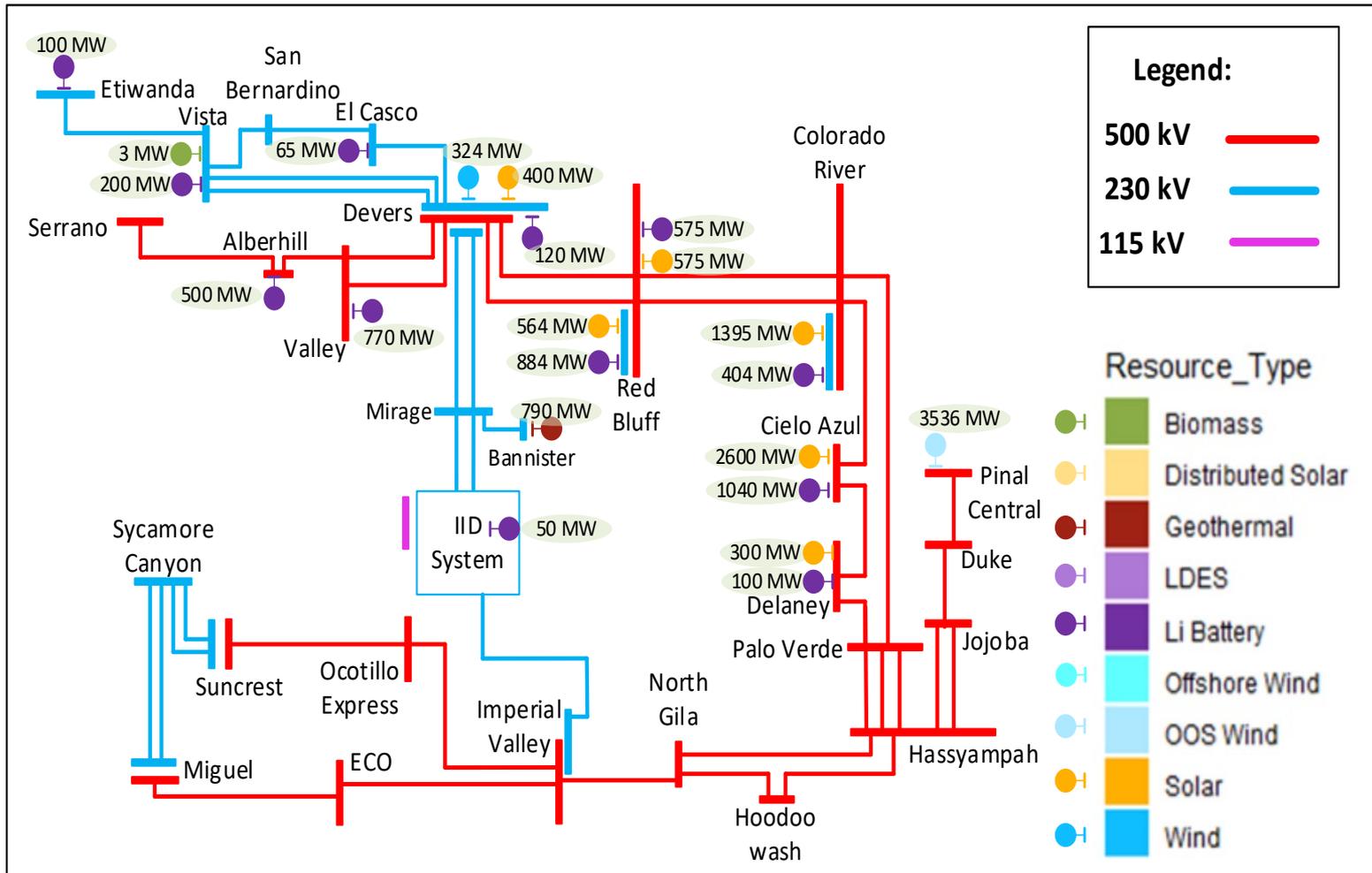
SCE Eastern Interconnection Area Portfolio Summary

Resource Type	2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	810	2,649	3,459	1,610	4,224	5,834	3,410	5,674	8,784
Wind – In State	224	100	324	224	100	324	224	100	324
Wind – Out-of-State	2,131	0	2,131	3,536	0	3,536	3,006	0	3,006
Wind - Offshore	0	0	0	0	0	0	0	0	0
Li Battery – 4 hr	3,770	468	4,238	3,270	468	3,738	3,179	468	3,647
Li Battery – 8 hr	270	0	270	1,070	0	1,070	1,875	0	1,875
Long Duration Energy Storage (LDES)	0	0	0	0	0	0	1,190	0	1,190
Geothermal	790	0	790	790	0	790	1,380	0	1,380
Biomass/Biogas	3	0	3	3	0	3	3	0	3
Distributed Solar	0	0	0	0	0	0	0	0	0
Total	7,997	3,217	11,214	10,502	4,792	15,294	14,266	6,242	20,508

2034 Base Portfolio: SCE Eastern Area



2039 Base Portfolio: SCE Eastern Area



2034 Base Portfolio On-Peak SCE Eastern area Deliverability Constraints

Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
Colorado River 500/230 kV Transformer No.1	Colorado River 500/230 kV Transformer No.2	HSN	121
Colorado River 500/230 kV Transformer No.2	Colorado River 500/230 kV Transformer No.1	HSN	121

2034 Base Portfolio On-Peak Colorado River 500/230 kV Constraint Summary

Affected transmission zones		Colorado River 230 kV
Portfolio resources behind the constraint (Installed FCDS capacity)		455 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		160 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		556 MW
Mitigation Options	RAS	Existing West of Colorado River CRAS
	Reduce generic battery storage (MW)	Not needed
	Transmission upgrade including cost	Not needed
Recommended Mitigation		Existing West of Colorado River CRAS

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio Off-Peak SCE Eastern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)
Colorado River 500/230 kV Transformer No.1	Colorado River 500/230 kV Transformer No.2	131
Colorado River 500/230 kV Transformer No.2	Colorado River 500/230 kV Transformer No.1	131
Red Bluff 500/230 kV Transformer No.1	Red Bluff 500/230 kV Transformer No.2	118
Red Bluff 500/230 kV Transformer No.2	Red Bluff 500/230 kV Transformer No.1	118

2034 Base Portfolio Off-Peak Colorado River 500/230 kV Constraint Summary

Affected renewable transmission zones		Colorado River 230 kV
Portfolio solar and wind resources behind the constraint		651 MW
Portfolio energy storage behind the constraint		160 MW
Renewable curtailment without mitigation		615 MW
Mitigation Options:	Portfolio ES (in charging mode)*	0 MW
	RAS	Existing West of Colorado River CRAS
	Transmission upgrades	Not needed
Recommended Mitigation		Existing West of Colorado River CRAS and/or baseline battery storage in charging mode

* The Portfolio energy storage (in charging mode) amount is the amount needed to mitigate the constraint after baseline battery storage is fully utilized.

2034 Base Portfolio Off-Peak Red Bluff 500/230 kV Constraint Summary

Affected renewable transmission zones		Red Bluff 230 kV
Portfolio solar and wind resources behind the constraint		471 MW
Portfolio energy storage behind the constraint		924 MW
Renewable curtailment without mitigation		370 MW
Mitigation Options:	Portfolio ES (in charging mode)*	0 MW
	RAS	Existing West of Colorado River CRAS
	Transmission upgrades	Not needed
Recommended Mitigation		Existing West of Colorado River CRAS and/or baseline battery storage in charging mode

* The Portfolio energy storage (in charging mode) amount is the amount needed to mitigate the constraint after baseline battery storage is fully utilized.

2039 On-Peak SCE Eastern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Colorado River 500/230 kV Transformer No.1	Colorado River 500/230 kV Transformer No.2	138	154
Colorado River 500/230 kV Transformer No.2	Colorado River 500/230 kV Transformer No.1	138	154
Devers – Red Bluff 500 kV No.1	Devers – Red Bluff 500 kV No.2	101	118
Devers – Red Bluff 500 kV No.2	Devers – Red Bluff 500 kV No.1	101	118
Coachella Valley – Ramon 230 kV No.1	Coachella Valley – Mirage 230 kV No.1	<100	113
Ramon – Mirage 230 kV No.1		<100	103
Coachella Valley – Mirage 230 kV No.1	Coachella Valley – Ramon 230 kV No.1	<100	108
Devers 500/230 kV Transformer No. 1	Serrano-Alberhill-Valley 500 kV No.1	<100	108
Serrano-Alberhill-Valley 500 kV No.1	Base Case	<100	102

2039 On-Peak Colorado River 500/230 kV Constraint Summary

Affected transmission zones		Colorado River 230 kV	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		857 MW	1500 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		360 MW	500 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0 MW	0 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		958 MW	1609 MW
Mitigation Options	RAS	Existing West of Colorado River CRAS	Existing West of Colorado River CRAS alone not sufficient
	Reduce generic battery storage (MW)	Not needed	Not sufficient
	Transmission upgrade including cost	Not needed	New Colorado River No.3 500/230 kV transformer (\$67M)
Recommended Mitigation		Existing West of Colorado River CRAS	TBD

Affected interties	N/A	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Devers-Red Bluff Constraint Summary

Affected transmission zones		SCE Eastern (east of Red Bluff) and SDG&E	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		8038 MW	10419 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		2456 MW	2969 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		7860 MW	8591 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		178 MW	1828 MW
Mitigation Options	RAS	Existing West of Colorado River CRAS	Existing West of Colorado River CRAS alone not sufficient
	Reduce generic battery storage (MW)	Not needed	Not sufficient
	Transmission upgrade including cost	Not needed	New Devers-Red Bluff 500 kV transmission line (\$875M) New Devers-Mira Loma 500 kV transmission line (\$1.1B)
Recommended Mitigation		Existing West of Colorado River CRAS	TBD

Affected interties	N/A	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak WECC Path 42 Constraint Summary

Affected transmission zones		IID	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	1608 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)			0 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)			1355 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)			253 MW
Mitigation Options	RAS		The ISO will discuss mitigation options with IID and SCE
	Reduce generic battery storage (MW)		
	Transmission upgrade including cost		
Recommended Mitigation			

Affected interties	N/A	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Serrano-Alberhill-Valley Constraint Summary

Affected transmission zones		SCE Eastern, SDG&E, IID	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	11725 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)			3775 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)			11250 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)			475 MW
Mitigation Options	RAS		Expand West of Colorado River CRAS to monitor overloads on Devers transformer. No RAS available to address Base Case overload.
	Reduce generic battery storage (MW)	Not sufficient	
	Transmission upgrade including cost	New Devers-Mira Loma 500 kV transmission line (\$1.1B)	
Recommended Mitigation			TBD

