2026-2027 Transmission Planning Process

Policy & Economic Preliminary Assessment and Study Updates

Stakeholder Meeting

November 18, 2026

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



If you are connected to audio through your computer or used the ‘call me’ option, select the raise hand icon located on the bottom of your screen.



If you are connected on the phone line only and not the Webex dial *3 to be added to the raise hand queue.



Please remember to state your name and affiliation before making your comment.



You may also send questions via chat to all panelists. Open the “Direct” tab, and select “All Panelists from the dropdown menu.



If you need technical assistance during the meeting, please send a chat to the event producer at Intellor Events.

2026-2027 Transmission Planning Process Stakeholder Call – Agenda

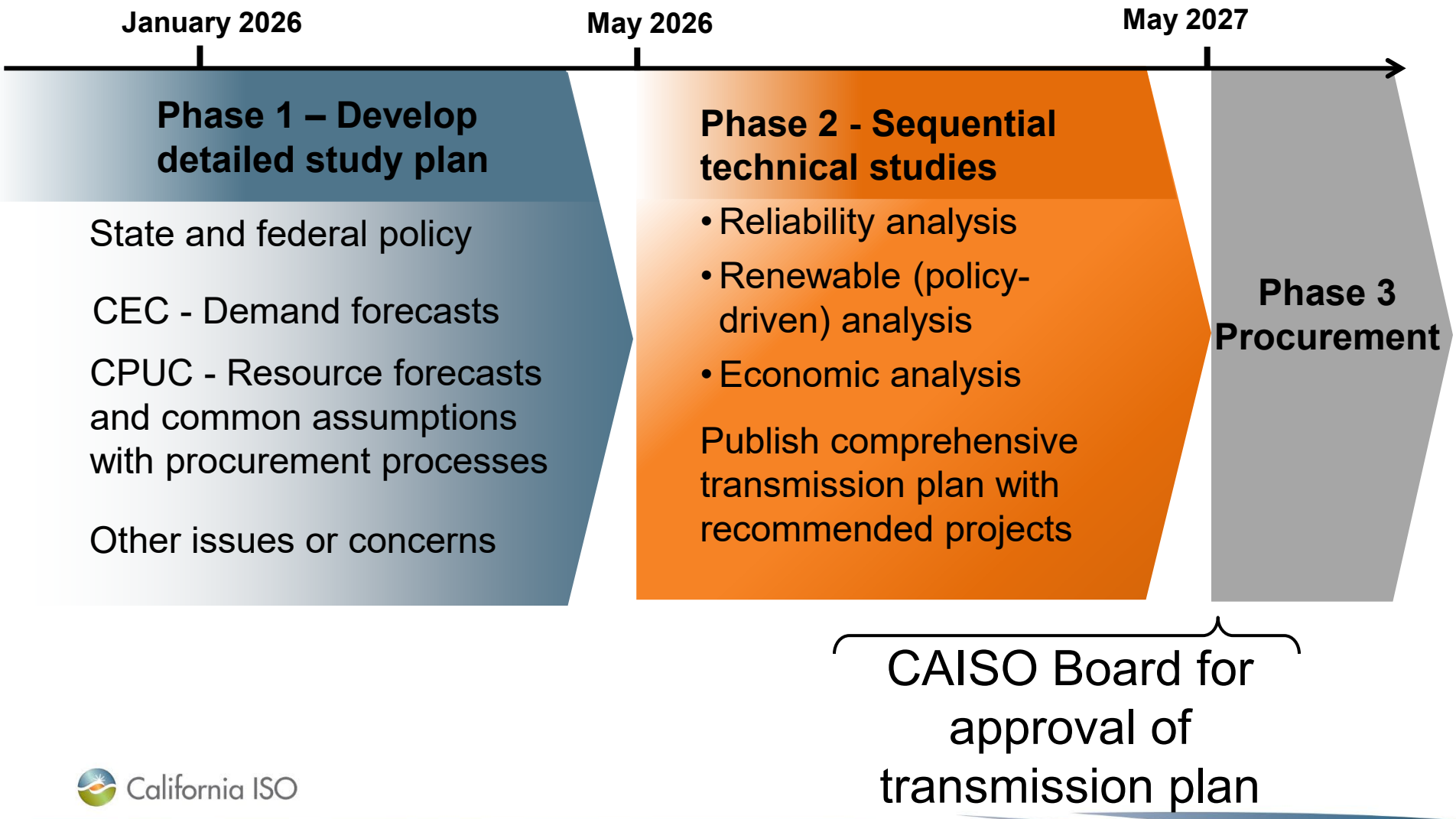
Topic	Presenter
Overview	Andrew Rivera
Reliability <$50 Million Project Recommendation - North	Preethi Rondla
MIC Expansion Requests	Catalin Micsa
Preliminary Policy Assessment Introduction - Preliminary Results of SCE and GLW areas - Preliminary Results for SDG&E area - Preliminary Results for PG&E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

2026-2027 Transmission Planning Process Overview

Andrew Rivera
Sr. Transmission Planning Specialist

2026-2027 Transmission Planning Process Stakeholder Meeting
November 18, 2026

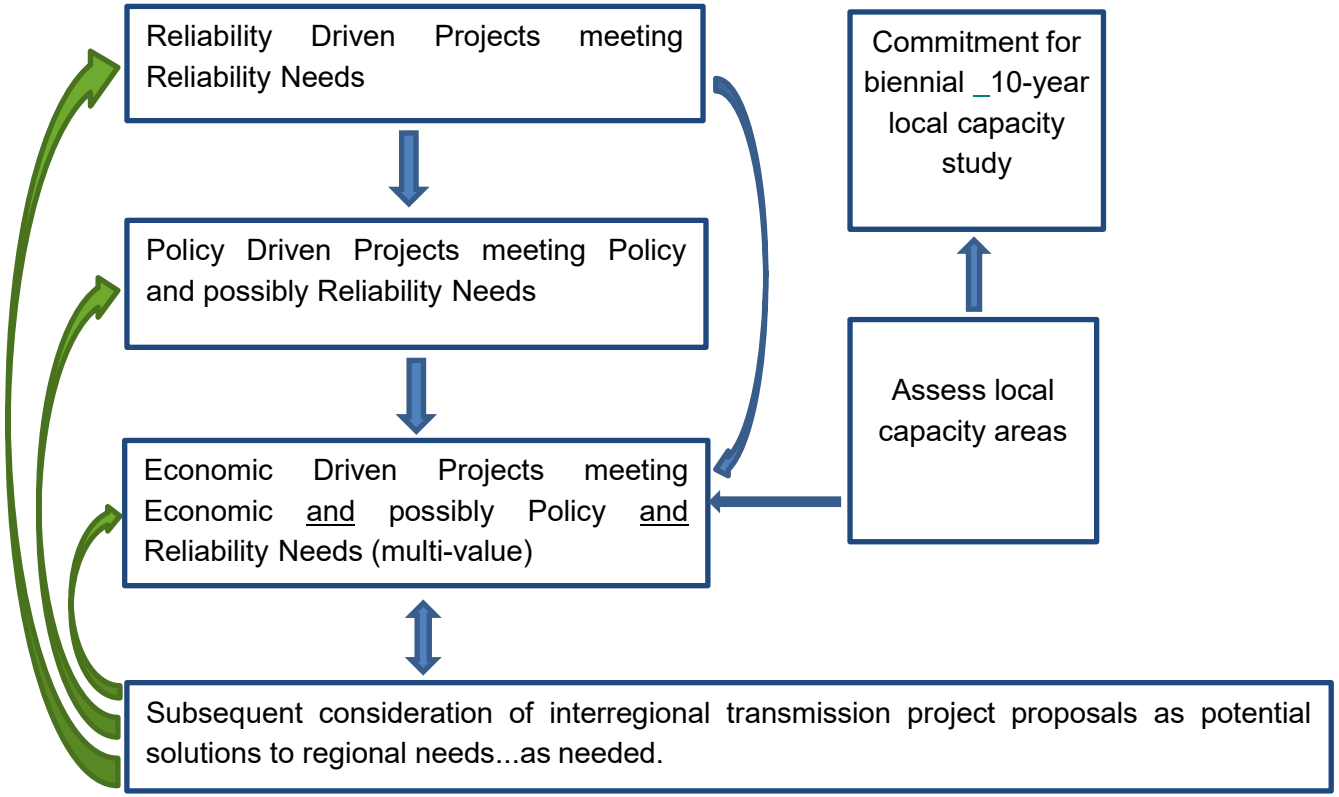
2026-2027 Transmission Planning Process



2026-2027 Transmission Plan Milestones

- Draft Study Plan posted on February 17
- Stakeholder Meeting: Draft Study Plan on February 24
  - Comments to be submitted by March 10
- Final Study Plan to be posted in April
- Preliminary reliability study results to be posted on August 14
- Stakeholder Meeting: Preliminary Reliability Results on September 23 and 24
  - Comments to be submitted by October 8
- Request window closes October 15
- Stakeholder Meeting: Preliminary policy and economic results on November 18
  - Comments to be submitted by December 4
- Stakeholder Meeting: Long Term LCR on December 7, 2026
- Draft transmission plan to be posted on March 31, 2027
- Stakeholder Meeting: Draft Transmission Plan on April 7, 2027
  - Comments to be submitted by April 21, 2027
- Revised draft for approval at May 2027 Board of Governor meeting

Studies are coordinated as a part of the transmission planning process



2026-2027 Transmission Planning Process
Reliability Assessment - Update

- Final reliability results were posted October 30, 2026.

- ISO recommended projects have two main 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 as well as less than $50 million projects not presented today for management approval, they will be included in draft plan to be issued for stakeholder comments by March 31, 2026

CAISO Management Approval

- Approving these projects allows streamlining the review and approval process of the annual transmission plan in 2026.
- Only those projects less than $50 million are considered for management approval that:
  - Can reasonably be addressed on a standalone basis
  - Are not impacted by policy or economic issues that are still being assessed.
  - None of the projects identified are considered eligible for competitive solicitation
  - Are not impacted by the approval of the transmission plan (and reliability projects over $50 million) by the Board of Governors in May 2026.
- Management will only approve these projects after a Board of Governors meeting (Held in December)

2026 PTO Request Window Submissions

Project Name	Submitter	Review of Submission
Exchequer 115 kV System Reconfiguration Project	PG&E	May be considered as a reliability alternative
Clear Lake-Lower Lake 60 kV Area Reinforcement Project	PG&E	May be considered as a reliability alternative
Banta - Tracy 115 kV Line Reconductor Project	PG&E	May be considered as a reliability alternative
Edenvale 115 kV Area Reinforcement Project	PG&E	May be considered as a reliability alternative
Maple Creek Area Reinforcement Project	PG&E	May be considered as a reliability alternative
Marysville 60 kV Reinforcement Project	PG&E	May be considered as a reliability alternative
Hammer - Country Club 60 kV Line Reconductor Project	PG&E	May be considered as a reliability alternative
Moraga 115 kV Bus Upgrade Project	PG&E	May be considered as a reliability alternative
Station MA Rearrangement Project	PG&E	May be considered as a reliability alternative
Reedley-Orosi-Dinuba 70 kV System Reinforcement Project	PG&E	May be considered as a reliability alternative
Newark E-F 230 kV Bus Tie Limiting Elements Upgrade Project	PG&E	May be considered as a reliability alternative
Metcalf and East San Jose Reconfiguration Project -Conceptual	PG&E	Submission incomplete (Conceptual project)
North San Jose & De Anza 230 kV System Import Reinforcement Project-Conceptual	PG&E	Submission incomplete (Conceptual project)
Lerdo 115 kV System Upgrade Project – Conceptual	PG&E	Submission incomplete (Conceptual project)
South Los Padres Reinforcement Project - Conceptual	PG&E	Submission incomplete (Conceptual project)
Millbrae 230 kV Addition and System Reconfiguration Project - Conceptual	PG&E	Submission incomplete (Conceptual project)
Watsonville Area Reinforcement Project - Conceptual	PG&E	Submission incomplete (Conceptual project)
Contra Costa – Newark 230 kV Corridor Reinforcement Project - Conceptual	PG&E	Submission incomplete (Conceptual project)

2026 PTO Request Window Submissions

Project Name	Submitter	Review of Submission
Whirlwind 230 kV SCD Upgrade	SCE	May be considered as a reliability alternative
Rio Hondo 230 kV SCD Upgrade	SCE	May be considered as a reliability alternative
Whirlwind 500 kV Transmission Line Relocation	SCE	May be considered as a reliability alternative
Mesa 1AA (Fourth) Bank	SCE	May be considered as a reliability alternative
Mesa-Vincent No. 2 500 kV Line Conversion	SCE	May be considered as a reliability alternative
New Coolwater CRAS	SCE	May be considered as a reliability alternative
Vincent 500 kV Reactive Power Reinforcement	SCE	May be considered as a reliability alternative
Devers 500 kV Reactive Power Reinforcement	SCE	May be considered as a reliability alternative
Mohave 500 kV Voltage Support	SCE	May be considered as a reliability alternative
Charleston Park Reliability Projects	GLW	May be considered as a reliability alternative
TL667-TL660 Reconductor	SDG&E	May be considered as a reliability alternative
TL610-TL6952 Reconductor	SDG&E	May be considered as a reliability alternative
TL649A Reconductor	SDG&E	May be considered as a reliability alternative
TL647 Reconductor	SDG&E	May be considered as a reliability alternative
TL645-TL646 Reconductor	SDG&E	May be considered as a reliability alternative
TL623B Reconductor	SDG&E	May be considered as a reliability alternative

2026 Request Window Submissions

Project Name	Submitter	Review of Submission
Pacific Transmission Expansion Project "PTEP"	California Western Grid Development, LLC	May be considered as a reliability alternative
Walker River - Tesla 500 kV AC Line	Cobalt Transmission Partners	May be considered as a reliability alternative
Kern-Southland Energy Link (K-SEL)	Grid United	Submission incomplete. Therefore, it will not be considered as a reliability solution in the development of the transmission plan.
MAP Upgrade	IO/Lotus Infrastructure Global Operations, LLC	The CAISO has determined that the MAP Upgrade Transmission Project 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, but it may be considered in the policy study process.
LA Basin Link	NextEra	May be considered as a reliability alternative
Recon 4th Transformer	NextEra	May be considered as a reliability alternative
Trout Canyon Expansion LCRIF	NextEra	May be considered as a reliability alternative
TBC Expansion	NextEra	May be considered as a reliability alternative
Estrella Loop-in (Templeton-Gates)	NextEra	May be considered as a reliability alternative
Quinto Switching Station RAS	Quinto Coalition	The CAISO has determined that the Quinto Switching Station RAS 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, but it may be considered in the policy study process.
Vincent - Windhub 230 kV Line	Terra-Gen	The CAISO has determined that the Windhub-Vincent Transmission Project 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, but it may be considered in the policy study process.
TransWest Express Transmission Project (TWE Project)	TransWest Express LLC	The CAISO has determined that the TWE Transmission Project 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, but it may be considered in the policy study process.

Comments

- Comments due by end of day December 4th, 2026

- Submit comments through the ISO's commenting tool, using the template provided on the process webpage:
- https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/2026-2027-Transmission-planning-process

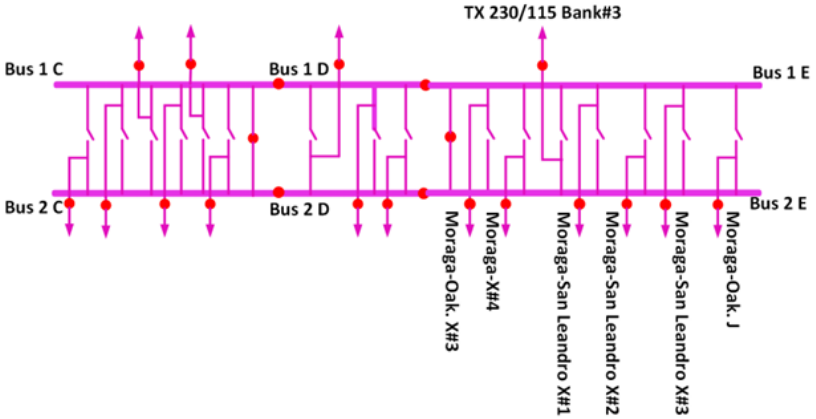
2026-2027 Transmission Planning Process
PG&E Area
Less than $50 Million Project Approvals and Project for Concurrence

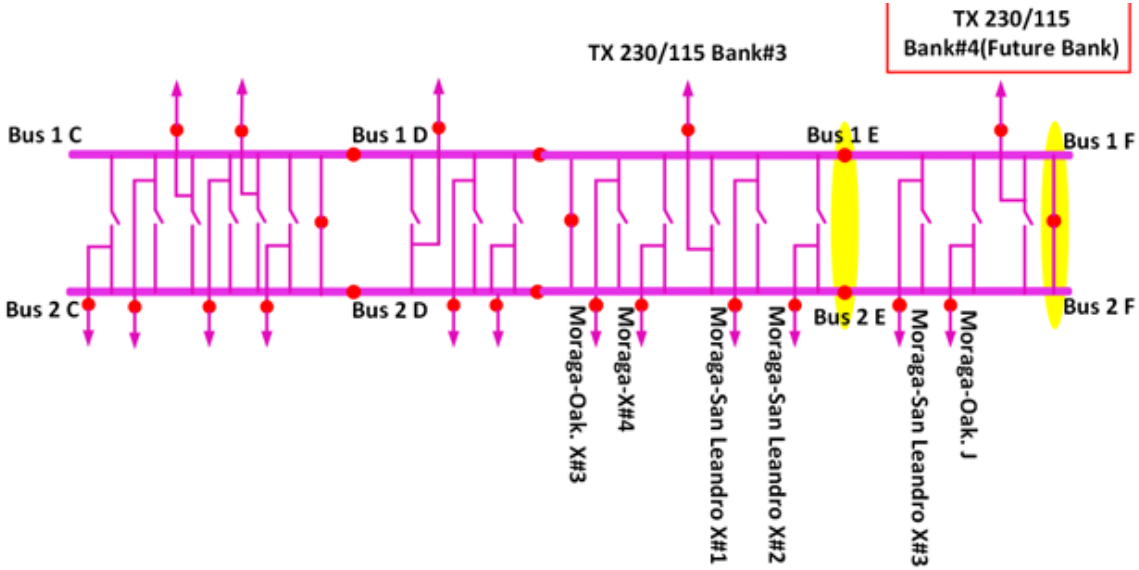
Preethi Rondla
Regional Transmission Engineer Lead

2026-2027 Transmission Planning Process Stakeholder Meeting
November 18, 2026

Moraga 115 kV Bus Upgrade Project

- Project Submitter : PG&E
- Reliability Assessment Need
  - Observed overloads on the Oakland J – Grant, Grant – East Shore, Grant – Eden Landing – East Shore 115 kV lines and the East Shore 230/115 kV transformer bank under P2-4 contingencies in the Moraga 115 kV bus E.
- Project Scope
  - Expand and sectionalize the existing Moraga 115 kV Bus Section E into two sections, Sections E and F, by installing two sectionalizing breakers and one bus-tie breaker.
- Alternative Considered:
  - Convert Moraga 115kV bus to BAAH. However, this alternative is not recommended due to its higher cost ($125-$250M).
- Project Cost: $20M-$40M
- Expected In-Service Date: May 2032 or earlier
- Impact of Proposed Project:
  - Prevent overloads under P2-4 contingencies in the Moraga substation
- Recommendation: Approval





2026 MIC Expansion Request

Catalin Micsa
Sr. Advisor Regional Transmission Engineer

2026-2027 Transmission Planning Process Stakeholder Meeting
November 18, 2026

2026 Valid MIC expansion requests

No.	Requestor Name	Intertie Name (Scheduling Point)	QC MW quantity	Resource type
1	Sunzia	PALOVRDE_ITC (PVWEST)	1727.42	Wind
2-11	Pattern Energy	ELDORADO_ITC (WILLOWBEACH)	42.69	Wind
12-13	Valley Electric Association	MEAD_ITC (MEAD230)	24	Hydro
14			85.84	Solar/Battery
15-16	California Community Power	IID-SDGE_ITC (IVLY2)	63	Geothermal
17		SILVERPK_ITC (SILVERPEAK55)	13	Geothermal

Not all MIC expansion requests trigger an actual need for expansion

- First the CAISO checks is 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 2026 MIC expansion requests

No.	Requestor Name	Intertie Name (Scheduling Point)	QC MW Quantity	Triggers Expansion	Comments
1	Sunzia	PALOVRDE_ITC (PVWEST)	1727.42	Yes	Partially included in the CPUC base portfolio.
2-11	Pattern Energy	ELDORADO_ITC (WILLOWBEACH)	42.69	No	Included in the CPUC base portfolio.
12-13	Valley Electric Association	MEAD_ITC (MEAD230)	24	No	Duplicate of 2025 request.
14			85.84	No	Duplicate of 2025 request.
15-16	California Community Power	IID-SDGE_ITC (IVLY2)	63	No	Included in the CPUC base portfolio.
17		SILVERPK_ITC (SILVERPEAK55)	13	Yes	Included in the CPUC base portfolio (main given at MONAIPPDC_ITC).

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

No	Year	Requestor Name	Intertie Name (Scheduling Point)	MW quantity (QC)	Resource type
1	2026	Sunzia	PALOVRDE_ITC (PVWEST)	755.02 (2027) 222.96 (LT)	Wind
2		California Community Power	SILVERPK_ITC (SILVERPEAK55)	13	Geothermal
3-4	2025	Valley Electric Association	MEAD_ITC (MEAD 230)	24	Hydro
5				85.84	Hybrid (Solar/Battery)
6	2024	California Community Power	SUMMIT_ITC (SUMMIT120)	18	Geothermal

2027 NQC Deliverability Study Results For MIC Expansion Requests Being Assessed

Intertie Name (Scheduling Point)	Status	Comments:
MEAD_ITC (MEAD 230)	PASS	For the part that is beyond the CPUC main portfolio.
SILVERPK_ITC (SILVERPEAK55)	PASS	Full. (Backup only)
SUMMIT_ITC (SUMMIT120)	PASS	Full. (Back-up only)
PALOVRDE_ITC (PVWEST)	FAIL	For the part that is beyond the CPUC main portfolio. Behind the Devers-Red Bluff constraints.

- Only applicable to MIC expansion request across RA year 2027
- 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:
MEAD_ITC (MEAD 230)	FAIL	Part included in the CPUC portfolio. For potential increase see mitigation for Lugo-Mohave and Lugo-Vincent constraints.
SILVERPK_ITC (SILVERPEAK55)	FAIL	Used as back-up only – main included in the CPUC portfolio. For potential increase see mitigation for Lugo-Vincent, Control-Inyokern and Control transformer constraint.
SUMMIT_ITC (SUMMIT120)	FAIL	Used as back-up only – main in the CPUC portfolio. For potential increase see mitigation for Table Mountain-Vaca Dixon constraint.
PALOVRDE_ITC (PVWEST)	FAIL	Part included in the CPUC portfolio. For potential increase see mitigation for Imperial Valley-Glamis, Lugo-Vincent, Devers-Red Bluff and Serrano-Alberhill-Valley, Mira Loma-Mesa constraints.

For a comprehensive view of future MIC increases (including due to main CPUC portfolio) please read chapter 6.1.2 Resource adequacy import capability of the 2025-2026 Transmission Plan.

Policy-driven Deliverability Assessment Preliminary Results

Transmission Infrastructure Planning

2026-2027 Transmission Planning Process Stakeholder Meeting
November 18, 2024

Introduction

- The 2026-2027 TPP policy-driven deliverability assessment is based on the base and low wind sensitivity portfolios transmitted by CPUC for the years 2036 and 2041
  - Base Portfolio is based on a 25 MMT GHG target by 2035 and 8 MMT by 2045, and is developed with the updated assumptions from 2024 CEC demand forecast
  - Sensitivity Portfolio is intended to study how the transmission needs would differ if the portfolios change to include fewer wind resources
- MIC expansion requests are assessed as part of the studies
- Existing demand response that is represented in the transmission planning models is turned on in the study cases to ensure that deliverability is not overallocated.

- New resources in the non-CPUC jurisdictional IRP, unaccounted for TPD allocations and resources added by PTO are also included in the study. Details of which have been presented in previous stakeholder meetings. A 19MW natural gas expansion project in non-CPUC IRP was added to the study after the stakeholder meeting presentation.
- The deliverability assessment consists of on-peak assessment (HSN and SSN) and Off-peak assessment
- Alternatives considered to address on-peak deliverability constraints
  - RAS or other operating solutions
  - Reducing generic battery-storage where applicable
  - Grid Enhancing Technology where applicable
  - Transmission upgrade alternatives (HSN)
  - Transmission upgrade alternatives if they provide sufficient, reliability, policy and 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
- Battery storage-specific transmission upgrades: Battery mappings are relatively flexible and accordingly, CAISO staff should consult with CPUC staff before moving forward with any new policy-driven transmission upgrades associated specifically with storage mapping in this planning cycle.

Base and Sensitivity Portfolios by Resource Type

Resource Type	2036 Base Portfolio			2041 Base Portfolio			2041 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Natural Gas	19	-	**19**	19	-	**19**	19	-	**19**
Solar	25,889	24,496	**50,385**	31,205	25,456	**56,661**	38,237	32,213	**70,450**
Wind – In State	2,446	129	**2,575**	4,526	229	**4,755**	2,430	69	**2,499**
Wind – Out-of-State	7,036	-	**7,036**	17,036	-	**17,036**	5,136	-	**5,136**
Wind - Offshore	2,924	-	**2,924**	4,531	-	**4,531**	-	-	**-**
Li Battery – 4 hr	37,327	1,908	**39,235**	37,286	1,908	**39,194**	35,587	1,873	**37,460**
Li Battery – 8 hr	11,831	50	**11,881**	11,831	50	**11,881**	17,124	50	**17,174**
Long Duration Energy Storage (LDES)	5,954	-	**5,954**	5,954	-	**5,954**	7,554	-	**7,554**
Geothermal	5,123	-	**5,123**	5,123	-	**5,123**	8,328	-	**8,328**
Biomass/Biogas	-	-	**-**	-	-	**-**	-	-	**-**
Distributed Solar		123	**123**		125	**125**	-	125	**125**
Net Dependable Gas Capacity not Retained	-1,653	-	**-1,653**	-1,653	-	**-1,653**	-1,226	-	**-1,226**
Total	96,877	26,706	**123,583**	115,839	27,768	**143,607**	113,170	34,330	**147,500**

Deliverability Reservations for Long Lead-Time Resources

- 2025-2026 Transmission Plan identified TPD reservations in Table 1-1

- For the 2026-2027 Transmission Plan the ISO intends to identify TPD reservation for the following resource types based on the capacity and locations included in the CPUC 2036 base portfolio:
  - Offshore wind;
  - Out-of-state/Out-of-CAISO wind;
  - Out-of-state/Out-of-CAISO geothermal;
  - In-CAISO EGS geothermal; and
  - Non-battery long duration energy storage (LDES) resources.

Draft Table 1-1 for 2026-2027 Transmission Plan

Resource type and Location	Base Portfolio		Deliverability reservation
	2036	2041	
Out-of-State Wind			
Wyoming wind (Eldorado)	3,000 MW	4,500 MW	3,000 MW
Wyoming wind (Tesla)	0 MW	4,000 MW	0 MW
Idaho wind (Harry Allen)	1,100 MW	1,100 MW	1,100 MW
New Mexico Wind (Palo Verde)	4,521 MW	6,021 MW	2,936 MW
New Mexico Wind (Lugo)	0 MW	3,000 MW	0 MW
New Mexico Wind (Mead)[1]	350 MW	350 MW	350 MW
Offshore Wind			
Offshore wind (North Coast - Humboldt 500 kV)	0 MW	1,607 MW	1,607 MW
Offshore wind (Central Coast - Diablo 500 kV)	2,924 MW	2,924 MW	2,924 MW
Long Duration Energy Storage (LDES)			
LDES (Bellota, Mokolumne)	400 MW	400 MW	400 MW
LDES (Gregg, Helms Uprate)	140 MW	140 MW	140 MW
LDES (Sycamore Canyon, San Vicente)	500 MW	500 MW	500 MW
LDES (Whirlwind, 230 kV, A-CAES)	300 MW	300 MW	300MW
LDES (Whirlwind, 500 kV, A-CAES)	480 MW	480 MW	480 MW
LDES (Alberhill, LEAPS)	200 MW	200 MW	200 MW
LDES (Mesa, Twitchell)	350 MW	350 MW	350 MW
LDES (Morro Bay, Whale Rock)	362 MW	362 MW	362 MW

Draft Table 1-1 for 2026-2027 Transmission Plan - Continued

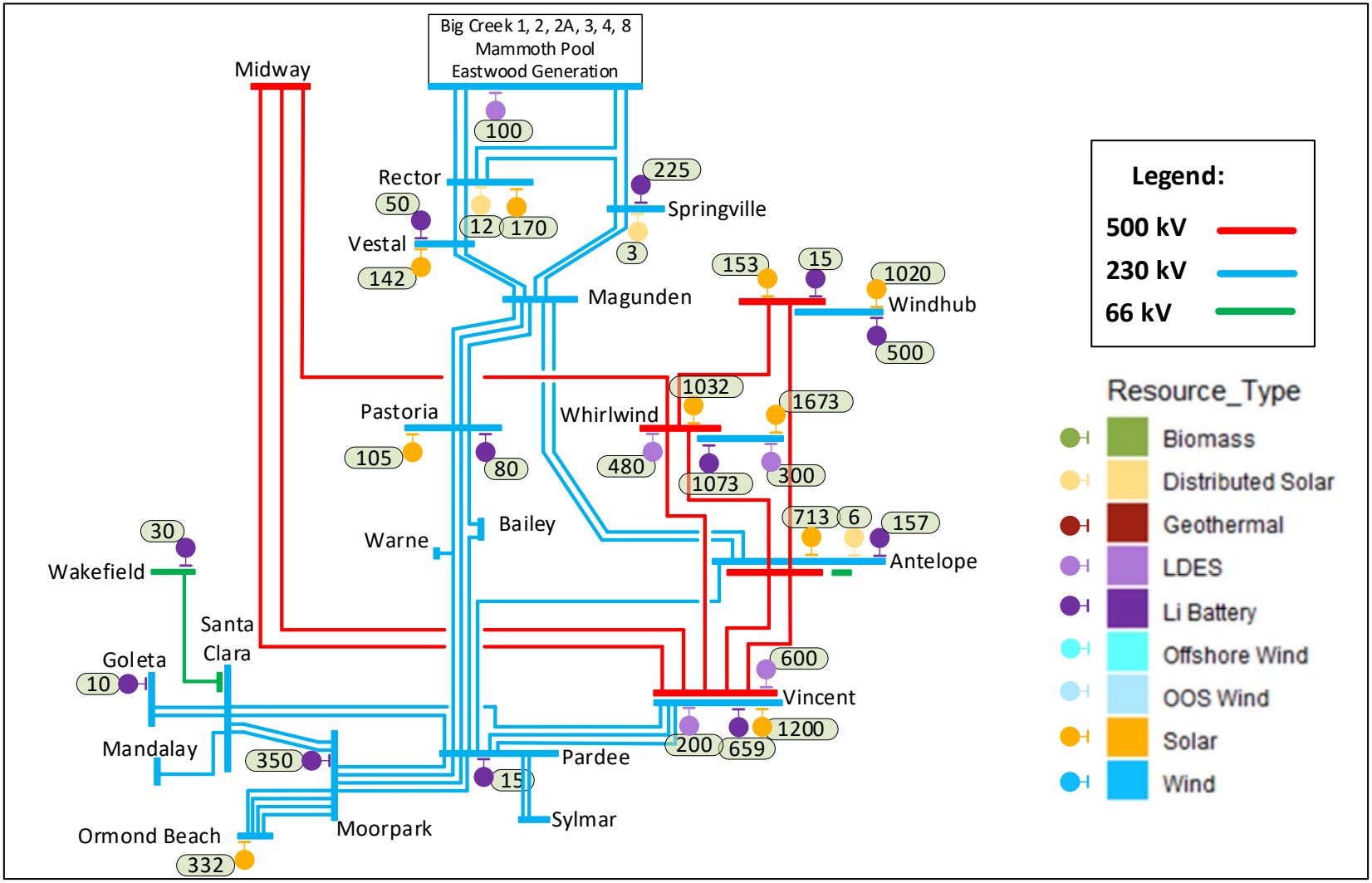
	Base Portfolio		Deliverability reservation
Resource type and Location	**2036**	**2041**	
Geothermal - Out-of-CAISO			
Geothermal (Imperial Irrigation District)	655 MW	655 MW	655 MW
Geothermal (IPP & IPPUtah)	90 MW	90 MW	90 MW
Geothermal (Mead)	45 MW	45 MW	45 MW
Geothermal (Summit)	40 MW	40 MW	40 MW
Northeast CA Geothermal (Malin 500 kV)	548 MW	548 MW	548 MW
Northeast CA Geothermal (Hilltop 345 kV)	159 MW	159 MW	159 MW
Geothermal – In-CAISO			
Beatty 230 kV	436 MW	436 MW	436 MW
Cloverdale 115 kV	112 MW	112 MW	112 MW
Eagle Rock (PG&E) 115 kV	22 MW	22 MW	22 MW
Fulton 230 kV	54 MW	54 MW	54 MW
Geysers 17 230 kV	20 MW	20 MW	20 MW
Inyokern 115 kV	100 MW	100 MW	100 MW
Bridgeville 115 kV	185 MW	185 MW	185 MW
Dos Amigos 230 kV	10 MW	10 MW	10 MW
James B Black 230 kV	130.5 MW	130.5 MW	130.5 MW
Jessup 115 kV	100 MW	100 MW	100 MW
Lakeville 115 kV	8 MW	8 MW	8 MW
Los Banos 230 kV	10 MW	10 MW	10 MW
New Sub - Westley - Quinto (Proposed) 230 kV	80 MW	80 MW	80 MW
Redbud 115 kV	241 MW	241 MW	241 MW
Rincon 115 kV	50 MW	50 MW	50 MW

SCE Northern Interconnection Area

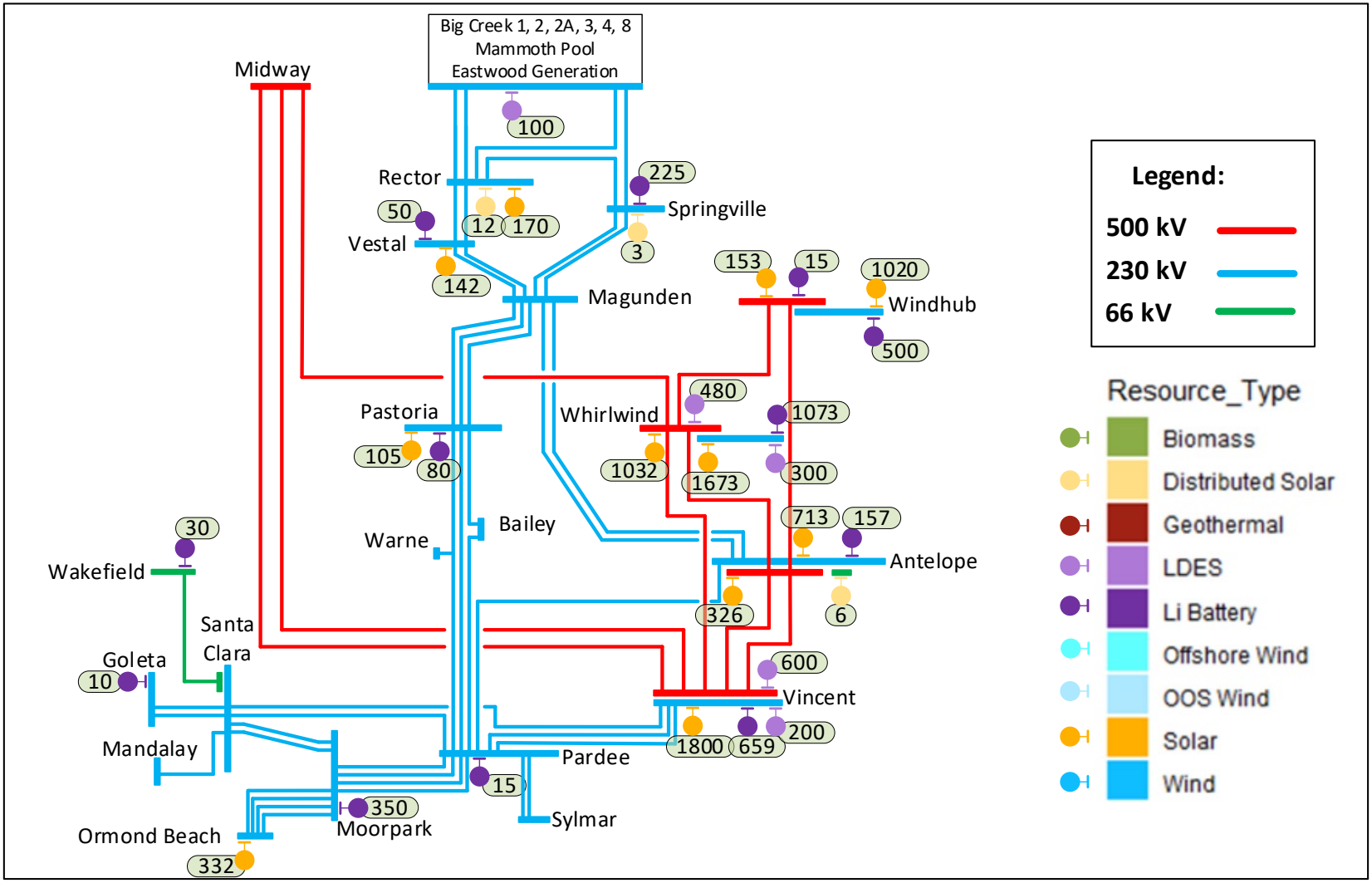
SCE Northern Interconnection Area Portfolio Summary

Resource Type	2036 Base Portfolio			2041 Base Portfolio			2041 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	5,960	2,738	**8,698**	6,886	2,738	**9,624**	8,060	4,194	**12,254**
Wind – Onshore	-	-	**-**	-	-	**-**	-	-	**-**
Wind – Out-of-State	-	-	**-**	-	-	**-**	-	-	**-**
Wind – Offshore	-	-	**-**	-	-	**-**	-	-	**-**
Li Battery – 4 hr	6,017	105	**6,122**	6,017	105	**6,122**	5,239	105	**5,344**
Li Battery – 8 hr	1,595	-	**1,595**	1,595	-	**1,595**	1,148	-	**1,148**
Long Duration Energy Storage (LDES)	1,686	-	**1,686**	1,686	-	**1,686**	3,092	-	**3,092**
Geothermal	-	-	**-**	-	-	**-**	-	-	**-**
Distributed Solar	-	14	**14**	-	14	**14**	-	14	**14**
Gas capacity not retained	-	-	**-**	-	-	**-**	-	-	**-**
Total	**15,258**	**2,856**	**18,114**	**16,184**	**2,856**	**19,040**	**17,539**	**4,312**	**21,851**

2036 Base Portfolio: SCE Northern Area



2041 Base Portfolio: SCE Northern Area



Path 26 Flow and Windhub Constraint Assumptions

CPUC portfolio[1]: expand Path 26 & Path 15 → **Path 26 S>N flow studied up to 5,000 MW** → **Windhub constraint exceeded**

Path 26 Flow



South-to-North (S>N) into PG&E area

Studied flows that exceed the existing Path 26 rating by up to 2,000 MW

Windhub Substation Deliverability



Overlapping outage of both 500 kV lines with no time for system adjustments could result in voltage collapse and uncontrolled cascading

Windhub dispatch limit exceeded in:

- 2036 HSN Base
- 2041 HSN Base
- 2041 HSN Sensitivity

CPUC base portfolios do not include generic resources at Windhub

1 Resource-to-Busbar Mapping & Other Modeling Assumptions for the 2026-2027 Transmission Planning Process

2036 Base Portfolio On-Peak SCE Northern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Midway – Whirlwind 500 kV No. 3 (PG&E Segment)	Base Case	157	148
Midway – Whirlwind 500 kV No. 3 (SCE Segment and Series Capacitor)	Base Case	113	107
Midway – Vincent 500 kV No. 2 (SCE's Series Capacitor)	Midway – Whirlwind 500 kV No. 3	121	< 100
	Midway – Vincent 500 kV No. 1	107	< 100
Midway – Vincent 500 kV No. 1 (SCE's Series Capacitors)	Midway – Whirlwind 500 kV No. 3	119	< 100
	Midway – Vincent 500 kV No. 2	106	< 100
Windhub #3 or #4 500/230 kV transformer	Windhub #3 or #4 500/230 kV transformer	107	< 100
Whirlwind #1, #3 or #4 500/230 kV transformer	Whirlwind #1, #3 or #4 500/230 kV transformer	101	154
	Base Case	< 100	123

2036 Base Portfolio On-Peak SCE Northern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Big Creek 3 – Rector 230 kV No. 1	Big Creek 1 – Rector 230 kV No. 1	102	< 100
	Big Creek 3 – Rector 230 kV No. 2	101	< 100
	Big Creek 3 – Rector 230 kV No. 2 and Rector – Springville 230 kV No. 1	102	< 100
Big Creek 3 – Rector 230 kV No. 2	Big Creek 1 – Rector 230 kV No. 1 and Big Creek 3 – Rector 230 kV No. 1	130	121
Big Creek 4 – Springville 230 kV No. 1	Big Creek 1 – Rector 230 kV No. 1 and Big Creek 3 – Rector 230 kV No. 1	115	111

2036 On-Peak Midway – Whirlwind Constraint Summary

Affected transmission zones		SCE Northern area	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		11,487 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		157 MW	
Unaccounted for TPD allocations behind the constraint		2,106 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		3,281 MW	6,728 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		8,206 MW	4,759 MW
Mitigation Options	RAS	Not applicable	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	Reconductor PG&E segment with advanced conductor	
	Transmission upgrade including cost	1. Windhub – Tesla 500 kV line (TBD) 2. Upgrade Midway – Whirlwind No. 3 and Midway – Vincent No.1 and No. 2 500 kV lines (TBD)	
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

Potential Transmission Upgrades for the Midway – Whirlwind Constraint

1 **Windhub – Tesla 500 kV line**

Several alternatives being evaluated

Tie the 500 kV line into various substations

Detailed engineering studies

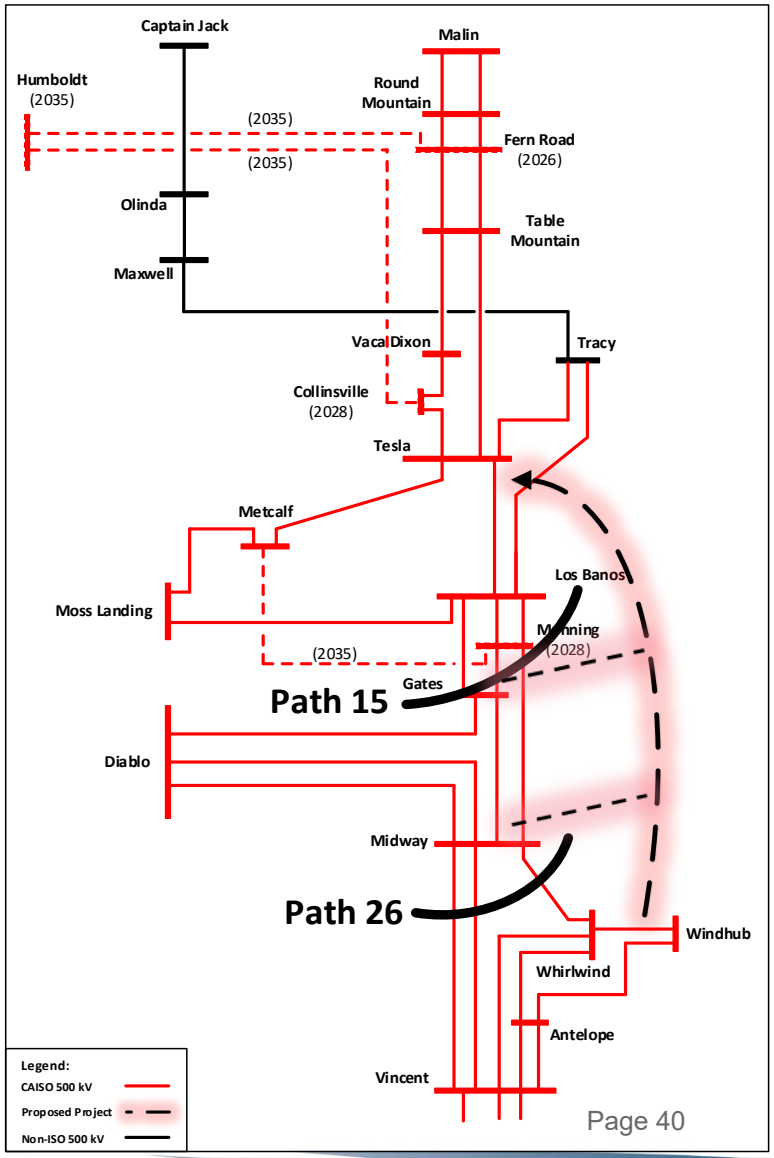
in coordination with the PTOs

Reliability and SCD studies

Determine whether additional upgrades are needed

Interconnection feasibility studies

Identify potential construction challenges at existing substations



California ISO

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Potential Transmission Upgrades for the Midway – Whirlwind Constraint

