20 Year Transmission Outlook Update

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Stakeholder Engagement and Policy Specialist

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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.
- To ask a question, press #2 on your telephone keypad. Please state your name and affiliation first.
- Calls are structured to stimulate an honest dialogue and engage different perspectives.
- Please keep comments friendly and respectful.

Stakeholder Call - Agenda

Topic	Presenter
Introduction	Kaitlin McGee
20 Year Transmission Outlook Update	Jeff Billinton Ebrahim Rahimi
Wrap-up & Next Steps	Kaitlin McGee

20-Year Transmission Outlook - Update

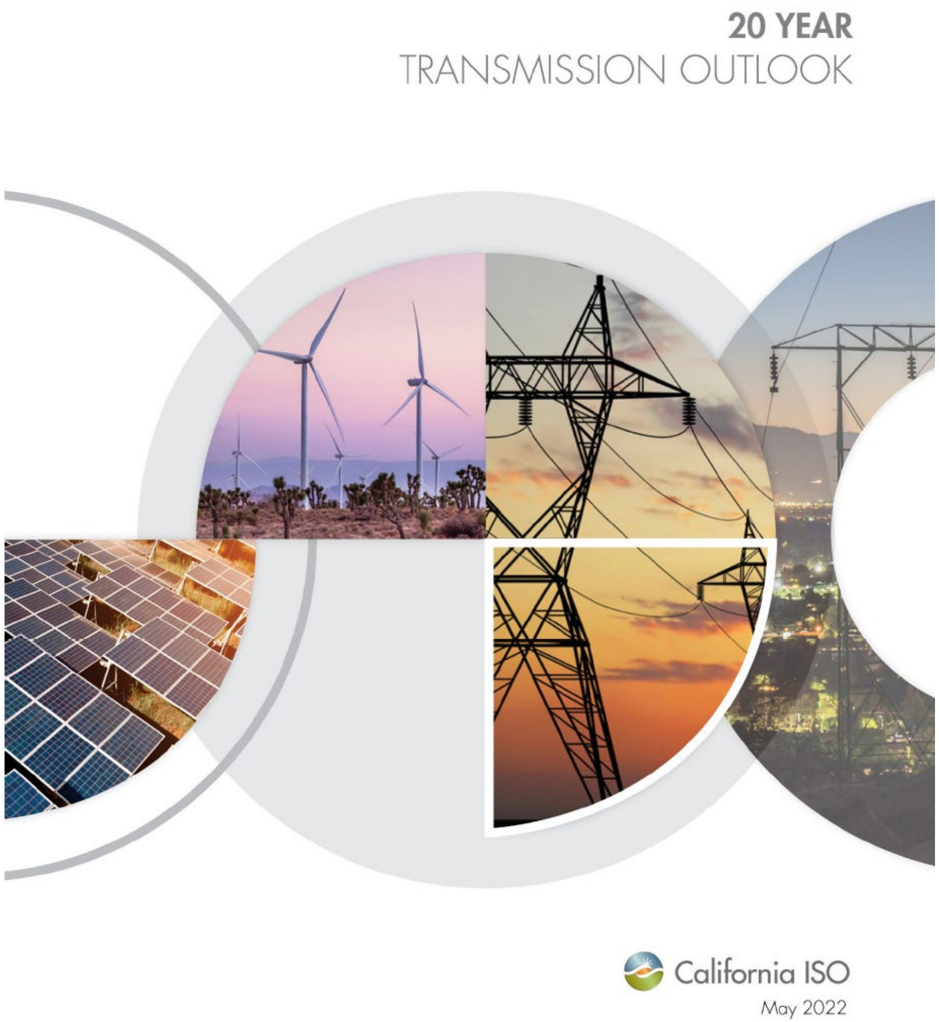
Jeff Billinton
Director, Transmission Infrastructure Planning

Ebrahim Rahimi
Sr. Advisor, Transmission Infrastructure Planning

20-Year Transmission Outlook

- The ISO produced its first ever 20-Year Transmission Outlook focused on providing a longer term view of transmission needed to reliably meet state clean energy goals