2039 On-Peak Serrano-Alberhill-Valley Constraint Summary

Affected interties	N/A	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

SCE Eastern Area On-Peak Constraints Summary

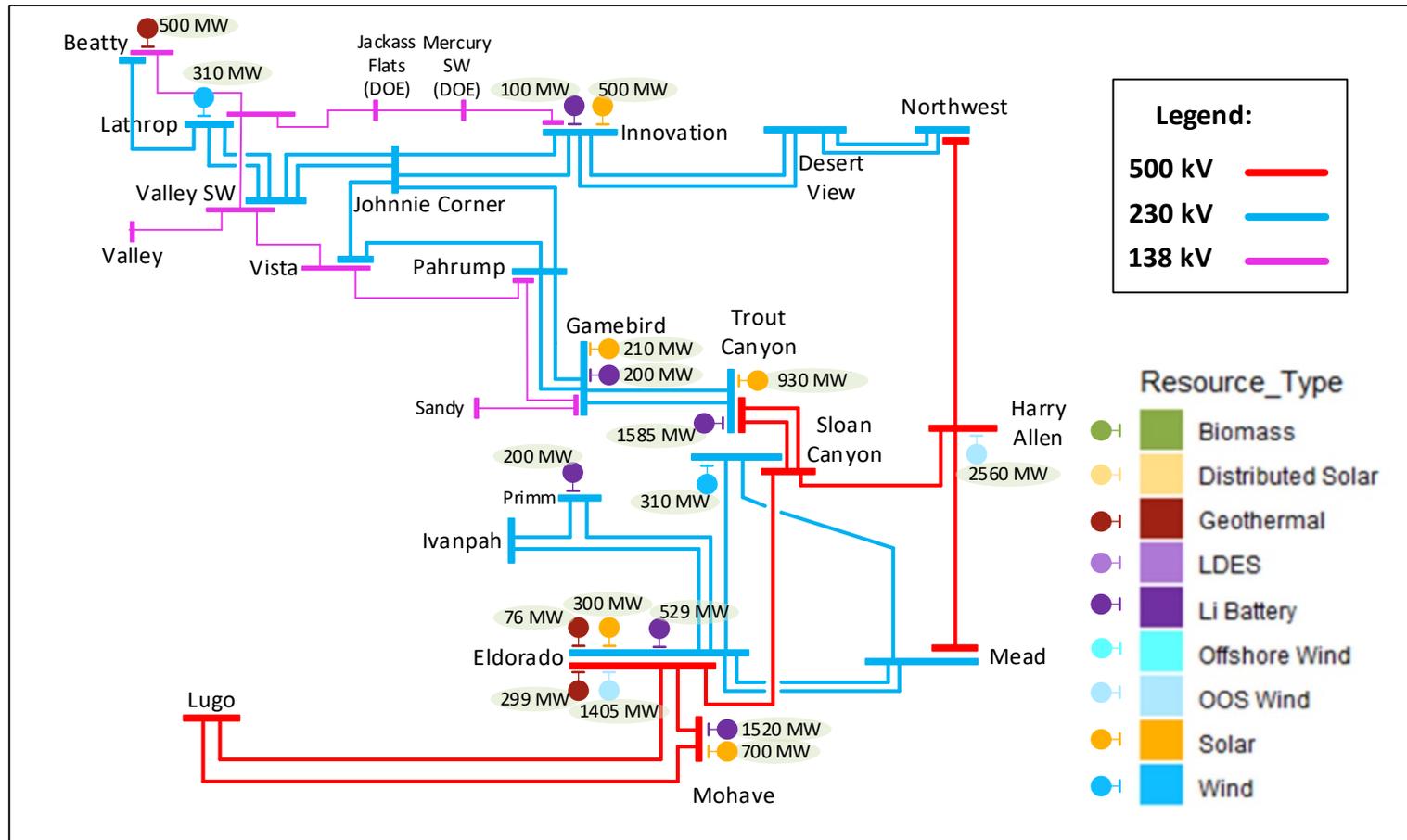
Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Colorado River 500/230 kV transformers	2034 Base	455	160	0	556	Existing West of Colorado River CRAS
	2039 Base	857	360	0	958	
	2039 Sensitivity	1500	500	0	1609	TBD
Devers-Red Bluff	2034 Base	N/A				
	2039 Base	8038	2456	7860	178	Existing West of Colorado River CRAS
	2039 Sensitivity	10419	2969	8591	1828	TBD
WECC Path 42	2034 Base	N/A				
	2039 Base	N/A				
	2039 Sensitivity	1608	0	1355	253	The ISO will discuss mitigation options with IID and SCE
Serrano-Aberhill-Valley	2034 Base	N/A				
	2039 Base	N/A				
	2039 Sensitivity	11725	3775	11250	475	TBD

East of Pisgah Interconnection Area

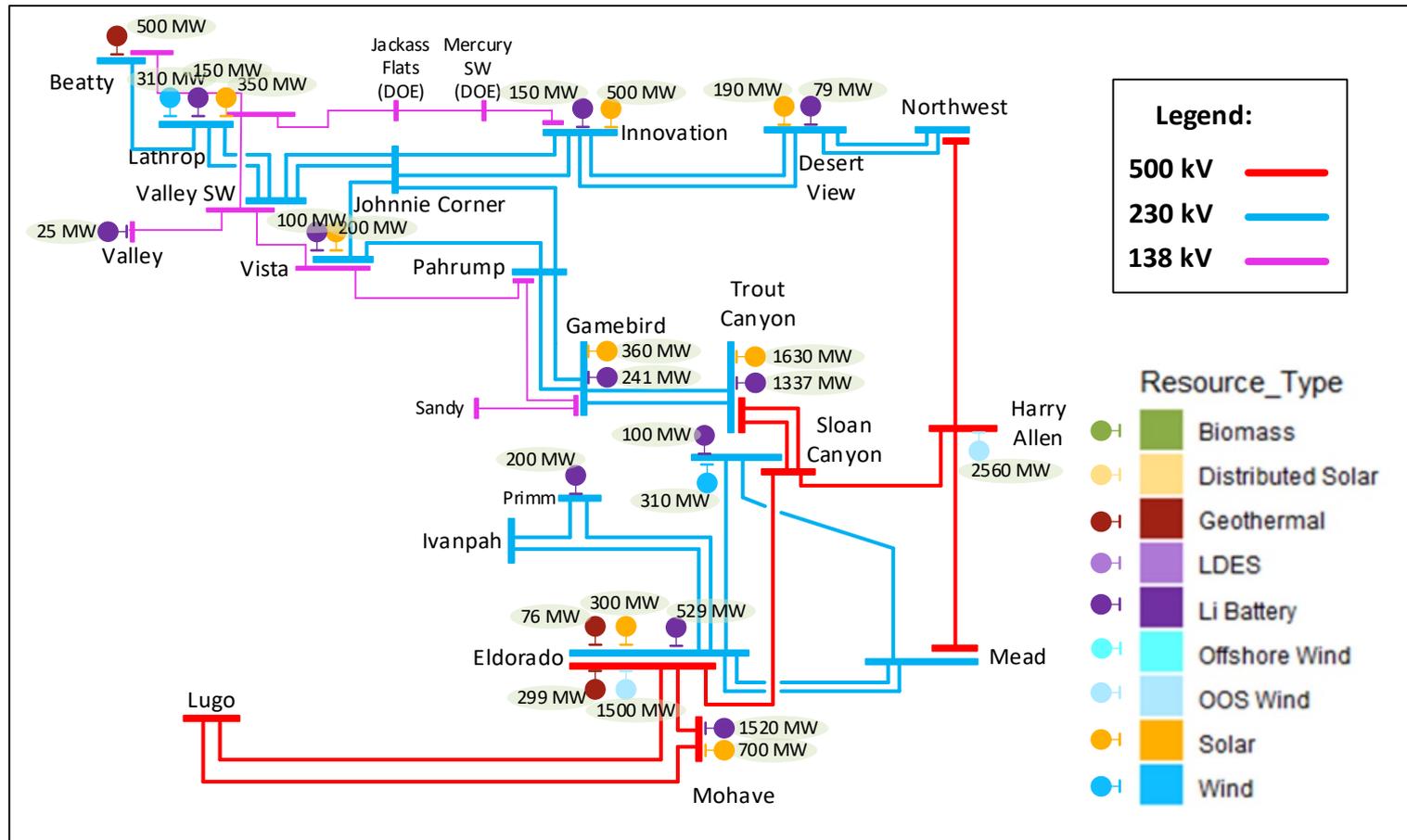
East of Pisgah Interconnection Area Portfolio Summary

Resource Type	2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	1,075	1,565	2,640	1,200	3,030	4,230	2,425	3,855	6,280
Wind – In State	620	0	620	620	0	620	620	0	620
Wind – Out-of-State	3,965	0	3,965	4,060	0	4,060	4,060	0	4,060
Wind - Offshore	0	0	0	0	0	0	0	0	0
Li Battery – 4 hr	3,954	0	3,954	3,735	0	3,735	2,839	0	2,839
Li Battery – 8 hr	180	0	180	696	0	696	1,769	0	1,769
Long Duration Energy Storage (LDES)	0	0	0	0	0	0	0	0	0
Geothermal	875	0	875	875	0	875	1,315	0	1,315
Biomass/Biogas	0	0	0	0	0	0	0	0	0
Distributed Solar	0	0	0	0	0	0	0	0	0
Total	10,669	1,565	12,234	11,186	3,030	14,216	13,028	3,855	16,883

2034 Base Portfolio: East of Pisgah Area



2039 Base Portfolio: East of Pisgah Area



2034 Base Portfolio On-Peak East of Pisgah Area Deliverability Constraints

Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
Gamebird 230/138 kV Transformer	Trout Canyon – Sloan Canyon 500kV Nos. 1&2 lines	HSN	152
Gamebird – Sandy 138 kV Line		SSN	138
Sandy – Amargosa 138 kV Line		SSN	159
Amargosa 230/138 kV Transformer		SSN	121
Innovation PST – IS Tap – Northwest 138 kV Tie Line		SSN	147
Innovation PST – IS Tap 138 kV Line	Innovation – Desert View 230kV Nos. 1&2 lines	SSN	109
	Desert View – Northwest 230kV Nos. 1&2 lines	SSN	109
Eldorado – McCullough 500 kV Line	Eldorado – Lugo 500kV line	HSN	143
	Lugo – Mohave 500kV line	HSN	134
	Harry Allen – Mead 500kV line	HSN	109
	Eldorado – Mohave 500kV line	HSN	104
Lugo – Victorville 500 kV Line	Eldorado – Lugo 500kV line	HSN	102

2034 Base Portfolio On-Peak GLW-VEA Constraint Summary

Affected transmission zones		GLW and VEA area
Portfolio resources behind the constraint (Installed FCDS capacity)		3,460 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		1,700 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1,568 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1,892 MW
Mitigation Options	RAS	RAS identified in GIP and reduce generic battery storage in the area
	Reduce generic battery storage (MW)	
	Transmission upgrade including cost	Trout Canyon – Lugo 500 kV line (\$2 B)
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Eldorado - McCullough Constraint Summary

Affected transmission zones		East of Pisgah, Out-of-state Wind
Portfolio resources behind the constraint (Installed FCDS capacity)		10,480 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		4,070 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		7,721 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		2,759 MW
Mitigation Options	RAS	Not applicable
	Reduce generic battery storage (MW)	Not sufficient
	Transmission upgrade including cost	<ol style="list-style-type: none"> 1. 10 Ohms series reactor on Eldorado – McCullough line 2. Trout Canyon – Lugo 500kV line (\$2B) 3. Marketplace-Adelanto AC-DC Conversion 4. Western Bounty HVDC
Recommended Mitigation		TBD

Affected interties	MEAD_ITC
MIC expansion request MW behind constraint	114
Deliverable MIC expansion request MW	0

2034 Base Portfolio On-Peak Lugo – Victorville Constraint Summary

Affected transmission zones		East of Pisgah, SCE Eastern, SCE Northern, SDG&E, Out-of-state Wind
Portfolio resources behind the constraint (Installed FCDS capacity)		14,178 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		5,022 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		13,994 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		184 MW
Mitigation Options	RAS	Existing Lugo – Victorville RAS
	Reduce generic battery storage (MW)	Not needed
	Transmission upgrade including cost	Not needed
Recommended Mitigation		Existing Lugo – Victorville RAS

Affected interties	MEAD_ITC, BLYTHE_ITC
MIC expansion request MW behind constraint	282
Deliverable MIC expansion request MW	282

2034 Base Portfolio Off-Peak East of Pisgah Area Deliverability Constraints

- There were no off-peak deliverability constraints identified in the East of Pisgah area

2039 On-Peak East of Pisgah Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Gamebird 230/138 kV T transformer	Trout Canyon – Sloan Canyon 500kV Nos. 1&2 lines	148	161
Gamebird – Sandy 138 kV Line		128	143
Sandy – Amargosa 138 kV Line		147	165
Amargosa 230/138 kV T transformer		110	126
VEA PST – IS Tap – Northwest 138 kV Tie Line		153	152
VEA PST – IS Tap – Northwest 138 kV Tie Line	Northwest – Desert View 230kV Nos. 1&2 lines	119	135
	Innovation – Desert View 230kV Nos. 1&2 lines	109	127
Eldorado – McCullough 500 kV Line	Base Case	<100	101
	Eldorado – Lugo 500kV line	157	161
	Lugo – Mohave 500kV line	142	146
	Harry Allen – Mead 500kV line	108	113
Lugo – Victorville 500 kV Line	Base Case	112	114
	Eldorado – Lugo 500kV line	127	130
	Lugo – Mohave 500kV line	118	121
	Eldorado – Mohave 500kV line	101	105
Eldorado – Lugo 500 kV Line	Lugo – Victorville 500kV line	111	113