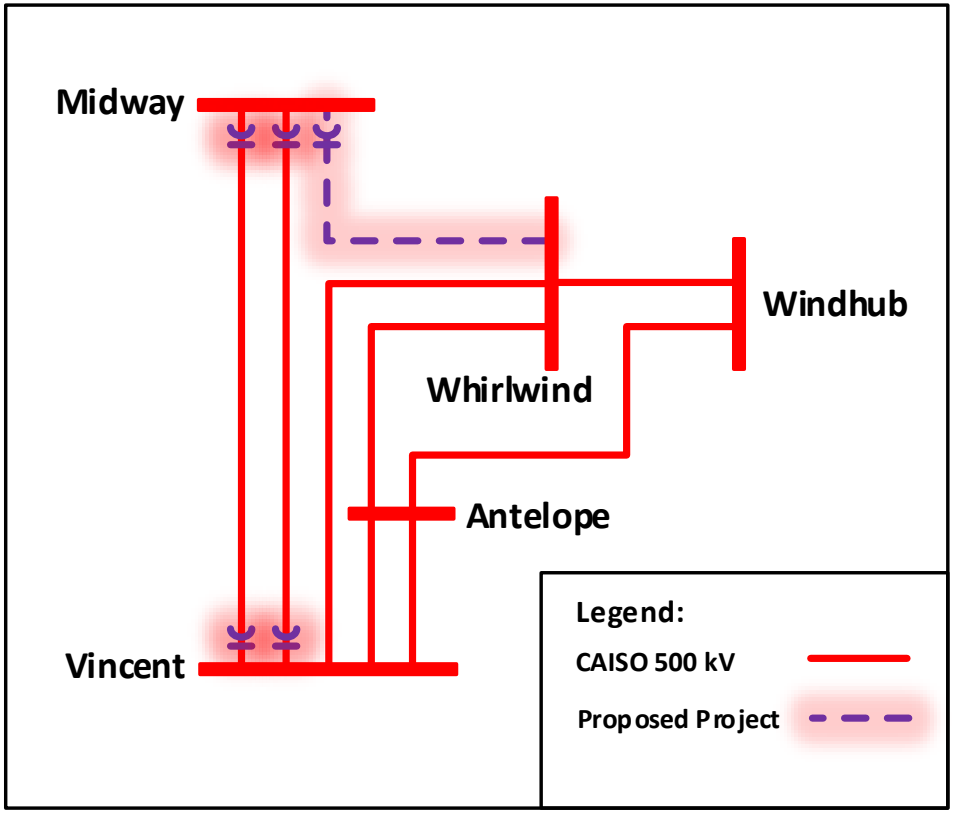
2 **Path 26 line upgrade**

Upgrade Midway – Whirlwind 500 kV line

- Reconductor PG&E's segment with advanced conductor
- Upgrade SCE's segment by raising towers
- Upgrade the series capacitor

Upgrade Midway – Vincent 500 kV lines

- Upgrade the series capacitors



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2036 On-Peak Windhub Area Constraint Summary

Affected transmission zones		Tehachapi area – Windhub	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		2,114 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD allocations behind the constraint		0 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1,851 MW	2,114 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		263 MW	0 MW
Mitigation Options	RAS	Not applicable	
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not applicable	
	Transmission upgrade including cost	1. Windhub – Tesla 500 kV line (TBD) 2. Windhub – Vincent 230 kV double circuit + Tehachapi CRAS Expansion (TBD) 3. Windhub – Whirlwind 500 kV No. 2 line (TBD)	
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

Potential Transmission Upgrades for the Windhub Area Constraint

1. **Windhub – Tesla 500 kV line**

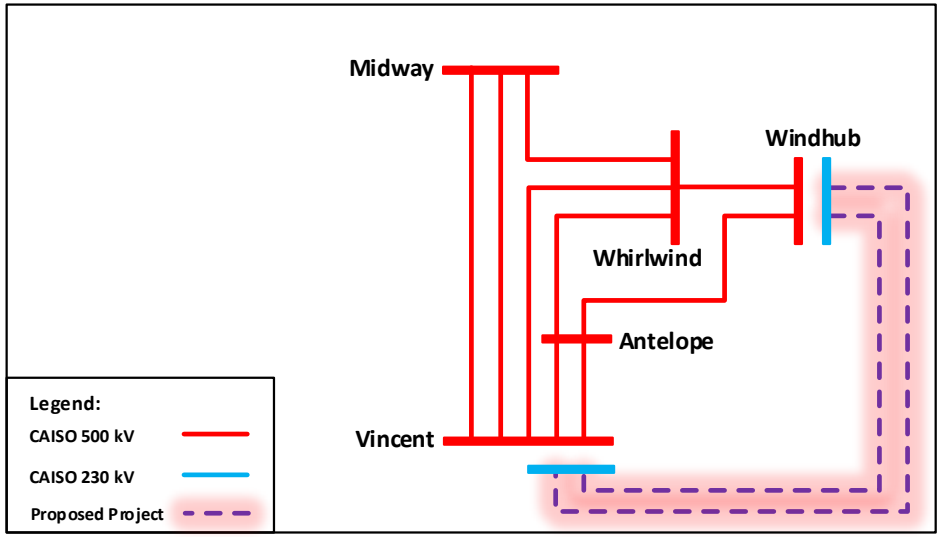
2. **Windhub – Vincent 230 kV double circuit**

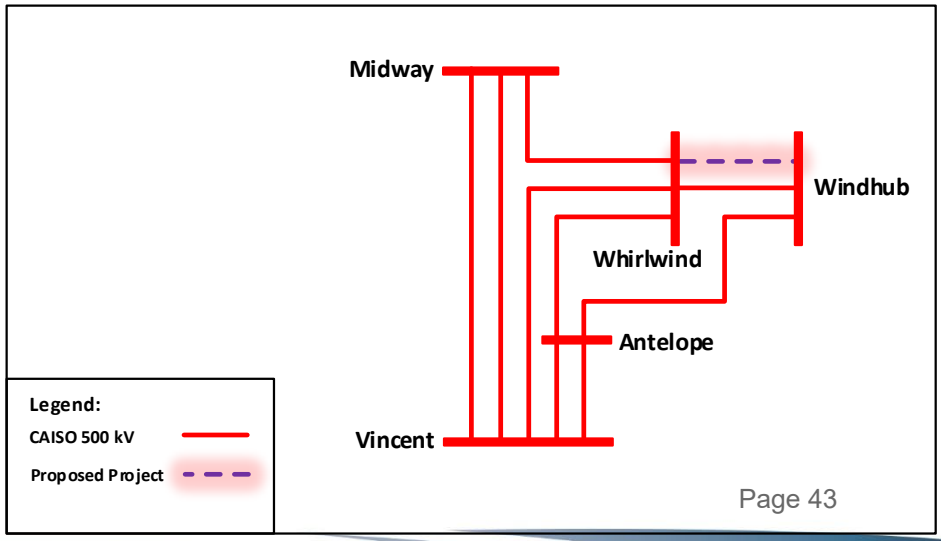
   ~47 mi Windhub – Vincent 230 kV double circuit line with HTLS conductor

   Tehachapi CRAS expansion to monitor the potentially excessive overload of Windhub – Vincent 230 kV lines due to the outage of Antelope – Windhub and Whirlwind – Windhub 500 kV lines

3. **Windhub – Whirlwind 500 kV No. 2 line**

   ~16 mi Windhub – Whirlwind 500 kV line





2036 On-Peak Windhub #3 & #4 500/230 kV transformers Constraint Summary

Affected transmission zones		Tehachapi area – Windhub 230 kV Bus B	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		165 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD allocations behind the constraint		0 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0 MW	165 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		207 MW	0 MW
Mitigation Options	RAS	Existing Tehachapi CRAS	
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not applicable	
	Transmission upgrade including cost	Not needed	
Recommended Mitigation		Existing Tehachapi CRAS	

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

2036 On-Peak Whirlwind 500/230 kV transformers Constraint Summary

Affected transmission zones		Tehachapi area – Whirlwind 230 kV	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		3,092 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD allocations behind the constraint		0 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		2,739 MW	954 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		353 MW	2,138 MW
Mitigation Options	RAS	Existing Tehachapi CRAS	Tehachapi CRAS not sufficient for P1 and not applicable for P0
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not applicable	
	Transmission upgrade including cost	Not needed	Whirlwind 230 kV SCD Upgrade ($123M-$165M) + relocating 240 MW of generic solar from 230 kV to 500 kV
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

Potential Transmission Upgrades for the Whirlwind 500/230 kV transformers Constraint

1 **Whirlwind 230 kV SCD Upgrade Project, including relocation of 240 MW of generic solar from the 230 kV bus to the 500 kV bus**

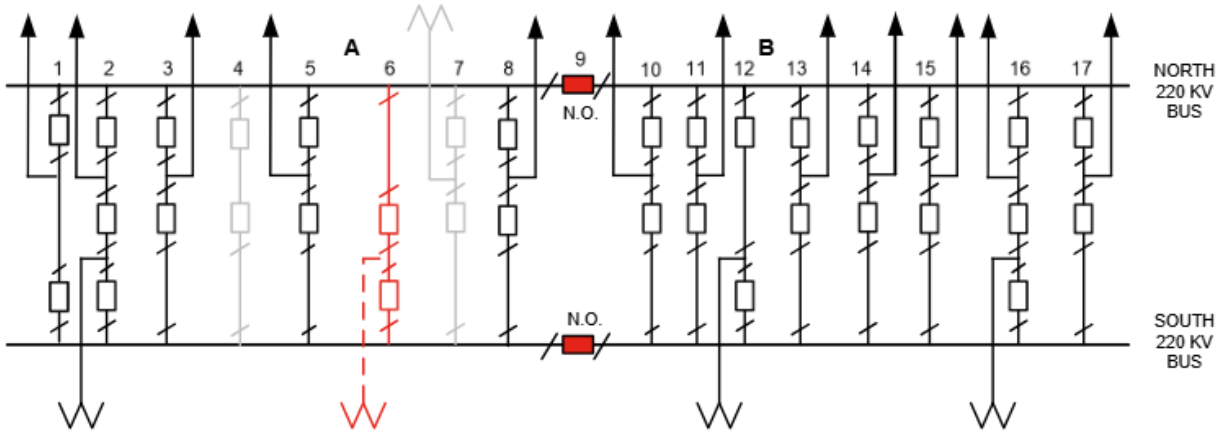
Install a fourth 500/230 kV AA Bank at the Whirlwind substation

Split the Whirlwind 230 kV bus by opening the existing sectionalizing breakers

Relocate 240 MW of generic solar from the 230 kV bus to the 500 kV bus

Whirlwind 230 kV: 1,441 MW → 1,201 MW generic FCDS solar resources

Whirlwind 500 kV: 1,032 MW → 1,272 MW generic FCDS solar resources



2036 On-Peak North of Magunden Constraint Summary

Affected transmission zones		North of Magunden	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		413 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD allocations behind the constraint		0 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0 MW	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		537 MW	528 MW
Mitigation Options	RAS	Existing Big Creek-San Joaquin Valley RAS	
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not needed	
	Transmission upgrade including cost	Not needed	
Recommended Mitigation		Existing Big Creek-San Joaquin Valley RAS	

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

2036 Base Portfolio Off-Peak SCE Northern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)
Midway – Whirlwind 500 kV No. 3 (PG&E Segment)	Base Case	134
Windhub #1 or #2 500/230 kV transformer	Windhub #1 or #2 500/230 kV transformer	134
Whirlwind #1, #3 or #4 500/230 kV transformer	Whirlwind #1, #3 or #4 500/230 kV transformer	127
	Base Case	101

2036 Base Portfolio Off-Peak Midway – Whirlwind Constraint Summary

Affected renewable transmission zones		SCE Northern Area
Portfolio solar and wind resources behind the constraint		8,662 MW
Portfolio energy storage behind the constraint		6,149 MW
Renewable curtailment without mitigation		1,820 MW
Mitigation Options:	Portfolio ES (in charging mode)*	0 MW
	RAS	Not applicable for P0 overload
	Grid Enhancing Technology	Reconductor PG&E segment with advanced conductor
	Transmission upgrades	1. Windhub – Tesla 500 kV line 2. Upgrade Midway – Whirlwind 500 kV line
Recommended Mitigation		TBD**

* The Portfolio energy storage (in charging mode) value 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

2036 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		1,615 MW
Portfolio energy storage behind the constraint		510 MW
Renewable curtailment without mitigation		464 MW
Mitigation Options:	Portfolio ES (in charging mode)*	0 MW
	RAS	Existing Tehachapi CRAS
	Grid Enhancing Technology	Not needed
	Transmission upgrades	Not needed
Recommended Mitigation		Existing Tehachapi CRAS

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

2036 Base Portfolio Off-Peak Whirlwind 500/230 kV transformers Constraint Summary

Affected renewable transmission zones		Tehachapi area – Whirlwind 230 kV
Portfolio solar and wind resources behind the constraint		1,681 MW
Portfolio energy storage behind the constraint		1,810 MW
Renewable curtailment without mitigation		773 MW
Mitigation Options:	Portfolio ES (in charging mode)*	245 MW
	RAS	Not sufficient for P1 and not applicable for P0
	Grid Enhancing Technology	Not applicable
	Transmission upgrades	Whirlwind 230 kV SCD Upgrade
Recommended Mitigation		TBD**

* The Portfolio energy storage (in charging mode) value 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

2041 On-Peak SCE Northern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Midway – Whirlwind 500 kV No. 3 (PG&E Segment)	Base Case	146	160
Midway – Whirlwind 500 kV No. 3 (SCE Segment and Series Capacitor)	Base Case	106	115
Midway – Vincent 500 kV No. 2 (SCE's Series Capacitor)	Midway – Whirlwind 500 kV No. 3	108	118
	Midway – Vincent 500 kV No. 1	< 100	101
Midway – Vincent 500 kV No. 1 (SCE's Series Capacitors)	Midway – Whirlwind 500 kV No. 3	105	115
	Midway – Vincent 500 kV No. 2	< 100	100
Windhub #3 or #4 500/230 kV transformer	Windhub #3 or #4 500/230 kV transformer	106	106

2041 On-Peak SCE Northern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Whirlwind #1, #3 or #4 500/230 kV transformer	Whirlwind #1, #3 or #4 500/230 kV transformer	101	101
Big Creek 3 – Rector 230 kV No. 1	Big Creek 1 – Rector 230 kV No. 1	102	< 100
	Big Creek 3 – Rector 230 kV No. 2	101	< 100
	Big Creek 3 – Rector 230 kV No. 2 and Rector – Springville 230 kV No. 1	103	< 100
Big Creek 3 – Rector 230 kV No. 2	Big Creek 1 – Rector 230 kV No. 1 and Big Creek 3 – Rector 230 kV No. 1	129	119
Big Creek 4 – Springville 230 kV No. 1	Big Creek 1 – Rector 230 kV No. 1 and Big Creek 3 – Rector 230 kV No. 1	112	101
Eagle Rock – Gould 230 kV No. 1	Sylmar – Gould 230 kV No. 1 and Eagle Rock – Mesa 230 kV No. 1	< 100	125
Mesa 230 kV – Lighthipe 230 kV No. 1	Mesa – Laguna Bell 230 kV No. 1 and Mesa – La Fresa 230 kV No. 1	< 100	104

2041 On-Peak Midway – Whirlwind Constraint Summary

Affected transmission zones		SCE Northern area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		11,780 MW	13,633 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		157 MW	310 MW
Unaccounted for TPD allocations behind the constraint		2,106 MW	1,094 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		4,191 MW	4,200 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		7,589 MW	9,433 MW
Mitigation Options	RAS	Not applicable	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	Reconductor PG&E segment with advanced conductor	
	Transmission upgrade including cost	1. Windhub – Tesla 500 kV line (TBD) 2. Upgrade Midway – Whirlwind No. 3 and Midway – Vincent No.1 and No. 2 500 kV lines (TBD)	
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

2041 On-Peak Windhub Area Constraint Summary

Affected transmission zones		Tehachapi area – Windhub	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		2,114 MW	2,594 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD allocations behind the constraint		0 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1,851 MW	1,851 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		263 MW	743 MW
Mitigation Options	RAS	Not applicable	
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not applicable	
	Transmission upgrade including cost	1. Windhub – Tesla 500 kV line (TBD) 2. Windhub – Vincent 230 kV double circuit + Tehachapi CRAS Expansion (TBD) 3. Windhub – Whirlwind 500 kV No. 2 line (TBD)	
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

2041 On-Peak Windhub #3 & #4 500/230 kV transformers Constraint Summary

Affected transmission zones		Tehachapi area – Windhub 230 kV Bus B	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		165 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD allocations behind the constraint		0 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0 MW	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		207 MW	
Mitigation Options	RAS	Existing Tehachapi CRAS	
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not applicable	
	Transmission upgrade including cost	Not needed	
Recommended Mitigation		Existing Tehachapi CRAS	

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

2041 On-Peak Whirlwind 500/230 kV transformers Constraint Summary

Affected transmission zones		Tehachapi area – Whirlwind 230 kV	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		3,092 MW	3,007 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD allocations behind the constraint		0 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		2,652 MW	2,817 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		440 MW	190 MW
Mitigation Options	RAS	Existing Tehachapi CRAS	
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not applicable	
	Transmission upgrade including cost	Whirlwind 230 kV SCD Upgrade ($123M-$165M)	
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

2041 On-Peak North of Magunden Constraint Summary

Affected transmission zones		North of Magunden	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		413 MW	513 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD allocations behind the constraint		0 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0 MW	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		530 MW	638 MW
Mitigation Options	RAS	Existing Big Creek-San Joaquin Valley RAS	
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not needed	
	Transmission upgrade including cost	Not needed	
Recommended Mitigation		Existing Big Creek-San Joaquin Valley RAS	

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

2041 On-Peak Eagle Rock – Gould Constraint Summary

Affected transmission zones		Eagle Rock substation, Ventura area, and Pardee - Pastoria 230 kV corridor	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	3,763 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)			590 MW
Unaccounted for TPD allocations behind the constraint			960 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)			3,424 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)			339 MW
Mitigation Options	RAS		New RAS to trip generic Eagle Rock BESS
	Reduce generic battery storage (MW)		Reduce generic Eagle Rock BESS
	Grid Enhancing Technology		Not needed
	Transmission upgrade including cost		Not needed
Recommended Mitigation			Reduce generic Eagle Rock BESS

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

2041 On-Peak Mesa – Lighthipe Constraint Summary

Affected transmission zones		Eagle Rock, Goodrich and Vincent 230 kV substations, Ventura area, and Pardee - Pastoria 230 kV corridor	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	3,847 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)			590 MW
Unaccounted for TPD allocations behind the constraint			960 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)			3,344 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)			503 MW
Mitigation Options	RAS		New RAS to trip generic Eagle Rock BESS
	Reduce generic battery storage (MW)		Reduce generic Eagle Rock BESS
	Grid Enhancing Technology		Not needed
	Transmission upgrade including cost		Not needed
Recommended Mitigation			Reduce generic Eagle Rock BESS

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

SCE Northern On-Peak HSN Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Midway-Whirlwind	2036 Base	11,487	157	3,281	8,206	TBD*
	2041 Base	11,780	157	4,191	7,589	
	2041 Low Wind	13,633	310	4,200	9,433	
Windhub Area	2036 Base	2,114	0	1,851	263	TBD*
	2041 Base	2,114	0	1,851	263	
	2041 Low Wind	2,594	0	1,851	743	
Windhub #3 & #4 500/230 kV transformers	2036 Base	165	0	0	207	Existing Tehachapi CRAS
	2041 Base	165	0	0	207	
	2041 Low Wind	165	0	0	207	
Whirlwind 500/230 kV transformers	2036 Base	3,092	0	2,739	353	TBD*
	2041 Base	3,092	0	2,652	440	
	2041 Low Wind	3,007	0	2,817	190	
North of Magunden	2036 Base	413	0	0	537	Existing Big Creek-San Joaquin Valley RAS
	2041 Base	413	0	0	530	
	2041 Low Wind	513	0	0	638	

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

SCE Northern On-Peak HSN Constraints Summary

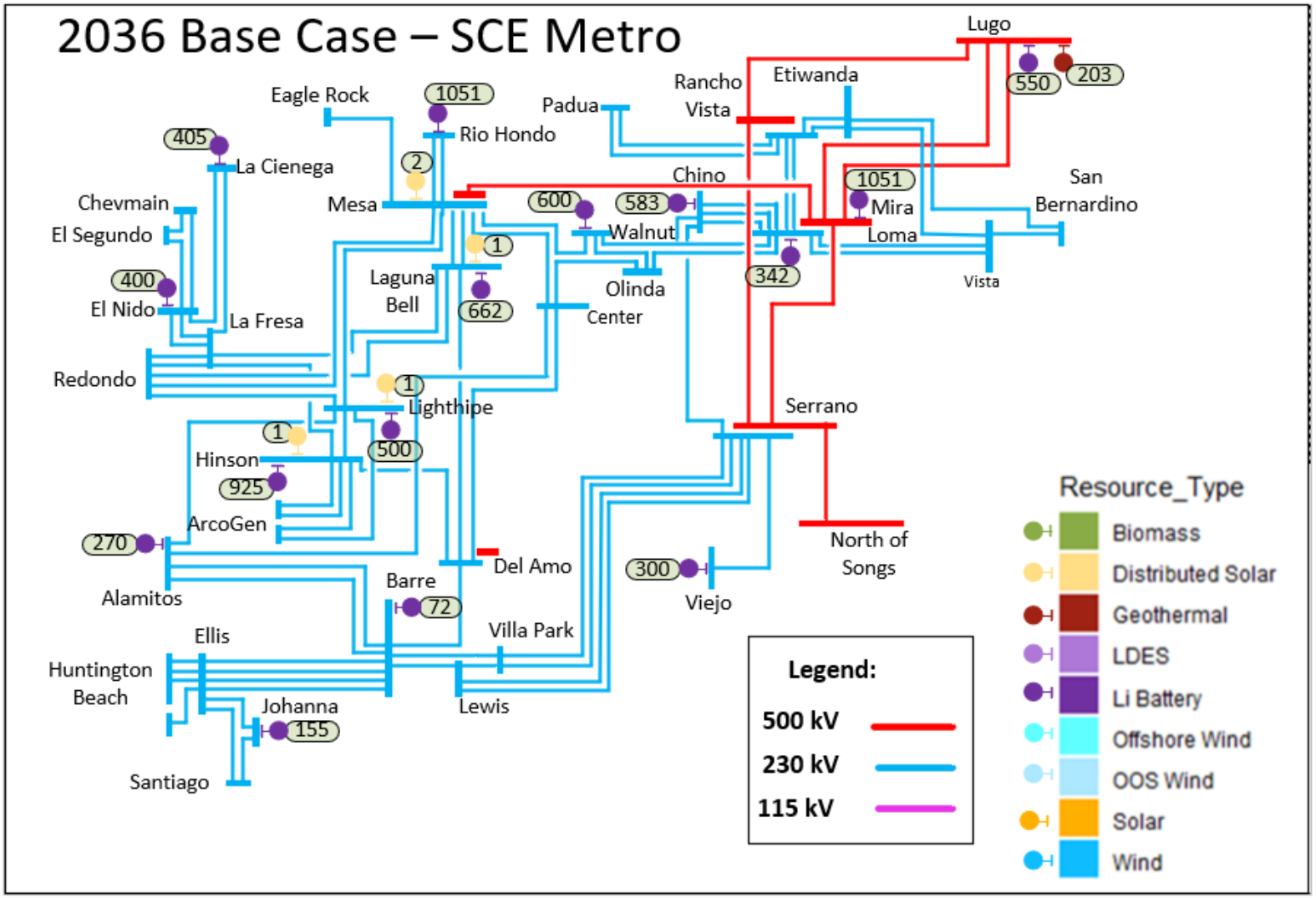
Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Eagle Rock – Gould	2036 Base	N/A				Reduce generic Eagle Rock BESS
	2041 Base					
	2041 Low Wind	3,763	590	3,424	339	
Mesa – Lighthipe	2036 Base	N/A				Reduce generic Eagle Rock BESS
	2041 Base					
	2041 Low Wind	3,847	590	3,344	503	

SCE Metro Interconnection Area

SCE Metro Interconnection Area Portfolio Summary

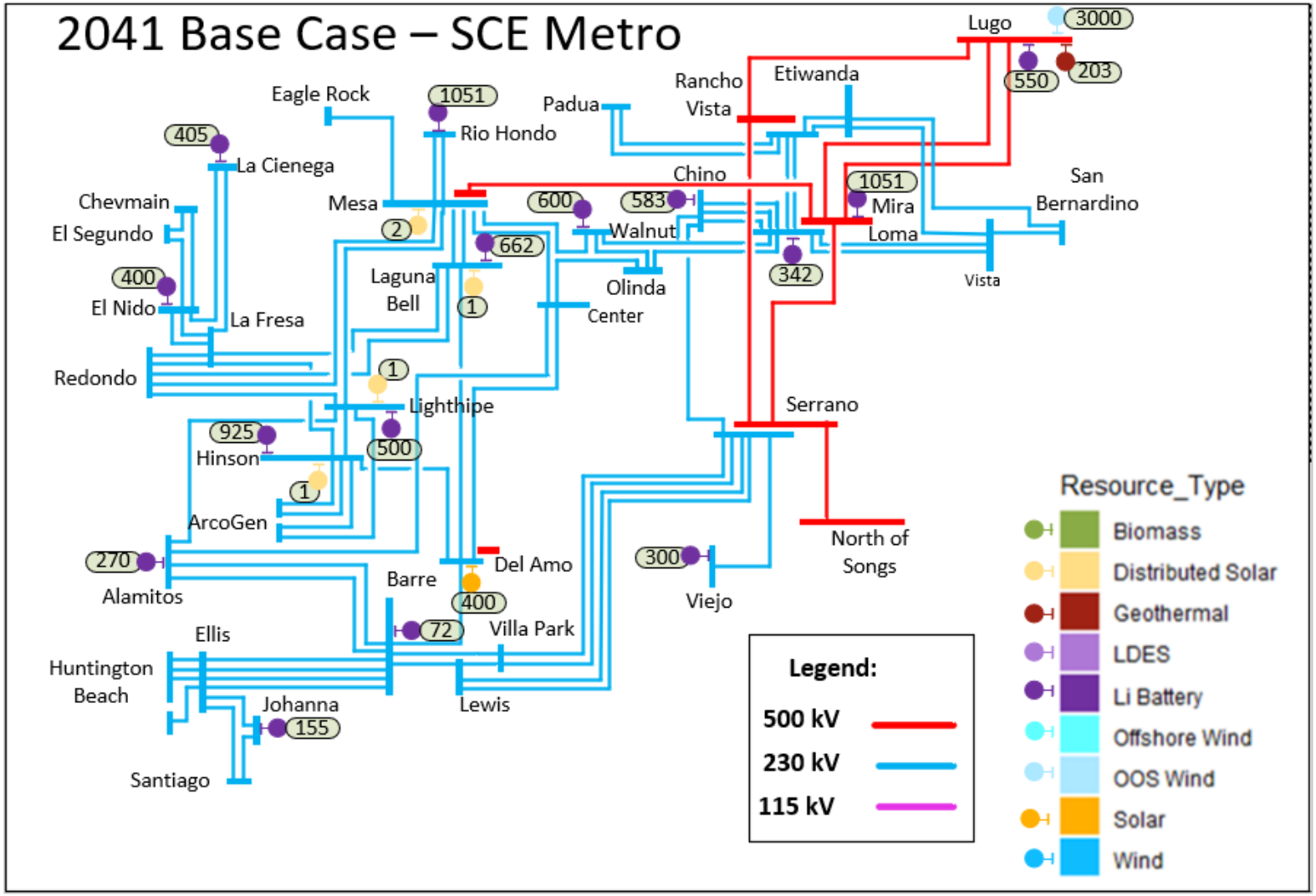
Resource Type	2036 Base Portfolio			2041 Base Portfolio			2041 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	0	0	**0**	400	0	**400**	382	0	**382**
Wind – Onshore	0	0	**0**	0	0	**0**	0	0	**0**
Wind – Out-of-State	0	0	**0**	3000	0	**3000**	0	0	**0**
Wind – Offshore	0	0	**0**	0	0	**0**	0	0	**0**
Li Battery – 4 hr	2500	96	**2596**	2500	96	**2596**	2500	96	**2596**
Li Battery – 8 hr	5982	0	**5982**	5982	0	**5982**	7504	0	**7504**
Long Duration Energy Storage (LDES)	0	0	**0**	0	0	**0**	0	0	**0**
Geothermal	183	0	**183**	183	0	**183**	183	0	**183**
Distributed Solar	0	4	**4**	0	4	**4**	0	4	**4**
Gas capacity not retained	-527	0	**-527**	-527	0	**-527**	-415	0	**-415**
Total	**8138**	**100**	**8238**	**11538**	**100**	**11648**	**10154**	**100**	**10254**

2036 Base Portfolio: SCE Metro Area



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2041 Base Portfolio: SCE Metro Area



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2036 Base Portfolio On-Peak SCE Metro Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Lugo-Vincent 500 kV No.2	Base Case	111.94	109.77
	Lugo-Rancho Vista 500 kV No.1	131.73	135.49
	Mira Loma-Serrano 500 kV No.1 & No.2	122.37	121.9
	Mira Loma-Serrano 500 kV No.1	121.53	122.06
	Rancho Vista-Mira Loma 500 kV No.1	121.52	122.05
	Pardee-Sylmar 230 kV No.1 and No.2	115.78	114.37

2036 On-Peak Lugo-Vincent 500 kV No.2 Constraint Summary

Affected transmission zones		SCE Northern, NOL, EOP, Eastern, Metro, East of Miguel	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		36708 MW	34638 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		1782 MW	1782 MW
Unaccounted for TPD behind the constraint		8830 MW	8080 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		15588 MW	25594 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		21120 MW	9044 MW
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	Not Sufficient	
	Grid Enhancing Technology	TBD	
	Transmission upgrade including cost	Upgrade Lugo-Vincent 500kV lines ($100 million)	
Recommended Mitigation		Upgrade Lugo-Vincent 500kV lines	

Affected interties	MEAD_ITC, PINAL_ITC, SILVERPK_ITC
MIC expansion request MW behind constraint	552
Deliverable MIC expansion request MW	0

2036 Base Portfolio Off-Peak SCE Metro Area Deliverability Constraints

- No off-peak deliverability constraints were identified

2041 On-Peak SCE Metro Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Lugo-Vincent 500 kV No.2	Base Case	<100	108.71
	Lugo-Rancho Vista 500 kV No.1	118.53	123.71
	Mira Loma-Serrano 500 kV No.1 & No.2	<100	116.01
	Mira Loma-Serrano 500 kV No.1	107.73	116.43
	Rancho Vista-Mira Loma 500 kV No.1	107.73	116.43
	Pardee-Sylmar 230 kV No.1 and No.2	107.31	116.4
	Lugo Collector-Vincent 500 kV No.1	111.02	<100
Lugo Collector-Vincent 500 kV No.1	Lugo Collector-Mira Loma 500 kV No.2 & No.3	110.15	<100

2041 On-Peak SCE Metro Area Deliverability Constraints (Cont.)

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
El Nido-La Cienega 230 kV No.1	La Fresa-El Nido 230 kV No.3 & No.4	<100	196.58
El Segundo-El Nido 230 kV No.1	El Nido-Chevmain 230 kV No.1	<100	144.01
La Cienega-La Fresa 230 kV No.1	La Fresa-El Nido 230 kV No.3 & No.4	<100	104.74
Chevmain-El Nido 230 kV No.1	Base Case	<100	115.97
	El Segundo-El Nido 230 kV No.1	<100	108.29

2041 On-Peak Lugo-Vincent 500 kV No.2 Constraint Summary

Affected transmission zones		NOL, EOP, Eastern, Metro, East of Miguel	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		30023 MW	25095 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		1232 MW	2823 MW
Unaccounted for TPD behind the constraint		5241 MW	6073 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		13366 MW	11599 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		16657 MW	13496 MW
Mitigation Options	RAS	N/A	N/A
	Reduce generic battery storage (MW)	Not Sufficient	Not Sufficient
	Grid Enhancing Technology	TBD	TBD
	Transmission upgrade including cost	Upgrade Lugo-Vincent 500kV lines ($100 million)	Upgrade Lugo-Vincent 500kV lines ($100 million)
Recommended Mitigation		Upgrade Lugo-Vincent 500kV lines	Upgrade Lugo-Vincent 500kV lines

Affected interties	MEAD_ITC, PINAL_ITC, SILVERPK_ITC
MIC expansion request MW behind constraint	552
Deliverable MIC expansion request MW	0

2041 On-Peak Lugo Collector-Vincent 500 kV No.1 Constraint Summary

Affected transmission zones		NOL, EOP, Metro	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		23264 MW	N/A
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		1305 MW	
Unaccounted for TPD behind the constraint		4324 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		15621 MW	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		7643 MW	
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	Not Sufficient	
	Grid Enhancing Technology	TBD	
	Transmission upgrade including cost	Upgrade Lugo-Vincent 500kV lines ($100 million)	
Recommended Mitigation		Upgrade Lugo-Vincent 500kV lines	

Affected interties	MEAD_ITC, SILVERPK_ITC
MIC expansion request MW behind constraint	123
Deliverable MIC expansion request MW	0

2041 On-Peak El Nido-La Cienega 230 kV No.1 Constraint Summary

Affected transmission zones		Metro	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	1290 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)			1290 MW
Unaccounted for TPD behind the constraint			0 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)			670 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)			620 MW
Mitigation Options	RAS		N/A
	Reduce generic battery storage (MW)		Reduce generic Chevmain BESS
	Grid Enhancing Technology		TBD
	Transmission upgrade including cost		Reconductor El Nido-La Cienega 230 kV No.1 ($255 million)
Recommended Mitigation			N/A

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

2041 On-Peak El Segundo-El Nido 230 kV No.1 Constraint Summary

Affected transmission zones		Metro	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	1000 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)			1000 MW
Unaccounted for TPD behind the constraint			0 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)			570 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)			430 MW
Mitigation Options	RAS		N/A
	Reduce generic battery storage (MW)		Reduce generic Chevmain BESS
	Grid Enhancing Technology		TBD
	Transmission upgrade including cost		Reconductor El Segundo-El Nido 230 kV No.1 ($100-200 million)
Recommended Mitigation			N/A

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

2041 On-Peak Chevmain-El Nido 230 kV No.1 Constraint Summary

Affected transmission zones		Metro	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	1000 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)			1000 MW
Unaccounted for TPD behind the constraint			0 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)			830 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)			170 MW
Mitigation Options	RAS		N/A
	Reduce generic battery storage (MW)		Reduce generic Chevmain BESS
	Grid Enhancing Technology		TBD
	Transmission upgrade including cost		Reconductor Chevmain-El Nido 230 kV No.1 ($152 million)
Recommended Mitigation			N/A

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

2041 On-Peak La Cienega-La Fresa 230 kV No.1 Constraint Summary

Affected transmission zones		Metro	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		N/A	1290 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)			1290 MW
Unaccounted for TPD behind the constraint			0 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)			1260 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)			30 MW
Mitigation Options	RAS		N/A
	Reduce generic battery storage (MW)		Reduce generic Chevmain BESS
	Grid Enhancing Technology		TBD
	Transmission upgrade including cost		Reconductor La Cienega-La Fresa 230 kV No.1 ($120 million)
Recommended Mitigation			N/A

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

SCE Metro On-Peak HSN Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Lugo-Vincent 500 kV No.2	2036 Base	36708	1782	15588	21120	Upgrade Lugo-Vincent 500kV line
	2041 Base	30023	1232	13366	16657	
	2041 Low Wind	25095	2823	11599	13496	
Lugo Collector-Vincent 500 kV No.1	2036 Base	N/A				Upgrade Lugo-Vincent 500kV line
	2041 Base	23264	1305	15621	7643	
	2041 Low Wind	N/A				
El Nido-La Cienega 230 kV No.1	2036 Base	N/A				N/A
	2041 Base					
	2041 Low Wind	1290	1290	670	620	
El Segundo-El Nido 230 kV No.1	2036 Base	N/A				N/A
	2041 Base					
	2041 Low Wind	1000	1000	570	430	

SCE Metro On-Peak HSN Constraints Summary

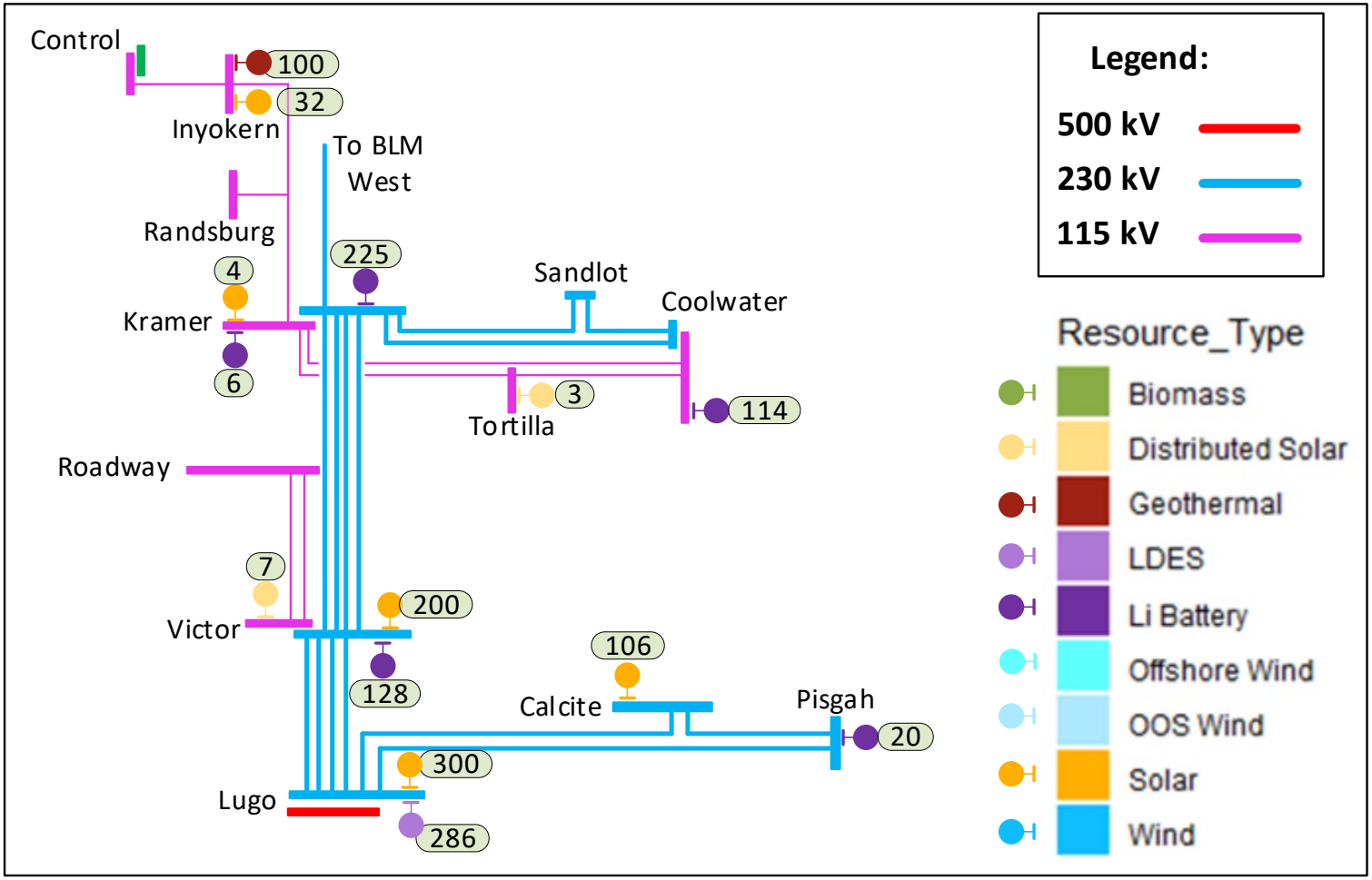
Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
La Cienega-La Fresa 230 kV No.1	2036 Base	N/A				N/A
	2041 Base					
	2041 Low Wind	1290	1290	1260	30	
Chevmain-El Nido 230 kV No.1	2036 Base	N/A				N/A
	2041 Base					
	2041 Low Wind	1000	1000	830	170	