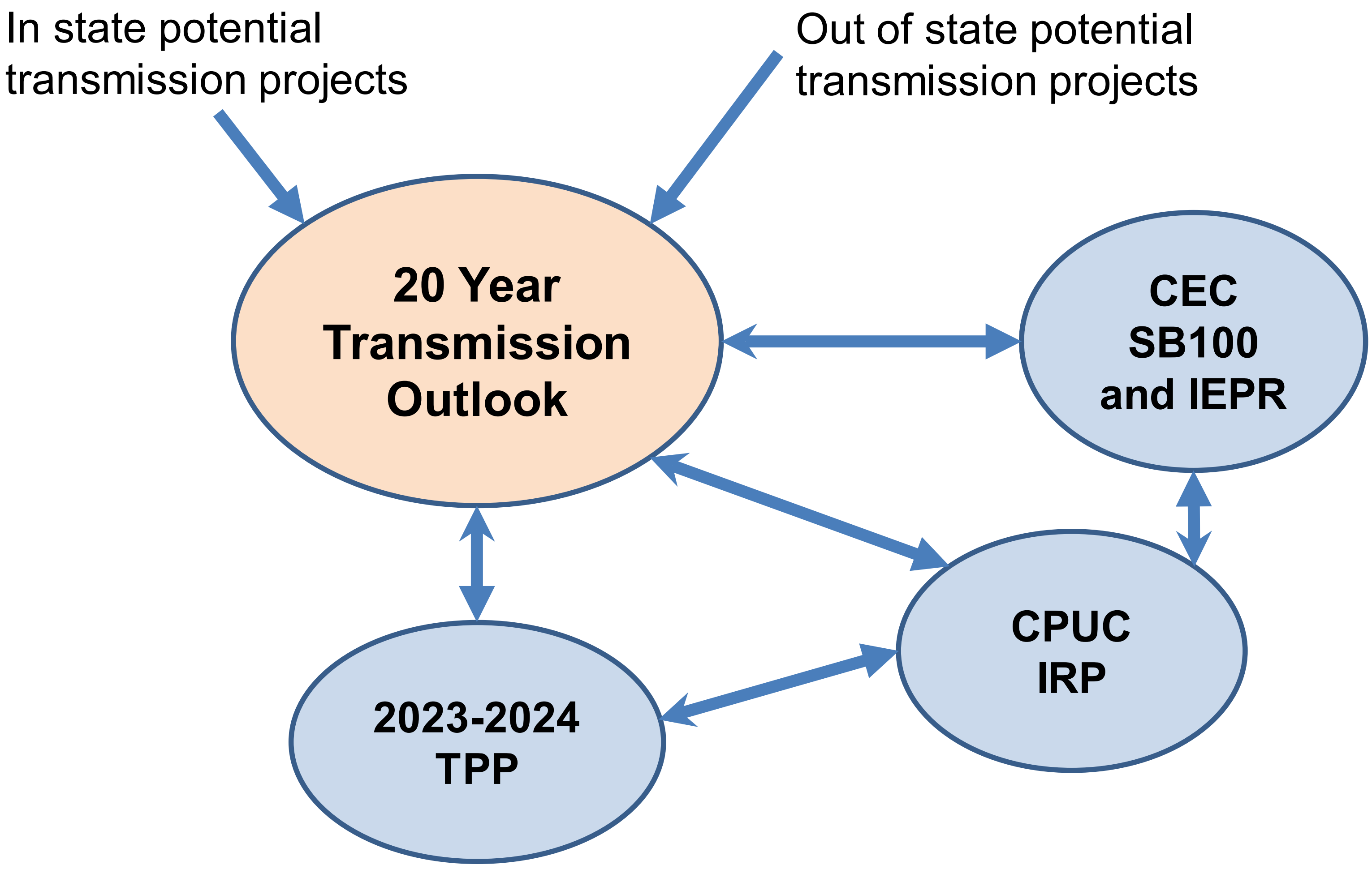
- Issued in May 2022 and posted on the ISO website
  http://www.caiso.com/InitiativeDocuments/20-YearTransmissionOutlook-May2022.pdf



The 20-year transmission outlook provides a "baseline" architecture setting stage for future planning activities:

- Is intended to:
  - help the state to further refine resource planning,
  - scope the challenges we face, and
  - provide longer term context for decisions made in the 10 year transmission plan process
- Included high level technical studies to test feasibility of alternatives, focusing on the bulk transmission system
- The May 2022 Outlook used a "Starting Point" scenario docketed that:
  - had diverse resources known to require transmission development such as offshore wind energy, out-of-state resources, and geothermal
  - gas power plant retirements that may require transmission development to reduce local area constraints

Primary Paths for Coordination with Other Initiatives



20-Year Transmission Outlook - Update

- The ISO is undertaking an update of the 20-Year Transmission Outlook in parallel with ISO's 2023-2024 transmission planning process
- The update is looking out to 2045 and will incorporate:
  - Updated portfolio
  - Updated load forecast
- Includes high level technical studies to test feasibility of alternatives, focusing on the bulk transmission system