2039 On-Peak GLW – VEA Constraint Summary

Affected transmission zones		GLW and VEA area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		3,476 MW	4,239 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		1,891 MW	2,033 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		2,259 MW	2,016 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1,217 MW	2,223 MW
Mitigation Options	RAS	RAS identified in GIP	Not applicable
	Reduce generic battery storage (MW)	Not sufficient	Not sufficient
	Transmission upgrade including cost	Not needed	Trout Canyon – Lugo 500kV line (\$2 B)
Recommended Mitigation		RAS identified in GIP	TBD

Affected interties	N/A	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Eldorado - McCullough Constraint Summary

Affected transmission zones		East of Pisgah, Out-of-state Wind	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		11,119 MW	13,133 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		4,413 MW	4,660 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		7,072 MW	8,243 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		4,047 MW	4,890 MW
Mitigation Options	RAS	Not applicable	
	Reduce generic battery storage (MW)	Not applicable	
	Transmission upgrade including cost	1. 10 Ohms series reactor on Eldorado – McCullough line 2. Trout Canyon – Lugo 500kV line (\$2 B) with 200-400MW battery storage relocation 3. Marketplace-Adelanto AC-DC Conversion 4. Western Bounty HVDC	
Recommended Mitigation		TBD	

Affected interties	MEAD_ITC	
	Base	Sensitivity
MIC expansion request MW behind constraint	114	114
Deliverable MIC expansion request MW	0	0

2039 On-Peak Lugo – Victorville Constraint Summary

Affected transmission zones		East of Pisgah, SCE Eastern, SCE Northern, SDG&E
		Base Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		17,145 MW 18,697 MW
Portfolio battery storage behind the constraint (Installed FCDS capacity)		5,770 MW 5,808 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		12,610 MW 12,009 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		4,535 MW 6,688 MW
Mitigation Options	RAS	Not sufficient
	Reduce generic battery storage (MW)	Not applicable
	Transmission upgrade including cost	1. Trout Canyon – Lugo 500kV Line (\$2 B) 2. Marketplace-Adelanto AC-DC Conversion 3. Western Bounty HVDC
Recommended Mitigation		TBD

Affected interties	MEAD_ITC, BLYTHE_ITC	
	Base	Sensitivity
MIC expansion request MW behind constraint	282	282
Deliverable MIC expansion request MW	0	0

East of Pisgah Area On-Peak Constraints Summary

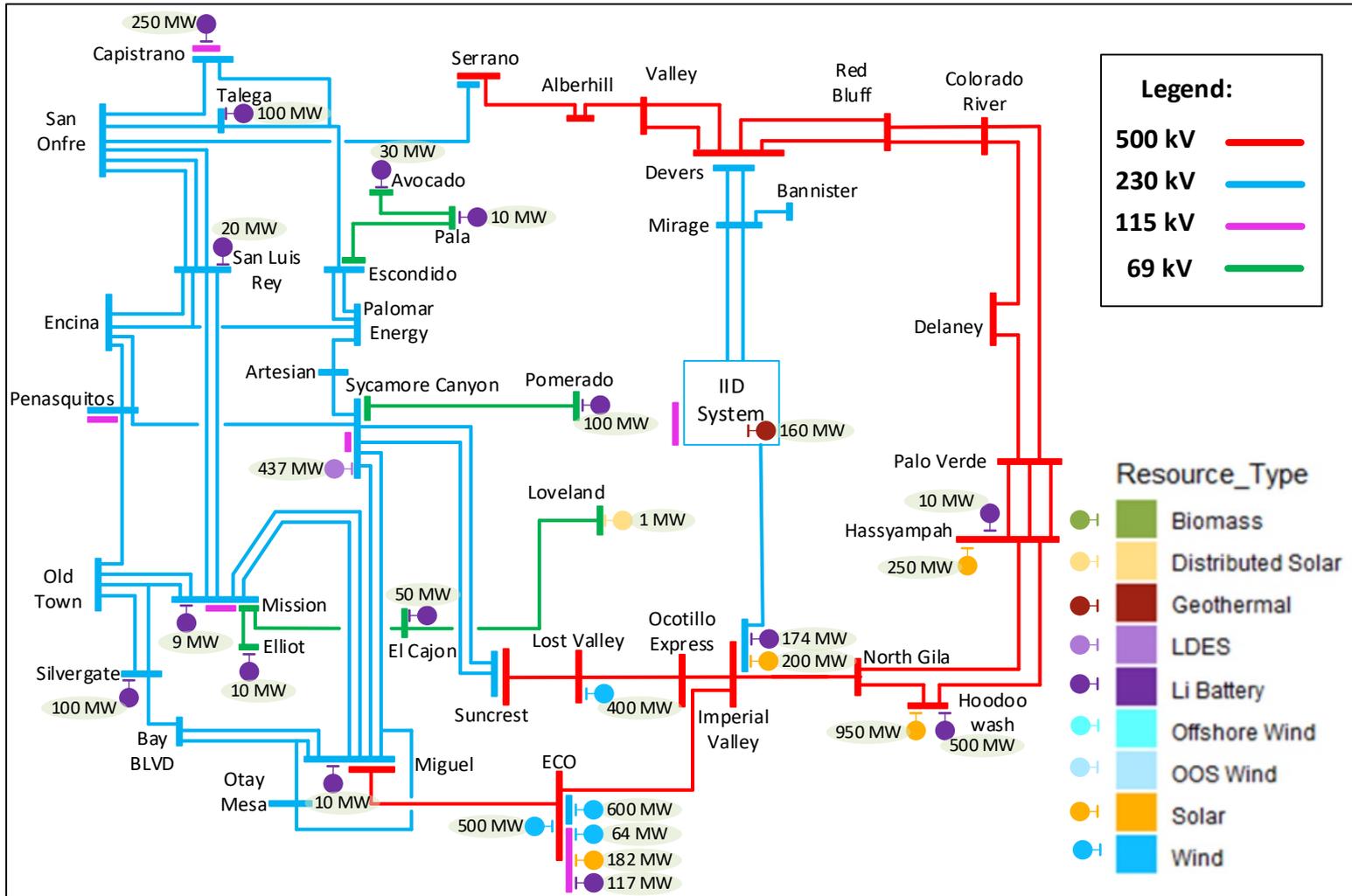
Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
GLW-VEA area constraint	2034 Base	3,460	1,700	1,568	1,892	TBD
	2039 Base	3,476	1,891	2,259	1,217	RAS identified in GIP
	2039 Sensitivity	4,239	2,033	2,016	2,223	TBD
Eldorado – McCullough	2034 Base	10,480	4,070	7,721	2,759	TBD
	2039 Base	11,119	4,413	7,072	4,047	
	2039 Sensitivity	13,133	4,660	8,243	4,890	
Lugo - Victorville	2034 Base	14,178	5,022	13,994	184	Existing Lugo – Victorville RAS
	2039 Base	17,145	5,770	12,610	4,535	TBD
	2039 Sensitivity	18,697	5,808	12,009	6,688	

SDG&E Interconnection Area

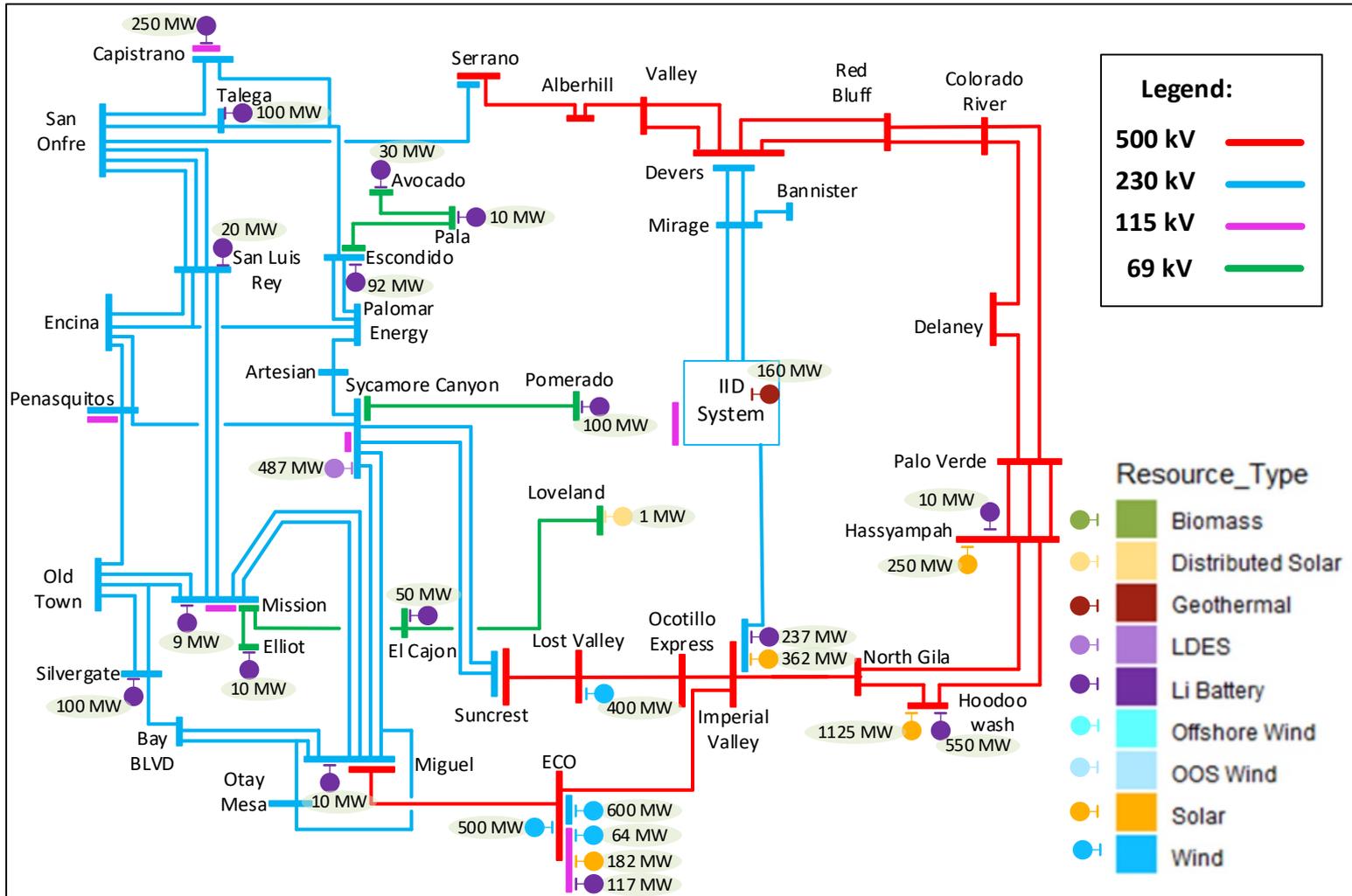
SDG&E Interconnection Area Portfolio Summary

Resource Type	2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	700	882	1,582	700	1,219	1,919	1,950	2,544	4,494
Wind – In State	1,325	239	1,564	1,325	239	1,564	1,295	289	1,584
Wind – Out-of-State	0	0	0	0	0	0	0	0	0
Wind - Offshore	0	0	0	0	0	0	0	0	0
Li Battery – 4 hr	1,390	0	1,390	1,390	0	1,390	1,100	0	1,100
Li Battery – 8 hr	100	0	100	305	0	305	985	0	985
Long Duration Energy Storage (LDES)	437	0	437	487	0	487	500	0	500
Geothermal	160	0	160	160	0	160	866	0	866
Biomass/Biogas	0	0	0	0	0	0	0	0	0
Distributed Solar	1	0	1	1	0	1	1	0	1
Total	4,113	1,121	5,234	4,368	1,458	5,826	6,697	2,833	9,530

2034 Base Portfolio: SDG&E Area



2039 Base Portfolio: SDG&E Area



2034 Base Portfolio On-Peak SDG&E Area Deliverability Constraints

Constraint	Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
BB-SG	Bay Boulevard-Silvergate 230 kV	Imperial Valley-North of SONGS 500 kV	HSN	105.75
		Miguel-Mission 230 kV #1 and #2	HSN	107.76
SG-OT	Silvergate-Old Town 230 kV	Silvergate-Mission-Old Town 230 kV	HSN	107.55
	Silvergate-Old Town Tap 230 kV	Silvergate-Old Town 230 kV	HSN	107.36
		Old Town-Mission 230 kV and Silvergate-Mission-Old Town 230 kV	HSN	103.19
EA-SLR	Encina Tap-San Luis Rey 230 kV	San Luis Rey-Encina 230 kV	SSN	109.84
SLR-SO	San Luis Rey-San Onofre 230 kV #1	San Luis Rey-San Onofre 230 kV #2 and #3	SSN	105.9