SCE North of Lugo (NOL) Interconnection Area

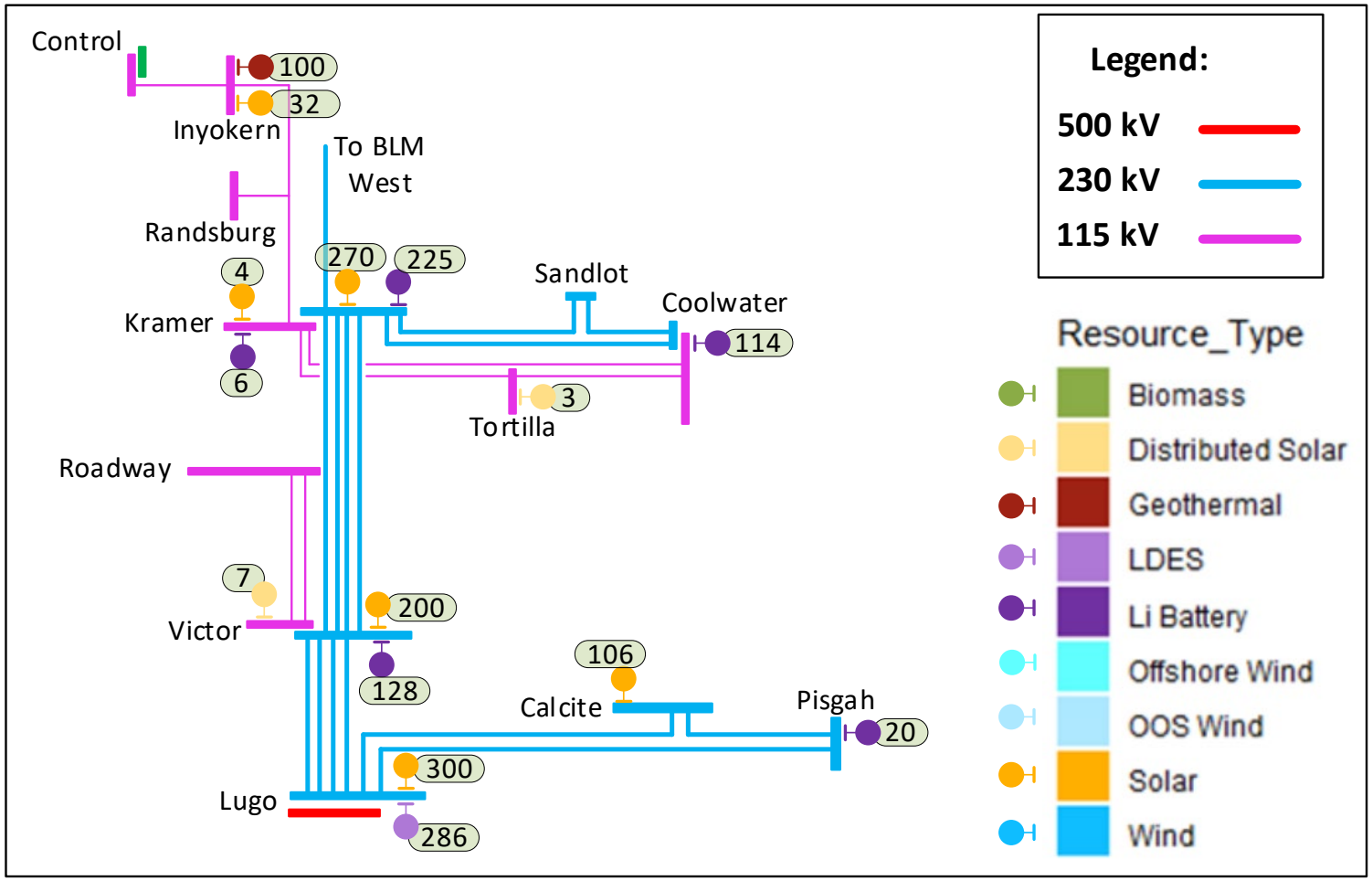
SCE North of Lugo Interconnection Area Portfolio Summary

Resource Type	2036 Base Portfolio			2041 Base Portfolio			2041 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	556	670	**1,226**	556	670	**1,226**	699	922	**1,621**
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	1338	92	**1430**	1491	92	**1583**	1338	92	**1,430**
Li Battery – 8 hr	134	0	**134**	134	0	**134**	6	0	**6**
Long Duration Energy Storage (LDES)	286	0	**286**	286	0	**286**	362	0	**362**
Geothermal	120	0	**120**	120	0	**120**	313	0	**313**
Distributed Solar	0	24	**24**	0	26	**26**	0	26	**26**
Gas capacity not retained	0	0	**0**	0	0	**0**	0	0	**0**
Total	**2,434**	**786**	**3,220**	**2,587**	**788**	**3,375**	**2,718**	**1,040**	**3,758**

2036 Base Portfolio: SCE North of Lugo Area



2041 Base Portfolio: SCE North of Lugo Area



2036 Base Portfolio On-Peak SCE North of Lugo Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Calcite-Lugo #1 230kV line	Pisgah–Lugo #2 230kV line	137	105
	Base Case	106	<100
Coolwater-Tap 705-Tortilla 115kV line	Kramer–Coolwater & Sandlot–Coolwater 230 kV lines	119	162
Coolwater Transformer #1		117	182
Coolwater-Kramer #1 115kV line		<100	121
Pisgah–Lugo #2 230kV line	Calcite-Lugo #1 230kV line	112	<100
Kramer-Victor #1 or #2 230kV line	Kramer-Victor #3 & Kramer-Victor #4 230kV lines	109	102

2036 Base Portfolio On-Peak SCE North of Lugo Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Sandlot-Kramer #1 or Coolwater-Kramer #2 230kV line	Kramer-Coolwater #2 or Sandlot-Kramer #1 230kV line	<100	134
Kramer-Sandlot #1 230kV line	Coolwater 115/230 kV transformer	<100	106
Kramer-Sandlot #1 230kV line	Coolwater-Segs2-Tortilla #1 115 kV line	<100	102
Lugo-Victor #1 or #2 or #3 or #4 230 kV line	Lugo-Victor #3 & Lugo-Victor#4 230kV lines Or Lugo-Victor #1 & Lugo-Victor#2 230kV lines	<100	100

2036 Base Portfolio On-Peak Coolwater 230/115kV transformer and Coolwater- Kramer 115 kV lines Constraint Summary

Affected transmission zones		NOL area	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		114 MW	401 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	0 MW
Unaccounted for TPD allocations behind the constraint		0 MW	0 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		23 MW	0 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		91 MW	401 MW
Mitigation Options	RAS	Proposed Coolwater CRAS	Proposed Coolwater CRAS
	Reduce generic battery storage (MW)	Not Needed	Not Needed
	Grid Enhancing Technology	Not Needed	Not Needed
	Transmission upgrade including cost	N/A	N/A
Recommended Mitigation		Proposed Coolwater CRAS	Proposed Coolwater CRAS

Affected interties	Silver Peak
MIC expansion request MW behind constraint	13 MW
Deliverable MIC expansion request MW	0 MW

2036 Base Portfolio On-Peak Kramer- Victor 230kV Constraint Summary

Affected transmission zones		NOL area	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		948 MW	948 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	0 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		780 MW	923 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		168 MW	25 MW
Mitigation Options	RAS	Kramer CRAS	Kramer CRAS
	Reduce generic battery storage (MW)	N/A	N/A
	Grid Enhancing Technology	N/A	N/A
	Transmission upgrade including cost	N/A	N/A
Recommended Mitigation		Kramer CRAS	Kramer CRAS

Affected interties	Silver Peak
MIC expansion request MW behind constraint	13 MW
Deliverable MIC expansion request MW	0 MW

2036 Base Portfolio On-Peak Lugo – Calcite – Pisgah 230kV area Constraint Summary

Affected transmission zones		NOL area	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		573 MW	573 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		20 MW	20 MW
Unaccounted for TPD allocations behind the constraint		447 MW	447 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		442 MW	549 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		131 MW	24 MW
Mitigation Options	RAS	Planned Calcite CRAS is not applicable for P0	Planned Calcite CRAS
	Reduce generic battery storage (MW)	N/A	N/A
	Grid Enhancing Technology	N/A	N/A
	Transmission upgrade including cost	TBD	N/A
Recommended Mitigation		1. For P0, relocate generic Solar and BESS from Calcite and Pisgah substation 2. For all other contingencies, use planned Calcite CRAS	Planned Calcite CRAS

2036 Base Portfolio Off-Peak SCE North of Lugo Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)
Sandlot-Kramer #1 230kV line	Kramer-Coolwater #2 230kV line	235
Kramer-Coolwater #2 230kV line	Sandlot-Kramer #1 230kV line	211
Kramer – Victor #2 230kV line	Kramer–Victor #3 & Kramer–Victor #4 230 kV lines	202
Kramer – Victor #1 230kV line		202
Coolwater Transformer #1	Kramer–Coolwater & Sandlot–Coolwater 230 kV lines	244
Coolwater - Tap 705 - Tortilla 115kV line		195
Coolwater – Kramer #1 115kV line		188
Lugo-Victor #1 or #2 or #3 or #4 230 kV line	Lugo-Victor #3 & Lugo-Victor#4 230kV lines Or Lugo-Victor #1 & Lugo-Victor#2 230kV lines	186
Sandlot - Kramer #1 230 kV line	Coolwater Transformer #1	179
Sandlot - Kramer #1 230 kV line	Coolwater-Segs2-Tortilla 115 kV line	175
	Coolwater-Dunn-Baker 115 kV line	

2036 Base Portfolio Off-Peak SCE North of Lugo Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)
Inyokern – Kramer #1 115kV line	Kramer-Inyokern-Randsburg #3 115kV line	174
Sandlot - Kramer #1 230 kV line	Kramer 115/230 kV #1 or #2 Transformer	173
Kramer Transformer #1	Kramer–Coolwater & Sandlot–Coolwater 230 kV lines	165
Control – Silver Peak 55kV line	Control-Inyokern #1 and Control-Coso-Inyokern #2 115kV lines	152
Lugo - Calcite #1 230 kV line	Lugo- Pisgah #2 230kV line	142
Kramer – Sandlot #1 230kV line	Base Case	171
Victor - Lugo #1 or #2 or #3 or #4 230 kV line		126
Lugo Transformer #1, #2 or #3		123
Calcite- Lugo #1 230kV line		110
Inyokern – Kramer #1 115kV line		106

2036 Base Portfolio Off-Peak Lugo- Calcite 230kV Line and Lugo transformer Constraint Summary

Affected renewable transmission zones		NOL area
Portfolio solar and wind resources behind the constraint		556 MW
Portfolio energy storage behind the constraint		799 MW
Renewable curtailment without mitigation		1391 MW
Mitigation Options:	Portfolio ES (in charging mode)*	Utilize portfolio ES resources in charging mode
	RAS	N/A for P0 overload, for all other contingencies use Calcite CRAS
	Grid Enhancing Technology	N/A
	Transmission upgrades	TBD
Recommended Mitigation		1. For P0, charge portfolio ES resources 2. For all other contingencies, use Calcite CRAS and charge BESS as needed

Affected interties	Silver Peak
MIC expansion request MW behind constraint	13 MW
Deliverable MIC expansion request MW	0 MW

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

2036 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		200 MW
Portfolio energy storage behind the constraint		281 MW
Renewable curtailment without mitigation		401 MW
Mitigation Options:	Portfolio ES (in charging mode)*	Utilize portfolio ES in charging mode
	RAS	Existing Mohave Desert RAS and proposed Coolwater CRAS
	Grid Enhancing Technology	N/A
	Transmission upgrades	TBD
Recommended Mitigation		Existing Mohave Desert RAS and proposed Coolwater CRAS + OP 127

Affected interties	Silver Peak
MIC expansion request MW behind constraint	13 MW
Deliverable MIC expansion request MW	0 MW

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

2036 Base Portfolio Off-Peak Kramer- Victor 230kV lines and transformer Constraint Summary

Affected renewable transmission zones		NOL area
Portfolio solar and wind resources behind the constraint		613 MW
Portfolio energy storage behind the constraint		828 MW
Renewable curtailment without mitigation		1341 MW
Mitigation Options:	Portfolio ES (in charging mode)*	Utilize portfolio ES in charging mode
	RAS	Existing Mohave Desert RAS and future Kramer CRAS
	Grid Enhancing Technology	N/A
	Transmission upgrades	TBD
Recommended Mitigation		. Existing Mohave Desert RAS and future Kramer CRAS + BESS at Kramer in charging mode

Affected interties	Silver Peak
MIC expansion request MW behind constraint	13 MW
Deliverable MIC expansion request MW	0 MW

2036 Base Portfolio Off-Peak Control-Inyokern 115kV area Constraint Summary

Affected renewable transmission zones		Control-Inyokern area
Portfolio solar and wind resources behind the constraint		32 MW
Portfolio energy storage behind the constraint		0 MW
Renewable curtailment without mitigation		44 MW
Mitigation Options:	Portfolio ES (in charging mode)*	N/A
	RAS	Bishop RAS
	Grid Enhancing Technology	N/A
	Transmission upgrades	N/A
Recommended Mitigation		. Bishop RAS

Affected interties	Silver Peak
MIC expansion request MW behind constraint	13 MW
Deliverable MIC expansion request MW	0 MW

2041 Base Portfolio On-Peak SCE North of Lugo Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Calcite-Lugo #1 230kV line	Pisgah–Lugo #2 230kV line	133	121
	Base Case	103	<100
Coolwater-Tap 705-Tortilla 115kV line	Kramer–Coolwater & Sandlot–Coolwater 230 kV lines	122	121
Coolwater Transformer #1		115	118
Pisgah–Lugo #2 230kV line	Calcite-Lugo #1 230kV line	107	<100
Kramer-Victor #1 or #2 230kV line	Kramer-Victor #3 & Kramer-Victor #4 230kV lines	119	130
Lugo-Victor #1 or #2 or #3 or #4 230 kV line	Lugo-Victor #3 & Lugo-Victor#4 230kV lines Or Lugo-Victor #1 & Lugo-Victor#2 230kV lines	106	103

2041 Base Portfolio On-Peak SCE North of Lugo Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Control- Silver Peak 55kV	Control-Inyokern #1 and Control-Coso-Inyokern #2 115kV lines	<100	190
Inyo Phase Shifter		<100	165
Control - Inyo 115kV line		<100	165
Inyokern- Kramer 115kV line	Kramer–BLM West/East-Navycoso and Kramer-Inyokern-Randsburg lines	<100	147
Tap 710 – Inyokern 115kV line	Base Case	<100	145
Tap189 – Inyokern 115kV line		<100	132
Control – Tap 188 115kV line		<100	100
Victor 115/230 kV Transformer #2, #3 or #1	Victor 115/230 kV Transformer #1, #2 or #3	<100	110

2041 On-Peak Lugo-Calcite-Pisgah area 230kV Constraint Summary

Affected transmission zones		Calcite and Pisgah Substations	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		573 MW	693 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		20 MW	0 MW
Unaccounted for TPD behind the constraint		447 MW	313 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		347 MW	271 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		226 MW	422 MW
Mitigation Options	RAS	Planned Calcite CRAS (except P0)	Planned Calcite CRAS
	Reduce generic battery storage (MW)	Relocate generic battery storage	N/A
	Grid Enhancing Technology	N/A	N/A
	Transmission upgrade including cost	TBD	TBD
Recommended Mitigation		1. For P0 overload, relocate generic BESS and solar 2. For all other contingencies, utilize planned Calcite CRAS	Planned Calcite CRAS

2041 On-Peak Coolwater 230/115kV transformer and Coolwater- Kramer 115 kV lines Constraint Summary

Affected transmission zones		NOL area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		114 MW	114 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	0 MW
Unaccounted for TPD behind the constraint		0 MW	0 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		12 MW	13 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		102 MW	101 MW
Mitigation Options	RAS	Proposed Coolwater CRAS	Proposed Coolwater CRAS
	Reduce generic battery storage (MW)	Not Needed	Not Needed
	Grid Enhancing Technology	Not Needed	Not Needed
	Transmission upgrade including cost	N/A	N/A
Recommended Mitigation		Proposed Coolwater CRAS	Proposed Coolwater CRAS

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

2041 On-Peak Kramer-Victor 230kV area Constraint Summary

Affected transmission zones		NOL area	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		1100 MW	1294 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	0 MW
Unaccounted for TPD behind the constraint		320 MW	320 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		791 MW	780 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		309 MW	514 MW
Mitigation Options	RAS	Existing Mohave Desert RAS and future Kramer CRAS	Existing Mohave Desert RAS and future Kramer CRAS
	Reduce generic battery storage (MW)	N/A	N/A
	Grid Enhancing Technology	N/A	N/A
	Transmission upgrade including cost	N/A	N/A
Recommended Mitigation		Existing Mohave Desert RAS and future Kramer CRAS	Existing Mohave Desert RAS and future Kramer CRAS

Affected interties	Silver Peak
MIC expansion request MW behind constraint	13 MW
Deliverable MIC expansion request MW	0 MW

SCE NOL On-Peak HSN 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	2036 Base	114	-	23	91	Proposed Coolwater CRAS
	2041 Base	114	-	12	102	
	2041 Low Wind	114	-	13	101	
Kramer – Victor 230kV lines	2036 Base	948	-	780	168	Existing Mohave Desert RAS and future Kramer CRAS
	2041 Base	1100	-	791	309	
	2041 Low Wind	1294	-	780	514	
Lugo-Calcite-Pisgah 230kV area Constraint	2036 Base	573	20	442	131	1. For P0, relocate generic Solar and BESS from Calcite and Pisgah substation 2. For all other contingencies, use Planned Calcite CRAS
	2041 Base	573	20	347	226	1. For P0, relocate generic Solar and BESS from Calcite and Pisgah substation 2. For all other contingencies, utilize Planned Calcite CRAS
	2041 Low Wind	693	-	271	422	Planned Calcite CRAS

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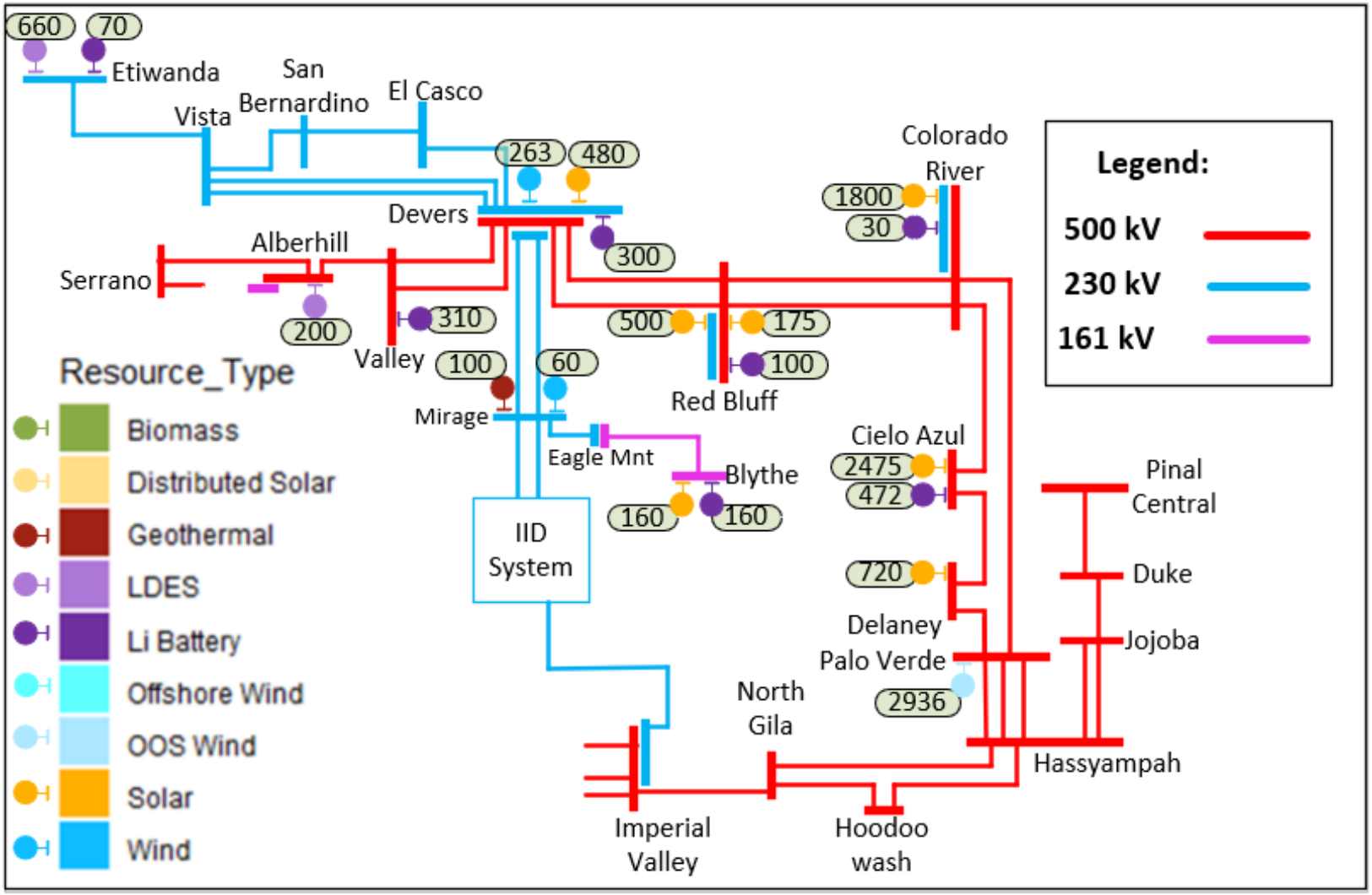
SCE Eastern Interconnection Area

SCE Eastern Interconnection Area Portfolio Summary

Resource Type	2036 Base Portfolio			2041 Base Portfolio			2041 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	919	5749	**6668**	1518	6481	**7998**	4927	7865	**12792**
Wind – Onshore	263	60	**323**	263	60	**323**	0	0	**0**
Wind – Out-of-State	2936	0	**2936**	4436	0	**4436**	2536	0	**2536**
Wind – Offshore	0	0	**0**	0	0	**0**	0	0	**0**
Li Battery – 4 hr	6156	968	**7124**	6131	968	**7100**	5328	968	**6297**
Li Battery – 8 hr	100	0	**100**	100	0	**100**	1002	0	**1002**
Long Duration Energy Storage (LDES)	860	0	**860**	860	0	**860**	1300	0	**1300**
Geothermal	100	0	**100**	100	0	**100**	1347	0	**1347**
Distributed Solar	0	0	**0**	0	0	**0**	0	0	**0**
Gas capacity not retained	-97	0	**-97**	-97	0	**-97**	-97	0	**-97**
Total	**11237**	**6777**	**18014**	**13311**	**7509**	**20820**	**16343**	**8834**	**25177**

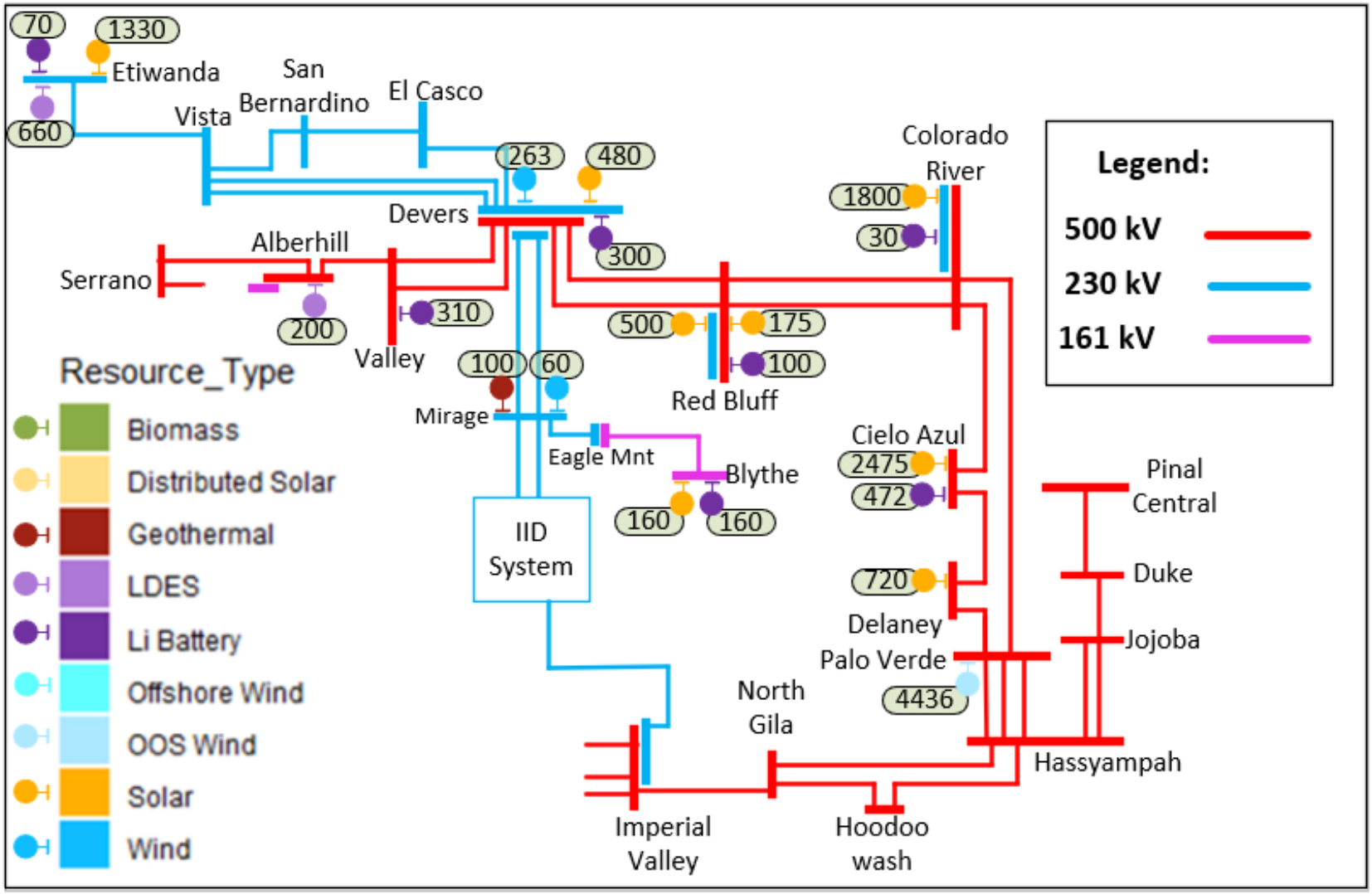
Approximately 2800 MW of in-development BESS was modeled in the western LA Basin. Additional studies may be needed with a reduced amount assumed to be in-development.

2036 Base Portfolio: SCE Eastern Area



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2041 Base Portfolio: SCE Eastern Area



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2036 Base Portfolio On-Peak SCE Eastern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Colorado River 500/230 kV Transformer No.1	Colorado River 500/230 kV Transformer No.2	143	165
Colorado River 500/230 kV Transformer No.2	Colorado River 500/230 kV Transformer No.1	143	165
Red Bluff 500/230 kV Transformer No.1	Red Bluff 500/230 kV Transformer No.2	194	174
	Base Case	115	104
Red Bluff 500/230 kV Transformer No.2	Red Bluff 500/230 kV Transformer No.1	194	174
	Base Case	115	103
Devers – Red Bluff 500 kV No.1	Devers – Red Bluff 500 kV No.2	144	144
Devers – Red Bluff 500 kV No.2	Devers – Red Bluff 500 kV No.1	144	144

2036 Base Portfolio On-Peak SCE Eastern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Devers 500/230 kV Transformer No. 1	Serrano-Alberhill-Valley 500 kV No.1	134	126
	Devers 500/230 kV Transformer No. 2	<100	113
Devers 500/230 kV Transformer No. 2	Serrano-Alberhill-Valley 500 kV No.1	131	123
	Devers 500/230 kV Transformer No. 1	<100	112
Serrano-Alberhill-Valley 500 kV No.1	Base Case	126	<100
	Devers-Vista 230 kV No.1 & No.2	124	<100
	Etiwanda-San Bernardino 230 kV & Vista-San Bernardino 230 kV	124	<100
	Imperial Valley-Recon 500 kV	124	<100
	Devers-El Casco 230 kV & Devers-San Bernardino 230 kV	122	<100
	El Casco-San Bernardino 230 kV & Devers-San Bernardino 230 kV	121	<100
	Etiwanda-San Bernardino 230 kV & Etiwanda-Vista 230 kV	117	<100

2036 Base Portfolio On-Peak SCE Eastern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Devers-Valley 500 kV No.1	Devers-Valley 500 kV No.2	105	<100
Devers-Valley 500 kV No.2	Devers-Valley 500 kV No.1	105	<100
Rancho Vista 500/230 kV Transformer No. 3	Serrano-Alberhill-Valley 500 kV No.1	121	<100
Rancho Vista 500/230 kV Transformer No. 4	Serrano-Alberhill-Valley 500 kV No.1	121	<100

2036 Base Portfolio On-Peak SCE Eastern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Etiwanda-Rancho Vista 230 kV No.1	Etiwanda-Rancho Vista 230 kV No.2	138	<100
	Serrano-Alberhill-Valley 500 kV No.1	109	<100
Etiwanda-Rancho Vista 230 kV No.2	Etiwanda-Rancho Vista 230 kV No.1	138	<100
	Serrano-Alberhill-Valley 500 kV No.1	109	<100
Mira Loma-Mesa 500 kV No.1	Base Case	110	<100
	Lugo Collector-Vincent 500 kV No.1	105	<100

2036 On-Peak Colorado River 500/230 kV Constraint Summary

Affected transmission zones		Colorado River 230 kV	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		850 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD allocations behind the constraint		201 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0 MW	0 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1120 MW	1245 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
	Grid Enhancing Technology	Not needed	Not applicable
	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
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

2036 On-Peak Red Bluff 500/230 kV Constraint Summary

Affected transmission zones		Red Bluff 230 kV	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		1700 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD allocations behind the constraint		1112 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		440 MW	0 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1260 MW	1974 MW
Mitigation Options	RAS	RAS not allowed to address Base Case overload	
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not applicable	
	Transmission upgrade including cost	New Red Bluff No.3 500/230 kV transformer ($69M)	
Recommended Mitigation		TBD	

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

2036 On-Peak Devers-Red Bluff Constraint Summary

Affected transmission zones		SCE Eastern (east of Red Bluff) and SDG&E	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		9721 MW	8581 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		477 MW	
Unaccounted for TPD allocations behind the constraint		2236 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		2223 MW	0 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		7498 MW	8761 MW
Mitigation Options	RAS	Existing West of Colorado River CRAS alone not sufficient	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	TBD	
	Transmission upgrade including cost	Option 1: New Devers-Red Bluff 500 kV transmission line ($875M) and New Devers-Mira Loma 500 kV transmission line ($1.1B) Option 2: New Red Bluff-Mira Loma 500 kV transmission line ($TBD)	
Recommended Mitigation		TBD	

Affected interties	PALOVRDE_ITC (PVWEST)
MIC expansion request MW behind constraint	429 nameplate wind
Deliverable MIC expansion request MW	0

2036 On-Peak Serrano-Alberhill-Valley Constraint Summary

Affected transmission zones		SCE Eastern, SDG&E, IID	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		9650 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		477 MW	
Unaccounted for TPD allocations behind the constraint		2986 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		3843 MW	4194 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		5807 MW	5456 MW
Mitigation Options	RAS	Inland Devers Extension CRAS cannot be expanded to monitor overloads on Devers transformers. RAS not allowed to address Base Case overload.	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	TBD	
	Transmission upgrade including cost	Option 1: New Devers-Mira Loma 500 kV transmission line ($1.1B) and New Devers-Red Bluff 500 kV transmission line ($875M) Option 2: New Red Bluff-Mira Loma 500 kV transmission line ($TBD)	
Recommended Mitigation		1. Use 1 hour emergency rating and operational procedures for Rancho Vista transformers 2. Transmission upgrades TBD	

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2036 On-Peak Serrano-Alberhill-Valley Constraint Summary

Affected interties	PALOVRDE_ITC (PVWEST)
MIC expansion request MW behind constraint	429 nameplate wind
Deliverable MIC expansion request MW	0

2036 On-Peak Etiwanda-Rancho Vista Constraint Summary

Affected transmission zones		SCE Eastern	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		6374 MW	N/A
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD allocations behind the constraint		2707 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		5824 MW	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		550 MW	
Mitigation Options	RAS	Not applicable	
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not applicable	
	Transmission upgrade including cost	Upgrade bus conductor at Etiwanda (Cluster 15 ADNU)	
Recommended Mitigation		The C15 merchant generator project is expected to fund the upgrade	

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

2036 On-Peak Mira Loma-Mesa Constraint Summary

Affected transmission zones		SCE Eastern, EOP, NOL, Metro and SDG&E	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		36648 MW	N/A
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		3684 MW	
Unaccounted for TPD allocations behind the constraint		10559 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		30196 MW	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		6452 MW	
Mitigation Options	RAS	RAS not allowed to address Base Case overload	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	TBD	
	Transmission upgrade including cost	New Mesa-Serrano 500 kV transmission line ($360M)	
Recommended Mitigation		TBD	

Affected interties	PALOVRDE_ITC (PVWEST), MEAD_ITC (MEAD 230), SILVERPK_ITC (SILVERPEAK55)
MIC expansion request MW behind constraint	552
Deliverable MIC expansion request MW	0

2036 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	232
	Base Case	139
Colorado River 500/230 kV Transformer No.2	Colorado River 500/230 kV Transformer No.1	232
	Base Case	135
Red Bluff 500/230 kV Transformer No.1	Red Bluff 500/230 kV Transformer No.2	156
Red Bluff 500/230 kV Transformer No.2	Red Bluff 500/230 kV Transformer No.1	156

2036 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		2066 MW
Portfolio energy storage behind the constraint		965 MW
Renewable curtailment without mitigation		2395 MW
Mitigation Options:	Portfolio ES (in charging mode)*	275 MW
	RAS	Existing West of Colorado River CRAS alone not sufficient
	Grid Enhancing Technology	Not needed
	Transmission upgrades	Not needed
Recommended Mitigation		Existing West of Colorado River CRAS and/or 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.

2036 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		625 MW
Portfolio energy storage behind the constraint		1700 MW
Renewable curtailment without mitigation		1043 MW
Mitigation Options:	Portfolio ES (in charging mode)*	0 MW
	RAS	Existing West of Colorado River CRAS
	Grid Enhancing Technology	Not needed
	Transmission upgrades	Not needed
Recommended Mitigation		Existing West of Colorado River CRAS and/or 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.

2041 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	143	142
Colorado River 500/230 kV Transformer No.2	Colorado River 500/230 kV Transformer No.1	143	142
Red Bluff 500/230 kV Transformer No.1	Red Bluff 500/230 kV Transformer No.2	195	196
	Base Case	116	116
Red Bluff 500/230 kV Transformer No.2	Red Bluff 500/230 kV Transformer No.1	195	196
	Base Case	115	116
Devers – Red Bluff 500 kV No.1	Devers – Red Bluff 500 kV No.2	153	160
Devers – Red Bluff 500 kV No.2	Devers – Red Bluff 500 kV No.1	153	160

2041 On-Peak SCE Eastern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Devers 500/230 kV Transformer No. 1	Serrano-Alberhill-Valley 500 kV No.1	137	135
Devers 500/230 kV Transformer No. 2	Serrano-Alberhill-Valley 500 kV No.1	134	132
Serrano-Alberhill-Valley 500 kV No.1	Base Case	126	146
	Devers-Vista 230 kV No.1 & No.2	125	147
	Etiwanda-San Bernardino 230 kV & Vista-San Bernardino 230 kV	124	145
	Imperial Valley-Recon 500 kV	126	137
	Devers-El Casco 230 kV & Devers-San Bernardino 230 kV	123	145
	El Casco-San Bernardino 230 kV & Devers-San Bernardino 230 kV	122	142
	Etiwanda-San Bernardino 230 kV & Etiwanda-Vista 230 kV	117	137

2041 On-Peak SCE Eastern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Devers-Valley 500 kV No.1	Devers-Valley 500 kV No.2	109	111
Devers-Valley 500 kV No.2	Devers-Valley 500 kV No.1	109	111
Rancho Vista 500/230 kV Transformer No. 3	Serrano-Alberhill-Valley 500 kV No.1	114	116
Rancho Vista 500/230 kV Transformer No. 4	Serrano-Alberhill-Valley 500 kV No.1	114	115
San Bernardino-Vista 230 kV No.1	Devers-Vista 230 kV No.1 & No.2	<100	111
Vista-Etiwanda 230 kV No.1	Wildlife-Vista 230.00 kV & Rancho Vista-Vista 230.00 kV	<100	108
	Serrano-Alberhill-Valley 500 kV No.1	<100	107
Vista-Rancho Vista 230 kV No.2	Etiwanda-San Bernardino 230 kV & Etiwanda-Vista 230 kV	<100	104

2041 On-Peak SCE Eastern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Etiwanda-Rancho Vista 230 kV No.1	Etiwanda-Rancho Vista 230 kV No.2	131	<100
	Serrano-Alberhill-Valley 500 kV No.1	105	<100
Etiwanda-Rancho Vista 230 kV No.2	Etiwanda-Rancho Vista 230 kV No.1	131	<100
	Serrano-Alberhill-Valley 500 kV No.1	105	<100
Mira Loma-Mesa 500 kV No.1	Base Case	116	<100
	Lugo Collector-Vincent 500 kV No.1	115	<100

2041 On-Peak SCE Eastern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Ramon – Mirage 230 kV No.1	Ramon – Mirage 230 kV No.2	<100	160
	Base Case	<100	106
Ramon – Mirage 230 kV No.2	Ramon – Mirage 230 kV No.1	<100	129
Julian Hinds-Eagle Mountain 230 kV	Devers-Mirage 230 kV No.1 & No.2	142	337
Eagle Mountain-Iron Mountain 230 kV		<100	238
Iron Mountain-Camino 230 kV		<100	233
Julian Hinds-Mirage 230 kV		<100	152
Eagle Mountain-Blythe 161 kV		<100	104
Julian Hinds-Eagle Mountain 230 kV	Devers-Mirage 230 kV No.1	<100	124
Devers-Mirage 230 kV No.1	Devers-Mirage 230 kV No.2	<100	117
Devers-Mirage 230 kV No.2	Devers-Mirage 230 kV No.1	<100	117

2041 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)		850 MW	652 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD behind the constraint		201 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0 MW	0 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1118 MW	929 MW
Mitigation Options	RAS	Existing West of Colorado River CRAS	
	Reduce generic battery storage (MW)	Not needed	
	Grid Enhancing Technology	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

2041 On-Peak Red Bluff 500/230 kV Constraint Summary

Affected transmission zones		Red Bluff 230 kV	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		1700 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD behind the constraint		1112 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		439 MW	430 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1261 MW	1270 MW
Mitigation Options	RAS	RAS not allowed to address Base Case overload	
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not applicable	
	Transmission upgrade including cost	New Red Bluff No.3 500/230 kV transformer ($69M)	
Recommended Mitigation		TBD	

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

2041 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)		11214 MW	12576 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		477 MW	2252 MW
Unaccounted for TPD behind the constraint		2228 MW	1512 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		2488 MW	2680 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		8726 MW	9896 MW
Mitigation Options	RAS	Existing West of Colorado River CRAS alone not sufficient	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	TBD	
	Transmission upgrade including cost	Option 1: New Devers-Red Bluff 500 kV transmission line ($875M) and New Devers-Mira Loma 500 kV transmission line ($1.1B) Option 2: New Red Bluff-Mira Loma 500 kV transmission line ($TBD)	
Recommended Mitigation		TBD	

Affected interties	PALOVRDE_ITC (PVWEST)
MIC expansion request MW behind constraint	429 nameplate wind
Deliverable MIC expansion request MW	0

2041 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)		11438 MW	13072 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		477 MW	902 MW
Unaccounted for TPD behind the constraint		3274 MW	2197 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		4294 MW	4697 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		7144 MW	8375 MW
Mitigation Options	RAS	Inland Devers Extension CRAS cannot be expanded to monitor overloads on Devers transformers. RAS not allowed to address Base Case overload.	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	TBD	
	Transmission upgrade including cost	Option 1: New Devers-Mira Loma 500 kV transmission line ($1.1B) and New Devers-Red Bluff 500 kV transmission line ($875M) Option 2: New Red Bluff-Mira Loma 500 kV transmission line ($TBD)	
Recommended Mitigation		1. Use 1 hour emergency rating and operational procedures for Rancho Vista transformers 2. Transmission upgrades TBD	

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2041 On-Peak Serrano-Alberhill-Valley Constraint Summary

Affected interties	PALOVRDE_ITC (PVWEST)
MIC expansion request MW behind constraint	429 nameplate wind
Deliverable MIC expansion request MW	0

2041 On-Peak Etiwanda-Rancho Vista Constraint Summary

Affected transmission zones		SCE Eastern	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		6918 MW	N/A
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD behind the constraint		2690 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		6481 MW	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		437 MW	
Mitigation Options	RAS	Not applicable	
	Reduce generic battery storage (MW)	Not applicable	
	Grid Enhancing Technology	Not applicable	
	Transmission upgrade including cost	Upgrade bus conductor at Etiwanda (Cluster 15 ADNU)	
Recommended Mitigation		The C15 merchant generator project is expected to fund the upgrade	

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

2041 On-Peak Mira Loma-Mesa Constraint Summary

Affected transmission zones		SCE Eastern, EOP, NOL, Metro and SDG&E	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		40984 MW	N/A
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		3683 MW	
Unaccounted for TPD behind the constraint		10566 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		34297 MW	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		6687 MW	
Mitigation Options	RAS	RAS not allowed to address Base Case overload	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	TBD	
	Transmission upgrade including cost	New Mesa-Serrano 500 kV transmission line ($360M)	
Recommended Mitigation		TBD	

Affected interties	PALOVRDE_ITC (PVWEST), MEAD_ITC (MEAD 230), SILVERPK_ITC (SILVERPEAK55)
MIC expansion request MW behind constraint	552
Deliverable MIC expansion request MW	0

2041 On-Peak WECC Path 42 Constraint Summary

Affected transmission zones		SCE Eastern, IID, MWD	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		230 MW	2467 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0 MW	
Unaccounted for TPD behind the constraint		0 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0 MW	909 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		340 MW	1558 MW
Mitigation Options	RAS	Existing Blythe Energy RAS	Existing Path 42 RAS, Blythe Energy RAS
	Reduce generic battery storage (MW)	Not needed	Not applicable
	Grid Enhancing Technology	Not needed	TBD
	Transmission upgrade including cost	Not needed	1.The ISO will discuss potential mitigation plans with IID and SCE, and/or 2. New Devers-Ramon 230 kV line ($TBD)
Recommended Mitigation		Existing Blythe Energy RAS	TBD

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

SCE Eastern On-Peak HSN Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Colorado River 500/230 kV transformers	2036 Base	850	0	0	1120	Existing West of Colorado River CRAS
	2041 Base	850	0	0	1118	
	2041 Low Wind	652	0	0	929	
Red Bluff 500/230 kV transformers	2036 Base	1700	0	440	1260	TBD
	2041 Base	1700	0	439	1261	
	2041 Low Wind	1700	0	430	1270	
Devers-Red Bluff	2036 Base	9721	477	2223	7498	TBD
	2041 Base	11214	477	2488	8726	
	2041 Low Wind	12576	2252	2680	9896	
Serrano-Alberhill-Valley	2036 Base	9650	477	3843	5807	TBD
	2041 Base	11438	477	4294	7144	
	2041 Low Wind	13072	902	4697	8375	
Etiwanda-Rancho Vista	2036 Base	6374	0	5824	550	Upgrade bus conductor at Etiwanda (Cluster 15 ADNU)
	2041 Base	6918	0	6481	437	
	2041 Low Wind	N/A				