CEC Docketed - 2045 Scenario for the Update of the 20-Year Transmission Outlook

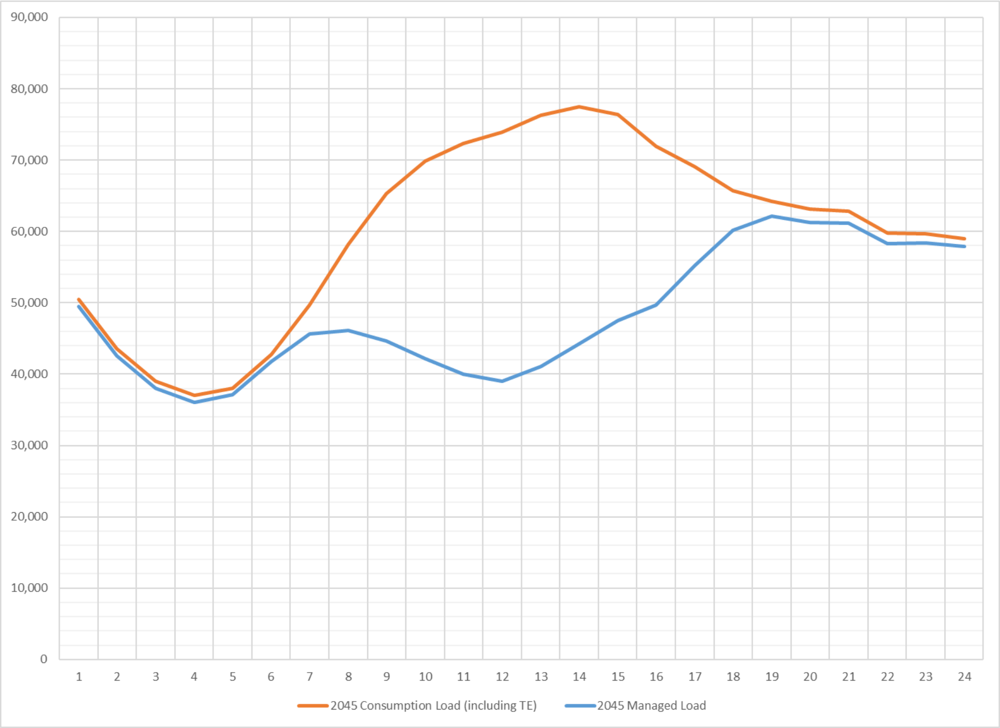
"The 2045 Scenario for the Update of the 20-Year Transmission Outlook staff paper describes a 2045 demand and resource scenario for use by the California Independent System Operator (California ISO) in the update of the 20-Year Transmission Outlook. The staff paper outlines the demand and resource assumptions within the scenario. The staff paper details the method for resource mapping the new renewable resource and energy storage capacity within the scenario."

https://www.energy.ca.gov/publications/2023/2045-scenario-update-20-year-transmission-outlook

Energy Demand Forecast

- CEC provided hourly forecasts for each PTO area (PG&E, SCE & SDG&E)
- Includes approximately 42 GW of BTM PV capacity in 2045
- For the additional achievable components of the forecast CEC has provided disaggregation to 2035
  - For 2036 through 2045, the ISO will disaggregate the load from the TAC area to busbar using a weighting approach