2034 Base Portfolio On-Peak BB-SG Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal
Portfolio resources behind the constraint (Installed FCDS capacity)		746
Portfolio battery storage behind the constraint (Installed FCDS capacity)		121
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		971
Mitigation Options	RAS	None
	Reduce generic battery storage (MW)	None
	Transmission upgrade including cost	Not needed
Recommended Mitigation		Use 2 hour emergency rating

Affected interties	IID-SDGE_ITC
MIC expansion request MW behind constraint	35
Deliverable MIC expansion request MW	35 (Use 2 hour emergency rating)

2034 Base Portfolio On-Peak SG-OT Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal
Portfolio resources behind the constraint (Installed FCDS capacity)		501
Portfolio battery storage behind the constraint (Installed FCDS capacity)		184
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		136
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		365
Mitigation Options	RAS	None
	Reduce generic battery storage (MW)	None
	Transmission upgrade including cost	Not needed
Recommended Mitigation		Use 30 minute emergency rating

Affected interties	IID-SDGE_ITC
MIC expansion request MW behind constraint	35
Deliverable MIC expansion request MW	35 (Use 30 minute emergency rating)

2034 Base Portfolio On-Peak EA-SLR Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal
Portfolio resources behind the constraint (Installed FCDS capacity)		2990
Portfolio battery storage behind the constraint (Installed FCDS capacity)		448
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1783
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1207
Mitigation Options	RAS	Existing CEC RAS
	Reduce generic battery storage (MW)	None
	Transmission upgrade including cost	Not needed
Recommended Mitigation		Existing CEC RAS

Affected interties	IID-SDGE_ITC
MIC expansion request MW behind constraint	35
Deliverable MIC expansion request MW	35 (Use existing CEC RAS)

2034 Base Portfolio On-Peak SLR-SO Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal, Arizona
Portfolio resources behind the constraint (Installed FCDS capacity)		3800
Portfolio battery storage behind the constraint (Installed FCDS capacity)		726
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		3325
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		475
Mitigation Options	RAS	Existing CEC RAS
	Reduce generic battery storage (MW)	Not sufficient
	Transmission upgrade including cost	Not needed
Recommended Mitigation		Existing CEC RAS

Affected interties	IID-SDGE_ITC
MIC expansion request MW behind constraint	35
Deliverable MIC expansion request MW	35 (Use existing CEC RAS)

2034 Base Portfolio Off-Peak SDG&E Area Deliverability Constraints

- There are no off-peak deliverability constraints identified in the SDG&E area

2039 On-Peak SDG&E Area Deliverability Constraints

Constraint	Overloaded Facility	Contingency	Loading (%)	
			Base	Sensitivity
Old Town	Old Town 230/69 kV #1	Old Town 230/69 kV #2	100.54	<100
	Old Town 230/69 kV #2	Old Town 230/69 kV #1	100.54	<100
Sycamore-Scripps	Sycamore-Scripps 69 kV	Sycamore-Penasquitos 230 kV	113.33	117.29
		Miramar GT-Miramar 69 kV	101.58	103.18
		Sycamore-Penasquitos 230 kV and Mira Sorrento-Penasquitos 69 kV	113.42	117.39
BB-SG	Bay Boulevard-Silvergate 230 kV	Imperial Valley-North of SONGS 500 kV	<100	104.02
		Miguel-Mission 230 kV #1 and #2	<100	103.17
SG-OT	Silvergate-Old Town 230 kV	Old Town-Mission 230 kV and Silvergate-Mission-Old Town 230 kV	<100	100.61
EA-SLR	Encina Tap-San Luis Rey 230 kV	San Luis Rey-Encina 230 kV	<100	103.19
		Imperial Valley-North of SONGS 500 kV	<100	101.8
ES-SM	Escondido-San Marcos 69 kV	San Luis Rey-Encina 230 kV and San Luis Rey-Encina-Palomar 230 kV	<100	105.54

2039 On-Peak Old Town Constraint Summary

Affected transmission zones		N/A	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		No generation in 5% DFAX circle	
Portfolio battery storage behind the constraint (Installed FCDS capacity)			
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)			
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)			
Mitigation Options	RAS	Overloads observed in reliability study, mitigation will be coordinated with that study	
	Reduce generic battery storage (MW)		
	Transmission upgrade including cost		
Recommended Mitigation			

Affected interties	N/A	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Sycamore-Scripps Constraint Summary

Affected transmission zones		SDGE Internal	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		591	601
Portfolio battery storage behind the constraint (Installed FCDS capacity)		101	101
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		479	489
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		113	113
Mitigation Options	RAS	None	
	Reduce generic battery storage (MW)	None	
	Transmission upgrade including cost	Not needed	
Recommended Mitigation		Use 30 minute emergency rating	

Affected interties	N/A	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak BB-SG Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		1579	3064
Portfolio battery storage behind the constraint (Installed FCDS capacity)		342	562
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1579	2699
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		0	364
Mitigation Options	RAS	None	
	Reduce generic battery storage (MW)	None	
	Transmission upgrade including cost	Not needed	
Recommended Mitigation		Use 2 hour emergency rating	

Affected interties	IID-SDGE_ITC	
	Base	Sensitivity
MIC expansion request MW behind constraint	35	N/A
Deliverable MIC expansion request MW	35	N/A

2039 On-Peak SG-OT Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		1303	1971
Portfolio battery storage behind the constraint (Installed FCDS capacity)		236	236
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1303	1862
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		0	109
Mitigation Options	RAS	None	
	Reduce generic battery storage (MW)	None	
	Transmission upgrade including cost	Not needed	
Recommended Mitigation		Use 30 minute emergency rating	

Affected interties	N/A	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak EA-SLR Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		3196	4646
Portfolio battery storage behind the constraint (Installed FCDS capacity)		1052	1271
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		3196	4348
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		0	298
Mitigation Options	RAS	Existing CEC RAS	
	Reduce generic battery storage (MW)	Not sufficient	
	Transmission upgrade including cost	Not needed	
Recommended Mitigation		Existing CEC RAS	

Affected interties	IID-SDGE_ITC	
	Base	Sensitivity
MIC expansion request MW behind constraint	35	N/A
Deliverable MIC expansion request MW	35	N/A

2039 On-Peak ES-SM Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		634	643
Portfolio battery storage behind the constraint (Installed FCDS capacity)		143	143
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		634	521
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		0	122
Mitigation Options	RAS	Existing CEC RAS	
	Reduce generic battery storage (MW)	None	
	Transmission upgrade including cost	Not needed	
Recommended Mitigation		Existing CEC RAS	

Affected interties	N/A	
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

SDG&E Area On-Peak Constraints Summary

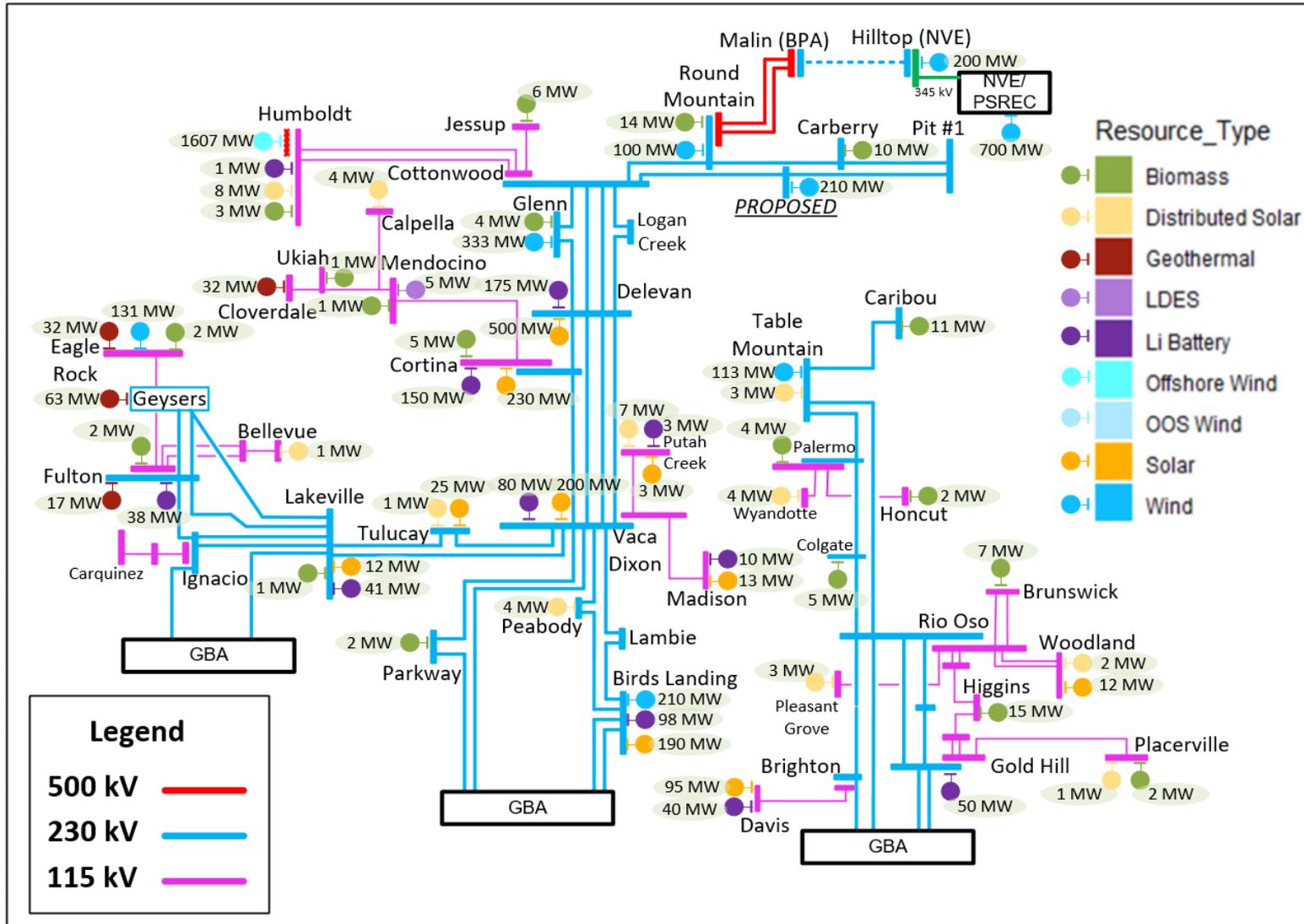
Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
BB-SG	2034 Base	746	121	0	971	Use 2 hour emergency rating
	2039 Base	1579	342	1579	0	
	2039 Sensitivity	3064	562	2699	364	
SG-OT	2034 Base	501	184	136	365	Use 30 minute emergency rating
	2039 Base	1303	236	1303	0	
	2039 Sensitivity	1971	236	1862	109	
EA-SLR	2034 Base	2990	448	1783	1207	Existing CEC RAS
	2039 Base	3196	1052	3196	0	
	2039 Sensitivity	4646	1271	4348	298	
SLR-SO	2034 Base	3800	726	3325	475	Existing CEC RAS
	2039 Base	N/A				
	2039 Sensitivity	N/A				
Old Town	2034 Base	N/A				No generation in 5% DFAX circle. Overloads observed in reliability study, mitigation will be coordinated with that study
	2039 Base	0	0	0	0	
	2039 Sensitivity	0	0	0	0	
Sycamore-Scripps	2034 Base	N/A				Use 30 minute emergency rating
	2039 Base	591	101	479	113	
	2039 Sensitivity	601	101	489	113	
ES-SM	2034 Base	N/A				Existing CEC RAS
	2039 Base	634	143	634	0	
	2039 Sensitivity	643	143	521	122	

PG&E North of Greater Bay Interconnection Area

PG&E North of Greater Bay Interconnection Area Portfolio Summary

Resource Type	2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	275	320	595	430	1,115	1,545	1,275	2,457	3,732
Wind – In State	778	320	1,097	1,678	320	1,997	674	260	933
Wind – Out-of-State	0	0	0	1,500	0	1,500	0	0	0
Wind - Offshore	931	0	931	1,607	0	1,607	0	0	0
Li Battery – 4 hr	293	0	293	293	0	293	93	0	93
Li Battery – 8 hr	88	0	88	488	0	488	1,073	0	1,073
Long Duration Energy Storage (LDES)	5	0	5	5	0	5	959	0	959
Geothermal	144	0	144	144	0	144	1,074	0	1,074
Biomass/Biogas	96	0	96	96	0	96	6	0	6
Distributed Solar	37	0	37	37	0	37	37	0	37
Total	2,647	639	3,287	6,279	1,434	7,713	5,191	2,716	7,907