SCE Eastern On-Peak HSN Constraints Summary

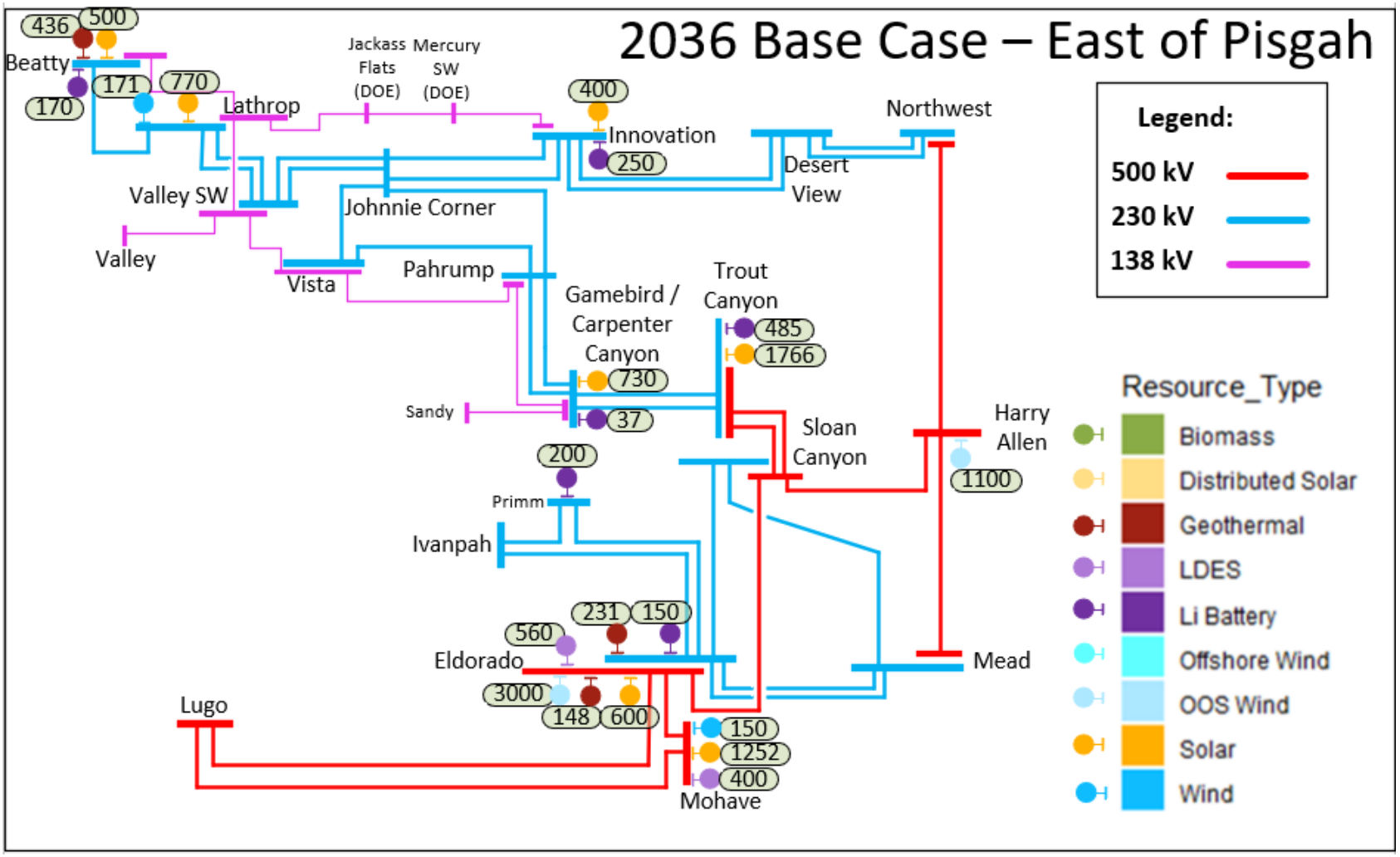
Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Mira Loma-Mesa	2036 Base	36648	3684	30196	6452	TBD
	2041 Base	40984	3683	34297	6687	
	2041 Low Wind	N/A				
WECC Path 42	2036 Base	N/A				TBD
	2041 Base	230	0	0	340	
	2041 Low Wind	2467	0	909	1558	

East of Pisgah Interconnection Area

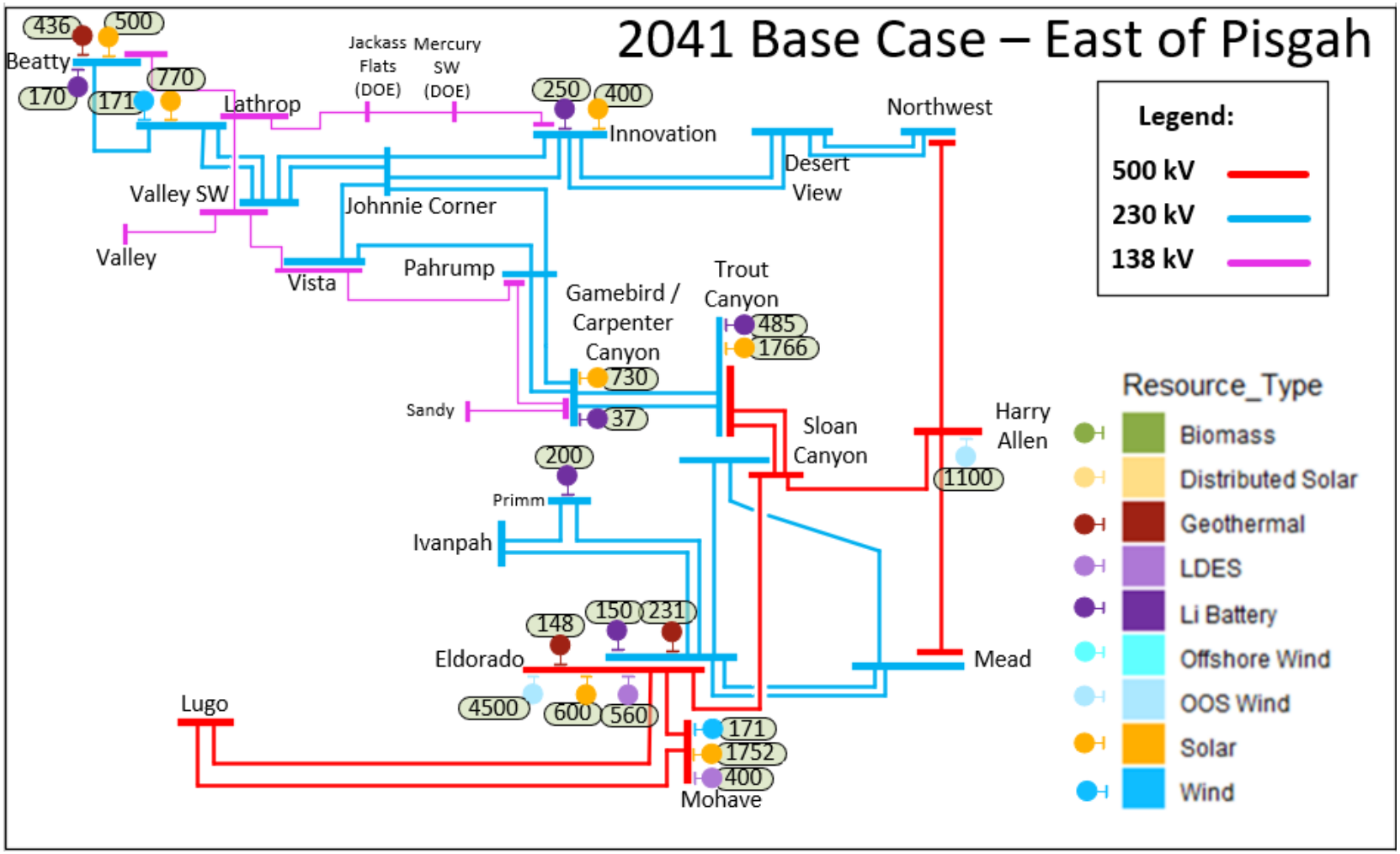
East of Pisgah Interconnection Area Portfolio Summary

Resource Type	2036 Base Portfolio			2041 Base Portfolio			2041 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	3,850	2,103	**5,953**	4,350	2,103	**6,453**	0	1,811	**1,811**
Wind – Onshore	321	0	**321**	321	0	**321**	250	0	**250**
Wind – Out-of-State	4,100	0	**4,100**	5,600	0	**5,600**	2,600	0	**2,600**
Wind – Offshore	0	0	**0**	0	0	**0**	0	0	**0**
Li Battery – 4 hr	4,424	35	**4,459**	4,307	35	**4,342**	4,384	0	**4,384**
Li Battery – 8 hr	607	0	**607**	607	0	**607**	477	0	**477**
Long Duration Energy Storage (LDES)	960	0	**960**	960	0	**960**	1,000	0	**1,000**
Geothermal	815	0	**815**	815	0	**815**	1,649	0	**1,649**
Distributed Solar	0	0	**0**	0	0	**0**	0	0	**0**
Gas capacity not retained	0	0	**0**	0	0	**0**	0	0	**0**
Total	**15,077**	**2,138**	**17,215**	**16,960**	**2,138**	**19,098**	**10,360**	**1,811**	**12,171**

2036 Base Portfolio: East of Pisgah Area



2041 Base Portfolio: East of Pisgah Area



2036 Base Portfolio On-Peak EOP Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Pahrump 230/138kV transformer No.1	Gamebird – Wheeler Pass 230kV Nos.1&2 lines	114	127
Pahrump 230/138kV transformer No.2		<100	110
Pahrump – Gamebird 138kV line		<100	109
Gamebird 230/138kV transformer	Gamebird – Trout Canyon 230kV Nos.1&2 lines	<100	132
VEA PST – IS Tap 138kV line	Northwest – Desert View 230kV Nos.1&2 lines	<100	115
	Innovation – Desert View 230kV Nos.1&2 lines	<100	115
Lugo Collector – Mohave 500kV line	Eldorado – Lugo 500kV line	108	<100
	Trout Canyon - Lugo 500kV line	107	<100
Eldorado – McCullough 500kV line	Lugo Collector – Mohave 500kV line	107	<100

2036 On-Peak Pahrump 230/138kV Transformer Constraint Summary

Affected transmission zones		GLW	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		2,516 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		420 MW	
Unaccounted for TPD allocation behind the constraint		289 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		2,337 MW	2,145 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		179 MW	371 MW
Mitigation Options	RAS	Doesn't meet RAS guideline	
	Reduce generic battery storage (MW)	Interact with unaccounted for TPD	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	Two Vista 230/138kV transformers	
Recommended Mitigation		Coordinate with reliability project	

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

2036 On-Peak Gamebird 230/138kV Transformer Constraint Summary

Affected transmission zones		GLW	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		1,823 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		37 MW	
Unaccounted for TPD allocation behind the constraint		0 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1,823 MW	452 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		0 MW	1,371 MW
Mitigation Options	RAS	N/A	Doesn't meet RAS guideline
	Reduce generic battery storage (MW)		Not sufficient
	Grid Enhancing Technology		N/A
	Transmission upgrade including cost		Two Vista 230/138kV transformers
Recommended Mitigation			Coordinate with reliability project

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

California ISO Public

2036 On-Peak VEA PST-IS Tap 138kV Constraint Summary

Affected transmission zones		GLW	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		2,895 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		420 MW	
Unaccounted for TPD allocation behind the constraint		289 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		2,895 MW	2,690 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		0 MW	205 MW
Mitigation Options	RAS	N/A	Update Innovation RAS
	Reduce generic battery storage (MW)		Interact with unaccounted for TPD
	Grid Enhancing Technology		N/A
	Transmission upgrade including cost		Not required
Recommended Mitigation			Update Innovation RAS

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

2036 On-Peak Lugo Collector-Mohave 500kV Constraint Summary

Affected transmission zones		East of Pisgah	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		9,144 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		150 MW	
Unaccounted for TPD behind the constraint		2,103 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		8,504 MW	9,114 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		640 MW	0 MW
Mitigation Options	RAS	Expand Lugo-Victorville RAS	N/A
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	TBD	
	Transmission upgrade including cost	Not required	
Recommended Mitigation		Expand Lugo-Victorville RAS	

Affected interties	MEAD_ITC
MIC expansion request MW behind constraint	109.8
Deliverable MIC expansion request MW	0

2036 On-Peak Eldorado-McCullough 500kV Constraint Summary

Affected transmission zones		East of Pisgah	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		14,775 MW	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		607 MW	
Unaccounted for TPD behind the constraint		3,674 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		13,785 MW	14,775 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		990 MW	0 MW
Mitigation Options	RAS	Expand Lugo-Victorville RAS	N/A
	Reduce generic battery storage (MW)	Interact with unaccounted for TPD	
	Grid Enhancing Technology	10 Ohms series reactor on Eldorado-McCullough line	
	Transmission upgrade including cost	Not needed	
Recommended Mitigation		Expand Lugo-Victorville RAS	

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

2036 Base Portfolio Off-Peak EOP Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)
Gamebird – Pahrump 138kV line	Gamebird – Wheeler Pass 230kV Nos. 1&2	117
Pahrump 230/138kV transformer		101

2036 Base Portfolio Off-Peak Pahrump-Gamebird Constraint Summary

Affected renewable transmission zones		East of Pisgah
Portfolio solar and wind resources behind the constraint		4,600 MW
Portfolio energy storage behind the constraint		455 MW
Renewable curtailment without mitigation		166 MW
Mitigation Options:	Portfolio ES (in charging mode)*	170 MW
	RAS	Doesn't meet RAS guideline
	Grid Enhancing Technology	N/A
	Transmission upgrades	Two Vista 230/138kV transformers
Recommended Mitigation		Coordinate with reliability project

2041 On-Peak EOP Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Pahrump 230/138kV transformer No.1	Gamebird – Wheeler Pass 230kV Nos.1&2 lines	109	150
Pahrump 230/138kV transformer No.2		<100	128
Pahrump – Gamebird 138kV line		<100	128
Eldorado – McCullough 500kV line	Lugo Collector – Mohave 500kV line	114	<100
	Eldorado – Lugo 500kV line	103	<100
Lugo Collector – Mohave 500kV line	Eldorado – Lugo 500kV line	100	<100

2041 On-Peak Pahrump 230/138kV Transformer Constraint Summary

Affected transmission zones		GLW	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		2,516 MW	1,735 MW
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		420 MW	360 MW
Unaccounted for TPD behind the constraint		289 MW	289 MW
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		2,390 MW	1,143 MW
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		126 MW	592 MW
Mitigation Options	RAS	Doesn't meet RAS guideline	
	Reduce generic battery storage (MW)	Interact with unaccounted for TPD	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	Two Vista 230/138kV transformers	
Recommended Mitigation		Coordinate with reliability project	

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

2041 On-Peak Eldorado-McCullough 500kV Constraint Summary

Affected transmission zones		EOP	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		15,148 MW*	N/A
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		607 MW	
Unaccounted for TPD behind the constraint		3,557 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		13,168 MW	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1,980 MW*	
Mitigation Options	RAS	Expand Lugo-Victorville CRAS	
	Reduce generic battery storage (MW)	Interact with unaccounted for TPD	
	Grid Enhancing Technology	10 Ohms series reactor on Eldorado-McCullough line	
	Transmission upgrade including cost	Not required	
Recommended Mitigation		Expand Lugo-Victorville CRAS	

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

*The numbers Include 1,500MW Wyoming wind mapped at Eldorado 500kV that CPUC recommend the CAISO to continue to conduct additional analysis on the potential transmission solutions

2041 On-Peak Lugo Collector-Mohave 500kV Constraint Summary

Affected transmission zones		EOP	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		11,019 MW*	N/A
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		150 MW	
Unaccounted for TPD behind the constraint		1,986 MW	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		10,809 MW	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		210 MW*	
Mitigation Options	RAS	Expand Lugo-Victorville CRAS	
	Reduce generic battery storage (MW)	Interact with unaccounted for TPD	
	Grid Enhancing Technology	TBD	
	Transmission upgrade including cost	Not required	
Recommended Mitigation		Expand Lugo-Victorville CRAS	

Affected interties	MEAD_ITC
MIC expansion request MW behind constraint	109.8
Deliverable MIC expansion request MW	0

*The numbers Include 1,500MW Wyoming wind mapped at Eldorado 500kV that CPUC recommend the CAISO to continue to conduct additional analysis on the potential transmission solutions

East of Pisgah On-Peak HSN Constraints Summary

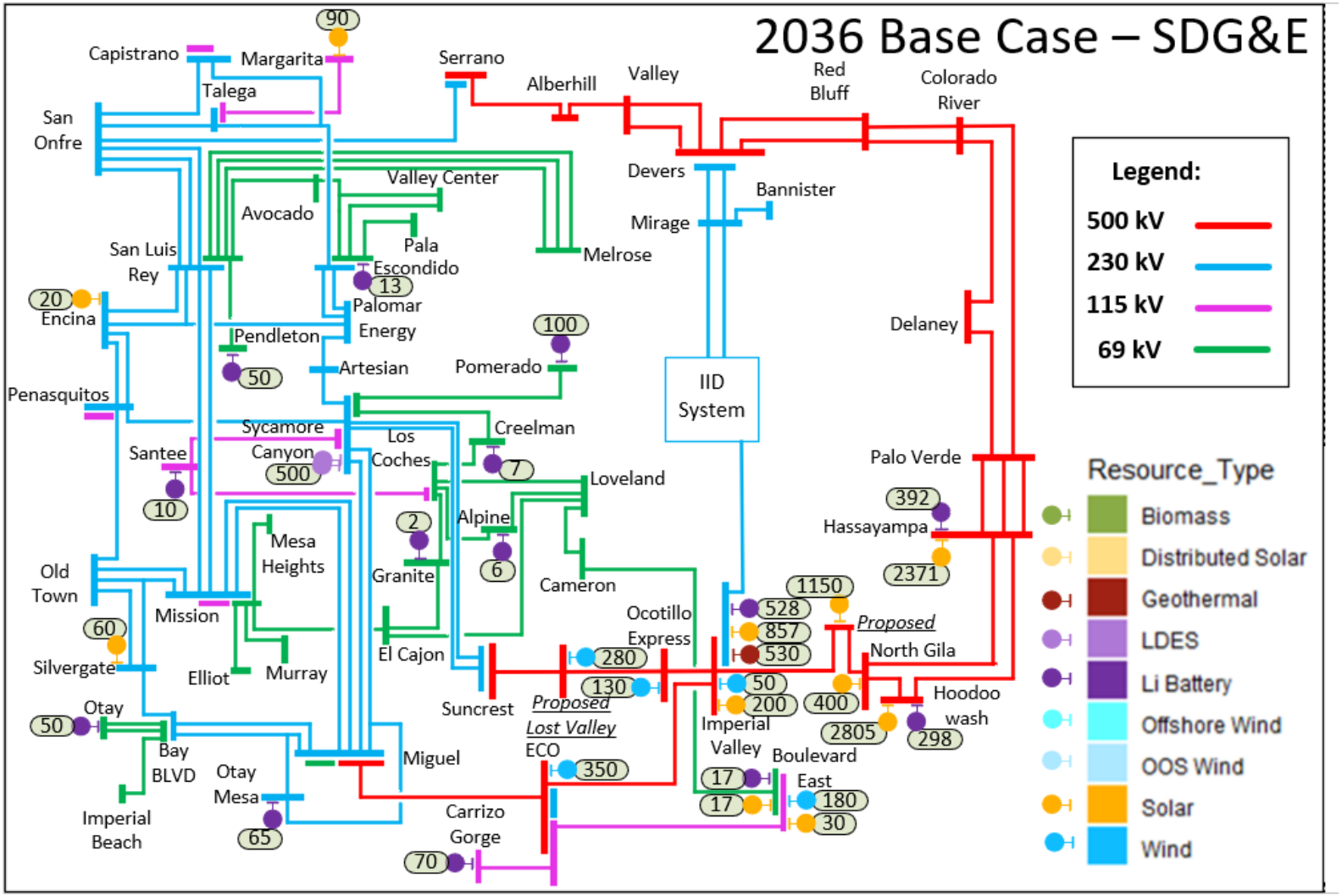
Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Pahrump 230/138kV transformer constraint	2036 Base	2,516	420	2,337	179	Coordinate with reliability project
	2041 Base	2,516	420	2,390	126	
	2041 Low Wind	1,735	360	1,143	592	
Eldorado – McCullough 500kV constraint	2036 Base	14,775	607	13,785	990	Expand Lugo-Victorville CRAS
	2041 Base	15,148	607	13,168	1,980	
	2041 Low Wind	N/A				
Lugo Collector – Mohave 500kV constraint	2036 Base	9,144	150	8,504	640	Expand Lugo-Victorville CRAS
	2041 Base	11,019	150	10,809	210	Expand Lugo-Victorville CRAS
	2041 Low Wind	N/A				

SDG&E Interconnection Area

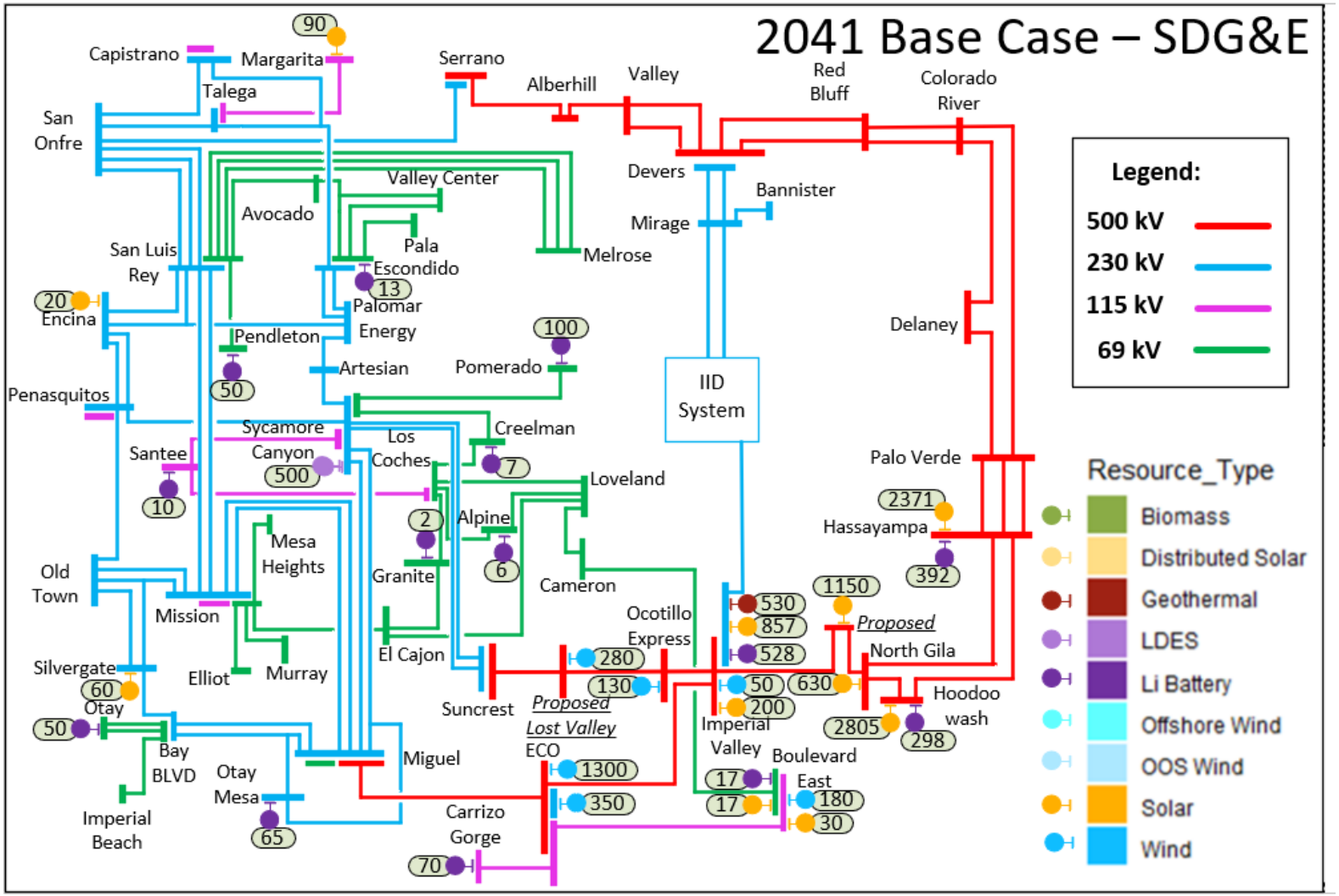
SDG&E Interconnection Area Portfolio Summary

Resource Type	2036 Base Portfolio			2041 Base Portfolio			2041 Sensitivity Portfolio		
	FCDS	EO	Total	FCDS	EO	Total	FCDS	EO	Total
	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)	(MW)
Solar	4064	4211	**8274**	4065	4439	**8504**	6592	9602	**16194**
Wind – Onshore	990	0	**990**	2290	0	**2290**	180	0	**180**
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	2471	612	**3083**	2514	612	**3127**	2472	612	**3085**
Li Battery – 8 hr	307	50	**357**	307	50	**357**	1324	50	**1374**
Long Duration Energy Storage (LDES)	500	0	**500**	500	0	**500**	500	0	**500**
Geothermal	530	0	**530**	530	0	**530**	1000	0	**1000**
Distributed Solar	0	0	**0**	0	0	**0**	0	0	**0**
Gas capacity not retained	0	0	**0**	-3	0	**-3**	-3	0	**-3**
Total	**8862**	**4873**	**13734**	**10206**	**5101**	**15308**	**12068**	**10264**	**22333**

2036 Base Portfolio: SDG&E Area



2041 Base Portfolio: SDG&E Area



2036 Base Portfolio On-Peak SDG&E Area Deliverability Constraints

Constraint Name	Overloaded Facility	Contingency	Loading (%)	
			HSN	SSN
Silvergate-Old Town	Silvergate-Old Town 230 kV	Silvergate-Mission-Old Town 230 kV	112.7	<100
		Old Town-Mission 230 kV and Silvergate-Mission-Old Town 230 kV	114.17	101.22
	Silvergate-Old Town Tap 230 kV	Silvergate-Old Town 230 kV	111.9	<100
Silvergate-Bay Boulevard	Silvergate-Bay Boulevard 230 kV	Imperial Valley-Recon 500 kV	118.68	114.96
		Miguel-Mission 230 kV #1 and #2	113.28	108.89
Encina-San Luis Rey	Encina Tap-San Luis Rey 230 kV	Imperial Valley-Recon 500 kV	111.67	<100
		Encina-San Luis Rey 230 kV	107.58	<100
	Encina-San Luis Rey 230 kV	Imperial Valley-Recon 500 kV	101.89	<100
ECO 120/138 kV	ECO 120/138 kV	Base Case	101.78	<100
IV-Glamis	Imperial Valley-Glamis 500 kV	Imperial Valley-North Gila 500 kV #2	104.1	109.57

2036 Base Portfolio On-Peak SDG&E Area Deliverability Constraints

Constraint Name	Overloaded Facility	Contingency	Loading (%)	
			HSN	SSN
Imperial Valley Bank 82	Imperial Valley 230/500 kV Bank 82	Base case	101.79	103.4
Imperial Valley Bank 81, 80	Imperial Valley 230/500 kV Bank 80	Imperial Valley 230/500 kV Bank 81	<100	103.11
	Imperial Valley 230/500 kV Bank 81	Imperial Valley 230/500 kV Bank 80	<100	103.56

2036 On-Peak Silvergate-Old Town Constraint Summary

Affected transmission zones		ECO/BUE, SDGE Internal	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		2155	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		11	
Unaccounted for TPD allocations behind the constraint		0	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		246	N/A
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1909	N/A
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	N/A	
Recommended Mitigation		Use 30 minute emergency rating	

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

2036 On-Peak Silvergate-Bay Boulevard Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		4954	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		3	
Unaccounted for TPD allocations behind the constraint		1111	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		468	N/A
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		4486	N/A
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	N/A	
Recommended Mitigation		Use emergency rating	

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

2036 On-Peak Encina-San Luis Rey Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		6091	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		13	
Unaccounted for TPD allocations behind the constraint		1165	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		5554	N/A
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		537	N/A
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	Advanced conductor upgrade of Encina Tap-San Luis Rey 230 kV (1050 MVA) and Encina-San Luis Rey 230 kV (950 MVA)	
	Transmission upgrade including cost	New Encina-San Luis Rey 230 kV line (912 MVA)	
Recommended Mitigation		Advanced conductor upgrade of Encina Tap-San Luis Rey 230 kV (1050 MVA) and Encina-San Luis Rey 230 kV (950 MVA)	

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

2036 On-Peak ECO 230/138 kV Constraint Summary

Affected transmission zones		ECO/BUE	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		521	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0	
Unaccounted for TPD allocations behind the constraint		0	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		396	N/A
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		125	N/A
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	N/A	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	2nd ECO 230/138 kV bank	
Recommended Mitigation		2nd ECO 230/138 kV bank	

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

2036 On-Peak IV-Glamis 500 kV Constraint Summary

Affected transmission zones		Imperial Valley, Arizona, Eastern	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		8401	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		477	
Unaccounted for TPD allocations behind the constraint		1835	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		8139	7380
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		262	904
Mitigation Options	RAS	new RAS to trip generation at Glamis for outage of Imperial Valley-North Gila 500 kV #2 line	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	N/A	
Recommended Mitigation		new RAS to trip generation at Glamis for outage of Imperial Valley-North Gila 500 kV #2 line	

Affected interties	NM_Wind_MIC (Paloverde)
MIC expansion request MW behind constraint	429
Deliverable MIC expansion request MW	0

2036 On-Peak Imperial Valley Bank 82 Constraint Summary

Affected transmission zones		Imperial Valley	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		1441	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0	
Unaccounted for TPD allocations behind the constraint		0	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1388	1356
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		53	85
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	N/A	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	Add 4th Imperial Valley 500/230 kV transformer	
Recommended Mitigation		Add 4th Imperial Valley 500/230 kV transformer	

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

2036 On-Peak Imperial Valley Bank 80 and 81 Constraint Summary

Affected transmission zones		Imperial Valley	
		HSN	SSN
Portfolio resources behind the constraint (Installed FCDS capacity)		1441	
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0	
Unaccounted for TPD allocations behind the constraint		0	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		N/A	1253
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		N/A	188
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	N/A	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	N/A	
Recommended Mitigation		Use 30 minute emergency rating	

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

2036 Base Portfolio Off-Peak SDG&E Area Deliverability Constraints

- No off-peak constraints were identified

2041 On-Peak SDG&E Area Deliverability Constraints

Constraint Name	Overloaded Facility	Contingency	Loading (%)	
			Base	Sensitivity
Silvergate-Old Town	Silvergate-Vine 230 kV	Old Town-Mission 230 kV and Silvergate-Mission-Old Town 230 kV	132.72	125.65
		Silvergate-Mission-Old Town 230 kV	128.88	121.65
	Silvergate-Old Town Tap 230 kV	Silvergate-Vine 230 kV	123.27	116.14
Silvergate-Bay Boulevard	Silvergate-Bay Boulevard 230 kV	Imperial Valley-Recon 500 kV	128.34	120.39
		Miguel-Mission 230 kV #1 and #2	122.22	116.97
Encina-San Luis Rey	Encina Tap-San Luis Rey 230 kV	Imperial Valley-Recon 500 kV	111.6	101.39
		Encina-San Luis Rey 230 kV	101.95	<100
	Encina-San Luis Rey 230 kV	Imperial Valley-Recon 500 kV	101.85	<100
ECO 120/138 kV	ECO 120/138 kV	Base Case	101.96	101.76
IV-Glamis	Imperial Valley-Glamis 500 kV	Imperial Valley-North Gila 500 kV #2	108.19	110.96

2041 On-Peak SDG&E Area Deliverability Constraints

Constraint Name	Overloaded Facility	Contingency	Loading (%)	
			Base	Sensitivity
Imperial Valley Bank 82	Imperial Valley 230/500 kV Bank 82	Base case	103.6	130.43
ECO-Miguel	ECO-Miguel 500 kV	Imperial Valley-Recon 500 kV	102.35	<100
		Suncrest-Lost Valley 500 kV	100.31	<100
Sycamore-Chicarita	Sycamore-Chicarita 138 kV	Imperial Valley-Recon 500 kV	105.77	102.39
		Sycamore-Santee 138 kV and Sycamore-Carlton Hills 138 kV	100.49	<100
Sycamore-Artesian	Sycamore-Artesian 230 kV	Imperial Valley-Recon 500 kV	102.28	<100

2041 On-Peak Silvergate-Old Town Constraint Summary

Affected transmission zones		ECO/BUE, SDGE Internal	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		3489	1717
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		9	9
Unaccounted for TPD allocations behind the constraint		1198	1156
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		0	0
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		3689	1917
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	N/A	
Recommended Mitigation		Use 30 minute emergency rating	

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

2041 On-Peak Silvergate-Bay Boulevard Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		6256	5502
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0	97
Unaccounted for TPD allocations behind the constraint		1111	1105
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		786	1035
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		5470	4467
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	N/A	
Recommended Mitigation		Use emergency rating	

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

2041 On-Peak Encina-San Luis Rey Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE, SDGE Internal	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		7530	6559
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		13	107
Unaccounted for TPD allocations behind the constraint		1201	1159
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		7015	6309
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		515	250
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	Not sufficient	
	Grid Enhancing Technology	Advanced conductor upgrade of Encina Tap-San Luis Rey 230 kV (1050 MVA) and Encina-San Luis Rey 230 kV (950 MVA)	
	Transmission upgrade including cost	New Encina-San Luis Rey 230 kV line (912 MVA)	
Recommended Mitigation		Advanced conductor upgrade of Encina Tap-San Luis Rey 230 kV (1050 MVA) and Encina-San Luis Rey 230 kV (950 MVA)	

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

2041 On-Peak ECO 230/138 kV Constraint Summary

Affected transmission zones		ECO/BUE	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		521	501
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0	0
Unaccounted for TPD allocations behind the constraint		0	0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		395	376
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		126	125
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	N/A	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	2nd ECO 230/138 kV bank	
Recommended Mitigation		2nd ECO 230/138 kV bank	

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

2041 On-Peak IV-Glamis 500 kV Constraint Summary

Affected transmission zones		Imperial Valley, Arizona, Eastern	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		9777	11540
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		477	2346
Unaccounted for TPD allocations behind the constraint		1827	1105
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		8342	10360
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1435	1180
Mitigation Options	RAS	new RAS to trip generation at Glamis for outage of Imperial Valley-North Gila 500 kV #2 line	
	Reduce generic battery storage (MW)	Not sufficient	Relocate generic battery storage (1100 MW)
	Grid Enhancing Technology	N/A	N/A
	Transmission upgrade including cost	N/A	N/A
Recommended Mitigation		new RAS to trip generation at Glamis for outage of Imperial Valley-North Gila 500 kV #2 line	

Affected interties	NM_Wind_MIC (Paloverde)
MIC expansion request MW behind constraint	429
Deliverable MIC expansion request MW	0

2041 On-Peak Imperial Valley Bank 82 Constraint Summary

Affected transmission zones		Imperial Valley	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		1441	2036
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0	0
Unaccounted for TPD allocations behind the constraint		0	0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		1351	1405
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		90	631
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	N/A	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	Add 4th Imperial Valley 500/230 kV transformer	
Recommended Mitigation		Add 4th Imperial Valley 500/230 kV transformer	

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

2041 On-Peak ECO-Miguel Constraint Summary

Affected transmission zones		Imperial Valley, ECO/BUE	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		5960	N/A
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0	
Unaccounted for TPD allocations behind the constraint		1111	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		5394	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		566	
Mitigation Options	RAS	New RAS to trip generation at ECO for outage of IV-Recon 500 kV or Suncrest-Lost Valley 500 kV	
	Reduce generic battery storage (MW)	N/A	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	N/A	
Recommended Mitigation		New RAS to trip generation at ECO for outage of IV-Recon 500 kV or Suncrest-Lost Valley 500 kV	

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

2041 On-Peak Sycamore-Chicarita Constraint Summary

Affected transmission zones		SDGE Internal	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		814	814
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		2	2
Unaccounted for TPD allocations behind the constraint		0	0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		695	756
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		119	58
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	N/A	
	Grid Enhancing Technology	Update scope of previously approved TPP reconductoring project from a 250 MVA normal/emergency rating to an advanced conductor upgrade with emergency rating of at least 280 MVA	
	Transmission upgrade including cost	N/A	
Recommended Mitigation		Update scope of previously approved TPP reconductoring project from a 250 MVA normal/emergency rating to an advanced conductor upgrade with emergency rating of at least 280 MVA	

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

2041 On-Peak Sycamore-Artesian Constraint Summary

Affected transmission zones		Imperial Valley	
		Base	Sensitivity
Portfolio resources behind the constraint (Installed FCDS capacity)		7229	N/A
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		13	
Unaccounted for TPD allocations behind the constraint		1201	
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		7093	
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		136	
Mitigation Options	RAS	N/A	
	Reduce generic battery storage (MW)	N/A	
	Grid Enhancing Technology	N/A	
	Transmission upgrade including cost	1. Use existing 912 MVA emergency rating. 2. Replace wave trap at Sycamore so that the normal and emergency ratings can be increased to 912 MVA consistent with the conductor rating	
Recommended Mitigation		Replace wave trap at Sycamore so that the normal and emergency ratings can be increased to 912 MVA consistent with the conductor rating	

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

SDG&E On-Peak HSN Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Silvergate-Old Town	2036 Base	2155	11	246	1909	Use 30 minute emergency rating
	2041 Base	3489	9	0	3689	
	2041 Low Wind	1717	9	0	1917	
Silvergate-Bay Boulevard	2036 Base	4954	3	468	4486	Use emergency rating
	2041 Base	6256	0	786	5470	
	2041 Low Wind	5502	97	1035	4467	
Encina-San Luis Rey	2036 Base	6091	13	5554	537	Advanced conductor upgrade of Encina Tap-San Luis Rey 230 kV (1050 MVA) and Encina-San Luis Rey 230 kV (950 MVA)
	2041 Base	7530	13	7015	515	
	2041 Low Wind	6559	107	6309	250	
ECO 230/138 kV	2036 Base	521	0	396	125	2nd ECO 230/138 kV bank
	2041 Base	521	0	395	126	
	2041 Low Wind	501	0	376	125	
IV-Glamis	2036 Base	8401	477	8139	262	new RAS to trip generation at Glamis for outage of Imperial Valley-North Gila 500 kV #2 line
	2041 Base	9777	477	8342	1435	
	2041 Low Wind	11540	2346	10360	1180	

SDG&E On-Peak HSN Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Imperial Valley Bank 82	2036 Base	1441	0	1356	85	Add 4th Imperial Valley 500/230 kV transformer
	2041 Base	1441	0	1351	90	
	2041 Low Wind	2036	0	1405	631	
Imperial Valley Bank 81, 80	2036 Base	1441	0	1253	188	Use 30 minute emergency rating
	2041 Base	N/A				
	2041 Low Wind					
ECO-Miguel	2036 Base	N/A				
	2041 Base	5960	0	5394	566	New RAS to trip generation at ECO for outage of IV-Recon 500 kV or Suncrest-Lost Valley 500 kV
	2041 Low Wind	N/A				

SDG&E On-Peak HSN Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Sycamore-Chicarita	2036 Base	N/A				
	2041 Base	814	1.5	695	119	Update scope of previously approved TPP reconductoring project from a 250 MVA normal/emergency rating to an advanced conductor upgrade with emergency rating of at least 280 MVA
	2041 Low Wind	814	1.5	756	58	
Sycamore-Artesian	2036 Base	N/A				
	2041 Base	7229	13	7093	136	Replace wave trap at Sycamore so that the normal and emergency ratings can be increased to 912 MVA consistent with the conductor rating
	2041 Low Wind	N/A				

PG&E North of Greater Bay Interconnection Area

Overview Presentation Structure

- Portfolio resource summary
- Area diagrams
- Constraint diagrams
- Constraint portfolio information
- Constraint overload summary
- Reference slides
  - Detailed constraint/portfolio summary tables

Malin - Round Mt #1 500 kV line Constraint Summary

Affected transmission zones		N/A			
		2036 HSN	2036 SSN	2041 Base	2041 Low Wind
Portfolio resources behind the constraint (Installed FCDS capacity)		1384	1384	1604	1604
Generic portfolio battery storage behind the constraint (Installed FCDS capacity)		0	0	0	0
Unaccounted for TPD allocations behind the constraint		0	0	0	0
Deliverable portfolio resources w/o mitigation (Installed FCDS capacity)		225	286	279	88
Total undeliverable baseline and portfolio resources (Installed FCDS capacity)		1158	1097	1325	1516
Mitigation Options	RAS	RAS not feasible due to potential interaction with PACE RAS			
	Reduce generic battery storage (MW)	N/A			
	Grid Enhancing Technology	N/A			
	Transmission upgrade including cost	TBD			
Recommended Mitigation		capacity upgrade may be explored			

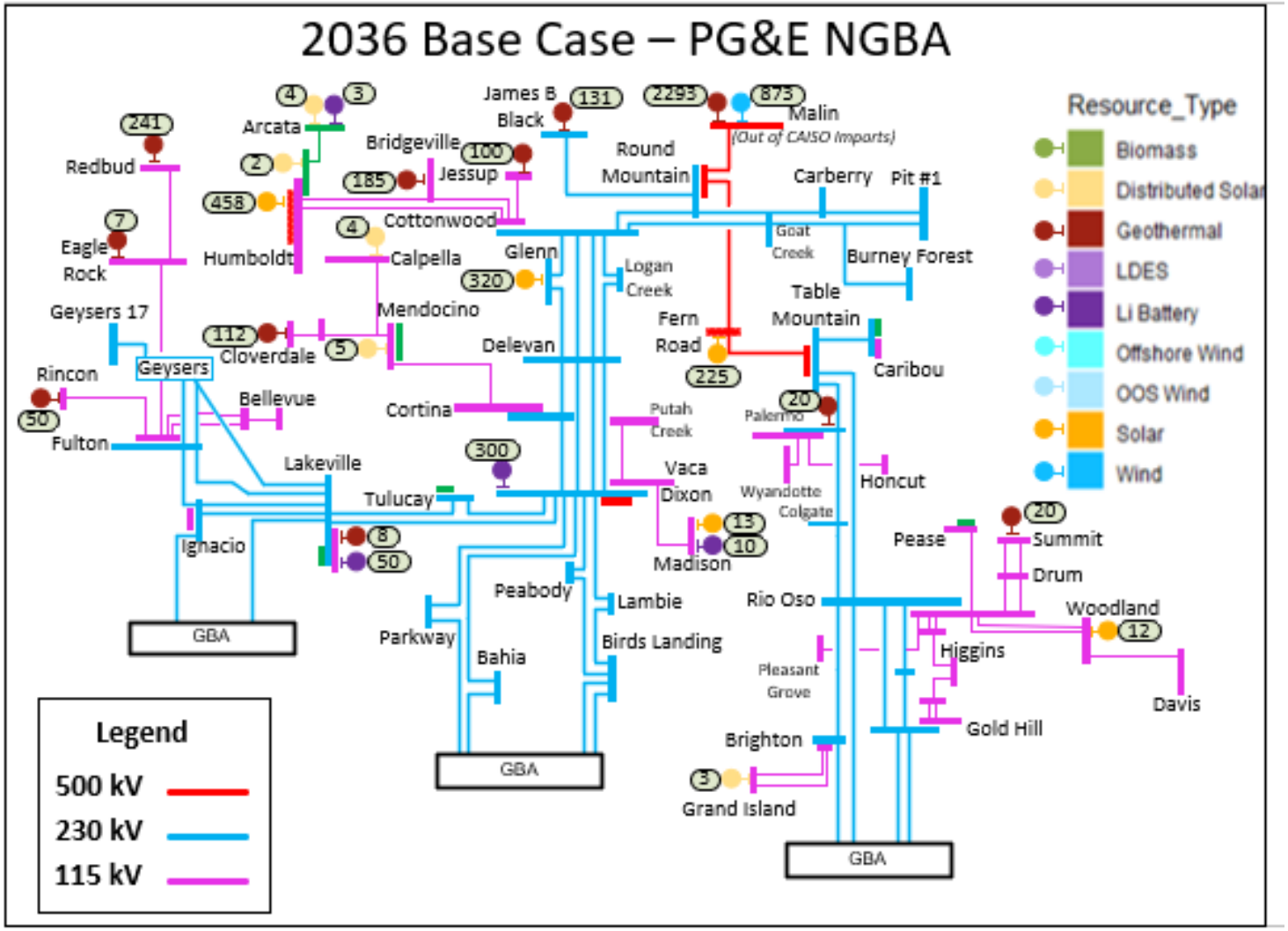
Affected interties	N/A
MIC expansion request MW behind constraint	N/A
Deliverable MIC expansion request MW	N/A