2039 Base Portfolio: PG&E North of Greater Bay Area



2034 Base Portfolio On-Peak PG&E North of Greater Bay Area Deliverability Constraints

Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
HOPLAND BANK 115/60.00 BANK NO.2	GEYSERS #9-LAKEVILLE & EAGLE ROCK-FULTON-SILVERADO LINES	HSN	139.72
Ukiah-Hopland-Cloverdale 115 kV (Ukiah sub 115kv to Hopland Jct 115kv)	EAGLE ROCK -REDBUD & CORTINA-MENDOCINO #1 LINES	HSN	117.78
GEYSER # 3 - CLOVERDALE 115K (CLOVERDALE 115KV to MPE TAP115KV)	EAGLE ROCK -REDBUD & CORTINA-MENDOCINO #1 LINES	HSN	112.42
Geyser #3 - Eagle Rock 115 kv	MENDOCINO-UKIAH & UKIAH-HOPLAND-CLOVERDALE LINES	HSN	113.95
Eagle Rock- Fulton- Silverado 115 kv (Eagle rock sub to Ricon Jct Jct2 115 kv)	LAKEVILLE-TULUCAY & VACA-LAKEVILLE #1 LINES	HSN	120.79
Fulton - Hopland 60 kV (Hopland Jct 60 kV to Cloverdale Jct 60 kV)	GEYSERS #9-LAKEVILLE & EAGLE ROCK-FULTON-SILVERADO LINES	HSN	166.10
Konocti - Eagle Rock 60kV	UKIAH-HOPLAND-CLOVERDALE 115KV [4050]	HSN	109.63
Gold Hill - Lodi Stig 230 kV Line	GOLD HILL-EIGHT MILE ROAD 230KV [4800] & LODI STIG-EIGHT MILE ROAD 230KV [5001]	HSN	102.80

2034 Base Portfolio On-Peak Hopland Bank 115/60 kV Bank #2 Constraint Summary

Affected transmission zones		North of Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		202
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		39
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		239
Mitigation Options	RAS	N/A
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	Maintenance Project
Recommended Mitigation		TBD

Affected inerties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Ukiah-Hopland-Cloverdale 115 kV (Ukiah sub 115kv to Hopland Jct 115kv) Constraint Summary

Affected transmission zones		North of Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		191
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		455
Mitigation Options	RAS	N/A
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	This constraint is a currently identified LDNU and will be addressed in GIP
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Geyser #3 – Cloverdale 115 kV Constraint Summary

Affected transmission zones		North of Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		159
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		353
Mitigation Options	RAS	N/A
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	This constraint is a currently identified LDNU and will be addressed in GIP
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Geyser #3 - Eagle Rock 115 kV Constraint Summary

Affected transmission zones		North of Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		90
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		64
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		30
Mitigation Options	RAS	N/A
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	This constraint is a currently identified LDNU and will be addressed in GIP
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Eagle Rock- Fulton-Silverado 115 kV Constraint Summary

Affected transmission zones		North of Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		282
Portfolio battery storage behind the constraint (Installed FCDS capacity)		150
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		165
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		281
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	TBD
	Transmission upgrade including cost	Reconductor
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Fulton - Hopland 60 kV Constraint Summary

Affected transmission zones		North of Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		202
Portfolio battery storage behind the constraint (Installed FCDS capacity)		150
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		53
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		350
Mitigation Options	RAS	N/A
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	This constraint is a currently identified LDNU and will be addressed in GIP
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Konocti - Eagle Rock 60kV Constraint Summary

Affected transmission zones		North of Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		191
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		53
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		192
Mitigation Options	RAS	N/A
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	This constraint is a currently identified LDNU and will be addressed in GIP
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Gold Hill - Lodi Stig 230 kV Line Constraint Summary

Affected transmission zones		North of Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		326
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		314
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		12
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	Reconductor
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak PG&E North of Greater Bay Area Deliverability Constraints – SSN Only

Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
Cortina - Vaca 230 kV Line	Delevan-Vaca Dixon No.2 230 kV Line & Delevan-Vaca Dixon No.3 230 kV Line	SSN	100.94
Lincoln - Pleasant Grove 115 kV Line	Rio Oso-Atlantic 230 kV Line & Rio Oso-Gold Hill 230 kV Line	SSN	100.69

2034 Base Portfolio Off-Peak PG&E North of Greater Bay Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	Mitigation
None			

2039 On-Peak PG&E North of Greater Bay Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Geyser # 12 - Fulton 230 kV (Fulton - Geyser#14 Jct)	Base Case	100.32	<100
Cortina - Vaca 230 kV Line	Delevan-Vaca Dixon No.2 230 kV Line & Delevan-Vaca Dixon No.3 230 kV Line	100.96	103.44
Cortina - Mendocino No.1 115 kV (Mendocino Sub 115kV to Lucerine Jct1 115 kv)	EAGLE ROCK-CORTINA & EAGLE ROCK-REDBUD LINES (2)	<100	110.75
Lincoln - Pleasant Grove 115 kV Line	Rio Oso-Atlantic 230 kV Line & Rio Oso-Gold Hill 230 kV Line	113.17	114.78

2039 On-Peak Geyser # 12 - Fulton 230 kV Constraint Summary

Affected transmission zones		North of Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		60	N/A
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0	N/A
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		61	N/A
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		2	N/A
Mitigation Options	RAS	TBD	N/A
	Reduce generic battery storage (MW)	TBD	N/A
	Transmission upgrade including cost	TBD	N/A
Recommended Mitigation		TBD	N/A

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Cortina - Vaca 230 kV Line Constraint Summary

Affected transmission zones		North of Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		720	706
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0	330
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		549	680
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1224	1693
Mitigation Options	RAS	TBD	TBD
	Reduce generic battery storage (MW)	TBD	TBD
	Transmission upgrade including cost	TBD	TBD
Recommended Mitigation		TBD	TBD

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Cortina - Mendocino No.1 115 kV Constraint Summary

Affected transmission zones		North of Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	81
Portfolio battery storage behind the constraint (Installed FCDS capacity)		N/A	150
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		N/A	0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		N/A	347
Mitigation Options	RAS	N/A	TBD
	Reduce generic battery storage (MW)	N/A	TBD
	Transmission upgrade including cost	N/A	TBD
Recommended Mitigation		N/A	TBD

Affected interties			
		Base	Sensitivity
MIC expansion request MW behind constraint		N/A	N/A
Deliverable MIC expansion request MW		N/A	N/A

2039 On-Peak Lincoln - Pleasant Grove 115 kV Line Constraint Summary

Affected transmission zones		North of Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		100	82
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0	135
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0	0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		459	539
Mitigation Options	RAS	TBD	TBD
	Reduce generic battery storage (MW)	TBD	TBD
	Transmission upgrade including cost	TBD	TBD
Recommended Mitigation		TBD	TBD

Affected interties			
		Base	Sensitivity
MIC expansion request MW behind constraint		N/A	N/A
Deliverable MIC expansion request MW		N/A	N/A

PG&E North of Greater Bay Area On-Peak Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Cortina - Mendocino No.1 115 kV (Mendocino Sub 115kV to Lucerine Jct1 115 kv)	39 Sensitivity	81	150	0	347	TBD
Cortina - Vaca 230 kV Line	39 Baseline	720	0	549	1224	TBD
	39 Sensitivity	706	330	680	1693	
Eagle Rock- Fulton- Silverado 115 kv (Eagle rock sub to Ricon Jct Jct2 115 kv)	34 HSN	282	150	147	290	TBD
	39 Baseline	277	0	165	134	
	39 Sensitivity	273	155	355	94	
Fulton - Hopland 60 kV (Hopland Jct 60 kV to Cloverdale Jct 60 kV)	34 HSN	202	150	53	350	TBD
	39 Baseline	197	0	53	553	
	39 Sensitivity	193	155	207	531	
Geyser # 12 - Fulton 230 kV (Fulton - Geyser#14 Jct)	39 Baseline	63	0	61	2	TBD
GEYSER # 3 - CLOVERDALE 115K (CLOVERDALE 115KV to MPE TAP115KV)	34 HSN	159	0	0	353	TBD
	39 Sensitivity	157	0	0	439	

PG&E North of Greater Bay Area On-Peak Constraints Summary

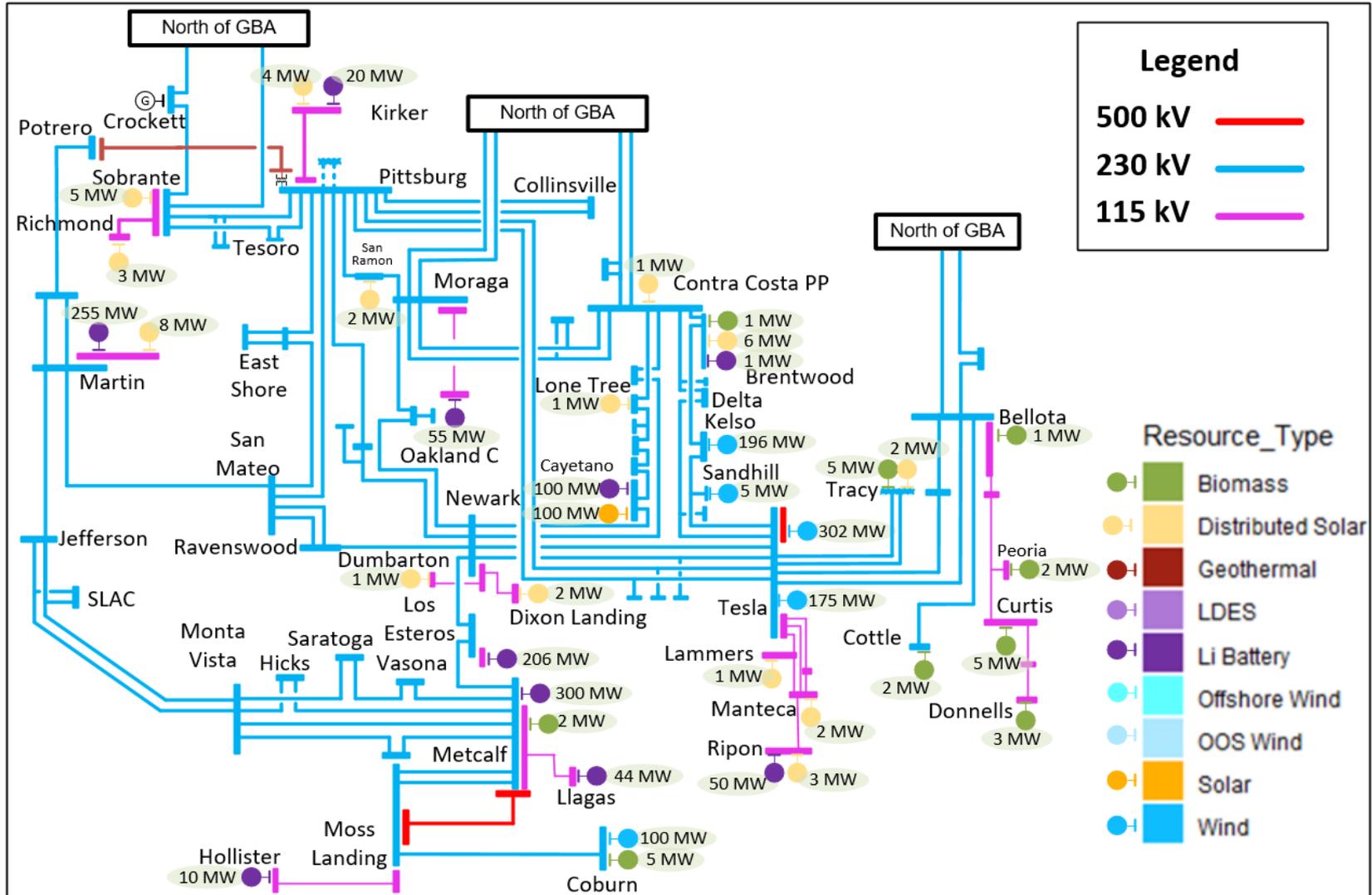
Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Geyser #3 - Eagle Rock 115 kv	34 HSN	90	0	64	30	TBD
	39 Baseline	85	0	70	33	
	39 Sensitivity	85	0	81	22	
Gold Hill - Lodi Stigg 230 kV Line	34 HSN	326	0	314	12	TBD
HOPLAND BANK 115/60.00 BANK NO.2	34 HSN	202	0	39	239	TBD
	39 Baseline	197	0	20	642	
	39 Sensitivity	193	5	45	618	
Konocti - Eagle Rock 60kV	34 HSN	191	0	53	179	TBD
Lincoln - Pleasant Grove 115 kV Line	39 Baseline	100	0	0	459	TBD
	39 Sensitivity	82	135	0	539	
Ukiah-Hopland-Cloverdale 115 kV (Ukiah sub 115kv to Hopland Jct 115kv)	34 HSN	191	0	0	455	TBD
	39 Sensitivity	189	0	0	471	