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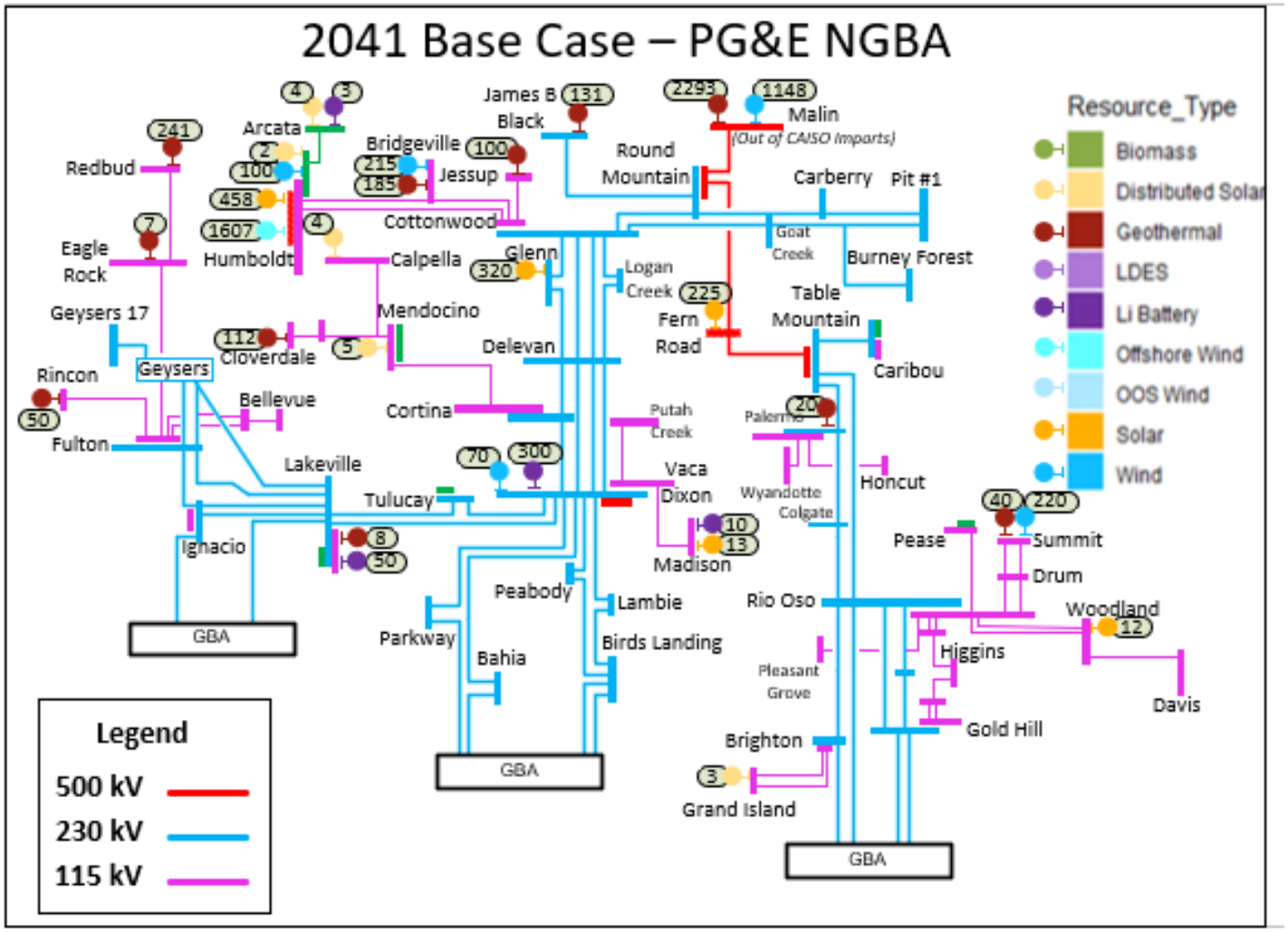
PG&E North of Greater Bay Interconnection Area Portfolio Summary

Resource Type	2036 Base Portfolio			2041 Base Portfolio			2041 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	0	1028	**1028**	0	1028	1028	0	1482	**1482**
Wind – In State	872	0	**872**	1652	100	1752	1750	0	**1750**
Wind – Out-of-State	0	0	**0**	0	0	0	0	0	**0**
Wind - Offshore	0	0	**0**	1607	0	1607	0	0	**0**
Li Battery – 4 hr	363	0	**363**	363	0	**363**	363	0	**363**
Li Battery – 8 hr	0	0	**0**	0	0	0	0	0	**0**
Long Duration Energy Storage (LDES)	0	0	**0**	0	0	0	0	0	**0**
Geothermal	3205	0	**3205**	3205	0	**3205**	3205	0	**3205**
Biomass/Biogas	0	0	**0**	0	0	0	0	0	**0**
Distributed Solar	0	18	**18**	0	18	**18**	0	18	**18**
Gas capacity not retained	-49	0	**-49**	-112	0	**-112**	-63	0	**-63**
Total	**4391**	**1046**	**5437**	**6715**	**1146**	**7861**	**5255**	**1500**	**6755**

2036 Base Portfolio: PG&E North of Greater Bay Area

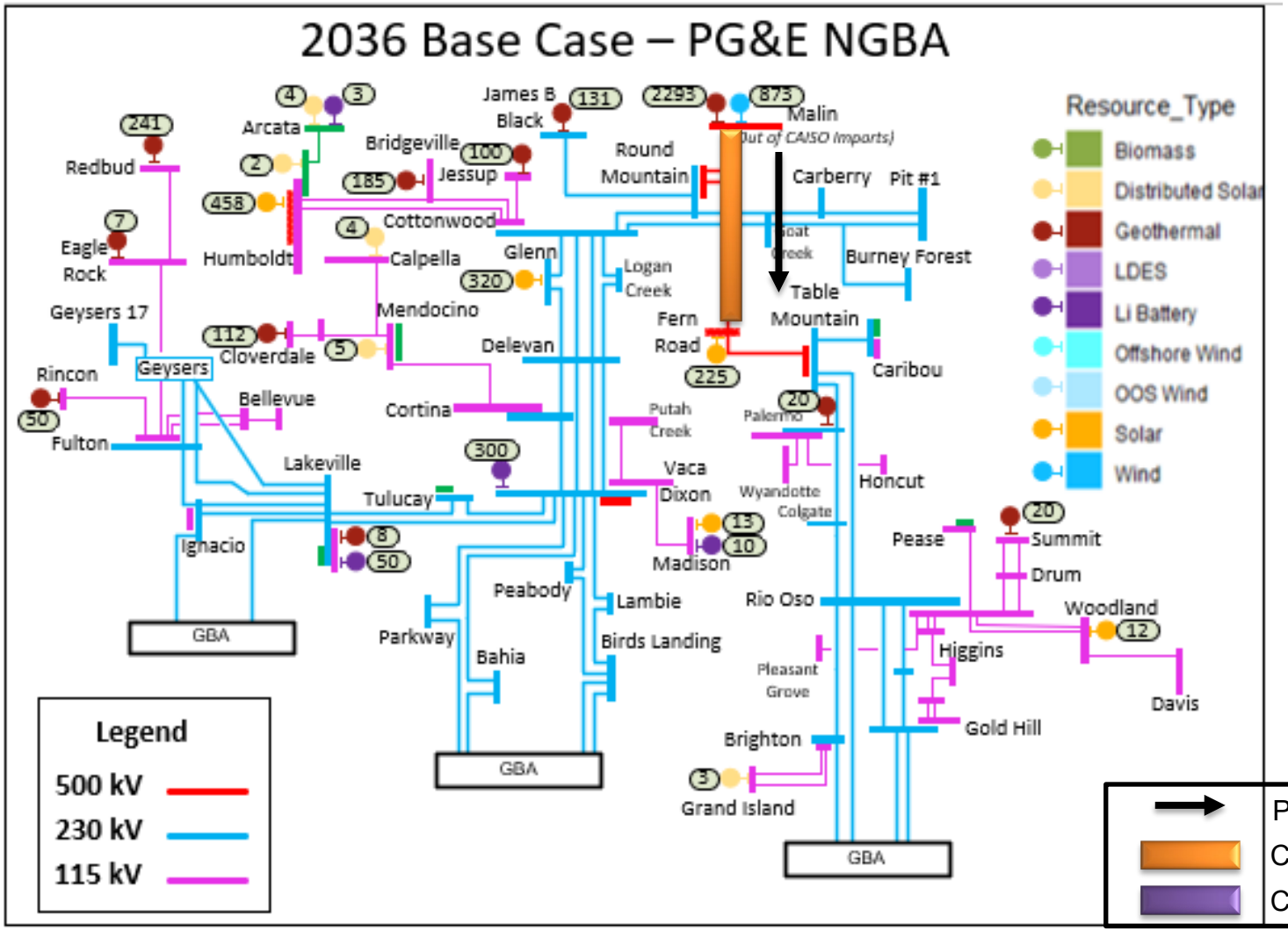


2041 Base Portfolio: PG&E North of Greater Bay Area



PGE NGBA Area Constraints

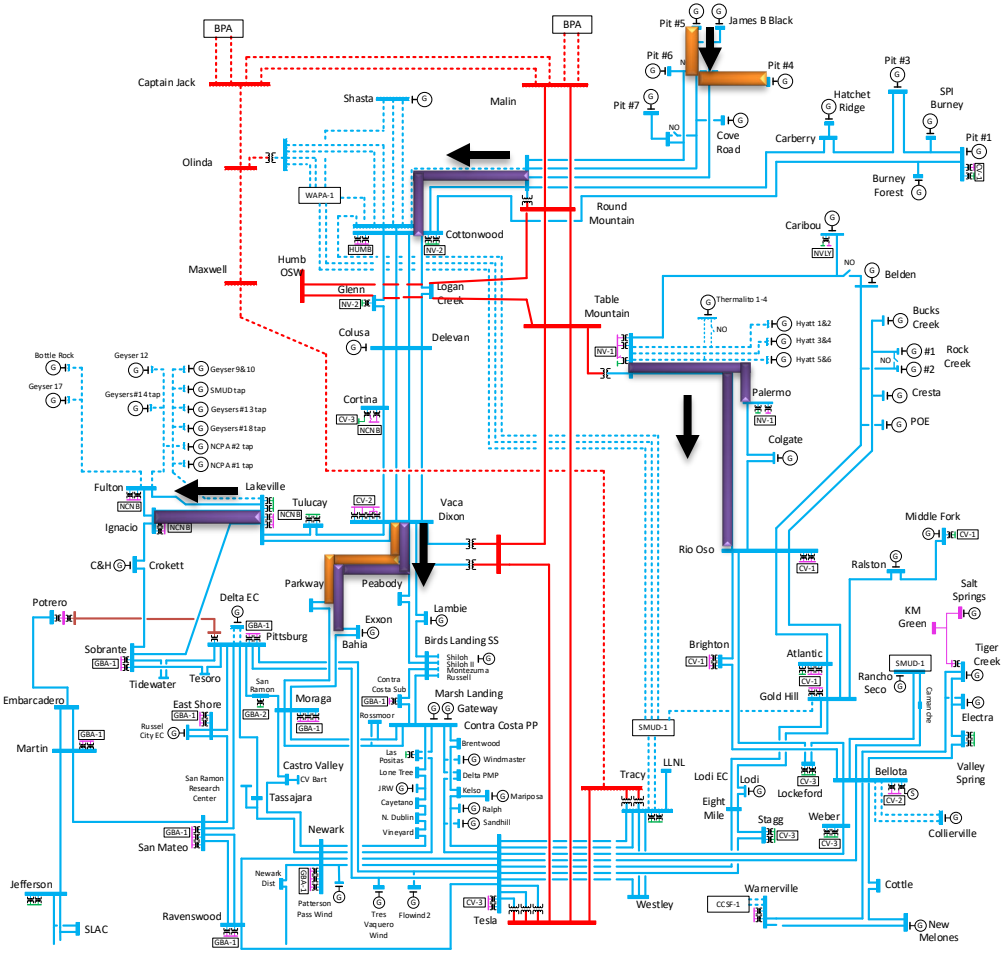
PG&E North of Greater Bay Area 500 kV Constraints



PGE NGBA On-Peak HSN Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the Constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Malin - Round Mt #1 500 kV line	2041 Base	1604	0	0	279	1325	RAS not feasible due to potential interaction with PACI RAS – capacity upgrade may be explored
	2041 Low Wind	1604	0	0	88	1516	
	2036 HSN	1384	0	0	225	1158	
	2036 SSN	1384	0	0	286	1097	
Malin - Round Mt #2 500 kV line	2036 HSN	1384	0	0	0	1384	
	2036 SSN	1384	0	0	0	1384	
	2041 Base	1604	0	0	0	1604	
Round Mt - Fernroad #1 500 kV line	2036 HSN	1799	7	0	416	2829	
	2036 SSN	1799	7	0	416	2829	
	2041 Base	2134	7	0	1212	2367	
	2041 Low Wind	2133	7	0	644	2975	
Round Mt - Fernroad #2 500 kV line	2036 HSN	1799	7	0	0	3375	
	2036 SSN	1799	7	0	0	3358	
	2041 Base	2134	7	0	595	2984	
	2041 Low Wind	2133	7	0	0	3619	
Table Mt-Vaca 500 kV Ckt 1	2036 SSN	1534	0	0	1172	2485	SSN and 2041 overloads only. Summit MIC expansion behind this constraint.
	2041 Base	3361	0	0	2054	3416	
	2041 Low Wind	1855	0	0	1709	2255	

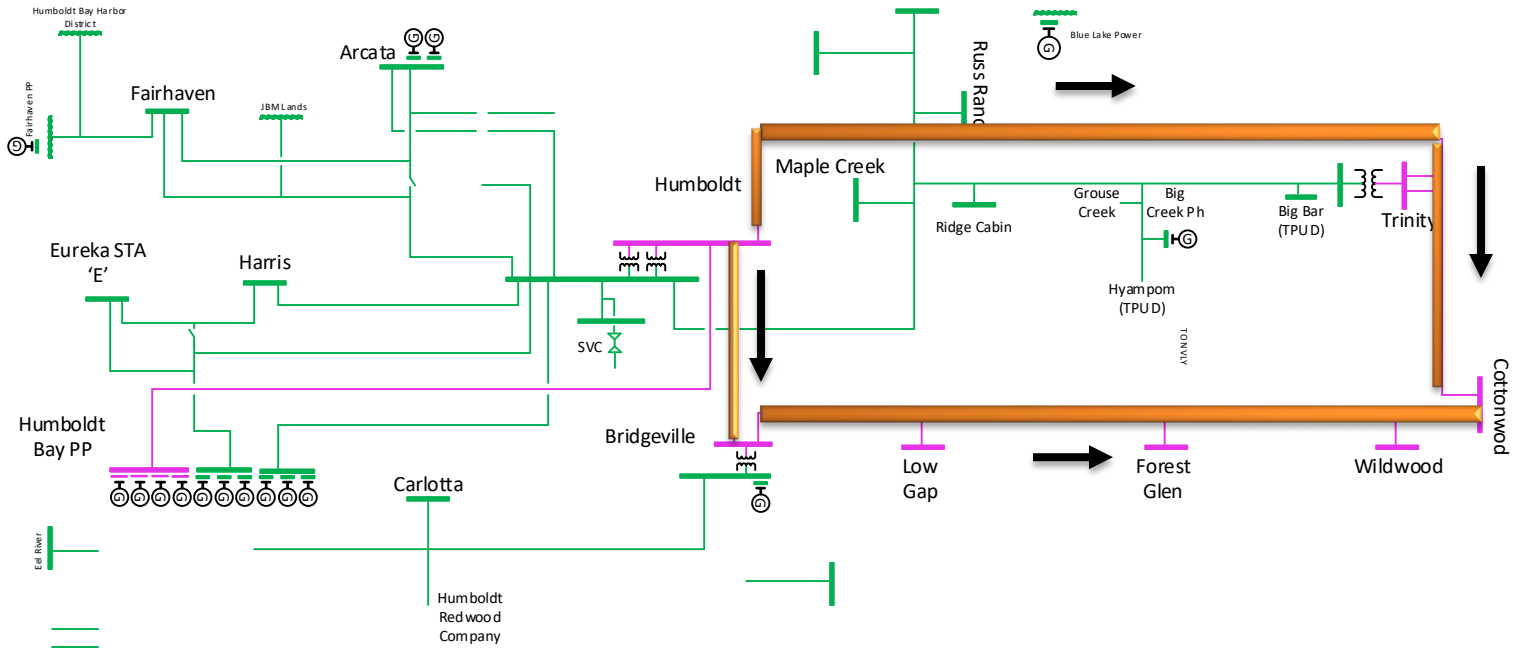
PG&E North of Greater Bay Area 230 kV Constraints



PGE NGBA On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the Constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Pit5 - Pit 4 230 kV Ckt 2	2036 HSN	131	0	0	69	61	Capacity upgrade or RAS
	2036 SSN	131	0	0	64	67	
	2041 Base	131	0	0	65	65	
	2041 Low Wind	131	0	0	65	66	
Vaca - Parkway 230 kV	2036 Base	0	317	111	0	871	Capacity upgrade, RAS or generic battery relocation.
	2041 Base	70	317	111	0	580	
Vaca-Dixon F - Bahia 230 kV Ckt 1	2041 Base	70	317	0	0	1527	2041 overload only
Round Mt – Cottonwood 230 kV Ckt 3	2041 Base	3121	0	0	2404	788	
Table Mtn D - Palermo 230 kV Ckt 1	2041 Base	2991	0	0	765	2266	
	2041 Low Wind	1384	0	0	1102	322	
Table Mtn - Rio Oso 230 kV Ckt 1	2041 Base	2991	0	0	1860	1170	
Lakeville - Ignacio 230 kV Ckt 2	2041 Base	158	0	0	158	326	
	2041 Low Wind	158	0	0	158	309	

PG&E North of Greater Bay Area 115 kV Constraints



Power Flow

Constraints (2036 & 2041)

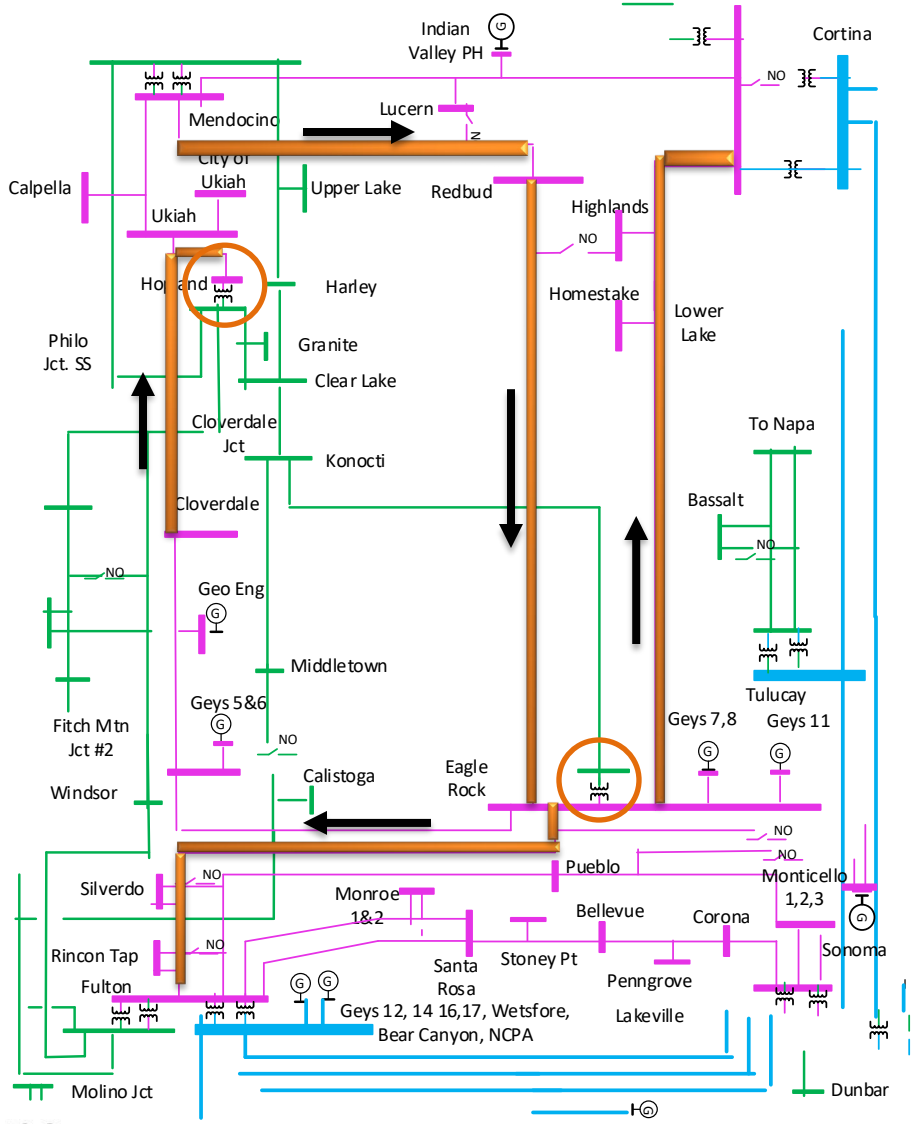
Constraints (2041 Only)

PGE NGBA On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the Constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
BRIDGEVILLE-COTTONWOOD 115KV	2036 HSN	185	0	0	112	73	Capacity upgrade, RAS or Local constraint evaluation
	2036 SSN	185	0	0	109	76	
	2041 Base	400	0	0	232	168	
	2041 Low Wind	398	0	0	230	167	
Humboldt - Bridgeville 115 kV Line	2036 HSN	185	0	0	95	90	
	2036 SSN	185	0	0	91	94	
	2041 Base	400	0	0	209	191	
	2041 Low Wind	398	0	0	207	191	
Humboldt-Trinity 115 kV Line	2036 SSN	185	7	0	85	107	
	2036 SSN	185	7	0	90	102	
	2041 Base	400	7	0	341	130	
	2041 Low Wind	398	7	0	338	131	
Trinity-Cottonwood 115 kV Line	2036 HSN	185	7	0	181	11	
	2036 SSN	185	7	0	185	7	
CASCADE-COTTONWOOD 115KV	2036 HSN	100	0	0	40	60	
	2036 SSN	100	0	0	35	65	

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PG&E North of Greater Bay Area 115 kV Constraints



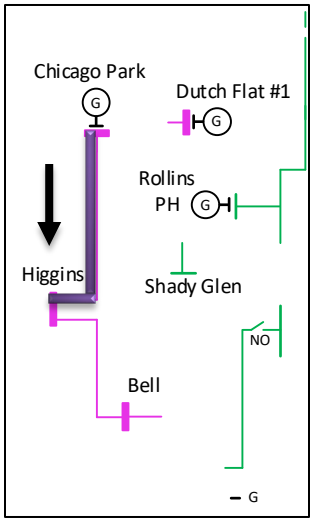
PGE NGBA On-Peak HSN Constraints (cont.)

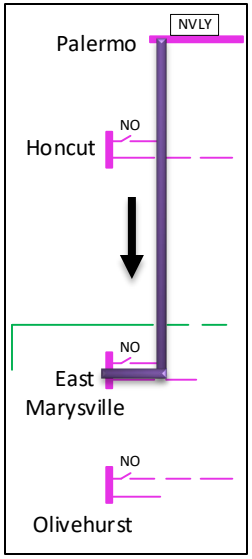
Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the Constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
EAGLE ROCK 115/60 KV BANK NO.1	2036 Base	108	0	0	58	50	Capacity upgrade, RAS or Local constraint evaluation
	2041 Base	108	0	0	0	146	
	2041 Low Wind	108	0	0	0	147	
Eagle Rock- Fulton-Silverado 115 kv	2036 HSN	349	0	0	187	162	
	2036 SSN	399	0	0	295	105	
	2041 Base	349	38	0	215	484	
	2041 Low Wind	349	38	0	211	488	
Eagle Rock- Redbud 115 kV	2036 HSN	241	0	0	117	124	
	2036 SSN	241	0	0	110	131	
	2041 Base	241	0	0	113	128	
	2041 Low Wind	241	0	0	113	128	
Eagle Rock - Cortina 115 kV	2036 HSN	349	0	0	165	184	
	2036 SSN	349	0	0	123	226	
	2041 Base	399	0	0	198	272	
	2041 Low Wind	399	0	0	198	272	

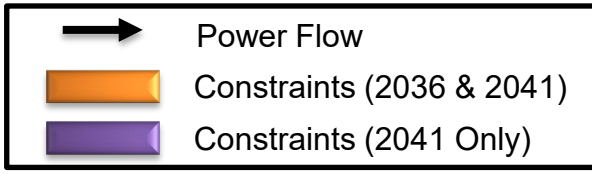
PGE NGBA On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the Constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
HOPLAND BANK 115/60.00 BANK NO.2	2036 Base	349	0	0	0	760	Capacity upgrade, RAS or Local constraint evaluation
	2036 SSN	349	0	0	0	379	
	2041 Base	349	0	0	0	400	
	2041 Low Wind	349	0	0	0	399	
Geyser #3 - Eagle Rock 115 kv	2036 HSN	108	0	0	58	50	
	2036 SSN	108	0	0	54	54	
	2041 Base	108	0	0	62	46	
	2041 Low Wind	108	0	0	61	47	
Ukiah-Hopland-Cloverdale 115 kV	2036 HSN	108	0	0	58	50	
	2036 SSN	108	0	0	53	55	
	2041 Base	108	0	0	60	48	
	2041 Low Wind	108	0	0	60	48	
MENDOCINO - REDBUD 115 KV	2036 HSN	241	0	0	107	134	
	2036 SSN	241	0	0	103	138	
	2041 Base	241	0	0	105	136	
	2041 Low Wind	241	0	0	105	136	

PG&E North of Greater Bay Area 115 kV Constraints



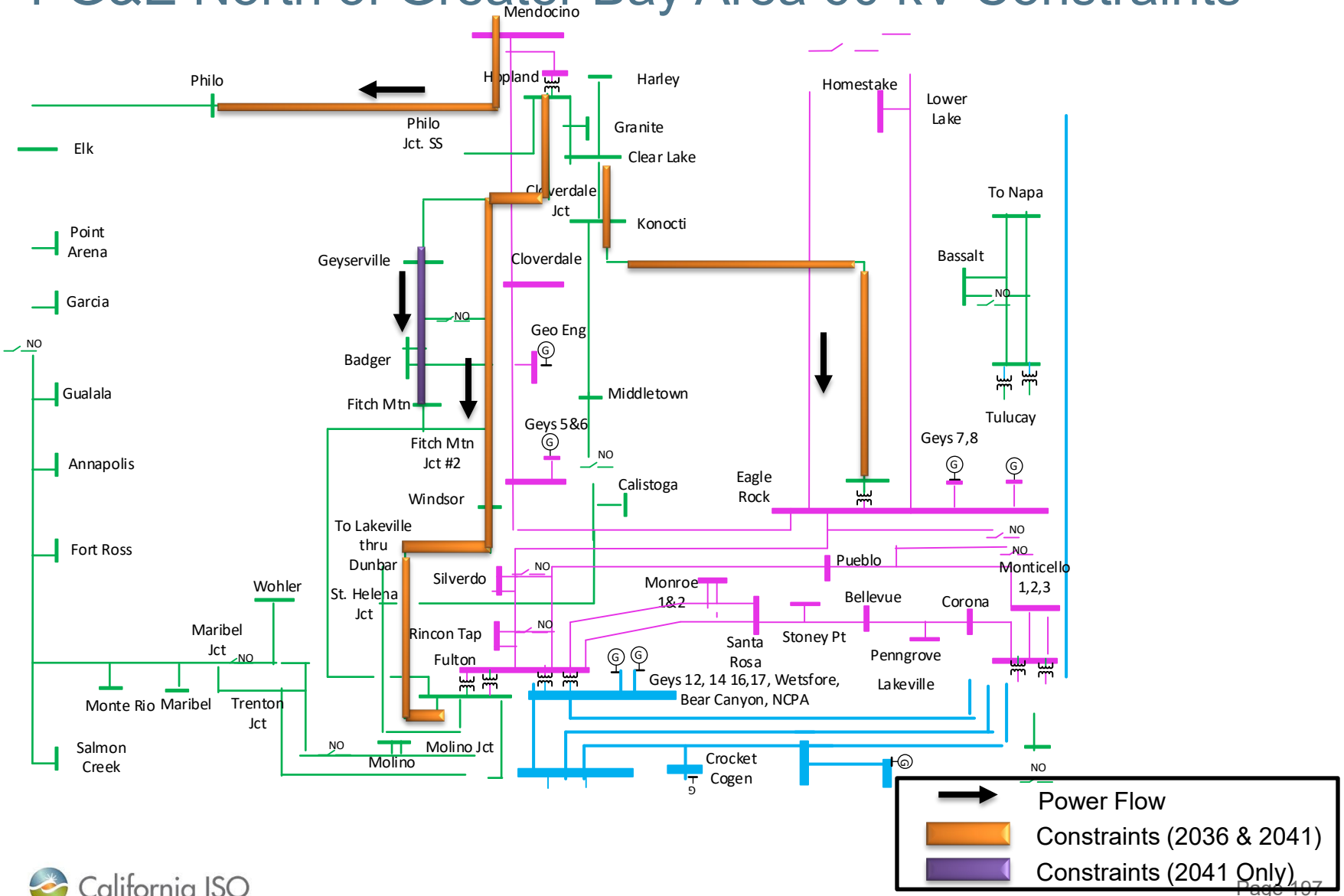




PGE NGBA On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the Constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Chicago Pk - Higgins 115 kV Ckt 1	2041 Base	220	0	0	179	45	Under review.
	2041 Low Wind	220	0	0	202	21	
Palermo – East Marysville 115 kV Ckt 1	2041 Base	20	0	0	0	391	2041 overload only
	2041 Low Wind	20	0	0	0	254	

PG&E North of Greater Bay Area 60 kV Constraints



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PGE NGBA On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the Constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Clear Lake - Eagle Rock 60 kV	2036 Base	108	0	0	89	19	Capacity upgrade, RAS or Local constraint evaluation
	2041 Base	108	0	0	36	72	
	2041 Low Wind	108	0	0	36	72	
Fulton - Hopland 60 kV	2036 Base	349	0	0	229	120	
	2036 SSN	349	0	0	185	164	
	2041 Base	349	0	0	265	95	
	2041 Low Wind	349	0	0	261	100	
MENDOCINO-PHILO JCT-HOPLAND 60KV	2036 Base	241	0	0	173	68	
	2036 SSN	349	0	0	314	35	
	2041 Base	349	0	0	244	105	
	2041 Low Wind	349	0	0	236	113	
Gysrjct1 - Ftchmtnp 60 kV Ckt 1	2041 Base	349	0	0	265	95	2041 overload only
	2041 Low Wind	349	0	0	261	99	

2036 Base Portfolio On-Peak NGBA Area Deliverability Constraints (1 of 2)

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Malin - Round Mt #1 500 kV line	MALIN-ROUND MT 500KV 2[6020]	117.2	115.7
Malin - Round Mt #2 500 kV line	MALIN-ROUND MT 500KV 1[0]	127.3	126.6
Round Mt - Fernroad #1 500 kV line	ROUND MT-FERNROADSS 500KV 2[0]	117.3	117.1
Round Mt - Fernroad #2 500 kV line	ROUND MT-FERNROADSS 500KV 1[0]	127.2	126.9
Table Mt - Vaca Dixon 500 kV line	Base Case	–	102.3
Cortina - Vaca 230 kV Line	FULTON-HOPLAND 60KV & GEYSERS #17-FULTON 230KV & EAGLE ROCK-FULTON-SILVERADO 115KV LINES	–	106.2
Pit5 - Pit 4 230 kV Ckt 2	Base Case	125.3	127.6
Vaca - Parkway 230 kV	Birds-CC PP 230 kV and Birds-CC Sub 230 kV lines	113.0	–
BRIDGEVILLE-COTTONWOOD 115KV	HUMBOLDT-BRIDGEVILLE 115KV [1810]	176.8	179.7
CASCADE-COTTONWOOD 115KV	CASCADE 115/60KV TB 1	158.4	162.8
Cortina - Mendocino No.1 115 kV	FULTON-HOPLAND 60KV & GEYSERS #17-FULTON 230KV & EAGLE ROCK-FULTON-SILVERADO 115KV LINES	–	100.2
Eagle Rock - Cortina 115 kV	FULTON-HOPLAND 60KV & GEYSERS #17-FULTON 230KV & EAGLE ROCK-FULTON-SILVERADO 115KV LINES	177.4	195.3
EAGLE ROCK 115/60 KV BANK NO.1	UKIAH-HOPLAND-CLOVERDALE 115KV [4050]	103.4	–
Eagle Rock- Fulton- Silverado 115 kv	MENDOCINO-UKIAH & UKIAH-HOPLAND-CLOVERDALE LINES	125.1	136.6
	EAGLE ROCK-CORTINA & CORTINA-MENDOCINO #1 LINES		
Eagle Rock- Redbud 115 kV	MENDOCINO-REDBUD & CORTINA-MENDOCINO #1 LINES	217.3	225.8

2036 Base Portfolio On-Peak NGBA Area Deliverability Constraints (2 of 2)

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
EGLE RCK-HOMSTKTP-CORTINA 115KV	FULTON-HOPLAND 60KV & GEYSERS #17-FULTON 230KV & EAGLE ROCK-FULTON-SILVERADO 115KV LINES	174.3	188.4
Geyser #3 - Eagle Rock 115 kv	MENDOCINO-UKIAH & UKIAH-HOPLAND-CLOVERDALE LINES	133.0	135.5
HOPLAND BANK 115/60.00 BANK NO.2	GEYSERS #9-LAKEVILLE & EAGLE ROCK-FULTON-SILVERADO LINES	202.7	194.2
Humboldt - Bridgeville 115 kV Line	BRIDGEVILLE-COTTONWOOD 115KV [1110]	214.6	217.6
Humboldt-Trinity 115 kV Line	HUMB115PST 115/115KV TB 1	146.2	143.6
MENDOCINO - REDBUD 115 KV	EAGLE ROCK-REDBUD 115KV [1480] (2)	230.2	239.5
	EAGLE ROCK-CORTINA & EAGLE ROCK-REDBUD LINES		
Trinity-Cottonwood 115 kV Line	HUMB115PST 115/115KV TB 1	115.0	113.4
Ukiah-Hopland-Cloverdale 115 kV	GEYSERS #3-EAGLE ROCK 115KV [1660]	133.3	137.3
Clear Lake - Eagle Rock 60 kV	UKIAH-HOPLAND-CLOVERDALE 115KV [4050]	102.4	–
Fulton - Hopland 60 kV	GEYSERS #9-LAKEVILLE & EAGLE ROCK-FULTON-SILVERADO LINES	122.1	130.7
MENDOCINO-PHILO JCT-HOPLAND 60KV	MENDOCINO-UKIAH & UKIAH-HOPLAND-CLOVERDALE LINES	107.7	104.0
	HPLND JT 115/60KV TB 2		

2041 On-Peak NGBA Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Malin - Round Mt #1 500 kV line	P1-2:A0:2:_MALIN-ROUND MT 500KV 2[6020]	118.2	119.0
Malin - Round Mt #2 500 kV line	P1-2:A0:1:_MALIN-ROUND MT 500KV 1[0]	131.6	–
Round Mt - Fernroad #1 500 kV line	P1-2:A0:5:_ROUND MT-FERNROADSS 500KV 2[0]_Dup1	109.7	115.7
Round Mt - Fernroad #2 500 kV line	P1-2:A0:4:_ROUND MT-FERNROADSS 500KV 1[0]	119.0	125.5
Table Mt-Vaca 500 kV Ckt 1	Base Case	111.8	100.2
Lakevile - Ignacio 230 kV Ckt 2	P7-1:A6:8:_LAKEVILLE-IGNACIO #1 & LAKEVILLE-SOBRANTE #2 230KV LINES	117.3	115.8
Pit5 - Pit 4 230 kV Ckt 2	Base Case	127.3	127.6
Round Mt - Cotwd_e 230 kV Ckt 3	P1-2:A0:3:_CAPTJACK-OLINDA 500KV [0]	109.1	–
Table Mtn D - Palermo 230 kV Ckt 1	P1-2:A3:31:_TABLE MTN-RIO OSO 230KV [5700]	113.1	101.0
Table Mtn D - Rio Oso 230 kV Ckt 1	P1-2:A3:30:_TABLE MTN-PALERMO 230KV [5690] MOAS OPENED ON TABLE MTN D_PALERMO	106.3	–
Vaca-Dixon F - Bahia 230 kV Ckt 1	P7-1:A8:3:_Birds-CC PP 230 KV and Birds-CC Sub 230 KV lines	118.2	–
BRIDGEVILLE-COTTONWOOD 115KV	P1-2:A1:1:_HUMBOLDT-BRIDGEVILLE 115KV [1810]	261.5	260.9
Chicago Pk - Higgins 115 kV Ckt 1	Base Case	105.2	103.6
Eagle Rock - Cortina 115 kV	P7-1:A6:16:_FULTON-HOPLAND 60KV & GEYSERS #17-FULTON 230KV & EAGLE ROCK-FULTON-SILVERADO 115KV LINES	162.5	162.5

2041 On-Peak NGBA Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
EAGLE ROCK 115/60 KV BANK NO.1	P1-2:A2:14:_UKIAH-HOPLAND-CLOVERDALE 115KV [4050]	111.5	111.5
Eagle Rock- Fulton- Silverado 115 kv	P7-1:A2:21:_FULTON - HOPLAND 60 KV & GEYSER 12 - FULTON & GEYSER 17 - FULTON 230 KV LINES	123.4	124.1
Eagle Rock- Redbud 115 kV	P1-2:A2:12:_MENDOCINO-REDBUD 115KV [2410]	223.4	223.4
EGLE RCK-HOMSTKTP-CORTINA 115KV	P7-1:A6:16:_FULTON-HOPLAND 60KV & GEYSERS #17-FULTON 230KV & EAGLE ROCK-FULTON-SILVERADO 115KV LINES	162.1	162.1
Geyser #3 - Eagle Rock 115 kv	P1-2:A2:14:_UKIAH-HOPLAND-CLOVERDALE 115KV [4050]	130.2	130.3
HOPLAND BANK 115/60.00 BANK NO.2	P1-2:A2:19:_EGLE RCK-FULTON-SILVERDO 115KV [0]	188.3	188.4
	P1-2:A6:12:_SILVERDO-FULTON-EGLE RCK 115KV [0]		
Humboldt - Bridgeville 115 kV Line	P1-2:A3:39:_BRIDGEVILLE-COTTONWOOD 115KV [1110]	333.1	332.1
	P1-2:A1:3:_BRIDGEVILLE-COTTONWOOD 115KV [1110]		
Humboldt-Trinity 115 kV Line	P1-3:A1:10:_HUMB115PST 115/115KV TB 1	128.0	128.4

2041 On-Peak NGBA Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
MENDOCINO - REDBUD 115 KV	P1-2:A2:24:_EAGLE ROCK-REDBUD 115KV [1480] (2)	237.3	237.3
Palermo – East Marysville 115 kV Ckt 1	P7-1:A3:13:_Colgate - Rio Oso 230KV and Table Mountain(D)-Rio Oso 230 KV Line	109.1	102.7
Ukiah-Hopland-Cloverdale 115 kV	P1-2:A2:17:_GEYSERS #3-EAGLE ROCK 115KV [1660]	131.7	131.7
Clear Lake - Eagle Rock 60 kV	P1-2:A2:14:_UKIAH-HOPLAND-CLOVERDALE 115KV [4050]	109.3	109.3
Fulton - Hopland 60 kV	P1-2:A6:12:_SILVERDO-FULTON-EGLE RCK 115KV [0]	115.4	116.2
	P1-2:A2:19:_EGLE RCK-FULTON-SILVERDO 115KV [0]		
Gysrjct1 - Ftchmtnp 60 kV Ckt 1	P1-2:A6:12:_SILVERDO-FULTON-EGLE RCK 115KV [0]	115.3	116.1
	P1-2:A2:19:_EGLE RCK-FULTON-SILVERDO 115KV [0]		
MENDOCINO-PHILO JCT-HOPLAND 60KV	P1-3:A2:25:_HPLND JT 115/60KV TB 2	113.4	113.9

2036 Base Portfolio Off-Peak NGBA Area Deliverability Constraints

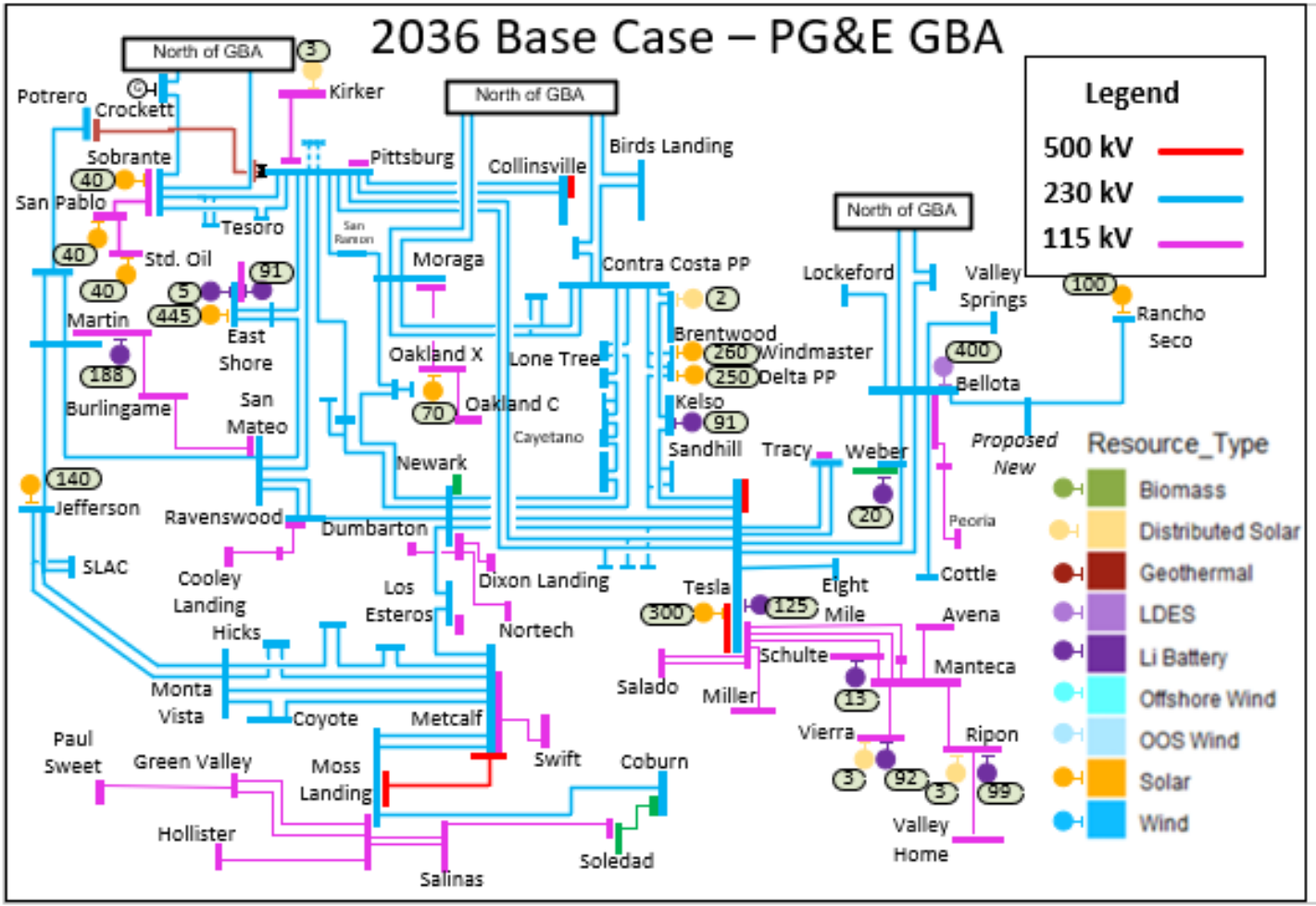
Facility	Contingency	%Loading
MALIN-ROUND MT 500KV 1	MALIN-ROUND MT 500KV 2	106.37
MALIN-ROUND MT 500KV 2	MALIN-ROUND MT 500KV 1	118.89
MALIN-ROUND MT 500KV 2	MALIN-ROUND MT 500KV 1	116.46
ROUND MT-FERNROADSS 500KV 2	ROUND MT-FERNROADSS 500KV 1	101.01