PG&E Greater Bay Interconnection Area

PG&E Greater Bay Interconnection Area Portfolio Summary

Resource Type	2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	0	100	100	470	215	685	670	670	1,340
Wind – In State	688	90	778	688	90	778	698	90	788
Wind – Out-of-State	0	0	0	0	0	0	0	0	0
Wind - Offshore	0	0	0	0	0	0	0	0	0
Li Battery – 4 hr	829	0	829	879	0	879	170	0	170
Li Battery – 8 hr	212	0	212	822	0	822	1,645	0	1,645
Long Duration Energy Storage (LDES)	0	0	0	0	0	0	0	0	0
Geothermal	0	0	0	0	0	0	0	0	0
Biomass/Biogas	26	0	26	26	0	26	5	0	5
Distributed Solar	40	0	40	40	0	40	69	0	69
Total	1,794	190	1,984	2,924	305	3,229	3,258	760	4,018

2034 Base Portfolio: PG&E Greater Bay Area



2034 Base Portfolio On-Peak PG&E Greater Bay Area Deliverability Constraints

Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
Cayetano-Lone Tree (USWP-Cayetano) 230kV Line	Contra Costa-Moraga Nos. 1 & 2 230 KV lines	HSN	110.36
Eastshore-San Mateo 230kV Line	Newark-Ravenswood 230 KV and Tesla-Ravenswood 230 KV lines	HSN	100.09
Kifer-FMC 115 kV Line	Newark - Los Esteros & Los Esteros - Metcalf 230 KV Lines	HSN	103.41
Metcalf-El Patio No. 2 115 kV Line	SANJOSEBHVDC-SANJOSEB #1 115KV [0]	HSN	100.86
Ripon - Ripon Jct 115 kV Line	Base Case	HSN	105.09
Nortech-NRS 115 kV Line	SSS-NRSriser SVP 230 kV path	HSN	139.71
Tesla - Westley 230 kV Line	TESLA 500/230KV TB 2	SSN	119.32

2034 Base Portfolio On-Peak Cayetano-Lone Tree (USWP-Cayetano) 230 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		314
Portfolio battery storage behind the constraint (Installed FCDS capacity)		38
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		211
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		498
Mitigation Options	RAS	No
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	Reconductor
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Eastshore-San Mateo 230 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		1
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		11
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	Reconductor
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Kifer-FMC 115 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		2
Portfolio battery storage behind the constraint (Installed FCDS capacity)		376
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		299
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		149
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	TBD
	Transmission upgrade including cost	TBD
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Metcalf-EI Patio No. 2 115 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		0
Portfolio battery storage behind the constraint (Installed FCDS capacity)		300
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		240
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		60
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	TBD
	Transmission upgrade including cost	TBD
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Ripon - Ripon Jct 115 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		3
Portfolio battery storage behind the constraint (Installed FCDS capacity)		50
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		48
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		5
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	TBD
	Transmission upgrade including cost	TBD
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Nortech-NRS 115 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		0
Portfolio battery storage behind the constraint (Installed FCDS capacity)		206
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		439
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	TBD
	Transmission upgrade including cost	TBD
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Tesla - Westley 230 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area
Portfolio resources behind the constraint (Installed FCDS capacity)		4023
Portfolio battery storage behind the constraint (Installed FCDS capacity)		201
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1447
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		3626
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	TBD
	Transmission upgrade including cost	TBD
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak PG&E Greater Bay Area Deliverability Constraints - SSN Only

Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
Manteca - Vierra 115 kV Lin	SCHULTE SW STA-KASSON-MANTECA 115KV [7472] & TESLA-SALADO-MANTECA 115KV [4000]	SSN	124.47
San Jose - Trimble 115 kV Line	FMC-SAN JOSE B 115KV [2021]	SSN	116.97
Melones - Cottle 230 kV Line	WARNERVILLE-WILSON 230KV [5870]	SSN	112.83

2034 Base Portfolio Off-Peak PG&E Greater Bay Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	Mitigation
Trimble - San Jose B - DG 115 kV line	FMC-SANJOSE B 115KV	122.07	TBD

2039 On-Peak PG&E Greater Bay Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
El Patio-San Jose Sta. 'A' 115 kV Line	Metcalf - Evergreen #1 and #2 115 KV Lines	<100	117.85
Lakewood-Meadow Lane-Clayton 115kV Line	LAKEWOOD-CLAYTON 115KV [2082]	116.7	118.62
Las Positas-Newark 230kV Line	Contra Costa-Moraga Nos. 1 & 2 230 KV lines	195.03	<100
Los Esteros - Nortech 115 kV line	SSS-NRSriser SVP 230 kV path	<100	127.56
Manteca - Vierra 115 kV Lin	SCHULTE SW STA-KASSON-MANTECA 115KV [7472] & TESLA-SALADO-MANTECA 115KV [4000]	111.64	<100
Bellota - Lockford 230 kV Line	LOCKFORD-BELLOTA 230KV & RIO OSO-LOCKEFORD 230KV [5620]	106.73	133.36
Newark-Northern Receiving Station #1 115kV Line	Newark - Los Esteros & Los Esteros - Metcalf 230 KV Lines	102.06	<100
San Jose Sta 'A'-'B' 115 kV Line	Metcalf - Evergreen #1 and #2 115 KV Lines	<100	117.04

2039 On-Peak El Patio-San Jose Sta. 'A' 115 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	0
Portfolio battery storage behind the constraint (Installed FCDS capacity)		N/A	470
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		N/A	0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		N/A	687
Mitigation Options	RAS	N/A	TBD
	Reduce generic battery storage (MW)	N/A	TBD
	Transmission upgrade including cost	N/A	TBD
Recommended Mitigation		N/A	TBD

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Lakewood-Meadow Lane-Clayton 115 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		4	4
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0	20
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0	0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		523	562
Mitigation Options	RAS	TBD	TBD
	Reduce generic battery storage (MW)	N/A	TBD
	Transmission upgrade including cost	TBD	TBD
Recommended Mitigation		TBD	TBD

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Las Positas-Newark 230 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		364	N/A
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0	N/A
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0	N/A
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		2848	N/A
Mitigation Options	RAS	TBD	N/A
	Reduce generic battery storage (MW)	N/A	N/A
	Transmission upgrade including cost	TBD	N/A
Recommended Mitigation		TBD	N/A

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Los Esteros - Nortech 115 kV line Constraint Summary

Affected transmission zones		Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	0
Portfolio battery storage behind the constraint (Installed FCDS capacity)		N/A	206
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		N/A	0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		N/A	479
Mitigation Options	RAS	N/A	TBD
	Reduce generic battery storage (MW)	N/A	TBD
	Transmission upgrade including cost	N/A	TBD
Recommended Mitigation		N/A	TBD

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Manteca - Vierra 115 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		1	N/A
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0	N/A
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0	N/A
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		186	N/A
Mitigation Options	RAS	TBD	N/A
	Reduce generic battery storage (MW)	N/A	N/A
	Transmission upgrade including cost	TBD	N/A
Recommended Mitigation		TBD	N/A

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Bellota - Lockford 230 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		253	244
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0	228
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0	132
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		865	1045
Mitigation Options	RAS	TBD	TBD
	Reduce generic battery storage (MW)	N/A	TBD
	Transmission upgrade including cost	TBD	TBD
Recommended Mitigation		TBD	TBD

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak San Jose Sta 'A'-'B' 115 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	0
Portfolio battery storage behind the constraint (Installed FCDS capacity)		N/A	470
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		N/A	0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		N/A	560
Mitigation Options	RAS	N/A	TBD
	Reduce generic battery storage (MW)	N/A	TBD
	Transmission upgrade including cost	N/A	TBD
Recommended Mitigation		N/A	TBD

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

2039 On-Peak Newark-Northern Receiving Station #1 115 kV Line Constraint Summary

Affected transmission zones		Greater Bay Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		1	N/A
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0	N/A
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0	N/A
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		115	N/A
Mitigation Options	RAS	TBD	N/A
	Reduce generic battery storage (MW)	N/A	N/A
	Transmission upgrade including cost	TBD	N/A
Recommended Mitigation		TBD	N/A

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

PG&E Greater Bay Area On-Peak Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Bellota - Lockford 230 kV Line	39 Baseline	253	0	0	861	TBD
	39 Sensitivity	244	228	362	762	
Cayetano-Lone Tree (USWP-Cayetano) 230kV Line	34 Base	314	38	211	498	TBD
Eastshore-San Mateo 230kV Line	34 Base	1	0	0	11	TBD
El Patio-San Jose Sta. 'A' 115 kV Line	39 Sensitivity	0	470	0	683	TBD
Kifer-FMC 115 kV Line	34 Base	2	376	229	149	TBD
Lakewood-Meadow Lane-Clayton 115kV Line	39 Baseline	4	0	0	523	TBD
	39 Sensitivity	4	20	0	562	
Las Positas-Newark 230kV Line	39 Baseline	364	0	0	2848	TBD
Los Esteros - Nortech 115 kV line	39 Sensitivity	0	206	0	479	TBD
Manteca - Vierra 115 kV Lin	34 Base	1	0	0	287	TBD
	39 Baseline	1	0	0	186	

PG&E Greater Bay Area On-Peak Constraints Summary

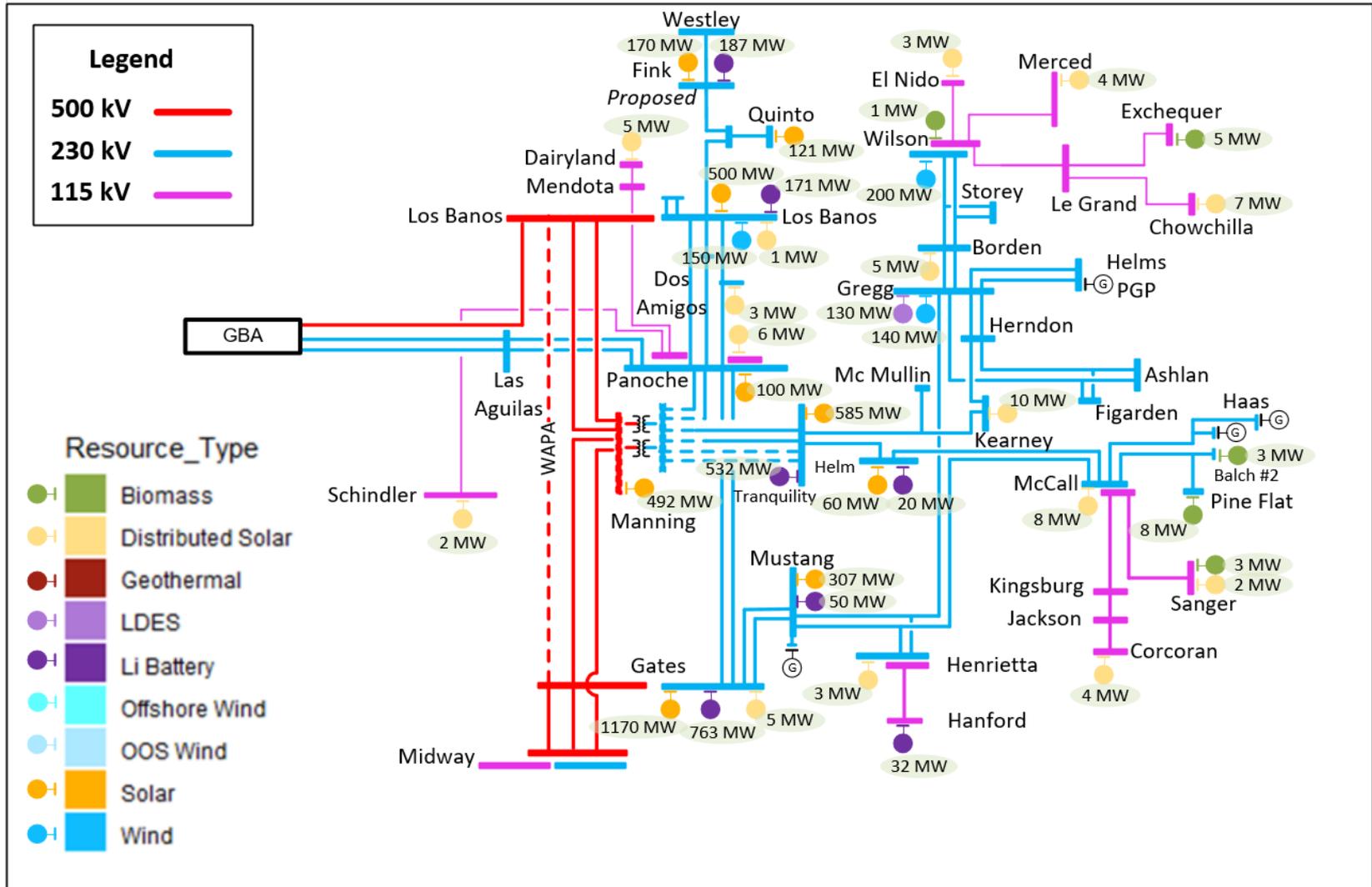
Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Melones - Cottle 230 kV Line	34 Base	455	0	0	761	TBD
Metcalf-El Patio No. 2 115 kV Line	34 Base	0	300	240	60	TBD
Newark-Northern Receiving Station #1 115kV Line	39 Baseline	1	0	0	115	TBD
Nortech-NRS 115 kV Line	34 Base	0	206	0	439	TBD
	39 Sensitivity	0	206	32	192	
Ripon - Ripon Jct 115 kV Line	34 Base	3	50	48	5	TBD
San Jose - Trimble 115 kV Line	34 Base	2	420	0	692	TBD
San Jose Sta 'A'-'B' 115 kV Line	39 Sensitivity	0	470	0	560	TBD
Tesla - Westley 230 kV Line	34 Base	1099	201	159	1901	TBD
	39 Baseline	899	0	109	1604	
	39 Sensitivity	898	201	255	1736	

PG&E Greater Fresno Interconnection Area

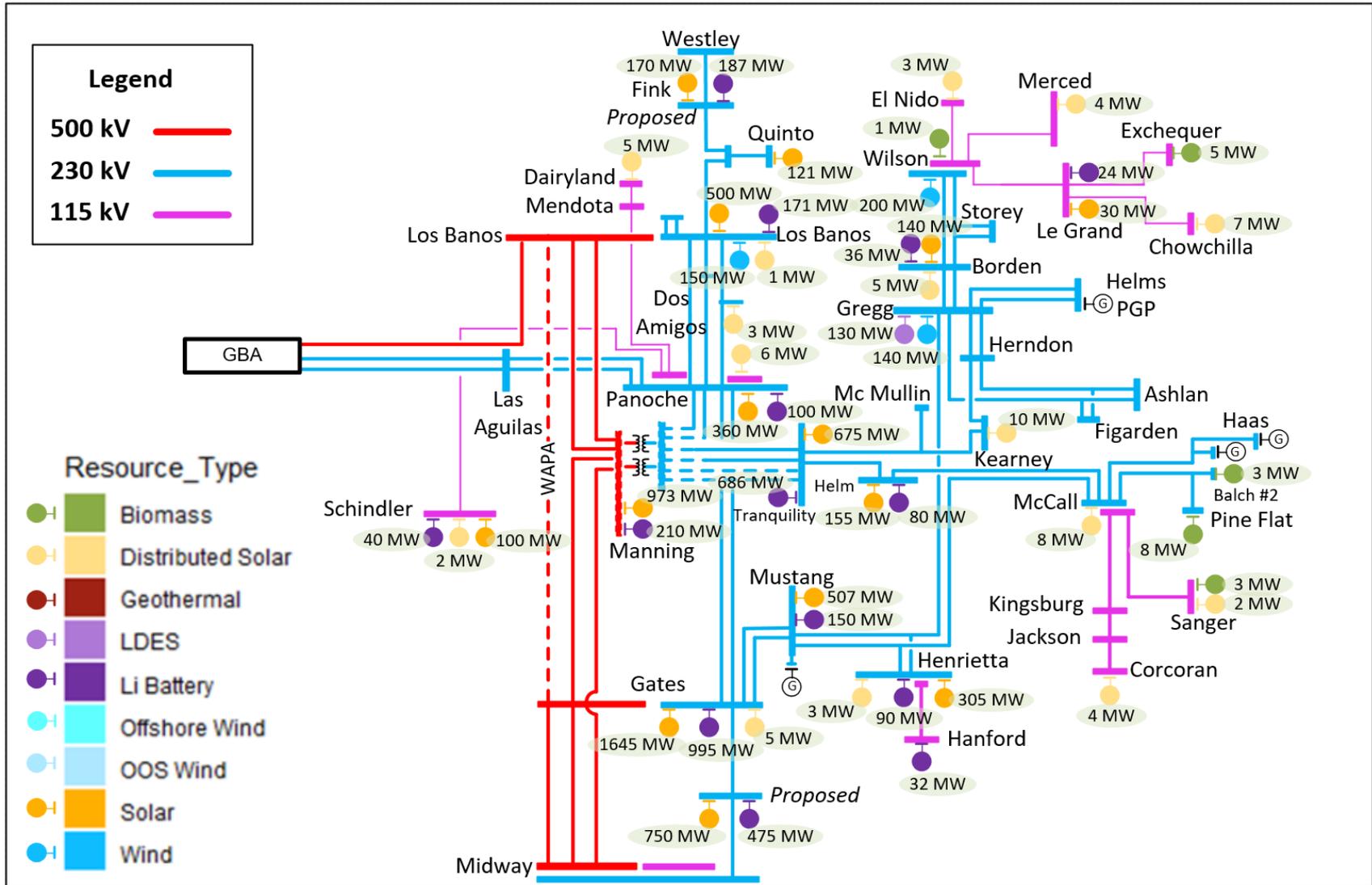
PG&E Greater Fresno Interconnection Area Portfolio Summary

Resource Type	2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	2,636	869	3,505	3,027	3,404	6,430	5,338	5,823	11,160
Wind – In State	394	96	490	394	96	490	360	40	400
Wind – Out-of-State	0	0	0	0	0	0	0	0	0
Wind - Offshore	0	0	0	0	0	0	0	0	0
Li Battery – 4 hr	1,554	0	1,554	1,669	0	1,669	1,455	0	1,455
Li Battery – 8 hr	200	0	200	1,607	0	1,607	2,780	0	2,780
Long Duration Energy Storage (LDES)	130	0	130	130	0	130	131	0	131
Geothermal	0	0	0	0	0	0	0	0	0
Biomass/Biogas	20	0	20	20	0	20	3	0	3
Distributed Solar	66	0	66	66	0	66	68	0	68
Total	5,001	965	5,966	6,913	3,500	10,412	10,134	5,863	15,997

2034 Base Portfolio: PG&E Greater Fresno Area



2039 Base Portfolio: PG&E Greater Fresno Area



2034 Base Portfolio On-Peak PG&E Greater Fresno Area Deliverability Constraints

Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
Crescent - Schindler 70 kV Line	HELM 230/70KV TB 1	SSN	555.63
GWF-Kingsburg 115 kV Line	HELM-MCCALL 230KV [4860] & HENTAP2-MUSTANGSS #1 230KV [0]	HSN	122.18
Herndon-Woodward 115 kV Line	HERNDON-BARTON 115KV [1750] & HERNDON-MANCHESTER 115KV [1780]	HSN	120.15
McCall-Sanger #3 115 kV Line	MCCALL-SANGER #1 115KV [2330] & MCCALL-SANGER #2 115KV [2340]	HSN	117.94
Helm-Crescent 70 kV Line	HELM 230/70KV TB 1	SSN	510.59

2034 Base Portfolio On-Peak Crescent - Schindler 70 kV Line Constraint Summary

Affected transmission zones		Fresno Area
Portfolio resources behind the constraint (Installed FCDS capacity)		200
Portfolio battery storage behind the constraint (Installed FCDS capacity)		81
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		202
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		79
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	TBD
	Transmission upgrade including cost	Reconductor
Recommended Mitigation		TBD

Affected interties	
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak GWF-Kingsburg 115 kV Line Constraint Summary

Affected transmission zones		Fresno Area
Portfolio resources behind the constraint (Installed FCDS capacity)		314
Portfolio battery storage behind the constraint (Installed FCDS capacity)		32
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		314
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		127
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	TBD
	Transmission upgrade including cost	Reconductor
Recommended Mitigation		TBD

Affected interties	
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Herndon-Woodward 115 kV Line Constraint Summary

Affected transmission zones		Fresno Area
Portfolio resources behind the constraint (Installed FCDS capacity)		240
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		566
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	Reconductor
Recommended Mitigation		TBD

Affected interties	
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak McCall-Sanger #3 115 kV Line Constraint Summary

Affected transmission zones		Fresno Area
Portfolio resources behind the constraint (Installed FCDS capacity)		21
Portfolio battery storage behind the constraint (Installed FCDS capacity)		32
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		316
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	TBD
	Transmission upgrade including cost	Reconductor
Recommended Mitigation		TBD

Affected interties	
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak Helm-Crescent 70 kV Line Constraint Summary

Affected transmission zones		Fresno Area
Portfolio resources behind the constraint (Installed FCDS capacity)		200
Portfolio battery storage behind the constraint (Installed FCDS capacity)		81
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		184
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		97
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	TBD
	Transmission upgrade including cost	Reconductor
Recommended Mitigation		TBD

Affected interties	
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak PG&E Greater Fresno Area Deliverability Constraints – SSN only

Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
(New) C577SS-Los Banos 230 kV Line	TESLA-LOS BANOS #1 500KV [6100]	SSN	100.74
Five Points - Calfax 70 kV Line	HELM 230/70KV TB 1	SSN	113.94
Helm 230/70 kV Transformer #1	CRESCENTSS-SCHLNDLR #1 70KV [0]	SSN	119.87
Panoche-Schindler #2 115 kV Line	HELM 230/70KV TB 1	SSN	101.52
Schindler - Paiges SLR JCT 70kV Line	HELM 230/70KV TB 1	SSN	112.66
Schindler 115/70 kV Transformer #1	HELM 230/70KV TB 1	SSN	131.39
Schindler-Coalinga #2 70 kV Line	HELM 230/70KV TB 1	SSN	110.64
Schindler-Huron-Gates 70 kV Line	HELM 230/70KV TB 1	SSN	113.61
Warnerville - Wilson 230 kV Line	COTTLE-MELONES 230KV [4530]	SSN	151.31
Wilson- Borden -Storey 230 kV Line	WILSON-BORDEN #1 230KV [5890]	SSN	108.79

2034 Base Portfolio Off-Peak PG&E Greater Fresno Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	Mitigation
BARTON-AIRWAYS-SANGER 115kV Line	P7-1:A14:26:_HENTAP1-MUSTANGSS #1 230KV [0] & TRANQLTYSS-MCMULLN1 #1 230KV [0]	106.82	TBD
Chowchilla-Kerckhoff 115kV Line	P7-1:A13:1:_WILSON-BORDEN 230KV #1 & #2 [9001]	149.78	TBD
Crescent Switching Station - Schindler 70kV Line	P1-2:A13:22:_TRANQUILLITY SW STA-HELM 230KV [5370]	167.58	68 MW Portfolio Battery dispatched in charging mode
Fink Switching Station - Westley 230kV Line	P1-2:A13:4:_QUINTO SW STA-WESTLEY 230KV [5070]	123.55	TBD
Fivepoint SSS - Calflax #1 70kV Line	P1-3:A14:28:_HELM 230/70KV TB 1	144.6	49 MW Portfolio Battery dispatched in charging mode
Gates - Huron - Calflax 70 kV Line	P1-3:A14:28:_HELM 230/70KV TB 1	154.31	58 MW Portfolio Battery dispatched in charging mode
Gates-Panoche #1 230kV Line	P1-2:A0:23:_GATES-MANNING 500KV [0]	149.18	TBD
Gates-Panoche #2 230kV Line	P1-2:A0:23:_GATES-MANNING 500KV [0]	158.49	TBD
GWF - Kingsburg 115kV Line	P7-1:A14:17:_HELM-MCCALL 230KV [4860] & HENTAP2-MUSTANGSS #1 230KV [0]	126.15	TBD
Helm 230/70KV TB 1	P7-1:A14:10:_PANOCHESCHINDLER #1 115KV [3250] & EXCELSIORSS-PANOCHES2 115KV [3231]	152.25	TBD