PG&E Greater Bay Interconnection Area

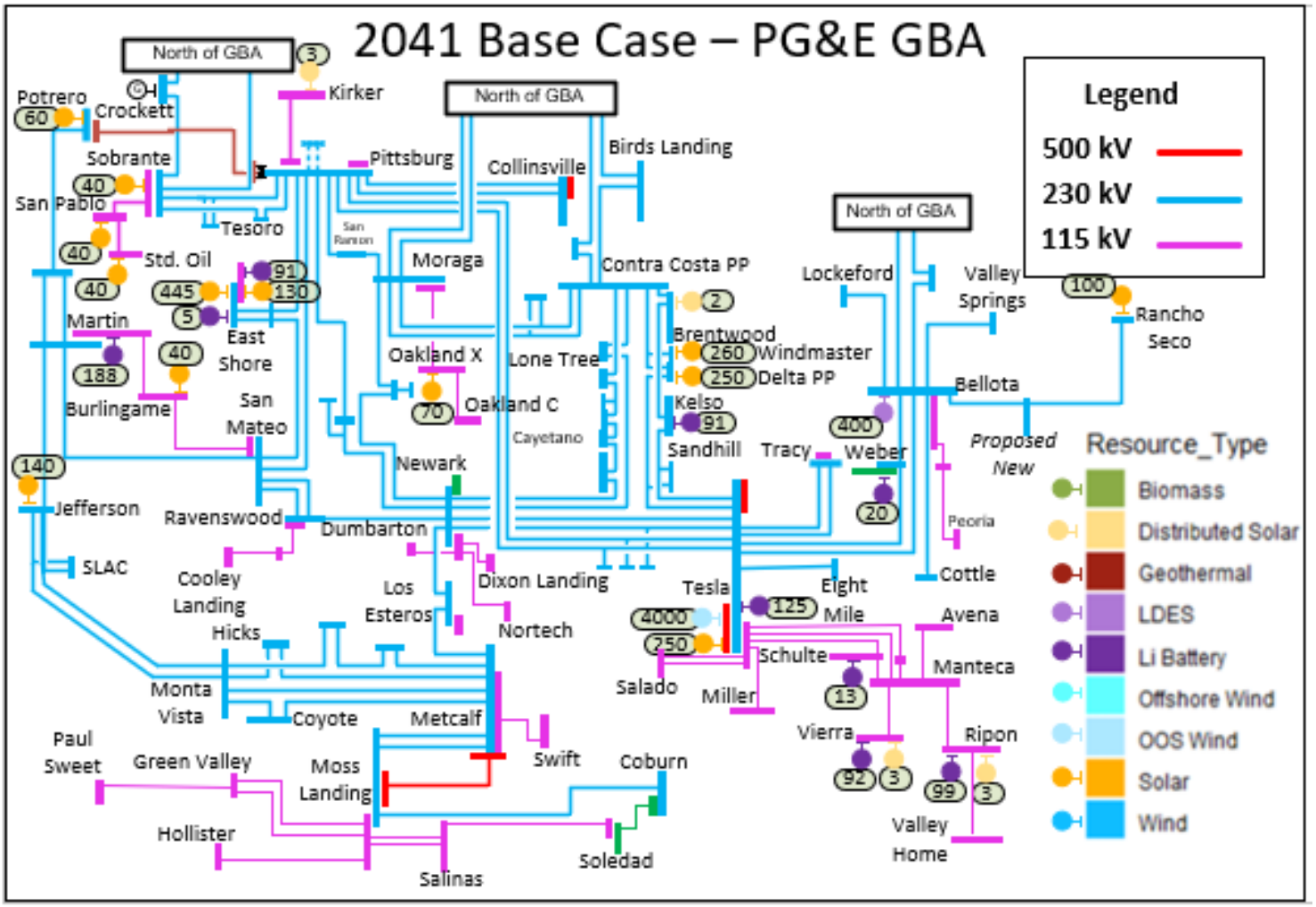
PG&E Greater Bay Interconnection Area Portfolio Summary

Resource Type	2036 Base Portfolio			2041 Base Portfolio			2041 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	755	930	**1685**	985	930	**1915**	2498	2090	**4588**
Wind – In State	0	0	**0**	1652	100	**1752**	250	0	**250**
Wind – Out-of-State	0	0	**0**	4000	0	**4000**	0	0	**0**
Wind - Offshore	0	0	**0**	0	0	**0**	0	0	**0**
Li Battery – 4 hr	7583	0	**7583**	7583	0	**7583**	7583	0	**7583**
Li Battery – 8 hr	96	0	**96**	96	0	**96**	13	0	**13**
Long Duration Energy Storage (LDES)	400	0	**400**	400	0	**400**	400	0	**400**
Geothermal	0	0	**0**	0	0	**0**	408	0	**408**
Biomass/Biogas	0	0	**0**	0	0	**0**	0	0	**0**
Distributed Solar	0	10	**10**	0	10	**10**	0	10	**10**
Gas capacity not retained	-236	0	**-236**	-558	0	**-558**	-533	0	**-533**
Total	**8598**	**940**	**9538**	**14158**	**1040**	**15198**	**10619**	**2100**	**12719**

2036 Base Portfolio: PG&E Greater Bay Area



2041 Base Portfolio: PG&E Greater Bay Area

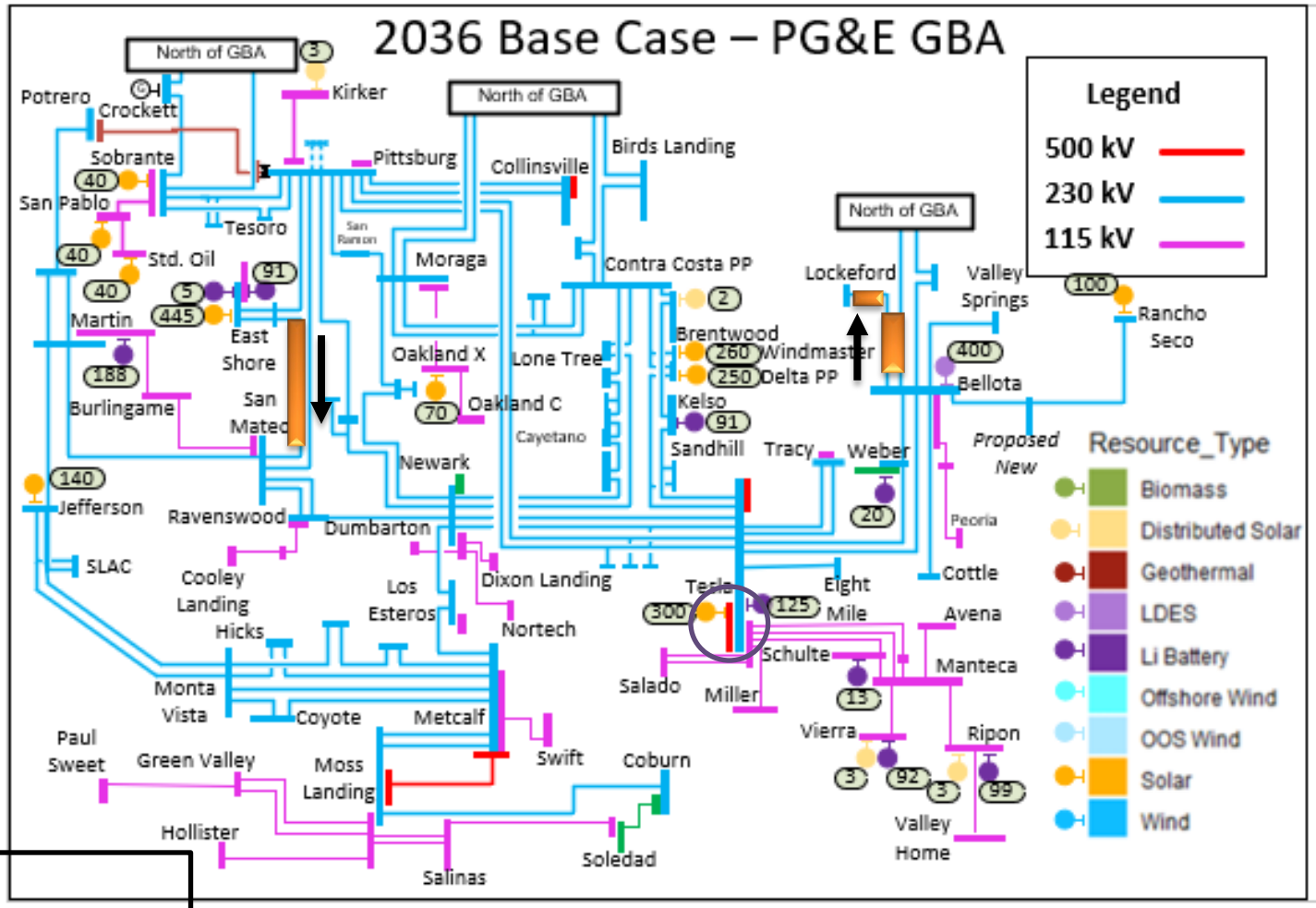


2041 Base Portfolio OOS Wind Sensitivity On-Peak Greater Bay Area

- No new deliverability constraints were observed after removing the OOS wind resource at Tesla (4000 MW), compared to the 2041 HSN Baseline scenario (which had the OOS wind in-service)
- Certain Constraints are worsened, and some see lower overloads (2-7% difference)

PGE GBA Area Constraints

PG&E Greater Bay Area Constraints



Power Flow

Constraints (2036 & 2041)

Constraints (2041 Only)

PGE GBA On-Peak HSN Constraints

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the Constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Tesla 500/230 kV Ckt 2	2041 Base	5607	0	900	0	6589	2041 overload only
	2041 Low Wind	0	0	900	0	146	
Bellota - Lockford 230 kV Ckt 1	2036 Base	400	30	944	7	1295	Capacity upgrade or RAS
	2041 Base	400	0	154	79	331	
	2041 Low Wind	410	0	154	0	424	
Bellota - Lockford 230 kV Ckt 2	2036 Base	400	30	944	0	1658	
	2041 Base	400	0	154	0	1285	
Eastshore-San Mateo #1 230kV Line	2036 Base	303	134	1000	335	1626	Review existing project
	2041 Base	375	134	1000	0	1425	
Eastshore-San Mateo #2 230kV Line	2036 Base	303	134	1000	335	1626	
	2041 Base	375	134	1000	0	1425	

PGE GBA On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the Constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Pittsburg-D – San Ramon 230 kV Ckt 1	2041 Base	0	0	1000	0	456	primarily driven by UTPD
	2041 Low Wind	0	0	1000	0	383	
LOS ESTEROS-METCALF 230KV	2041 Base	0	0	1850	0	1012	
	2041 Low Wind	106	0	1850	0	1650	
Melones - Cottle 230 kV Ckt 1	2041 Base	1395	493	410	405	1952	2041 overload only
	2041 Low Wind	250	0	410	64	601	
Cayetano - Ndublin 230 kV Ckt 1	2041 Base	360	0	211	100	464	
Tesla D - Sandhlwjct 230 kV Ckt 1	2041 Low Wind	285	0	13	16	352	

PGE GBA On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the Constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Metcalf 230/115 kV Ckt 2	2041 Low Wind	137	0	0	0	383	Sensitivity only
Metcalf 230/115 kV Ckt 3	2041 Low Wind	137	0	0	0	363	
Moss landing - Metcalf 230 kV Ckt 1	2041 Low Wind	1708	13	1810	1548	411	
Moss landing - Metcalf 230 kV Ckt 2	2041 Low Wind	1708	13	1810	1548	411	
Martinez-Oleum 115kV Line	2036 Base	0	0	1000	0	281	Review existing project
	2041 Base	0	0	1000	0	1398	
	2041 Low Wind	0	0	1000	0	1388	
Clayton - Lakewood-C 115 kV Ckt 2	2041 Base	0	0	325	0	779	primarily driven by UTPD
	2041 Low Wind	0	0	325	0	758	
MARTNZ D-NRTH TWR 115KV	2041 Base	0	0	325	0	114	Review existing project
	2041 Low Wind	0	0	325	0	103	
TESLA-SALADO-Q1103 115KV	2041 Low Wind	100	0	0	67	33	Sensitivity only
Mosslnsw - Greenvalley 115 kV Ckt 2	2041 Low Wind	364	0	110	0	637	
Lakewood Bus Tie 115 kV	2036 Base	0	0	1000	0	40	primarily driven by UTPD
	2041 Base	0	0	1000	0	1029	
	2041 Low Wind	0	0	1000	0	1010	

PGE GBA On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the Constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
HELLYERSWTST-METCALFE #1 115KV 1	2041 Base	0	0	295	0	50	primarily driven by UTPD
	2041 Low Wind	0	0	295	0	170	
HELLYERSWTST-METCALFE #2 115KV	2041 Base	0	0	295	0	50	
	2041 Low Wind	0	0	295	0	170	
DE ANZA SS-NORTECH 115KV	2041 Base	0	0	203	0	384	
	2041 Low Wind	80	0	203	0	448	
LOS ESTEROS-TRIMBLE 115KV	2041 Base	0	0	203	0	129	
	2041 Low Wind	0	0	203	0	54	
Moss landing – Green valley 115 kV Ckt 1	2041 Base	0	0	110	0	293	
	2041 Low Wind	364	0	110	244	120	
BAIR-REDWOOD-CLY LNDG 60KV	2041 Low Wind	0	0	65	0	65	

2036 Base Portfolio On-Peak GBA Area Deliverability Constraints (1 of 1)

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Bellota - Lockford 230 kV Ckt 1	LOCKEFORD-BELLOTA 230KV [4990]	131.7	–
Bellota - Lockford 230 kV Ckt 2	BELLOTA-LOCKFORD 230KV [0]	131.7	–
Eastshore-San Mateo #1 230kV Line	SANMATEO-E. SHORE #2 230KV [0]	107.0	–
Eastshore-San Mateo #2 230kV Line	EASTSHORE-SAN MATEO 230KV [4650]	107.0	–
Lakewood Bus Tie	Pittsburg-Tidewater 230 kV and Pittsburg-Tesoro SW STA 230 kV lines	101.1	–
Martinez-Oleum 115kV Line	Pittsburg-Tidewater 230 kV and Pittsburg-Tesoro SW STA 230 kV lines	113.7	–

2041 On-Peak GBA Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Moss Landing - Metcalf 500 kV line	P1-2:A0:36:_MANNING - METCALF 500 kV [0]	119.5	113.0
Tesla 500/230 kV Ckt 2	P1-2:A13:9:_FINKSWSTA-WESTLEY #1 230KV [0]	119.6	100.1
	P7-1:A3:18:_Table Mountain(D)-Rio Oso 230 KV Line and Table Mountain(D)-Palermo 230 KV Line		
Bellota - Lockford 230 kV Ckt 1	P7-1:A3:18:_Table Mountain(D)-Rio Oso 230 KV Line and Table Mountain(D)-Palermo 230 KV Line	119.8	105.6
Cayetano - Ndublin 230 kV Ckt 1	P7-1:A8:4:_Contra Costa-Moraga Nos. 1 & 2 230 KV lines	100.6	–
Eastshore-San Mateo #1 230kV Line	P1-2:A16:80:_SANMATEO-E. SHORE #2 230KV [0]	107.0	–
Eastshore-San Mateo #2 230kV Line	P1-2:A16:15:_EASTSHORE-SAN MATEO 230KV [4650]	107.0	–
LOS ESTEROS-METCALF 230KV	P7-1:A18:21:_Metcalf - Hicks & Metcalf - Vasona 230 KV Lines	103.3	107.0
	P1-2:A18:2:_METCALF1D-TRIMBLE #1 230KV [0]		
Melones - Cottle 230 kV Ckt 1	P1-2:A13:11:_WARNERVILLE-WILSON 230KV [5870]	101.9	101.9
Metcalf 230/115 kV Ckt 2	P7-1:A17:26:_Metcalf-Monta Vista No. 3 & Monta Vista-Coyote Sw. Sta. 230 KV Line	–	108.2
Metcalf 230/115 kV Ckt 3	P7-1:A17:26:_Metcalf-Monta Vista No. 3 & Monta Vista-Coyote Sw. Sta. 230 KV Line	–	106.5
Moss landing - Metcalf 230 kV Ckt 1	P1-2:A0:17:_METCALF-MOSSLANDING 500KV [6050]	–	100.9
Moss landing - Metcalf 230 kV Ckt 2	P1-2:A0:17:_METCALF-MOSSLANDING 500KV [6050]	–	100.9
Pittsburg-D – San Ramon 230 kV Ckt 1	P7-1:A8:11:_Pittsburg-Tidewater 230 KV and Pittsburg-Tesoro SW STA 230 KV lines	107.0	105.8

2041 On-Peak GBA Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Tesla D - Sandhlwjct 230 kV Ckt 1	P7-1:A8:3:_Birds-CC PP 230 KV and Birds-CC Sub 230 KV lines	–	102.0
Alhamtp1 - Nrth Twr 115 kV Ckt 1	P7-1:A8:11:_Pittsburg-Tidewater 230 KV and Pittsburg-Tesoro SW STA 230 KV lines	103.8	103.4
Claytn - Lakewd-C 115 kV Ckt 2	P1-2:A8:58:_CLAYTN-LAKEWD-C-MEDW LNE-WALNUTCR 115KV [0]	120.2	119.6
DE ANZA SS-NORTECH 115KV	P7-1:A18:8:_Los Esteros - Trimble & Los Esteros - Montague 115 KV	132.5	132.9
	P7-1:A18:9:_Los Esteros - Trimble & Montague - Trimble 115 KV Line		
Lakewood Bus Tie	P7-1:A8:11:_Pittsburg-Tidewater 230 KV and Pittsburg-Tesoro SW STA 230 KV lines	121.0	120.3
Ls Est&1 - Trimble-Gis 115 kV Ckt 1	P1-2:A18:102:_LOS ESTEROS-NORTECH 115KV [4032]	103.3	101.4
Martinez-Oleum 115kV Line	P7-1:A8:11:_Pittsburg-Tidewater 230 KV and Pittsburg-Tesoro SW STA 230 KV lines	150.3	149.9
Metcalfe - Hellye&1 115 kV Ckt 1	P1-2:A18:37:_HELLYERSWTST-METCALFE #2 115KV [0]	100.7	103.9
Metcalfe - Hellye&1 115 kV Ckt 2	P1-2:A18:38:_HELLYERSWTST-METCALFE #1 115KV [0]	100.7	103.9
Mosslnsw - Greenvalley 115 kV Ckt 1	P1-2:A19:12:_MOSS LANDING-GREEN VALLEY #2 115KV [2860]	106.2	102.1
Mosslnsw - Greenvalley 115 kV Ckt 2	P1-2:A19:11:_MOSS LANDING-GREEN VALLEY #1 115KV [2850]	–	114.4
TESLA-SALADO-Q1103 115KV	Base Case	–	169.0
BAIR-REDWOOD-CLY LNDG 60KV	P7-1:A10:19:_Ravenswood-Bair Nos. 1 & 2 115 KV lines	–	108.0
WEBER-FRENCH CAMP #2 60KV	Base Case	282.3	282.6

2036 Base Portfolio Off-Peak GBA Area Deliverability Constraints

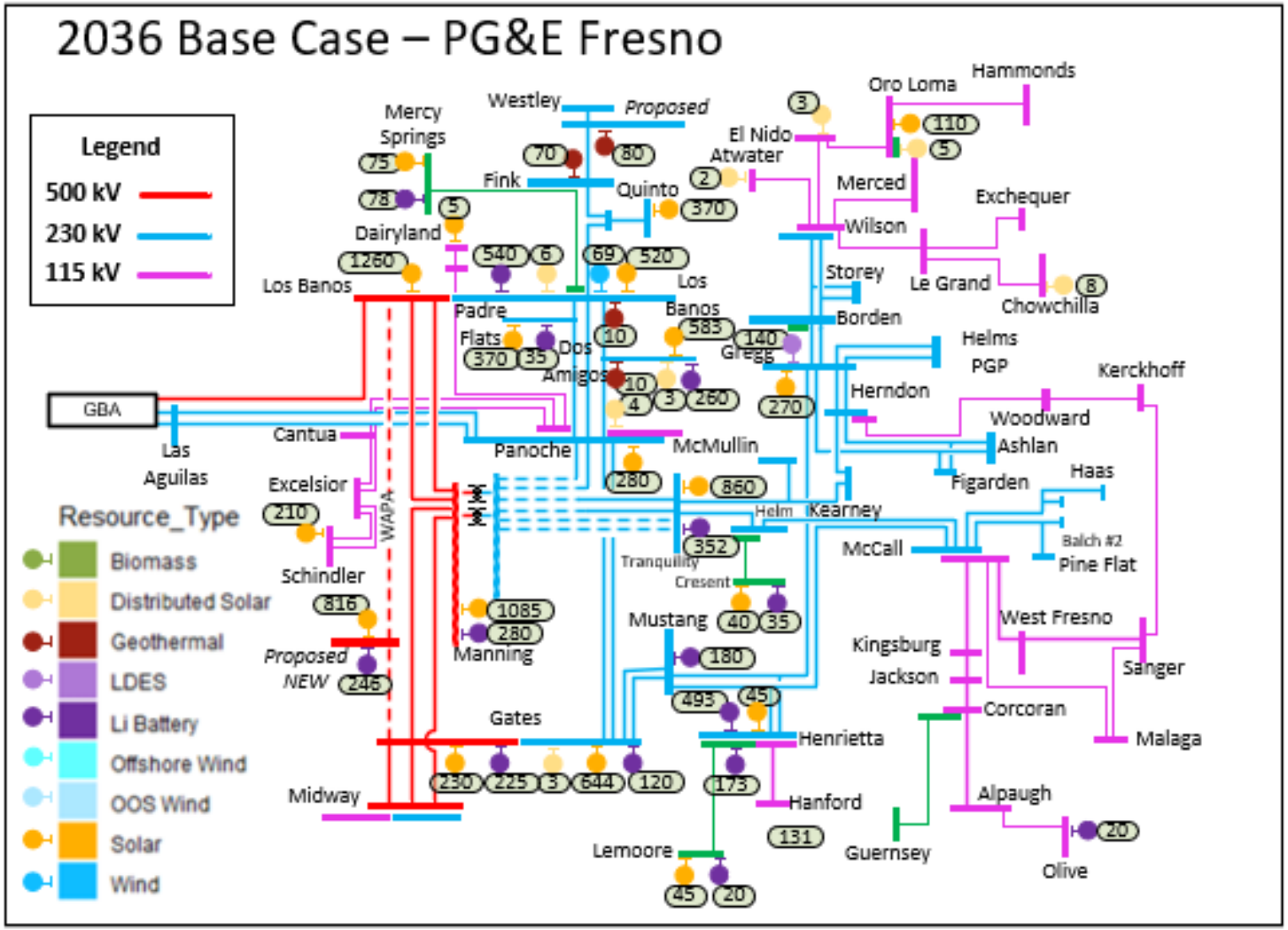
- No off-peak constraints were identified

PG&E Fresno Interconnection Area

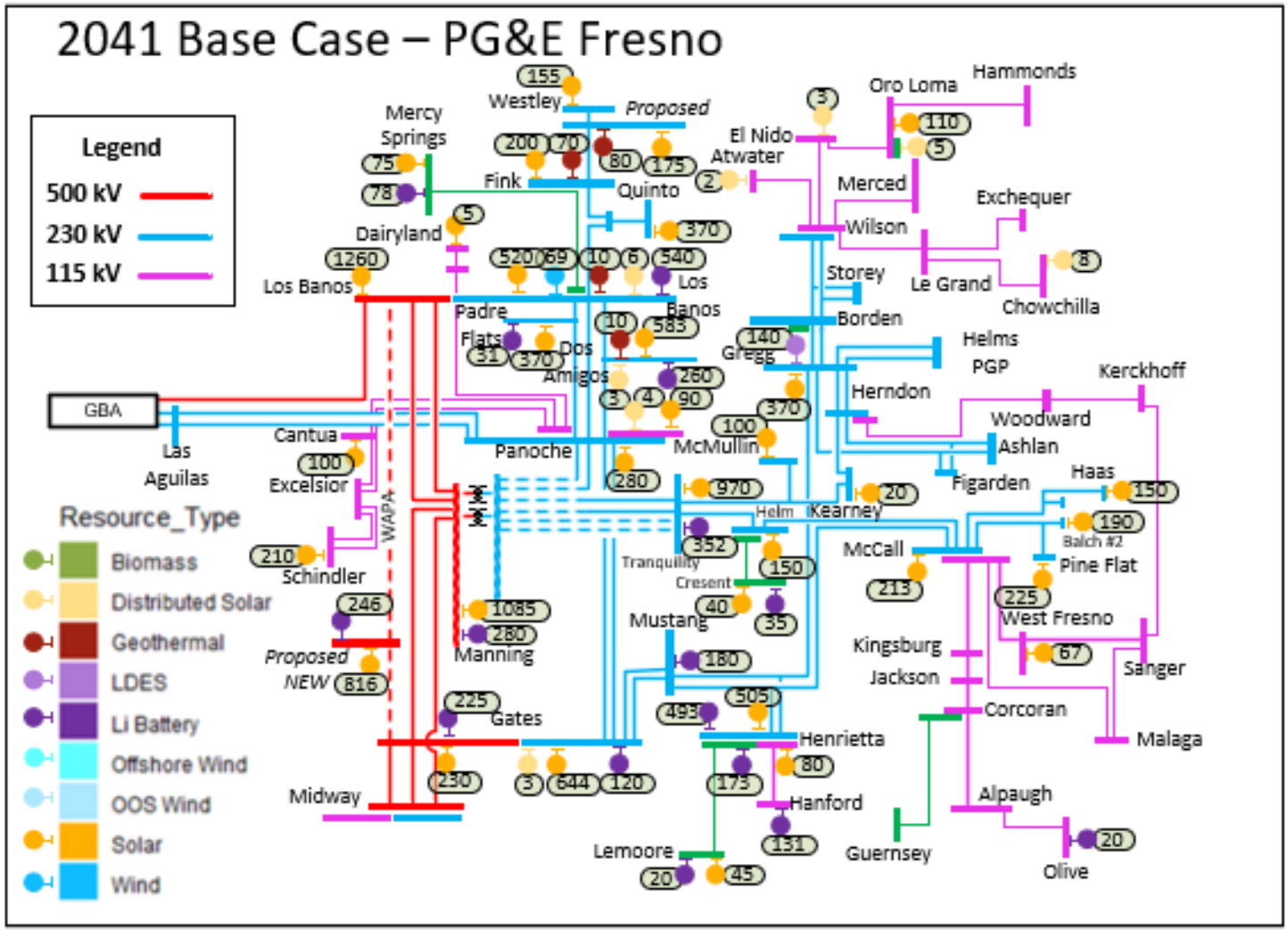
PG&E Fresno Interconnection Area Portfolio Summary

Resource Type	2036 Base Portfolio			2041 Base Portfolio			2041 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	4280	3537	**7817**	6940	3538	**10478**	7583	1466	**9049**
Wind – In State	0	69	**69**	0	69	**69**	0	69	**690**
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	4702	0	**4702**	4626	0	**4626**	4626	0	**4626**
Li Battery – 8 hr	2205	0	**2205**	2205	0	**2205**	5650	0	**5650**
Long Duration Energy Storage (LDES)	140	0	**140**	140	0	**140**	140	0	**140**
Geothermal	170	0	**170**	170	0	**170**	220	0	**220**
Biomass/Biogas	0	0	**0**	0	0	**0**	0	0	**0**
Distributed Solar	0	34	**34**	0	34	**34**	0	34	**34**
Gas capacity not retained	-138	0	**-138**	-146	0	**-146**	-146	0	**-146**
Total	**11359**	**3640**	**14999**	**13935**	**3641**	**17576**	**18073**	**1569**	**20263**

2036 Base Portfolio: PG&E Fresno Area

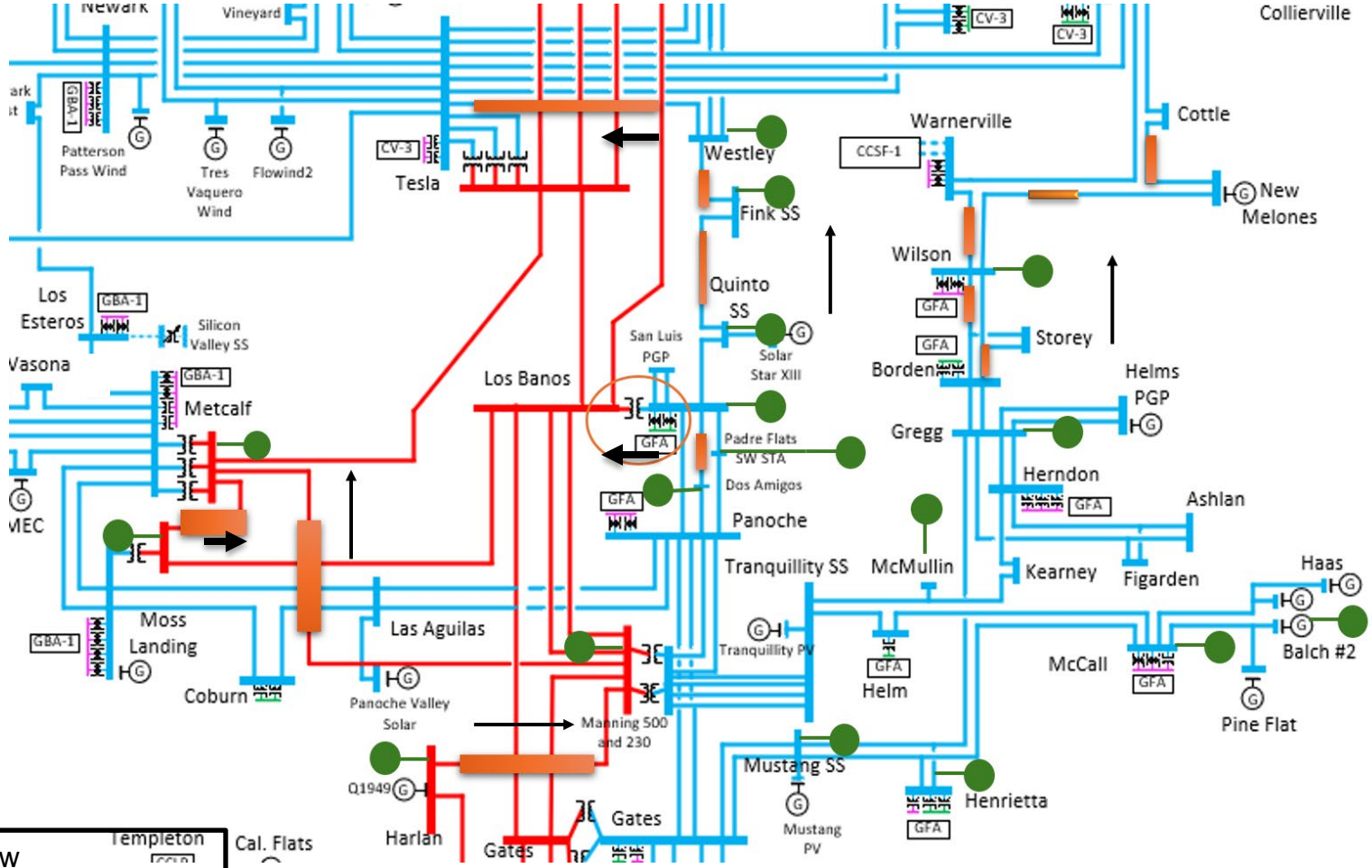


2041 Base Portfolio: PG&E Fresno Area



PGE Fresno Area Constraints

PG&E Fresno Area Constraints (500kV and 230kV)



PGE Fresno On-Peak HSN Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Moss Landing - Metcalf 500 kV line	2036 Base	0	0	1610	0	1169	Primarily driven by UTPD
	2041 Base	0	0	1610	0	1234	
	2041 Low Wind	1708	0	1610	0	2433	
Manning - Metcalf 500 kV Ckt 1	2036 Base	2556	526	782	1884	788	Windhub-Tesla 500kV to be tested alongside reviewing UTPD and Generic Portfolio storage reduction/relocation
	2041 Base	2556	526	782	603	2478	
	2041 Low Wind	3559	1046	111	2605	2000	
Los Banos 500/230kV Transformer	2036 Base	2922	1187	638	2845	3887	
	2041 Base	3857	1187	585	2760	4634	
	2041 Low Wind	3334	2858	226	3502	4093	
Harlan - Manning 500 kV line	2036 Base	2726	621	582	957	2972	
	2036 SSN	2726	621	582	1100	2828	
	2041 Base	2726	621	582	1102	2245	

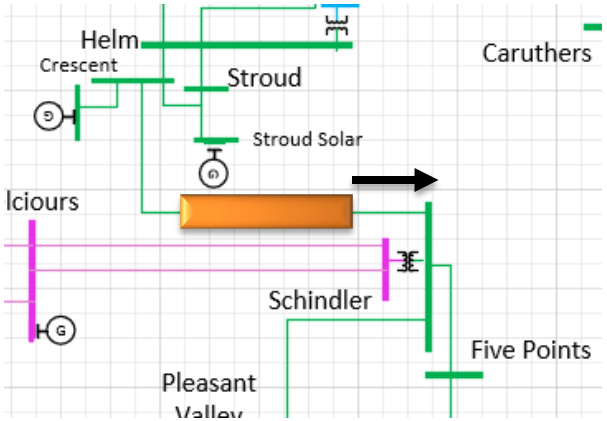
PGE Fresno On-Peak HSN Constraints (cont.)

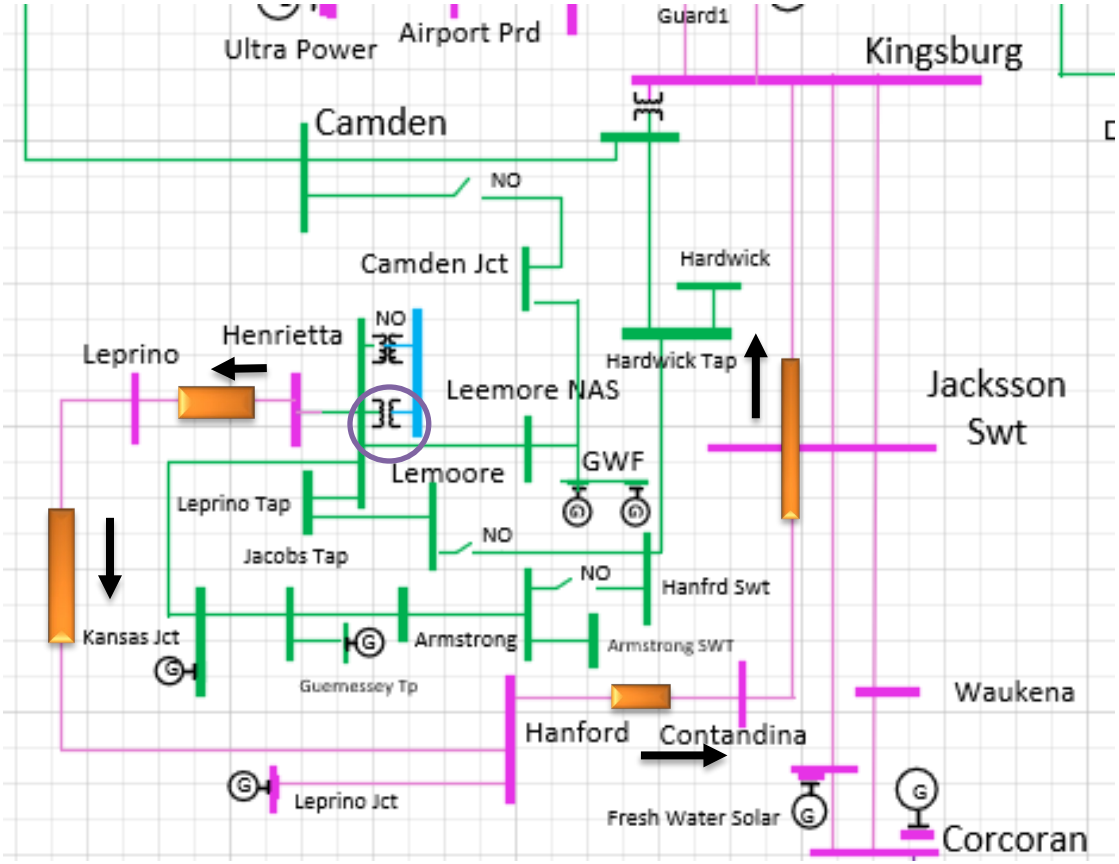
Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Westley - Tesla 230 kV Line	2036 Base	2052	831	519	1250	3139	Windhub-Tesla 500kV to be tested alongside reviewing UTPD and Generic Portfolio storage reduction/relocation
	2041 Base	2572	831	466	0	5475	
	2041 Low Wind	2920	3758	0	182	7886	
Fink SwSta - Westley #1 230KV	2036 Base	5841	1187	638	2307	6588	
	2036 SSN	2376	831	451	1726	2502	
	2041 Base	6466	1187	260	1163	9676	
	2041 Low Wind	6393	3214	1451	3400	8332	
Quinto SS-Fink SwSta #1 230KV	2041 Low Wind	984	1800	0	1769	1015	
	2036 Base	5471	1187	530	4989	3543	
	2041 Base	6086	1187	1407	4307	5933	
Poleline – Los Banos 230 kV Ckt 1	2036 Base	389	260	0	636	13	Generic Portfolio storage reduction/relocation
	2041 Base	389	260	0	634	14	
	2041 Low Wind	818	758	0	1002	574	
Ds Amigo - Poleline 230 kV Ckt 1	2036 Base	202	260	0	393	69	
	2041 Base	202	260	0	400	62	
	2041 Low Wind	642	758	0	771	629	
Ds Amigo - Poleline 230 kV Ckt 2	2036 Base	202	260	0	393	69	
	2041 Base	202	260	0	400	62	
	2041 Low Wind	642	758	0	771	629	

PGE Fresno On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Wilson-Warnerville 230KV	2036 Base	345	693	570	142	2709	Windhub-Tesla 500kV to be tested alongside reviewing UTPD and Generic Portfolio storage reduction/relocation
	2036 SSN	345	693	570	0	2710	
	2041 Base	2025	693	570	48	4196	
	2041 Low Wind	1536	1092	570	2269	1940	
Storeyjct1 - Wilson 230 kV Ckt 1	2036 Base	230	693	210	522	1277	
	2036 SSN	230	693	210	728	867	
	2041 Base	1910	693	210	863	2707	
Borden - Storeyjct2 230 kV Ckt 2	2036 Base	230	693	210	243	1521	
	2036 SSN	230	693	210	252	1284	
	2041 Base	1910	693	210	600	2969	
Wilson - Melones 230 kV Ckt 1	2036 Base	0	0	54	0	5	Primarily driven by UTPD
	2041 Base	0	0	54	0	3	
	2041 Low Wind	0	0	54	0	3	
Poleline - Panoche 230 kV Ckt 1	2041 Low Wind	818	758	0	1338	238	Sensitivity Only
Quinto SS – Los Banos 230 kV Ckt 1	2041 Low Wind	1379	1800	0	2081	1098	Sensitivity Only
Los Banos - Panoche 230 kV Ckt 2	2041 Low Wind	2920	2858	0	5235	996	Sensitivity Only
Padreflat SS - Panoche 230 kV Ckt 1	2041 Low Wind	2920	2858	0	5408	823	Sensitivity Only

PG&E Fresno Area Constraints (115kV and 70kV)





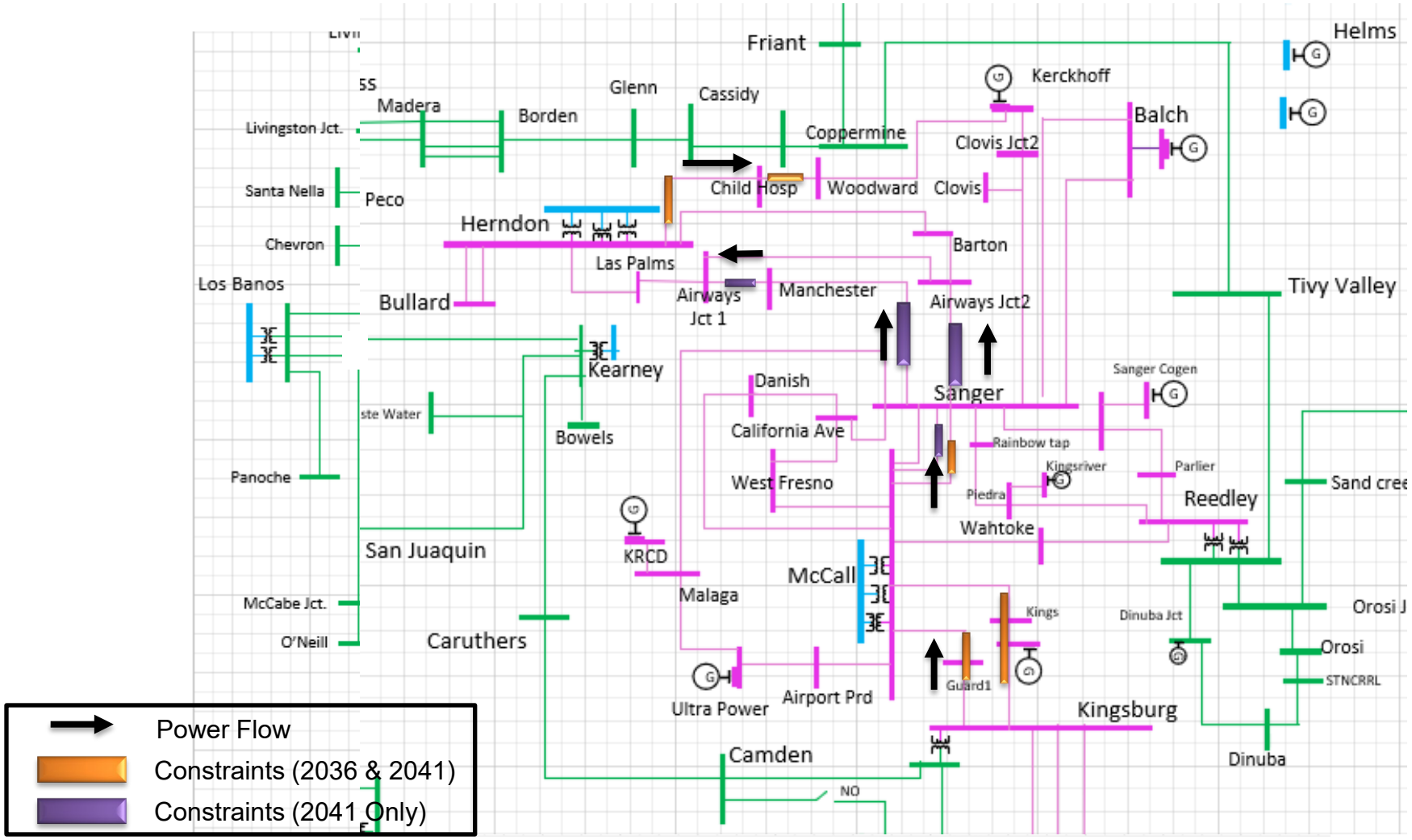
Power Flow
Constraints (2036 & 2041)
Constraints (2041 Only)

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PGE Fresno On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
GWF Hanford-Kingsburg 115 kV	2036 Base	90	513	0	473	130	Review GWF-Kingsburg line reconductoring project
	2041 Base	630	513	0	946	197	
Henrietta – Leprino Jct SS 115 kV	2036 Base	90	513	0	343	260	Generic Portfolio storage reduction/relocation or RAS options
	2041 Base	630	513	0	823	320	
Leprino Jct SS – GWF Hanford SS 115 kV	2036 Base	90	513	0	361	242	
	2041 Base	630	513	0	839	304	
Henretta 230/115 kV Transformer 3	2041 Base	550	513	0	1025	38	Review Henrietta RAS
Crescent SS-Schindler #1 70KV	2036 Base	40	0	34	40	21	Review Helm-Crescent reconductoring Project
	2036 SSN	40	0	34	21	53	
	2041 Base	40	0	34	17	24	
	2041 Low Wind	35	0	34	17	19	

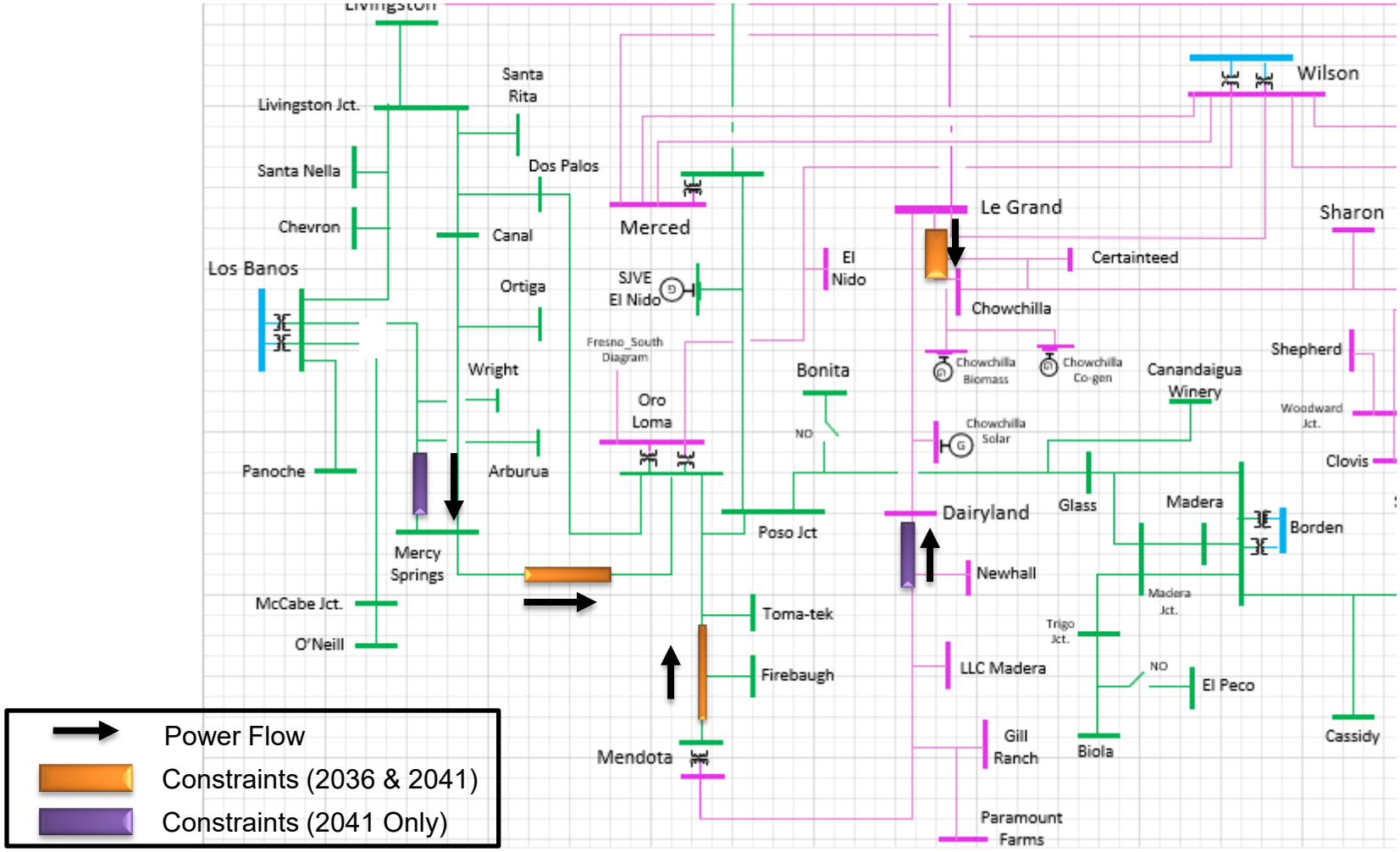
PG&E Fresno Area Constraints (115kV and 70kV)



PGE Fresno On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Sanger - Airwaysjct1 115 kV	2041 Base	1020	493	210	361	1240	2041 overload only
Sanger - Airwaysjct2 115 kV	2041 Base	1020	493	210	0	1622	
McCall – Sanger #2 115 kV	2041 Base	778	0	10	0	932	Under Review
	2041 Low Wind	0	0	10	0	70	
McCall - Sanger #3 115 kV	2036 Base	0	0	10	0	215	
	2036 SSN	0	0	10	0	12	
	2041 Base	778	0	10	0	1131	
	2041 Low Wind	0	0	10	0	263	
Kingsburg – McCall #1 115 kV	2036 Base	90	513	10	562	53	Generic Portfolio storage reduction/relocation
	2041 Base	630	513	10	1029	140	
Kingsburg- McCall #2 115KV	2036 Base	90	513	10	578	37	
	2041 Base	630	513	10	1030	139	
Herndon - Woodward 115 kV	2036 Base	140	0	0	0	484	Under Review
	2041 Base	260	0	0	0	461	
	2041 Low Wind	140	0	0	0	622	

PG&E Fresno Area Constraints (115kV and 70kV)



PGE Fresno On-Peak HSN Constraints (cont.)

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
(New)Mercy Spring-Oro Loma 70 kV Line	2036 Base	76	260	0	306	30	Generic Portfolio storage reduction/relocation or RAS options
	2041 Base	76	260	0	43	293	
	2041 Low Wind	76	758	0	25	810	
Poleline – Mercyspring SS 70 kV	2041 Low Wind	642	758	0	1081	319	Sensitivity Only
Mercyspring SS - Mrcysprs 70 kV	2041 Low Wind	717	758	0	1172	303	Sensitivity Only
Mendota – Tomatek 70kV	2036 Base	0	0	160	0	32	Primarily driven by UTPD and review 70kV summer setup
	2036 SSN	5	0	160	5	30	
	2041 Base	0	0	160	0	78	
	2041 Low Wind	0	0	160	0	18	
Le Grand-Chowchilla 115 kV Line	2036 Base	5	0	360	0	419	Primarily driven by UTPD
	2041 Base	5	0	360	0	452	
	2041 Low Wind	0	0	360	0	433	
Newhall - Dairyland 115 kV Ckt 1	2041 Base	100	0	160	0	155	Primarily driven by UTPD
	2041 Low Wind	0	0	160	0	35	

2036 Base Portfolio On-Peak Fresno Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
(New) Mercy Spring-Oro Loma 70 kV Line	Panoche-Oro Loma 115kV	101	–
Crescentss-Schlndlr #1 70kV	Helm-Crescent Sw Sta 70kV	146	–
	Helm 230/70kV Tb 1	–	168
Finkswsta-Westley #1 230kV	Manning - Metcalf 500 kV	134	112
Gwf-Kingsburg 115 kV Line	Mustangss-Gates #1 230kV & Mustangss-Gates #2 230kV	138	–
Harlan - Manning 500 kV Line	Base Case	127	112
Henrietta-Gwf 115 kV Line	Mustang Sw Sta-Gregg 230kV	231	–
Le Grand-Chowchilla 115 kV Line	Helm-McCall 230kV & Hentap2-Mustangss #1 230kV	118	–
Los Banos 500/230 kV	Finkswsta-Westley #1 230kV	113	–
McCall-Kingsburg #1 115 kV Line	Mustangss-Gates #1 230kV & Mustangss-Gates #2 230kV	114	–
McCall-Kingsburg #2 115 kV Line	Mustang Sw Sta-Gregg 230kV	108	–

2036 Base Portfolio On-Peak Fresno Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
McCall-Sanger #3 115 kV Line	McCall-Sanger #1 115kV & McCall-Sanger #2 115kV	113	100
Melones-Wilsonpgae 230kV Line	Bellota-Cottle 230kV	101	–
Poleline – Losbanos 230 kV Line	Poleline-Panoche #1 230kV	103	–
Los Banos 500/230 kV Transformer	Finkswsta-Westley #1 230kV	112	–
Poleline-Ds Amigo #1 230kV	Poleline-Ds Amigo #2 230kV	120	–
Poleline-Ds Amigo #2 230kV	Poleline-Ds Amigo #1 230kV	120	–
Moss Landing - Metcalf 500 kV Line	Manning - Metcalf 500 kV	115	–
Manning – Metcalf 500kV Line	Metcalf-Mosslanding 500kV	103	NA
Oro Loma-Mendota 70kV	Los Banos-Panoche #1 230kV & Panoche-Oro Loma 115kV	104	–
	Panoche-Mendota 115kV	–	109
Panoche-Mendota 115 kV Line	Dairyland-Mendota 115kV & Tomatak-Mendota #1 70kV	–	102
Panoche-Schindler #2 115 kV Line	Cantua-Excelsiorss 115kV Moas Opened On Panoche1	–	105
Quinto_ss-Finkswsta #1 230kV	Manning - Metcalf 500 kV	110	–
Warnerville-Wilson 230kV	Cottle-Melones 230kV	154	141
Wilson-Borden #1 230kV	Wilson-Borden #2 230kV	106	105
Wilson-Borden #2 230kV	Wilson-Borden #1 230kV	115	112
Herndon - Woodward115 kV Ckt 1	Herndon-Barton 115kV & Herndon-Manchester 115kV	120	105

2041 On-Peak Fresno Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Borden - Storeyjct2 230 kV Ckt 2	Wilson-Borden #1 230kV	120	NA
Certan T - Chwchlla 115 kV Ckt 1	Helm-McCall 230kV & Hentap2-Mustangss #1 230kV	122	NA
Crescentss - Schlndlr 70 kV Ckt 1	Helm-Crescent Sw Sta 70kV	141	139
Ds Amigo - Poleline 230 kV Ckt 1	Poleline-Ds Amigo #2 230kV	118	283
Ds Amigo - Poleline 230 kV Ckt 2	Poleline-Ds Amigo #1 230kV	118	283
Finkswsta - Quinto_ss 230 kV Ckt 1	Finkswsta-Westley #1 230kV	NA	185
Finkswsta - Westley 230 kV Ckt 1	Losbanos 500/230kV Tb 1	NA	223
	Manning - Metcalf 500 kV	136	NA
GWF Hanford SS - Kingsburg 115 kV Ckt 1	Mustangss-Gates #1 230kV & Mustangss-Gates #2 230kV	155	NA
Harlan-Manning 500 kV Ckt 2	Base Case	118	NA
Henretta - Lprnjctss 115 kV Ckt 1	Mustang Sw Sta-Gregg 230kV	263	NA
Henrietta_f - Henretta 230/115 kV Ckt 3	Mustang Sw Sta-Gregg 230kV	108	NA
Herndon - Woodward115 kV Ckt 1	Herndon-Barton 115kV & Herndon-Manchester 115kV	115	126

2041 On-Peak Fresno Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Kingsburg - Mc Call 115 kV Ckt 1	Mustang Sw Sta-Gregg 230kV	129	NA
Kingsburg - Mc Call 115 kV Ckt 2	Mustang Sw Sta-Gregg 230kV	124	NA
Los Banos Transformer 500/230 kV Ckt 1	Finkswsta-Westley #1 230kV	109	200
Losbanos - Panoche 230 kV Ckt 2	Finkswsta-Westley #1 230kV	NA	116
Lprnjctss - Gwfhanfordss 115 kV Ckt 1	Mustangss-Gates #1 230kV & Mustangss-Gates #2 230kV	257	NA
Manning - Metcalf 500 kV Ckt 1	Base Case	NA	106
	Metcalf-Mosslanding 500kV	106	NA
Mc Call - Sanger 115 kV Ckt 2	McCall-Reedley 115kV & McCall-Sanger #3 115kV	112	103
Mc Call - Sanger 115 kV Ckt 3	McCall-Sanger #1 115kV & McCall-Sanger #2 115kV	130	116
Melones - Wilsonpgae 230 kV Ckt 1	Bellota-Cottle 230kV & Bellota-Warnerville 230kV	100	100
Mendota - Tomatek 70 kV Ckt 1	Dairyland-Mendota 115kV	NA	102
	Los Banos-Panoche #1 230kV & Panoche-Oro Loma 115kV	110	NA

2041 On-Peak Fresno Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Mercysprngss - Mrcysprs 70 kV Ckt 1	Los Banos-Panoche #2 230kV & Los Banos-Dos Amigos 230kV	NA	120
Mrcysprs - Oro Loma 70 kV Ckt 1	Panoche-Oro Loma 115kV	116	NA
	Finkswsta-Westley #1 230kV	NA	150
Newhall - Dairylnd 115 kV Ckt 1	Hentap1-Mustangss #1 230kV & Tranqltyss-Mcmulln1 #1 230kV	105	103
Padreflatss - Panoche 230 kV Ckt 1	Finkswsta-Westley #1 230kV	NA	108
Poleline - Losbanos 230 kV Ckt 1	Poleline-Panoche #1 230kV	103	249
Poleline - Mercysprngss 70 kV Ckt 1	Los Banos-Panoche #2 230kV & Los Banos-Dos Amigos 230kV	NA	143
Poleline - Panoche 230 kV Ckt 1	Losbanos-Poleline #1 230kV	NA	133
Quinto_ss - Finkswsta 230 kV Ckt 1	Manning - Metcalf 500 kV	113	NA
Quinto_ss - Losbanos 230 kV Ckt 1	Finkswsta-Westley #1 230kV	NA	190
Sanger - Airwaysjct1 115 kV Ckt 1	Hentap1-Mustangss #1 230kV & Tranqltyss-Mcmulln1 #1 230kV	105	NA
Sanger - Airwaysjct2 115 kV Ckt 1	Hentap1-Mustangss #1 230kV & Tranqltyss-Mcmulln1 #1 230kV	110	NA
Storeyjct1 - Wilsonpgae 230 kV Ckt 1	Wilson-Borden #2 230kV	110	NA
Westley - Tesla E 230 kV Ckt 1	Tesla 500/230kV Tb 2	151	225
Wilson - Warnerville 230 kV Ckt 1	Finkswsta-Westley #1 230kV	125	106

2036 Base Portfolio Off-Peak Fresno Area Deliverability Constraints

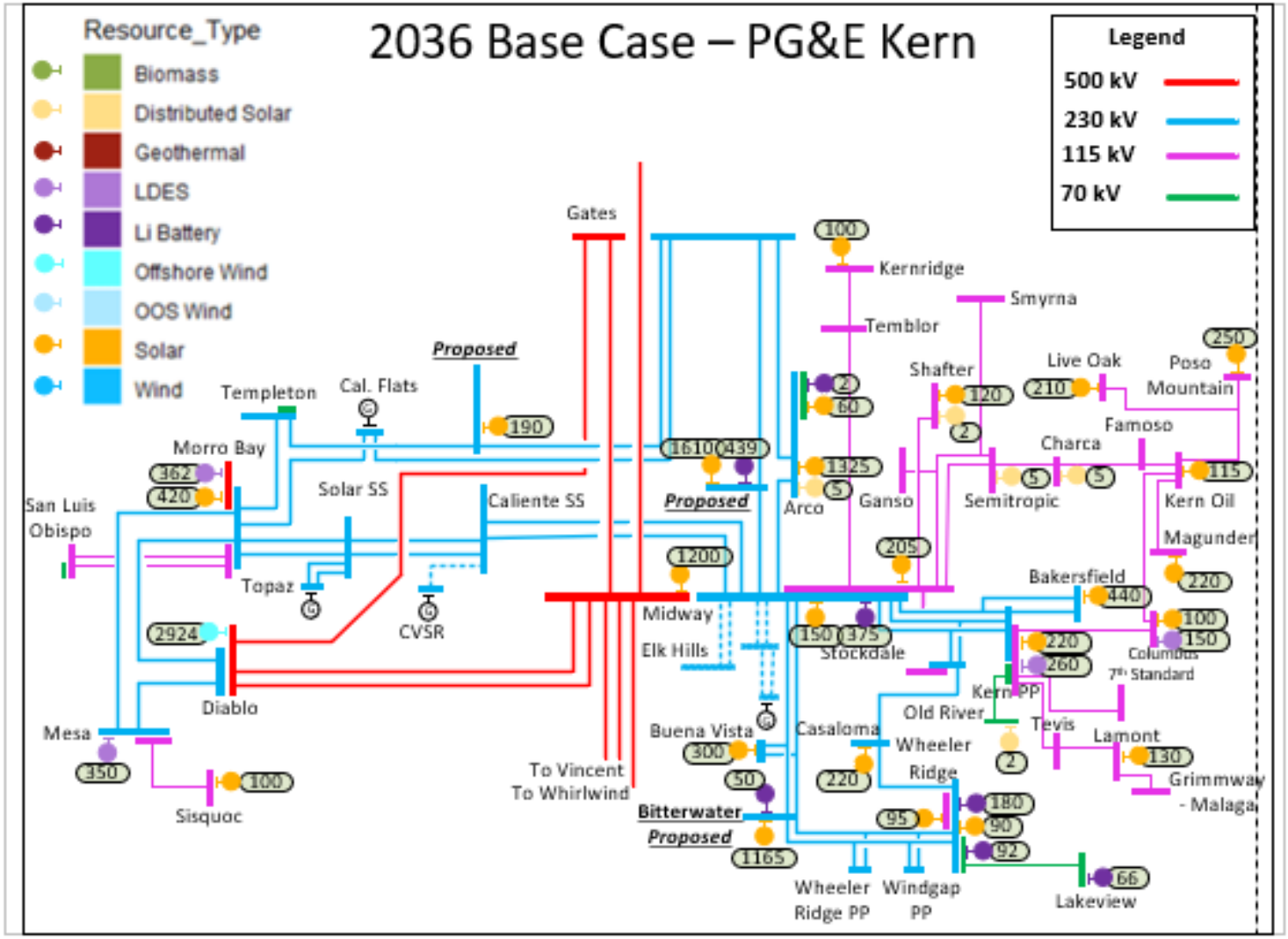
Constraint	Contingency	Loading (%)
Cantua-Excelsiorss 115kV	Panoche-Excelsior Sw Sta #2 115kV	192
Crescentss-Schlndlr #1 70kV	Helm 230/70kV Tb 1	325
Excelsior Sw Sta-Schindler #1 115kV	Excelsior Sw Sta-Schindler #2 115kV	150
Excelsior Sw Sta-Schindler #2 115kV	Excelsior Sw Sta-Schindler #1 115kV	150
Fivepointsss-Calflax #1 70kV	Panoche-Schindler #1 115kV	252
Gates-Huron 70kV	Panoche-Schindler #1 115kV	142
Gates-Huron-Calflax 70kV	Panoche-Schindler #1 115kV	272
Gates-Tulare Lake 70kV	Base Case	151
Guernsey-Henrietta 70kV	Base Case	126
Helm 230/70kV Tb 1	Panoche-Schindler #1 115kV	118
Helm-Crescent Sw Sta 70kV	Panoche-Schindler #1 115kV	361
Henrietta_D 230/70kV Tb 4	Base Case	123
Herndon-Woodward 115kV	Herndon-Barton 115kV	115
Kingsburg-Corcoran #1 115kV	Kingsburg-Waukena Sw Sta 115kV	109
Kingsburg-Waukena Sw Sta 115kV	Kingsburg-Corcoran #1 115kV	110
Losbanos - Poleline 230 kV Line	Poleline-Panoche #1 230kV	163
Poleline - Ds Amigo 230 kV Line	Poleline-Ds Amigo #2 230kV	159
Losbanos -L.Bans M 500 kV Line	Finkswsta-Westley #1 230kV	134
Crescentss - Stroud 70.0 kV Line	Base Case	115
Schindler-Coalinga #2 70kV	Panoche-Schindler #1 115kV	226
Schindler-Five Points Sw Sta 70kV	Panoche-Schindler #1 115kV	223
Schindlr 115/12.47kV Tb 2	Panoche-Schindler #1 115kV	323
Suncity-Sanddrag-Ketlmn T 70kV	Base Case	109
Warnerville-Wilson 230kV	Helms-Gregg #1 230kV	186

PG&E Kern Interconnection Area

PG&E Kern Interconnection Area Portfolio Summary

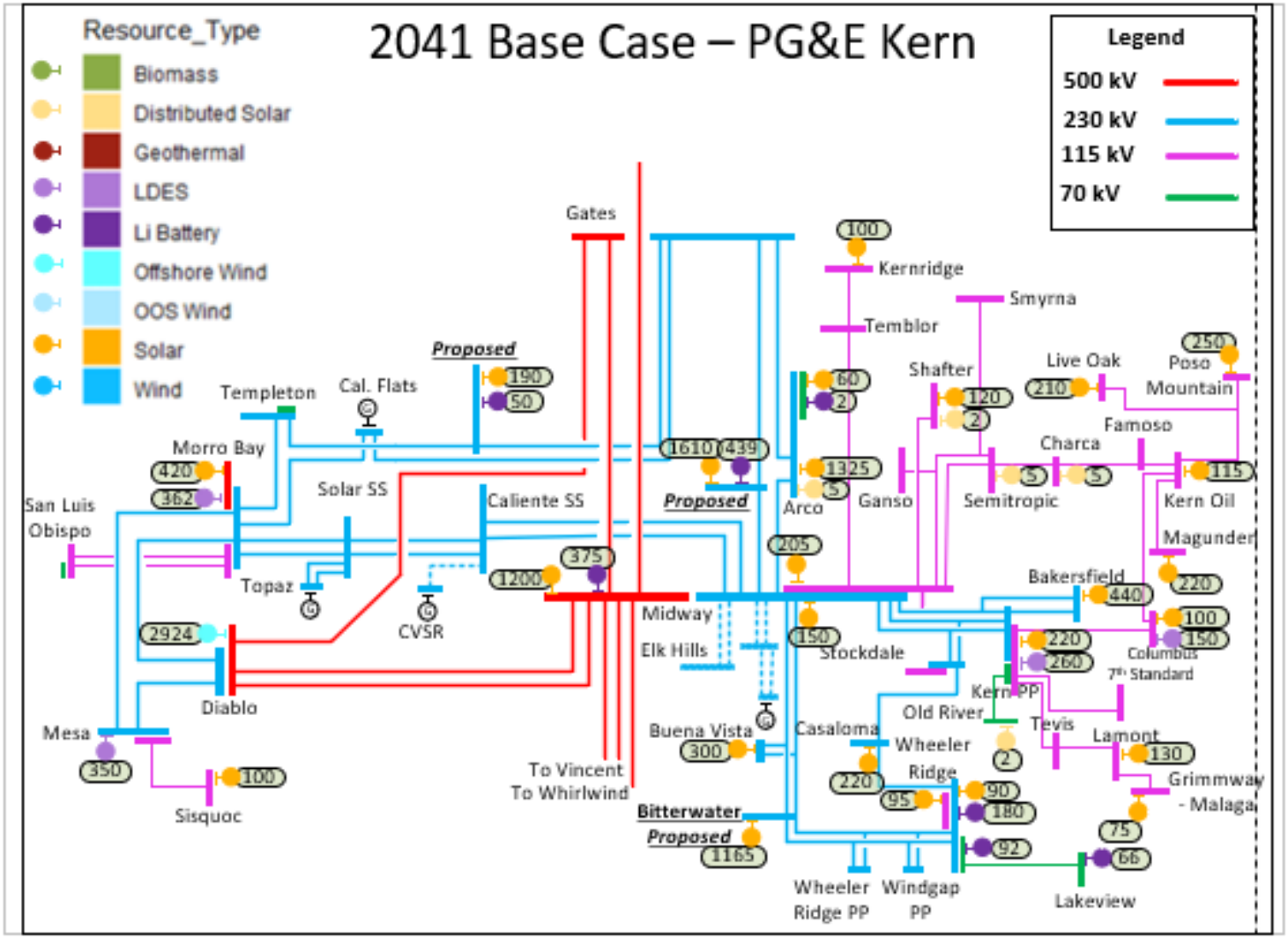
Resource Type	2036 Base Portfolio			2041 Base Portfolio			2041 Sensitivity Portfolio		
	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)	FCDS (MW)	EO (MW)	Total (MW)
Solar	5505	3530	**9035**	5505	3530	**9035**	7496	2781	**10277**
Wind – In State	0	0	**0**	0	0	**0**	0	0	**0**
Wind – Out-of-State	0	0	**0**	0	0	**0**	0	0	**0**
Wind - Offshore	2924	0	**2924**	2924	0	**2924**	0	0	**0**
Li Battery – 4 hr	1755	0	**1755**	1755	0	**1755**	1755	0	**1755**
Li Battery – 8 hr	805	0	**805**	805	0	**805**	0	0	**0**
Long Duration Energy Storage (LDES)	1122	0	**1122**	1122	0	**1122**	760	0	**760**
Geothermal	0	0	**0**	0	0	**0**	0	0	**0**
Biomass/Biogas	0	0	**0**	0	0	**0**	0	0	**0**
Distributed Solar	0	19	**19**	0	19	**19**	0	19	**19**
Gas capacity not retained	-880	0	**-880**	-1167	0	**-1167**	-901	0	**-901**
Total	**11231**	**3549**	**14780**	**10944**	**3549**	**14493**	**9110**	**2800**	**11910**

2036 Base Portfolio: PG&E Kern Area



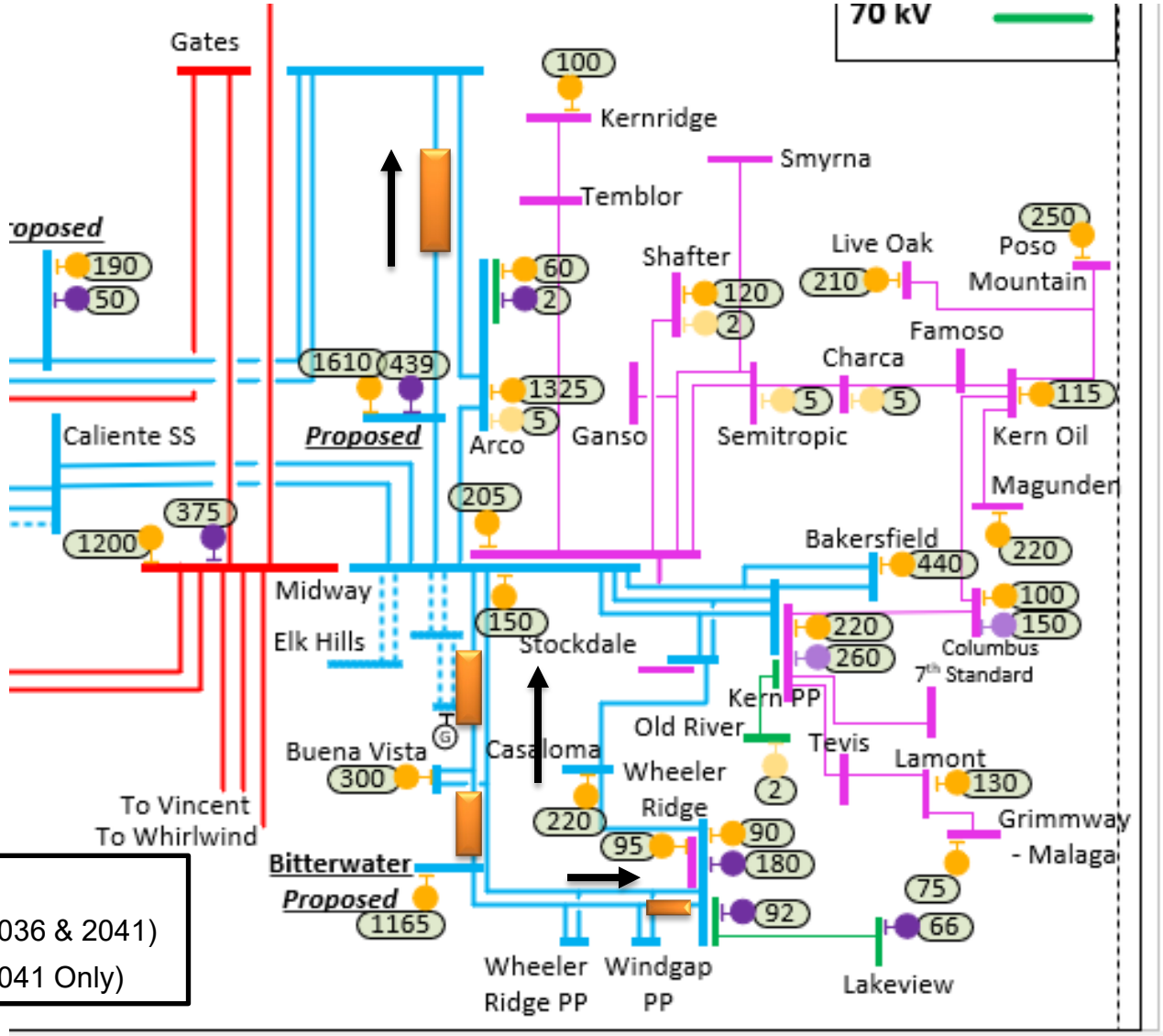
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2041 Base Portfolio: PG&E Kern Area



PGE Kern Area Constraints

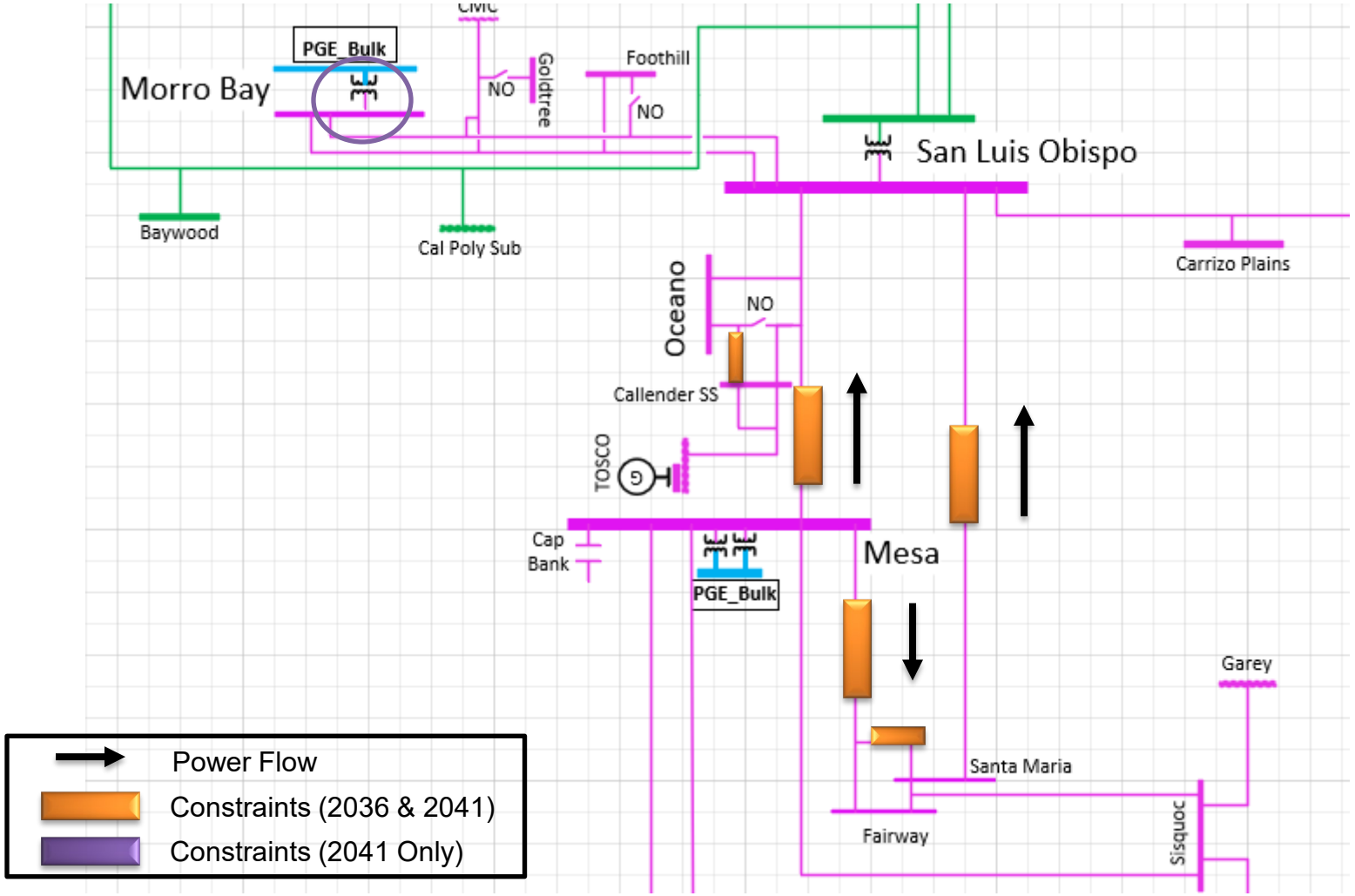
PG&E Kern Area Constraints (230kV)



PGE Kern On-Peak HSN Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Whlr Rj2 - Wind Gap J2 230 kV	2041 Low Wind	1900	0	0	1632	268	Sensitivity Only
Wind Gap J2-Wheeler 230KV	2036 Base	885	50	0	735	200	Constraints in the same pocket are also seen in the TPP reliability study hence common mitigation addressing these constraints will be developed
	2041 Base	891	50	0	632	310	
	2041 Low Wind	1900	0	0	907	993	
Buena Vista J2-Midway 230kV	2036 Base	986	323	0	529	780	
	2036 SSN	1030	323	4	1261	91	
	2041 Base	986	323	0	481	828	
	2041 Low Wind	2400	93	0	1506	986	
Bitter water SS – Buena Vista J2 230 kV	2036 Base	980	323	0	811	492	
	2041 Base	980	323	0	842	462	
	2041 Low Wind	2400	93	0	1868	625	
Q1593SWSTA - Gates 230 kV line	2036 Base	889	440	0	873	457	
	2036 SSN	3835	763	192	2116	4036	
	2041 Base	889	440	0	866	463	
	2041 Low Wind	1900	240	0	865	1275	

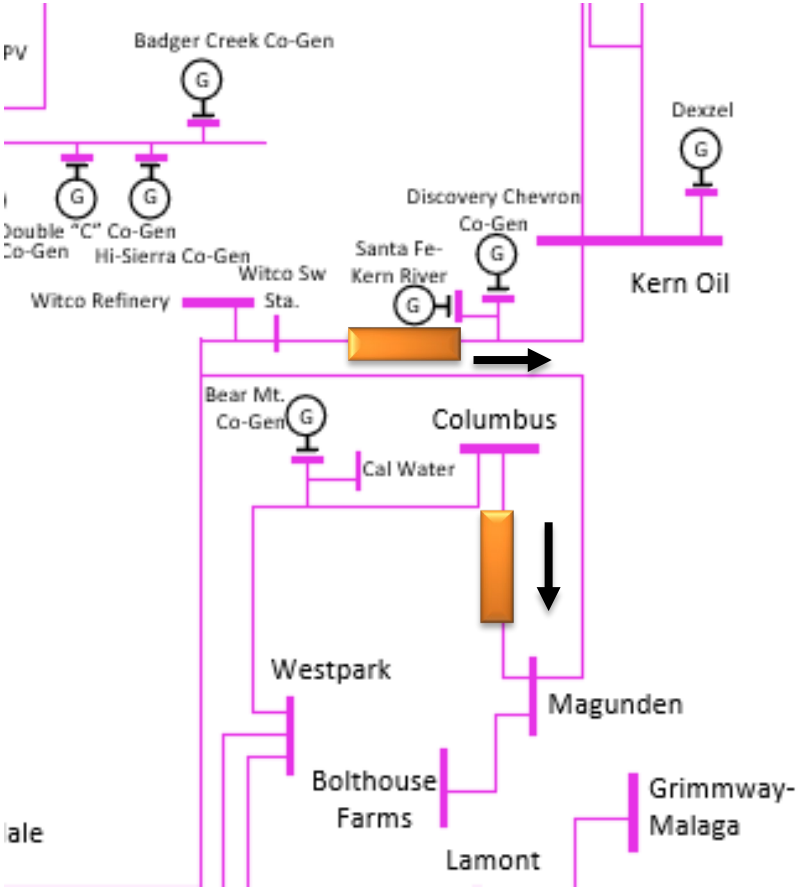
PG&E Kern Area Constraints (230kV & 115kV)

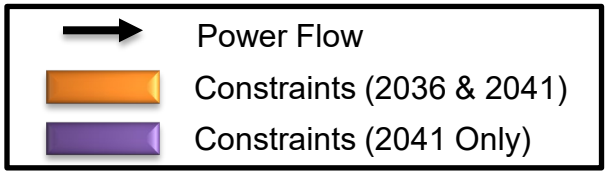


PGE Kern On-Peak HSN Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Mesa – Callendar Sw Sta 115 kV Line	2036 Base	1225	0	110	925	299	Constraints also seen in the TPP reliability study hence common mitigation addressing CCLP area constraints will be developed.
	2036 SSN	1225	0	110	1153	172	
	2041 Base	1225	0	110	1058	267	
	2041 Low Wind	1774	0	110	1618	256	
Santa Maria – San Luis Obispo 115 kV Line	2036 Base	1225	0	110	1043	181	
	2041 Base	1225	0	110	1191	134	
	2041 Low Wind	1774	0	110	1743	131	
Santa Maria Tap - Santa Maria 115 kV	2036 Base	1225	0	110	1012	212	
	2041 Base	1225	0	110	1132	193	
	2041 Low Wind	1774	0	110	1688	186	
Callender Sw. Sta – Oceano 115 kV Line	2036 Base	1225	0	110	922	302	
	2036 SSN	1225	0	110	1150	175	
	2041 Base	1225	0	110	1055	270	
	2041 Low Wind	1774	0	110	1615	259	
Mesa-Santa Maria Tap 115 kV Line	2036 Base	1225	0	100	940	284	
	2036 SSN	1225	0	100	1171	153	
	2041 Base	1225	0	100	1046	279	
	2041 Low Wind	1774	0	100	1606	268	

PG&E Kern Area Constraints (115kV)





PGE Kern On-Peak HSN Constraints Summary

Constraint	Portfolio	Portfolio MW behind the constraint	Generic portfolio storage MW behind the constraint	Unaccounted for TPD behind the constraint	Deliverable Portfolio MW w/o mitigation	Total undeliverable baseline and portfolio MW	Mitigation
Morrobay - Templeton 230 kV Ckt 1	2041 Low Wind	2274	0	110	2267	161	Sensitivity Only
Morrobay 230/115 kV Transformer	2041 Base	1225	0	110	0	1260	Also seen in TPP reliability study hence common mitigation addressing CCLP area constraints will be developed
	2041 Low Wind	2274	0	110	0	2403	
Columbus-Magunden 115 kV Line	2036 Base	250	0	0	239	11	Under Review, RAS options to be explored
	2036 SSN	250	0	0	235	14	
	2041 Base	250	0	0	244	53	
Witco Jct – Discovery Tap 115 kV	2041 Base	616	0	0	473	143	2041 overload only
Magunden J - Magunden 70 kV	2036 Base	980	273	0	1238	15	Generic Portfolio storage reduction/relocation
	2041 Base	980	273	0	1215	39	
	2041 Low Wind	2400	93	0	1544	948	
Magunden - Bakersfield 70 kV	2036 Base	980	273	0	1234	19	
	2041 Base	980	273	0	1215	38	
	2041 Low Wind	2400	93	0	1551	942	

2036 Base Portfolio On-Peak Kern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		HSN	SSN
Buenavj2-Midway-D 230kV	Wheeler-Casaloma #1 230kV	122.0	–
	Stockdale-Casaloma #1 230kV & Casaloma-Kern PP 230kV	–	101.2
Bitterwatrss-Wheeler 230kV	Midway-Wheeler Ridge #1 230kV & Bitterwater SS-Midway 230kV	107.5	–
Callender Sw. Sta-Mesa 115 kV Line	Morro Bay-Mesa And Morro Bay-Diablo 230 kV Lines	267.7	139.3
Kern-Magunden 70 kV Line	Wheeler-Casaloma #1 230kV	101.8	–
Magndn J - Magunden 70 kV Ckt 1	Wheeler-Casaloma #1 230kV	101.9	–
Mesa-Santa Maria 115 kV Line	Morro Bay-Mesa And Morro Bay-Diablo 230 kV Lines	179.6	114.1
Bitterwater SS - Buenavj2 230 kV	Wheeler-Casaloma #1 230kV	113.6	–
Q1593Swsta - Gates 230 kV Line	Dry Lake-Midway-F #1 230kV & Arco-Midway 230kV	168.6	–
	Midway 500/230kV Tb 12	–	119.6
Oceano-Callender Sw. Sta 115 kV Line	Morro Bay-Mesa And Morro Bay-Diablo 230 kV Lines	269.1	140.7
San Luis Obispo-Santa Maria 115 kV Line	Morro Bay-Mesa And Morro Bay-Diablo 230 kV Lines	204.4	–
Columbus-Magunden 115 kV Line	Kern-Magunden 70kV & Westpark-Columbus 115kV	110.7	114.4

2041 On-Peak Kern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Bitterwater SS - Buenavj2 230 kV Ckt 2	Wheeler-Casaloma #1 230kV	113	117
Buenavj2 - Midway-D 230 kV Ckt 2	Wheeler-Casaloma #1 230kV	123	128
Callenderss - Oceano 115 kV Ckt 1	Morro Bay-Mesa And Morro Bay-Diablo 230 kV Lines	192	188
Columbus - Maguden J 115 kV Ckt 1	Kern-Magunden 70kV & Westpark-Columbus 115kV	105	NA
Magndn J - Magunden 70 kV Ckt 1	Wheeler-Casaloma #1 230kV	105	109
Magunden - Bakrsfld 70 kV Ckt 1	Wheeler-Casaloma #1 230kV	105	109
Mesa_Pge - Callenderss 115 kV Ckt 1	Morro Bay-Mesa And Morro Bay-Diablo 230 kV Lines	191	187

2041 On-Peak Kern Area Deliverability Constraints

Overloaded Facility	Contingency	Loading (%)	
		Base	Sensitivity
Mesa_Pge - Sntamrtp 115 kV Ckt 1	Morro Bay-Mesa And Morro Bay-Diablo 230 kV Lines	148	146
Morrobay 230/115 kV Transformer	Callender Sw Sta-Mesa & San Luis Obispo-Santa Maria 115 kV Lines	110	125
Morrobay - Templeton 230 kV Ckt 1	Midway-Calntess 230 kV Line No. 1 & 2	NA	100
Q1593Swsta - Gates F 230 kV Ckt 1	Dry Lake-Midway-F #1 230kV & Arco-Midway 230kV	169	NA
	Q1593Swsta-Midway-F #1 230kV	NA	155
Snta Mra - Sn Ls Ob 115 kV Ckt 1	Morro Bay-Mesa And Morro Bay-Diablo 230 kV Lines	120	118
Sntamrtp - Snta Mra 115 kV Ckt 1	Morro Bay-Mesa And Morro Bay-Diablo 230 kV Lines	126	124
Whlr Rj2 - Wnd Gpj2 230 kV Ckt 2	Midway-Wheeler Ridge #1 230kV & Bitterwater SS-Midway 230kV	NA	110
Witco_Jct - Dscvrytp 115 kV Ckt 1	7th Standard-Kern 115kV	122	NA
Wnd Gpj2 - Wheeler 230 kV Ckt 2	Midway-Wheeler Ridge #1 230kV & Bitterwater SS-Midway 230kV	111	138