2034 Base Portfolio Off-Peak PG&E Greater Fresno Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	Mitigation
Le Grand - Dairyland 115kV Line	P7-1:A13:13:_BORDEN-GREGG 230KV #1 & #2 [4400]	111.57	TBD
Los Banos - Manning #1 500kV Line	P1-2:A0:16:_LOSBANOS-MANNING 500KV [0] (2)	158.53	TBD
Los Banos - Manning #2 500kV Line	P1-2:A0:15:_LOSBANOS-MANNING 500KV [0]	158.53	TBD
Los Banos - Panoche #2 230kV Line	P1-3:A0:15:_LOSBANOS 500/230KV TB 1	125.32	TBD
Los Banos-Quinto Switching Station 230kV Line	P1-2:A0:11:_TESLA-LOS BANOS #1 500KV [6100]	173.06	TBD
Manning - Gates 500kV Line	Base Case	135.84	TBD
Mc Call - Sanger #3 115kV Line	P7-1:A14:26:_HENTAP1-MUSTANGSS #1 230KV [0] & TRANQLTYSS-MCMULLN1 #1 230KV [0]	115.27	TBD
Melones - Wilson 230kV Line	P1-2:A13:3:_WARNERVILLE-WILSON 230KV [5870]	124.14	TBD
Moss Landing-Las Aguilas Switching Station 230kV Line	P1-2:A0:13:_MOSS LANDING-LOS BANOS 500KV [6040]	144.61	TBD
Panoche - Excelsior Switching Station #2 115kV Line	P1-3:A14:28:_HELM 230/70KV TB 1	124.02	33 MW Portfolio Battery dispatched in charging mode

2034 Base Portfolio Off-Peak PG&E Greater Fresno Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	Mitigation
Panoche-Schindler#1 115 kV Line	P1-3:A14:28:_HELM 230/70KV TB 1	123.35	56 MW Portfolio Battery dispatched in charging mode
Quinto Switching Station - Fink Switching Station 230kV Line	P1-2:A13:4:_QUINTO SW STA-WESTLEY 230KV [5070]	117.19	TBD
Quinto Switching Station-Westley 230kV Line	P1-2:A13:1:_FINKSWSTA-WESTLEY #1 230KV [0]	123.24	TBD
Schindler 115/70 kV Transformer#1	P1-3:A14:28:_HELM 230/70KV TB 1	214.23	TBD
Schindler-Coalinga#2 70 kV Line	P1-3:A14:28:_HELM 230/70KV TB 1	123.84	21 MW Portfolio Battery dispatched in charging mode
Warnerville - Wilson 230 kV Line	P1-2:A12:2:_COTTLE-MELONES 230KV [4530]	220.06	TBD
Wilson - Borden #1 230kV Line	P1-2:A13:27:_WILSON-BORDEN #2 230KV [9001]	178.29	TBD
Wilson - Borden #2 230kV Line	P1-2:A13:26:_WILSON-BORDEN #1 230KV [5890]	154.45	TBD
Wilson-Le Grand 115 kV Line	P7-1:A13:1:_WILSON-BORDEN 230KV #1 & #2 [9001]	105.41	TBD
Wilson-Oro Loma 115 kV Line	P7-1:A13:13:_BORDEN-GREGG 230KV #1 & #2 [4400]	186.31	TBD

2039 On-Peak PG&E Greater Fresno Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Corcoran-Smyrna (Alpaugh-Smyrna) 115 kV Line	Base Case	<100	112.27
McCall-Sanger #1 115 kV Line	MCCALL-REEDLEY 115KV [2320] & MCCALL-SANGER #3 115KV [2350]	104.9	107.65
McCall-Sanger #2 115 kV Line	MCCALL-REEDLEY 115KV [2320] & MCCALL-SANGER #3 115KV [2350]	118.46	121.56

2039 On-Peak Corcoran-Smyrna (Alpaugh-Smyrna) 115 kV Line Constraint Summary

Affected transmission zones		Fresno Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	24
Portfolio battery storage behind the constraint (Installed FCDS capacity)		N/A	10
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		N/A	34
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		N/A	0
Mitigation Options	RAS	N/A	TBD
	Reduce generic battery storage (MW)	N/A	TBD
	Transmission upgrade including cost	N/A	TBD
Recommended Mitigation		N/A	TBD

Affected interties			
		Base	Sensitivity
MIC expansion request MW behind constraint		N/A	N/A
Deliverable MIC expansion request MW		N/A	N/A

2039 On-Peak McCall-Sanger #1/#2 115 kV Line(s) Constraint Summary

Affected transmission zones		Fresno Area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		21	10
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0	32
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0	0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		163	146
Mitigation Options	RAS	TBD	TBD
	Reduce generic battery storage (MW)	N/A	TBD
	Transmission upgrade including cost	Reconductor	Reconductor
Recommended Mitigation		TBD	TBD

Affected interties		
	Base	Sensitivity
MIC expansion request MW behind constraint	N/A	N/A
Deliverable MIC expansion request MW	N/A	N/A

PG&E Greater Fresno Area On-Peak Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
(New) C577SS-Los Banos 230 kV Line	34 Base	8021	1433	5754	10941	TBD
Corcoran-Smyrna (Alpaugh-Smyrna) 115 kV Line	39 Sensitivity	24	10	34	0	TBD
Crescent - Schindler 70 kV Line	34 Base	200	81	202	79	TBD
Crescent - Schindler 70 kV Line	39 Baseline	201	0	0	286	TBD
Crescent - Schindler 70 kV Line	39 Sensitivity	201	106	222	104	TBD
Five Points - Calfax 70 kV Line	34 Base	202	81	194	98	TBD
GWF-Kingsburg 115 kV Line	34 Base	314	32	314	127	TBD
Helm 230/70 kV Transformer #1	34 Base	200	81	220	61	TBD
Herndon-Woodward 115 kV Line	34 Base	240	0	0	566	TBD
Herndon-Woodward 115 kV Line	39 Baseline	189	0	0	785	TBD
Herndon-Woodward 115 kV Line	39 Sensitivity	189	166	0	709	TBD
McCall-Sanger #1 115 kV Line	39 Baseline	21	0	0	163	TBD
McCall-Sanger #1 115 kV Line	39 Sensitivity	10	32	0	146	TBD

PG&E Greater Fresno Area On-Peak Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
McCall-Sanger #2 115 kV Line	39 Baseline	21	0	0	467	TBD
McCall-Sanger #2 115 kV Line	39 Sensitivity	10	32	0	438	TBD
McCall-Sanger #3 115 kV Line	34 Base	21	32	0	316	TBD
Panoche-Schindler #2 115 kV Line	34 Base	202	81	182	147	TBD
Schindler - Paiges SLR JCT 70kV Line	34 Base	202	81	162	121	TBD
Schindler 115/70 kV Transformer #1	34 Base	200	91	166	134	TBD
Schindler-Coalinga #2 70 kV Line	34 Base	202	81	168	115	TBD
Schindler-Huron-Gates 70 kV Line	34 Base	202	81	190	102	TBD
Helm-Crescent 70 kV Line	34 Base	200	81	184	97	TBD
Helm-Crescent 70 kV Line	39 Baseline	201	0	0	295	TBD
Helm-Crescent 70 kV Line	39 Sensitivity	201	106	216	110	TBD
Warnerville - Wilson 230 kV Line	34 Base	789	102	300	2243	TBD
Wilson- Borden -Storey 230 kV Line	34 Base	596	82	300	1237	TBD

PG&E Kern Interconnection Area

PG&E Kern Interconnection Area Portfolio Summary

Resource Type	2034 Base Portfolio			2039 Base Portfolio			2039 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	680	1,301	1,981	1,036	2,061	3,096	2,029	2,762	4,791
Wind – In State	300	10	310	300	10	310	190	10	200
Wind – Out-of-State	0	0	0	0	0	0	0	0	0
Wind - Offshore	2,924	0	2,924	2,924	0	2,924	0	0	0
Li Battery – 4 hr	777	0	777	777	0	777	186	0	186
Li Battery – 8 hr	142	0	142	682	0	682	1,217	0	1,217
Long Duration Energy Storage (LDES)	0	0	0	0	0	0	400	0	400
Geothermal	0	0	0	0	0	0	0	0	0
Biomass/Biogas	18	0	18	18	0	18	0	0	0
Distributed Solar	73	0	73	73	0	73	79	0	79
Total	4,913	1,311	6,224	5,809	2,071	7,879	4,101	2,772	6,873

2034 Base Portfolio On-Peak PG&E Kern Area Deliverability Constraints

Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
Taft-Maricopa 70 kV Line	MIDWAY-KERN #4 & KERN-BAKERSFIELD & MIDWAY-KERN #3 LINES	HSN	107.37

2034 Base Portfolio On-Peak Taft-Maricopa 70 kV Line Constraint Summary

Affected transmission zones		Kern Area
Portfolio resources behind the constraint (Installed FCDS capacity)		13
Portfolio battery storage behind the constraint (Installed FCDS capacity)		0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		50
Mitigation Options	RAS	TBD
	Reduce generic battery storage (MW)	N/A
	Transmission upgrade including cost	Reconductor
Recommended Mitigation		TBD

Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2034 Base Portfolio On-Peak PG&E Kern Area Deliverability Constraints – SSN Only

Overloaded Facility	Contingency	More Limiting Condition	Loading (%)
Callender Sw. Sta-Mesa 115 kV Line	MORROBAY 230/115KV TB 6	SSN	108.63
Copus-Old River 70 kV Line	MIDWAY-KERN#4 & KERN-BAKERSFIELD & MIDWAY-KERN#3 LINES	SSN	103.24
Midway - Vincent #1 500 kV Line	MIDWAY-VINCENT 500KV [0] (2)	SSN	112.6
Midway - Vincent #2 500 kV Line	MIDWAY-VINCENT 500KV [0]	SSN	115.19
Oceano-Callender Sw. Sta 115 kV Line	MORROBAY 230/115KV TB 6	SSN	108.98
South Kern Jct - San Emidio 70 kV Line	MIDWAY-KERN#4 & KERN-BAKERSFIELD & MIDWAY-KERN#3 LINES	SSN	103.45

2034 Base Portfolio Off-Peak PG&E Kern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	Mitigation
Callendar Switching Station - Mesa 115kV Line	P7-1:A20:16:_Morro Bay-Mesa and Morro Bay-Diablo 230 kV Lines	271.12	TBD
San Miguel - UnionPGAE 70kV Line	P7-1:A14:14:_TEMPLETON-GATES 230KV [5934] & GATES-CALFLATSSS #1 230KV [0]	114.38	104 MW Portfolio Battery dispatched in charging mode

2039 On-Peak PG&E Kern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
None			

PG&E Kern Area On-Peak Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Energy storage portfolio MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Callender Sw. Sta-Mesa 115 kV Line	34 Base	189	110	49	250	TBD
Copus-Old River 70 kV Line	34 Base	13	0	0	15	TBD
Midway - Vincent #1 500 kV Line	34 Base	12868	4434	2073	47478	TBD
Midway - Vincent #2 500 kV Line	34 Base	12868	4434	2352	47199	TBD
Oceano-Callender Sw. Sta 115 kV Line	34 Base	189	110	29	271	TBD
South Kern Jct - San Emidio 70 kV Line	34 Base	13	0	0	15	TBD
Taft-Maricopa 70 kV Line	34 Base	13	0	0	50	TBD

NEXT STEPS

Comments

- Comments due by end of day November 27, 2024
- Submit comments through the ISO's commenting tool, using the template provided on the process webpage:
- <https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/2024-2025-Transmission-planning-process>