2036 Base Portfolio Off-Peak Kern Area Deliverability Constraints (1of 2)

Facility	Contingency	%Loading
7th Standard-Kern 115kV	Kern Oil-Witco 115kV	105
Arco-Midway 230kV	Midway-D-Midway-R12 #1 230kV	102
Arco-Twisselman 70kV	Base Case	125
Atascadero-Cayucos 70kV	Morro Bay-Calflats Ss And Morro Bay-Templeton 230 kV Lines	135
Atascadero-San Luis Obispo 70kV	Morro Bay-Calflats Ss And Morro Bay-Templeton 230 kV Lines	155
Bitterwatrss-Midway-Dbaah 230kV	Casaloma-Kern Pp 230kV & Kern-Stockdale #1 230kV	349
Bitterwatrss-Wheeler 230kV	Midway-Wheeler Ridge #1 230kV	273
Callender Sw Sta-Mesa 115kV	Morro Bay-Mesa And Diablo-Mesa 230 kV Lines	236
Charca-Famoso 115kV	Midway-Kern #1(Midway-Bakersfield) & Midway-Kern #2 230kV	104
Coalinga #1-San Miguel 70kV	Templeton-Gates 230kV	187
Columbus-Magunden 115kV	Kern-Magunden-Witco 115kV	177
Kern Oil-Liveoakswsta-Poso Mt 115kV	Base Case	361
Kern Oil-Witco 115kV	Lerdo-Kern Oil-7th Standard 115 kV Line & Kern-Live Oak 115 kV Lines	472
Kern-Magunden 70kV	Casaloma-Kern Pp 230kV & Kern-Stockdale #1 230kV	175
Kern-Magunden-Witco 115kV	Lerdo-Kern Oil-7th Standard 115 kV Line & Kern-Live Oak 115 kV Lines	265
Lerdo-Famoso 115kV	Midway-Kern #1(Midway-Bakersfield) & Midway-Kern #2 230kV	119
Lerdo-Kern Oil-7th Standard 115kV	Midway-Kern #1(Midway-Bakersfield) & Midway-Kern #2 230kV	142
Magunden-Weedptch-Kerncanyonph 70kV	Casaloma-Kern Pp 230kV & Kern-Stockdale #1 230kV	175
Maricopa-Copus 70kV	Midway-Kern #1(Midway-Bakersfield) & Midway-Kern #2 230kV	131
Mesa_Pge-Snta Mra 115kV	Morro Bay-Mesa And Diablo-Mesa 230 kV Lines	118
Midway 500/230kV Tb 11	Midway-D-Midway-R12 #1 230kV	157
Midway 500/230kV Tb 12	Morro Bay-Calflats Ss And Morro Bay-Templeton 230 kV Lines	167
Midway-Wheeler Ridge #1 230kV	Casaloma-Kern Pp 230kV & Kern-Stockdale #1 230kV	184
Morro Bay-Diablo 230kV	Morro Bay-Mesa And Diablo-Mesa 230 kV Lines	246
Morro Bay-San Luis Obispo #1 115kV	Morro Bay-Mesa And Diablo-Mesa 230 kV Lines	101
Morro Bay-San Luis Obispo #2 115kV	Morro Bay-Mesa And Diablo-Mesa 230 kV Lines	103

2036 Base Portfolio Off-Peak Kern Area Deliverability Constraints (2 of 2)

Facility	Contingency	%Loading
Morro Bay-Templeton 230kV	California Flats Sw Sta-Gates 230kV	182
Morrobay 230/115kV Tb 6	Morro Bay-Mesa And Diablo-Mesa 230 kV Lines	146
Templeton-14C1959SS 230 kV Line	Templeton-Gates 230kV	198
Estrella - Calflatsss 230 kV Line	Gates D-14C1959SS #1 230kV	181
Morrobay- Estrella 230 kV Line	Gates D-14C1959SS #1 230kV	173
Posomtjct1 - Kern Oil 115 kV Line	Kern-Kern Oil-Famoso 70kV	154
Midway 500/230kV Tb 11	Midway 500/230kV Tb 12	135
Midway 500/230kV Tb 13	Midway 500/230kV Tb 12	134
Midway-E 230/115kV Tb 3	Midway-E 230/115kV Tb 2	125
Casaloma -Arvinj1 115 kV Line	Casaloma-Lamont 115kV	124
Midway-E 230/115kV Tb 2	Midway-E 230/115kV Tb 3	124
Stockdalee- Stockdalef 230 kV Line	Midway-Wheeler Ridge #1 230kV	122
Casaloma - Arvinj2 115 kV Line	Casaloma-Lamont 115kV	118
Wheeler - Casaloma 230 kV Line	Midway-Wheeler Ridge #1 230kV	116
Midway-F - Kern Pp 230 kV Line	Midway-Kern No. 3 & Midway-Kern No. 4 230 kV Lines	116
Uniontap - Paso Robles 70.0 kV Line	Morro Bay-Calflats Ss And Templeton-Gates 230 kV Lines	101
Oceano-Callender Sw Sta 115kV	Morro Bay-Mesa And Diablo-Mesa 230 kV Lines	241
Q1493-Arco #1 70kV	Midway-D-Midway-R12 #1 230kV	104
San Luis Obispo-Cayucos 70kV	Morro Bay-Calflats Ss And Morro Bay-Templeton 230 kV Lines	127
San Luis Obispo-Oceano 115kV	Morro Bay-Mesa And Diablo-Mesa 230 kV Lines	171
San Luis Obispo-Santa Maria 115kV	Morro Bay-Mesa And Diablo-Mesa 230 kV Lines	237
Skic10-Skern20-Copus_D-Old Rivr 70kV	Midway-Kern #1(Midway-Bakersfield) & Midway-Kern #2 230kV	137
Stockdle-Lamont-Kern Pp-Tevis 115kV	Casaloma-Lamont 115kV	124
Taft A-Berrycogen18-Maricopa-Cadet 70kV	Midway-Kern #1(Midway-Bakersfield) & Midway-Kern #2 230kV	107
Taft-Cuyama #1 70kV	Base Case	100
Templeton-Atascadero 70kV	Morro Bay-Calflats Ss And Morro Bay-Templeton 230 kV Lines	162
Weedpatch-San Bernard 70kV	Casaloma-Kern Pp 230kV & Kern-Stockdale #1 230kV	123
Wheeler 115/70kV Tb 2	Base Case	152

The complete set of PG&E Constraint Summary tables are posted as reference material on the 2026-2027 Transmission Planning Process Stakeholder Process Page

Preliminary Economic Assessment Results

Yi Zhang
Sr. Advisor, Transmission Infrastructure Planning

2026-2027 Transmission Planning Process Stakeholder Meeting

November 18, 2025

Outline of the presentation

- 2036 Base portfolio PCM preliminary results
- 2041 Base portfolio PCM preliminary results
- Preliminary high priority study areas
- Preliminary economic assessment results for Path 15 corridor connection mitigation

2036 Base portfolio preliminary congestion results

2036 Base portfolio preliminary PCM – congestion

Area or branch group	Total Congestion Cost ($M)	Total Congestion Hours (Hrs)
Path 15 Corridor	558.21	9,377
Path 26 Corridor	184.51	4,041
East of Pisgah - Eldorado - McCullough 500 kV	143.98	8,612
PG&E VacaDixon - Moraga 230 kV	127.72	1,470
PG&E Los Banos - Westley 230 kV	93.75	2,117
PG&E Manning - Metcalf 500 kV	80.83	794
COI Corridor	57.82	942
Path 65 PDCI	47.25	2,036
PG&E Fresno 230 kV	32.02	2,095
PG&E GBA	28.35	1,822
Path 24 PG&E - Sierra	27.49	6,792
PG&E Midway - Gates 230 kV	23.29	3,211
PG&E Round MT 230 kV	22.12	2,012
SCE Metro	22.08	5,364
SCE Lugo - Rancho Vista 500 kV	18.83	1,147
SDG&E ECO	17.79	810
PG&E Los Banos - Panoche 230 kV	14.65	2,705
PG&E MorroBay 230 kV	14.07	2,286
East of Pisgah - GLW/VEA	12.76	3,539
SCE Vincent 500/230 kV	11.23	937
SCE Eastern	10.40	873
PG&E Gates 230 kV	9.94	2,258
Path 46 WOR	9.11	222
PG&E Midway Wheeler Ridge 230 kV	8.51	2,420
PG&E Lakevile - Fulton 230 kV	7.45	1,272
PG&E Cortina - VacaDixon 230 kV	6.64	723
SCE Eastern Parker - Gene 230 kV	4.70	260
SDG&E/CFE	4.56	1,599
PG&E Sierra	3.70	1,049
PG&E Humboldt 500/115 kV	3.55	1,786
PG&E Moss Landing - Las Aguilas 230 kV corridor	2.03	781

2036 Congestion - Path 15 corridor

Constraints Name	Cost Forward ($K)	Duration Forward (Hrs)	Cost Backward ($K)	Duration Backward (Hrs)	Costs Total ($K)	Duration Total (Hrs)	*From Bus Name*	*From Bus ID*	*To Bus Name*	*To Bus ID*	*CKT*
P15 Midway-LosBanos S-N	223,187	2,333	0	0	223,187	2,333					
MANNING-MNG_HRL_21 500 kV line #2	0	0	141,910	3,096	141,910	3,096	MANNING	30052	MNG_HRL_21	300562	2
GATES-GAT_MDW_11 500 kV line, subject to PG&E N-1 Midway-Manning 500 kV South Gates	0	0	68,855	1,227	68,855	1,227	GATES	30055	GAT_MDW_11	300551	1
MNG_HRL_21-HARLANSWSTA 500 kV line #2	0	0	38,151	796	38,151	796	MNG_HRL_21	300562	HARLANSWSTA	30056	2
GATES-GAT_MDW_11 500 kV line #1	0	0	37,491	728	37,491	728	GATES	30055	GAT_MDW_11	300551	1
GAT_MDW_11-MIDWAY 500 kV line #1	0	0	18,757	338	18,757	338	GAT_MDW_11	300551	MIDWAY	30060	1
HRL_MDW_24-MIDWAY 500 kV line, subject to PG&E N-1 Midway-Gates 500 kV with SPS	0	0	15,883	364	15,883	364	HRL_MDW_24	300567	MIDWAY	30060	2
GAT_MDW_11-MIDWAY 500 kV line, subject to PG&E N-1 Midway-Manning 500 kV South Gates	0	0	8,229	176	8,229	176	GAT_MDW_11	300551	MIDWAY	30060	1
LOSBANOS-LB_GT_31 500 kV line #3	0	0	2,870	100	2,870	100	LOSBANOS	30050	LB_GT_31	300511	3
LB_GT_32-GATES 500 kV line #3	0	0	2,045	47	2,045	47	LB_GT_32	300512	GATES	30055	3
LB_GT_31-LB_GT_32 500 kV line #3	0	0	585	18	585	18	LB_GT_31	300511	LB_GT_32	300512	3
MNG_HRL_21-HARLANSWSTA 500 kV line, subject to PG&E N-1 Midway-Gates 500 kV with SPS	0	0	239	151	239	151	MNG_HRL_21	300562	HARLANSWSTA	30056	2
PANOCHE-GATES E 230 kV line, subject to PG&E N-2 Mustang-Gates #1 and #2 230 kV	0	0	11	3	11	3	PANOCHE	30790	GATES E	30902	2

2036 Congestion - Path 26 corridor

Constraints Name	Cost Forward ($K)	Duration Forward (Hrs)	Cost Backward ($K)	Duration Backward (Hrs)	Costs Total ($K)	Duration Total (Hrs)	*From Bus Name*	*From Bus ID*	*To Bus Name*	*To Bus ID*	*CKT*
MW_WRLWND_32-WIRLWIND 500 kV line, subject to SCE N-2 Midway-Vincent 500 kV	1	9	120,180	1,693	120,181	1,702	MW_WRLWND_32	24594	WIRLWIND	29402	3
MW_WRLWND_31-MW_WRLWND_32 500 kV line, subject to SCE N-2 Midway-Vincent 500 kV	465	130	54,314	1,258	54,778	1,388	MW_WRLWND_31	24595	MW_WRLWND_32	24594	3
MW_VINCNT_22-VINCENT 500 kV line, subject to SCE N-1 Midway-Vincent #1 500kV	6,947	465	24	4	6,970	469	MW_VINCNT_22	24592	VINCENT	24156	2
MW_WRLWND_31-MW_WRLWND_32 500 kV line #3	0	0	2,451	421	2,451	421	MW_WRLWND_31	24595	MW_WRLWND_32	24594	3
P26 Northern-Southern California N-S	71	44	0	0	71	44					
MW_VINCNT_22-VINCENT 500 kV line #2	22	6	0	0	22	6	MW_VINCNT_22	24592	VINCENT	24156	2
MW_WRLWND_32-WIRLWIND 500 kV line #3	0	0	17	3	17	3	MW_WRLWND_32	24594	WIRLWIND	29402	3
MW_WRLWND_31-MW_WRLWND_32 500 kV line, subject to SCE N-1 Whirlwnd-Antelope 500kV	0	0	10	1	10	1	MW_WRLWND_31	24595	MW_WRLWND_32	24594	3
MIDWAY-MW_VINCNT_11 500 kV line, subject to SCE N-1 Midway-Vincent #2 500kV	5	4	0	0	5	4	MIDWAY	30060	MW_VINCNT_11	24591	1
MIDWAY-MW_VINCNT_11 500 kV line #1	3	1	0	0	3	1	MIDWAY	30060	MW_VINCNT_11	24591	1
MW_VINCNT_12-VINCENT 500 kV line, subject to SCE N-1 Midway-Vincent #2 500kV	1	2	0	0	1	2	MW_VINCNT_12	24590	VINCENT	24156	1

Path 15 and Path 26 south to north congestion occurrence pattern

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

Midway - Manning

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

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

2041 Base portfolio preliminary congestion results

2041 Base portfolio preliminary PCM – congestion

Area or Branch group	Total Congestion Cost ($M)	Total Congestion Hours (Hrs)
PG&E VacaDixon - Moraga 230 kV	769.91	4,979
Path 15 Corridor	644.98	9,026
Path 26 Corridor	284.50	4,728
PG&E Manning - Metcalf 500 kV	235.47	1,397
PG&E GBA	196.88	5,170
East of Pisgah - Eldorado - McCullough 500 kV	169.23	8,384
PG&E Los Banos - Westley 230 kV	135.34	2,376
SCE Metro	126.38	6,193
COI Corridor	63.55	726
Path 65 PDCI	56.98	2,015
SCE Lugo - Rancho Vista 500 kV	53.52	1,461
Path 24 PG&E - Sierra	36.77	7,911
SCE Vincent 500/230 kV	36.14	1,243
SCE Northern - Pardee 230 kV	35.09	1,685
PG&E Moss Landing - Las Aguilas 230 kV corridor	33.37	2,193
PG&E Fresno 230 kV	29.52	1,780
PG&E Round MT 230 kV	23.51	1,796
Path 46 WOR	20.82	345
PG&E Midway - Gates 230 kV	20.76	2,907
PG&E Humboldt 500/115 kV	16.54	1,558
PG&E MorroBay 230 kV	12.53	2,146
SCE Eastern	12.10	772
East of Pisgah - GLW/VEA	12.03	3,168
SDG&E ECO	11.51	754
PG&E Los Banos - Panoche 230 kV	10.77	2,511
SDG&E/CFE	9.03	1,981
SDG&E MIGUEL 230 kV	8.99	615
PG&E Tesla 500/230 kV	8.19	213
SCE Eastern Parker - Gene 230 kV	7.66	371
PG&E Midway Wheeler Ridge 230 kV	7.23	2,307
PG&E Sierra	5.61	2,383
PG&E Gates 230 kV	5.36	1,484
PG&E Lakevile - Fulton 230 kV	5.32	1,132
PG&E Tesla 230 kV	4.27	391
SDG&E Eco - Miguel 500 kV	2.96	142
PG&E Table MT 230 kV	2.69	88
Moenkope - Eldorado 500 kV	2.59	190
PG&E Cortina - VacaDixon 230 kV	2.42	330

2041 Congestion - Path 15 corridor

Constraints Name	Cost Forward ($K)	Duration Forward (Hrs)	Cost Backward ($K)	Duration Backward (Hrs)	Costs Total ($K)	Duration Total (Hrs)	*FromBusName*	*FromBusID*	*ToBusName*	*ToBusID*	*CKT*
P15 Midway-LosBanos S-N	181,552	1,701			181,552	1,701					
MANNING-MNG_HRL_21 500 kV line #2			157,120	2,959	157,120	2,959	MANNING	30052	MNG_HRL_21	300562	2
GATES-GAT_MDW_11 500 kV line, subject to PG&E N-1 Midway-Manning 500 kV South Gates			94,580	1,254	94,580	1,254	GATES	30055	GAT_MDW_11	300551	1
GATES-GAT_MDW_11 500 kV line #1			72,501	865	72,501	865	GATES	30055	GAT_MDW_11	300551	1
GAT_MDW_11-MIDWAY 500 kV line #1			61,813	574	61,813	574	GAT_MDW_11	300551	MIDWAY	30060	1
MNG_HRL_21-HARLANSWSTA 500 kV line #2			34,806	655	34,806	655	MNG_HRL_21	300562	HARLANSWSTA	30056	2
HRL_MDW_24-MIDWAY 500 kV line, subject to PG&E N-1 Midway-Gates 500 kV with SPS			18,960	390	18,960	390	HRL_MDW_24	300567	MIDWAY	30060	2
GAT_MDW_11-MIDWAY 500 kV line, subject to PG&E N-1 Midway-Manning 500 kV South Gates			10,739	177	10,739	177	GAT_MDW_11	300551	MIDWAY	30060	1
LOSBANOS-LB_GT_31 500 kV line #3			7,314	165	7,314	165	LOSBANOS	30050	LB_GT_31	300511	3
LB_GT_32-GATES 500 kV line #3			4,372	86	4,372	86	LB_GT_32	300512	GATES	30055	3
LB_GT_31-LB_GT_32 500 kV line #3			981	35	981	35	LB_GT_31	300511	LB_GT_32	300512	3
MNG_HRL_21-HARLANSWSTA 500 kV line, subject to PG&E N-1 Midway-Gates 500 kV with SPS			239	163	239	163	MNG_HRL_21	300562	HARLANSWSTA	30056	2
PANOCHE-GATES E 230 kV line, subject to PG&E N-2 Mustang-Gates #1 and #2 230 kV	0	0	1.104216	2	1.104216158	2	PANOCHE	30790	GATES E	30902	2

2041 Congestion - Path 26 corridor

Constraints Name	Cost Forward ($K)	Duration Forward (Hrs)	Cost Backward ($K)	Duration Backward (Hrs)	Costs Total ($K)	Duration Total (Hrs)	*FromBusName*	*FromBusID*	*ToBusName*	*ToBusID*	*CKT*
MW_WRLWND_32-WIRLWIND 500 kV line, subject to SCE N-2 Midway-Vincent 500 kV	47	41	245,568	2,478	245,615	2,519	MW_WRLWND_32	24594	WIRLWIND	29402	3
MIDWAY-MW_WRLWND_31 500 kV line, subject to SCE N-2 Midway-Vincent 500 kV	13	12	25,763	438	25,776	450	MIDWAY	30060	MW_WRLWND_31	24595	3
MW_WRLWND_31-MW_WRLWND_32 500 kV line #3			6,551	1,106	6,551	1,106	MW_WRLWND_31	24595	MW_WRLWND_32	24594	3
MW_VINCNT_22-VINCENT 500 kV line, subject to SCE N-1 Midway-Vincent #1 500kV	6,351	577	39	9	6,389	586	MW_VINCNT_22	24592	VINCENT	24156	2
P26 Northern-Southern California N-S	76.324643	48	0	0	76.3246431	48					
MW_VINCNT_22-VINCENT 500 kV line #2	45.867991	10	0	0	45.86799097	10	MW_VINCNT_22	24592	VINCENT	24156	2
MIDWAY-MW_VINCNT_11 500 kV line #1	15.01541	3	0	0	15.01540991	3	MIDWAY	30060	MW_VINCNT_11	24591	1
MW_VINCNT_12-VINCENT 500 kV line #1	12.859725	3	0	0	12.85972534	3	MW_VINCNT_12	24590	VINCENT	24156	1
MIDWAY-MW_VINCNT_11 500 kV line, subject to SCE N-1 Midway-Vincent #2 500kV	11.308161	2	0	0	11.30816064	2	MIDWAY	30060	MW_VINCNT_11	24591	1
MW_VINCNT_12-VINCENT 500 kV line, subject to SCE N-1 Midway-Vincent #2 500kV	3.4144585	1	0	0	3.414458496	1	MW_VINCNT_12	24590	VINCENT	24156	1

2041 Congestion - PG&E Vaca-Dixon – Moraga 230 kV corridor

Constraints Name	Cost Forward ($K)	Duration Forward (Hrs)	Cost Backward ($K)	Duration Backward (Hrs)	Costs Total ($K)	Duration Total (Hrs)	*From Bus Name*	*From Bus ID*	*To Bus Name*	*To Bus ID*	*CKT*
VACA-DIXON F-PARKWAY 230 kV line, subject to PG&E N-1 VacaDixon-Bahia 230kV	723,574	4,552			723,574	4,552	VACA-DIXON F	30460	PARKWAY	30467	1
VACA-DIXON F-BAHIA 230 kV line, subject to PG&E N-1 VacaDixon-Parkway 230kV	37,750	386			37,750	386	VACA-DIXON F	30460	BAHIA	30465	1
VACA-DIXON F-PARKWAY 230 kV line #1	7,991	38			7,991	38	VACA-DIXON F	30460	PARKWAY	30467	1
VACA-DIXON F-BAHIA 230 kV line #1	591	3			591	3	VACA-DIXON F	30460	BAHIA	30465	1

Vaca-Dixon – Parkway 230 kV congestion under Vaca-Dixon – Bahia 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	25	25	16	9	7	4	6	21	22	25	20	14	11	12	14	6	14	21	23	25	24	25	25	28
Feb	25	27	20	9	6	4	12	16	16	13	9	4	1	1	0	1	4	15	18	23	23	22	20	21
Mar	28	24	19	14	11	9	15	20	19	19	15	12	9	8	9	10	8	19	22	24	25	26	24	23
Apr	28	26	21	18	16	15	15	17	14	9	6	5	3	4	5	4	6	13	23	24	25	25	25	26
May	31	31	28	25	22	18	11	13	14	16	14	14	13	14	12	14	14	22	29	31	31	31	31	31
Jun	30	30	30	29	28	26	21	15	17	16	18	16	17	20	19	21	25	29	30	30	30	30	30	30
Jul	29	24	22	21	19	19	13	15	15	16	13	14	15	14	15	20	28	31	31	31	31	31	31	31
Aug	30	27	22	20	16	14	17	16	15	15	17	19	18	18	16	21	27	30	31	31	31	31	31	31
Sep	26	21	15	7	3	6	6	8	9	9	10	11	12	14	13	18	22	28	29	29	28	28	28	27
Oct	9	4	0	0	0	0	0	0	1	0	0	0	0	0	0	1	3	4	3	5	5	7	8	8
Nov	20	18	15	6	1	0	5	5	5	3	3	3	2	2	2	3	5	13	12	19	16	13	17	17
Dec	11	11	7	2	3	2	2	11	14	10	8	5	3	3	4	4	10	10	10	13	13	13	13	13

2041 Congestion - PG&E Manning – Metcalf

Constraints Name	Cost Forward ($K)	Duration Forward (Hrs)	Cost Backward ($K)	Duration Backward (Hrs)	Costs Total ($K)	Duration Total (Hrs)	*From Bus Name*	*From Bus ID*	*To Bus Name*	*To Bus ID*	*CKT*
MANNING-MNMC_SC1 500 kV line #1	158,493	836			158,493	836	MANNING	30052	MNMC_SC1	399110	1
MNMC_SC2-METCALF 500 kV line #1	39,082	250			39,082	250	MNMC_SC2	399111	METCALF	30042	1
MANNING-MNMC_SC1 500 kV line, subject to PG&E N-1 Mosslanding-LosBanos 500 kV with SPS	20,572	171			20,572	171	MANNING	30052	MNMC_SC1	399110	1
MNMC_SC1-MNMC_SC2 500 kV line #1	8,937	73			8,937	73	MNMC_SC1	399110	MNMC_SC2	399111	1
MNMC_SC2-METCALF 500 kV line, subject to PG&E N-1 Mosslanding-LosBanos 500 kV with SPS	4,232	35			4,232	35	MNMC_SC2	399111	METCALF	30042	1
MNMC_SC1-MNMC_SC2 500 kV line, subject to PG&E N-1 Mosslanding-LosBanos 500 kV with SPS	1,683	21			1,683	21	MNMC_SC1	399110	MNMC_SC2	399111	1
MANNING-MNMC_SC1 500 kV line, subject to PG&E-BANC N-2 Tesla-Tracy 500kV #1 and Tracy-LosBanos 500kV #1	1,228	6			1,228	6	MANNING	30052	MNMC_SC1	399110	1
MNMC_SC2-METCALF 500 kV line, subject to PG&E-BANC N-2 Tesla-Tracy 500kV #1 and Tracy-LosBanos 500kV #1	1,054	3			1,054	3	MNMC_SC2	399111	METCALF	30042	1
MNMC_SC2-METCALF 500 kV line, subject to PG&E N-1 LosBanos-Tesla 500kV with SPS	152	1			152	1	MNMC_SC2	399111	METCALF	30042	1
MNMC_SC1-MNMC_SC2 500 kV line, subject to PG&E-BANC N-2 Tesla-Tracy 500kV #1 and Tracy-LosBanos 500kV #1	33	1			33	1	MNMC_SC1	399110	MNMC_SC2	399111	1

2041 Congestion - PG&E Greater Bay Area

Constraints Name	Cost Forward ($K)	Duration Forward (Hrs)	Cost Backward ($K)	Duration Backward (Hrs)	Costs Total ($K)	Duration Total (Hrs)	*From Bus Name*	*From Bus ID*	*To Bus Name*	*To Bus ID*	*CKT*
VASCOWINDJCT-CAYETANO 230 kV line, subject to PG&E N-2 C.Costa-Moraga 230 kV	79,838	790			79,838	790	VASCOWIN DJCT	30590	CAYETANO	30530	1
E. SHORE-SANMATEO 230 kV line, subject to PG&E N-1 Pittsburg-SanMateo 230kV	21,179	1,279			21,179	1,279	E. SHORE	30560	SANMATEO	30700	1
METCALF2D-LS ESTRS 230 kV line #1	16,474	412			16,474	412	METCALF2 D	30736	LS ESTRS	30731	1
C.COSTAPPE-WINDMASTERJT 230 kV line #1			15,705	868	15,705	868	C.COSTAPP E	30725	WINDMAST ERJT	30574	1
NRS-TRIMBLE 230 kV line #1			15,419	1,053	15,419	1,053	NRS	38900	TRIMBLE	364606	1
METCALFF 230/500 kV transformer #14			10,707	269	10,707	269	METCALFF	30743	METCALF	30042	14
VASCOWINDJCT-CAYETANO 230 kV line, subject to PG&E N-1 C.Costa-LasPositas 230kV	8,441	34			8,441	34	VASCOWIN DJCT	30590	CAYETANO	30530	1
LONETREE-VASCOWINDJCT 230 kV line, subject to PG&E N-1 C.Costa-LasPositas 230kV	7,556	24			7,556	24	LONETREE	30567	VASCOWIN DJCT	30590	1
LS PSTAS-NEWARK D 230 kV line, subject to PG&E N-2 C.Costa-Moraga 230 kV	5,597	145			5,597	145	LS PSTAS	30585	NEWARK D	30630	1
VASCOWINDJCT-CAYETANO 230 kV line #1	4,650	13			4,650	13	VASCOWIN DJCT	30590	CAYETANO	30530	1
LONETREE-VASCOWINDJCT 230 kV line #1	4,086	13			4,086	13	LONETREE	30567	VASCOWIN DJCT	30590	1
MARIPOSA-KELSO 230 kV line #1	2,701	100			2,701	100	MARIPOSA	30568	KELSO	30569	1
METCALF2D-LS ESTRS 230 kV line, subject to PG&E-BANC N-2 Tesla-Tracy 500kV #1 and Tracy-LosBanos 500kV #1	2,235	135			2,235	135	METCALF2 D	30736	LS ESTRS	30731	1
LS PSTAS-NEWARK D 230 kV line, subject to PG&E N-1 C.Costa-LoneTree 230kV	1,388	4			1,388	4	LS PSTAS	30585	NEWARK D	30630	1
E. SHORE-SANMATEO 230 kV line, subject to PG&E N-2 Newark-Ravenswood 230kV and Tesla-Ravenswood 230kV	367	1			367	1	E. SHORE	30560	SANMATEO	30700	1
LS PSTAS-NEWARK D 230 kV line #1	291	1			291	1	LS PSTAS	30585	NEWARK D	30630	1
DELTAPMP-SANDHLWJCT 230 kV line #1	0	0	172	10	172	10	DELTAPMP	38610	SANDHLWJCT	30580	1
MONTAVIS-HICKS 230 kV line #1	0	0	43	1	43	1	MONTAVIS	30705	HICKS	30730	1
LS ESTRS 230/230 kV transformer #1	29	18	0	0	29	18	LS ESTRS	30731	SSS	38904	1

2041 Congestion - PG&E Los Banos – Westley 230 kV and Los Banos – Panoche 230 kV

Constraints Name	Cost Forward ($K)	Duration Forward (Hrs)	Cost Backward ($K)	Duration Backward (Hrs)	Costs Total ($K)	Duration Total (Hrs)	*FromBus Name*	*FromBusID*	*ToBusName*	*ToBusID*	*CKT*
FINKSWSTA-WESTLEY 230 kV line, subject to PG&E N-1 LosBanos-Tesla 500kV with SPS	133,420	2,167			133,420	2,167	FINKSWSTA	30761	WESTLEY	30670	1
LOSBANOS-PADREFLATSS 230 kV line #1			10,577	2,186	10,577	2,186	LOSBANOS	30765	PADREFLATSS	30766	1
QUINTO_SS-FINKSWSTA 230 kV line #1	1,017	145			1,017	145	QUINTO_SS	30763	FINKSWSTA	30761	1
FINKSWSTA-WESTLEY 230 kV line #1	880	54			880	54	FINKSWSTA	30761	WESTLEY	30670	1
LOSBANOS-POLELINE 230 kV line #1	0	0	154	298	154	298	LOSBANOS	30765	POLELINE	30768	1
LOSBANOS-PADREFLATSS 230 kV line, subject to PG&E N-2 Panoche-Manning 230 kV	0	0	43	27	43	27	LOSBANOS	30765	PADREFLATSS	30766	1
QUINTO_SS-LOSBANOS 230 kV line, subject to PG&E N-1 LosBanos-Tesla 500kV with SPS	0	0	23	10	23	10	QUINTO_SS	30763	LOSBANOS	30765	1

Fink – Westley 230 kV congestion under LB-TS 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	0	5	7	6	6	5	3	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	3	15	25	20	18	15	15	12	6	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	4	17	15	16	15	13	12	10	6	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	0	9	19	20	16	14	14	11	12	11	3	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	19	23	24	24	20	19	17	17	21	21	0	1	0	0	0	0
Jun	0	0	0	0	0	0	0	11	24	26	25	23	22	22	20	23	26	27	2	3	0	0	0	0
Jul	0	0	0	0	0	0	0	3	28	29	29	29	28	30	30	29	31	31	10	14	8	0	0	0
Aug	0	0	0	0	0	0	0	0	26	30	30	30	30	30	30	31	31	29	5	10	0	0	0	0
Sep	0	0	0	0	0	0	0	0	22	29	29	29	28	28	28	30	30	1	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	26	29	29	29	29	28	28	3	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	3	18	26	26	24	22	20	16	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0	2	11	15	14	11	5	0	0	0	0	0	0	0	0	0

2041 Congestion - PG&E Moss Landing – Las Aguilas 230 kV

Constraints Name	Cost Forward ($K)	Duration Forward (Hrs)	Cost Backward ($K)	Duration Backward (Hrs)	Costs Total ($K)	Duration Total (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 Manning-Metcalf 500 kV with SPS			28,733	849	28,733	849	MOSSLNSW	30755	LASAGLSRCTR	30798	1
COBURN-LASAGUILASS 230 kV line, subject to PG&E N-1 Manning-Metcalf 500 kV with SPS			2,794	433	2,794	433	COBURN	30760	LASAGUILASS	30797	1
COBURN-LASAGUILASS 230 kV line #1			1,366	879	1,366	879	COBURN	30760	LASAGUILASS	30797	1
MOSSLNSW-COBURN 230 kV line #1			448	26	448	26	MOSSLNSW	30755	COBURN	30760	1
MOSSLNSW-LASAGLSRCTR 230 kV line #1			23	1	23	1	MOSSLNSW	30755	LASAGLSRCTR	30798	1
MOSSLNSW-COBURN 230 kV line, subject to PG&E N-1 Mosslanding-LosBanos 500 kV with SPS			3	5	3	5	MOSSLNSW	30755	COBURN	30760	1

Moss Landing – Las Aguilas 230 kV under Manning – Metcalf 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	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	0	0	0	0	0	0	0	0	10	14	10	4	1	3	1	0	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	1	12	16	18	14	12	12	8	4	3	0	0	0	0	0	0	0
Jun	0	0	0	0	0	0	0	9	15	18	17	14	15	14	13	15	11	1	0	0	0	0	0	0
Jul	0	0	0	0	0	0	0	3	23	24	20	19	21	20	21	17	13	0	0	0	0	0	0	0
Aug	0	0	0	0	0	0	0	1	15	24	25	25	25	24	21	19	4	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0	9	24	21	21	19	19	19	18	1	0	0	0	0	0	0	0
Oct	0	0	0	0	0	0	0	0	0	16	16	6	4	3	2	2	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

SCE Metro area

Constraints Name	Cost Forward ($K)	Duration Forward (Hrs)	Cost Backward ($K)	Duration Backward (Hrs)	Costs Total ($K)	Duration Total (Hrs)	*FromBus Name*	*FromBusID*	*ToBusName*	*ToBusID*	*CKT*
LCIENEGA-LA FRESA 230 kV line, subject to SCE N-2 La Fresa-El Nido #3 and #4 230 kV			118,180	3,949	118,180	3,949	LCIENEGA	24082	LA FRESA	24074	1
MESA CAL 500/13.8 kV transformer #4	4,561	730			4,561	730	MESA CAL	24386	mesa4i	24390	4
MESA CAL 500/13.8 kV transformer #2	2,434	183			2,434	183	MESA CAL	24386	mesa2i	24391	2
BARRE-LEWIS 230 kV line #1			892	585	892	585	BARRE	24016	LEWIS	25201	1
LITEHIPE-MESA CAL 230 kV line, subject to SCE N-2 Mesa-Laguna Bell 230 kV and Mesa-La Fresa 230 kV			172	449	172	449	LITEHIPE	24084	MESA CAL	24091	1
LAGUBELL-MESA CAL 230 kV line, subject to SCE N-2 Mesa-Laguna Bell 230 kV #2 and Mesa-Lighthipe 230 kV			65	125	65	125	LAGUBELL	24076	MESA CAL	24091	1
MESACALS-LAGUBELL 230 kV line, subject to SCE N-2 Mesa-Laguna Bell 230 kV and Mesa-La Fresa 230 kV	22	8			22	8	MESACALS	24393	LAGUBELL	24076	2
LITEHIPE-MESA CAL 230 kV line, subject to SCE N-2 Mesa-Laguna Bell 230 kV #1 and #2	0	0	16	94	16	94	LITEHIPE	24084	MESA CAL	24091	1
MIRALOMA 500/13.8 kV transformer #1	14	31			14	31	MIRALOMA	24092	mirlom1i	24178	1
MESACALS-LAGUBELL 230 kV line #2	13	3			13	3	MESACALS	24393	LAGUBELL	24076	2
LITEHIPE-MESA CAL 230 kV line #1			5	26	5	26	LITEHIPE	24084	MESA CAL	24091	1
HINSON-DELAMO 230 kV line, subject to SCE N-2 La Fresa-Laguna Bell 230 kV #1 and La Fresa-Mesa 230 kV #1			4	10	4	10	HINSON	24065	DELAMO	24029	1

2036 and 2041 Base portfolio preliminary curtailment results

Renewable curtailment – 2036 base portfolio

Renewable zone	Generation (GWh)	Curtailment (GWh)	Total potential (GWh)	Curtailment Ratio
NV-North	1,119	1,590	2,709	58.70%
SDGE Bulk Power	18,776	7,595	26,371	28.80%
PG&E Kern	13,690	5,075	18,765	27.04%
AZ-Hassayampa	5,805	2,042	7,847	26.02%
PG&E Central Coast	5,223	1,721	6,944	24.79%
SCE Eastern	22,779	7,080	29,859	23.71%
AZ-WALC	1,317	326	1,643	19.83%
EOP	14,994	3,449	18,443	18.70%
SCE NOL	5,906	1,256	7,162	17.53%
SDGE	551	97	648	14.98%
WY	10,179	1,585	11,764	13.47%
NM	22,884	3,196	26,080	12.25%
PG&E Fresno	29,243	3,741	32,985	11.34%
SCE Northern	42,555	5,134	47,689	10.77%
IID	1,245	133	1,379	9.67%
SCE Metro	400	36	437	8.31%
OSW-DiabloCanyon	10,751	530	11,280	4.69%
NW	2,265	87	2,353	3.71%
ID	2,050	54	2,104	2.58%
PG&E North Valley	1,452	33	1,485	2.22%
BANC	648	13	661	1.91%
PG&E Central Valley	1,268	24	1,292	1.88%
PG&E North Coast	1,181	15	1,196	1.26%
PG&E GBA	9,933	120	10,053	1.19%
Total	226,214	44,934	271,148	16.57%

Renewable curtailment – 2041 base portfolio

Renewable zone	Generation (GWh)	Curtailment (GWh)	Total potential (GWh)	Curtailment Ratio
NV-North	912	2,653	3,565	74.41%
SDGE Bulk Power	20,373	9,746	30,119	32.36%
SCE Eastern	20,960	8,899	29,859	29.80%
AZ-Hassayampa	5,655	2,192	7,847	27.93%
PG&E Kern	13,692	5,073	18,765	27.04%
PG&E Fresno	259	92	351	26.18%
PG&E Central Coast	5,154	1,790	6,944	25.78%
EOP	15,156	4,335	19,491	22.24%
PG&E North Valley	1,595	432	2,027	21.30%
SCE NOL	5,672	1,490	7,162	20.80%
AZ-WALC	1,318	325	1,643	19.79%
SDGE	528	119	648	18.41%
SCE Metro	4,454	734	5,188	14.15%
WY	26,914	4,393	31,307	14.03%
PG&E Fresno	31,803	5,169	36,972	13.98%
SCE Northern	43,383	6,469	49,851	12.98%
NM	40,612	5,776	46,388	12.45%
IID	1,248	131	1,379	9.49%
PG&E Central Valley	1,380	94	1,474	6.40%
OSW-DiabloCanyon	10,640	640	11,280	5.67%
PG&E North Coast	2,086	123	2,209	5.58%
NW	2,254	99	2,353	4.21%
ID	2,025	79	2,104	3.75%
PG&E GBA	10,456	245	10,701	2.29%
BANC	647	14	661	2.11%
OSW-Humboldt Bay	2,775	54	2,829	1.90%
Total	271,952	61,165	333,117	18.36%

Preliminary economic assessment results for Path 15 corridor congestion mitigation

Case Name	ISO Load Payment ($M/year)	ISO Gen Profit ($M/year)	ISO Trans Revenue ($M/year)	ISO Net Payment ($M/year)	WECC Production Cost ($M/year)	Production cost saving ($M/year)	WECC Saving ($M/year)	PV of Production cost saving ($M)	Total Cost ($M)	Benefit to Cost Ratio	Description of Alternative
Base	14,896	7,224	2,575	5,097	23,286						2041 Base portfolio
WH-TS A0	13,891	6,937	2,337	4,617	23,055	480	231	6,622	2,865	2.31	WH-TS without any tie-in
WH-TS A1	13,771	6,938	2,278	4,555	23,000	542	285	7,474	3,180	2.35	WH-TS with tie-in MW
WH-TS A2	13,749	6,944	2,258	4,548	22,994	549	292	7,572	3,495	2.17	WH-TS with tie-in MW and GT (the A6 in 2025-2026 TPP)
WH-TS A3	13,721	6,919	2,241	4,560	22,996	536	290	7,399	3,495	2.12	WH-TS with tie-in MW and MN
WH-TS A4	13,706	6,886	2,236	4,584	22,992	513	294	7,076	3,811	1.86	WH-TS with tie-in MW, GT, and MN
WH-TS A5	13,697	6,894	2,232	4,571	22,989	525	297	7,247	4,126	1.76	WH-TS with tie-in MW, GT, MN, and LB

Next Steps

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:
  - Path 15 corridor and adjacent transmission congestion
    - Path 15 corridor
    - Manning – Metcalf 500 kV
    - Los Banos – Westley and Los Banos – Panoche 230 kV
  - Path 26 corridor congestion
  - Vaca-Dixion – Moraga 230 kV corridor 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 updates from WECC 2036 ADS PCM
  - 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

Energy-Only Resources Assessment Preliminary Findings

2026-2027 Transmission Planning Process Stakeholder Meeting

November 19, 2025

Outline of the presentation

- In the 2026–2027 TPP Study Plan, the 2036 summer off-peak scenario was developed with: high battery charging, to the extent feasible; load representing typical late morning on the summer peak day; and high production of solar and FCDS resources necessary to serve the load and battery charging
- The ISO presented preliminary results during the September 23 stakeholder meeting
- Additional results are provided today quantifying the resource curtailment necessary to mitigate the identified overloads

2036 Summer Off-Peak Scenario North Area Energy-Only Resources Assessment

Energy Only Generation Curtailment				
Study Area	Energy Only (MW) Installed Capacity	Total Curtailment (MW)		
		P0	P1	P7
Humboldt	458	0	0	0
NCNB	0	0	0	0
NVLY	545	0	304	0
GBA	600	0	133	52
CVLY	330	0	0	0
Fresno	2,578	466	1,310	835
Kern	2,227	0	0	8
CCLP	595	0	0	200

2036 Summer Off-Peak Scenario South Area Energy-Only Resources Assessment

Energy Only Generation Curtailment				
Study Area	Energy Only (MW) Installed Capacity	Total Curtailment (MW)		
		P0	P1	P7
Tehachapi/Big Creek	2702	0	0	0
NOL	683	0	0	683
Eastern	7,389	0	0	0
Metro	83	0	0	0
Ventura	0	0	0	0
East Of Pisgah	588	0	0	588
VEA	1,546	0	0	589
SDG&E	5,420	0	215	0

Additional Findings

- Some FCDS generation needed to be curtailed to mitigate some of the transmission facility overloads in several of the study areas in the northern part of the ISO
- A large amount of battery charging needed to be curtailed in the SCE Metro area and battery charging curtailment was needed in several other areas as well, to mitigate transmission system overloads

Discussion of Study Assumptions

- Some stakeholders raised concerns that the ISO study is unreasonably limited to only a worst-case condition, especially the assumption that thermal FCDS resources are dispatched at a high output.
  - The ISO study focuses on charging batteries for the peak load day of the year because that is when a resource shortage is most likely to occur if the batteries cannot be charged
  - Almost all EO generation is solar generation so the study focused on the morning hours of the peak load day when the batteries can be charged by EO generation for the peak load day of the year

Discussion of Study Assumptions continued

- Both CPUC SERVM and ISO Plexos studies have shown that the thermal fleet is dispatched at near maximum output nearly the entire peak load day in the long-term planning horizon
- The 11:00 am hour reasonably represents the time period when charging needs to occur with solar producing at a high output and the load well below the peak load hour.

Discussion of results

- The ISO study shows that EO generation is constrained by the transmission system in some areas during critical energy storage charging conditions
- Further coordination is needed with the CPUC and other Local Regulatory Agencies on this topic

Wrap Up – Next Steps

- Comments due by end of day December 4th, 2026

- Submit comments through the ISO's commenting tool, using the template provided on the process webpage:
- https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/2026-2027-Transmission-planning-process

- Questions? Email ISOStakeholderAffairs@caiso.com



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