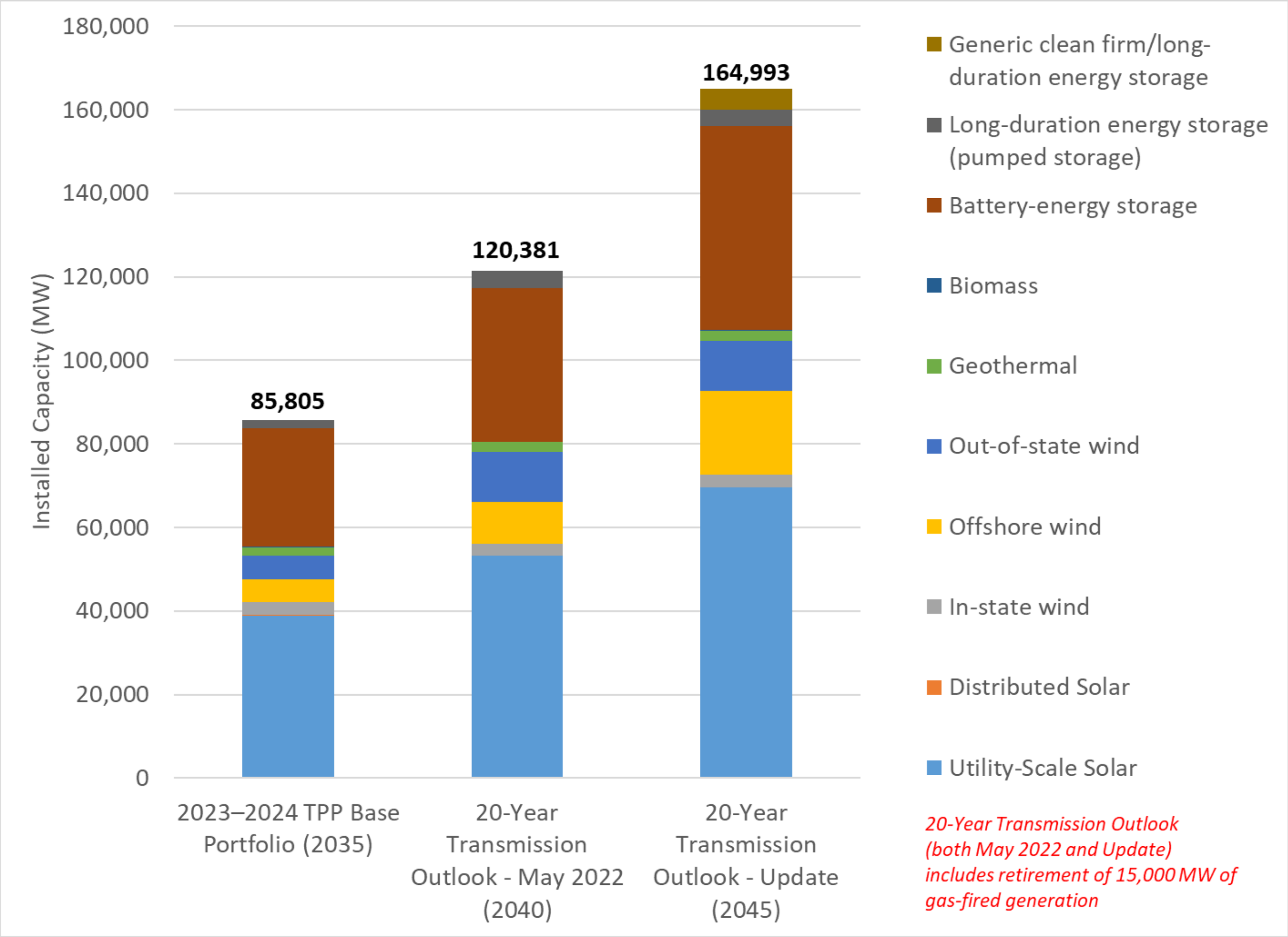
2045 CAISO Peak Day Hourly Profile



Portfolios – 2023-2024 Transmission Planning Process and 20-Year Transmission Outlook

Resource Type (MW)	2023-2024 Transmission Planning Process		20-Year Transmission Outlook	
	Base Portfolio (2035)	OSW Sensitivity (2035)	May 2022 2040 SB100 Starting Point Scenario (MW)	Update New Resource Assumption in the 2045 Scenario (MW)
Natural Gas Fired Power Plants	-	-	(-15,000)	(-15,000)
Utility-Scale Solar	38,947	25,746	53,212	69,640
Distributed Solar	125	125	-	125
In-state wind	3,074	3,074	2,837	3,074
Offshore wind	5,497	13,400	10,000	20,000
Out-of-state wind	5,618	5,618	12,000	12,000
Geothermal	2,037	1,149	2,332	2,332
Biomass	134	134	-	134
Battery-energy storage	28,373	23,545	37,000	48,813
Long-duration energy storage (pumped storage)	2,000	1,000	4,000	4,000
Generic clean firm/long-duration energy storage	-	-	-	5,000

Portfolios – 2023-2024 Transmission Planning Process and 20-Year Transmission Outlook



Natural Gas Power Plant Retirements

- The 2045 Scenario retains the assumption from the 2021 Starting Point Scenario that 15,000 MW of natural gas power plant capacity would be retired by 2040
- Assumed gas-fired generation retired by local capacity area

Local Capacity Area	Capacity (MW)
Greater Bay Area	4427
Sierra	153
Stockton	361
Fresno	669
Kern	407
LA Basin	3,632
Big Creek-Ventura	695
San Diego-IV	131
ISO System	3,933
Total	**14,408**

Geographic Allocation of Resources

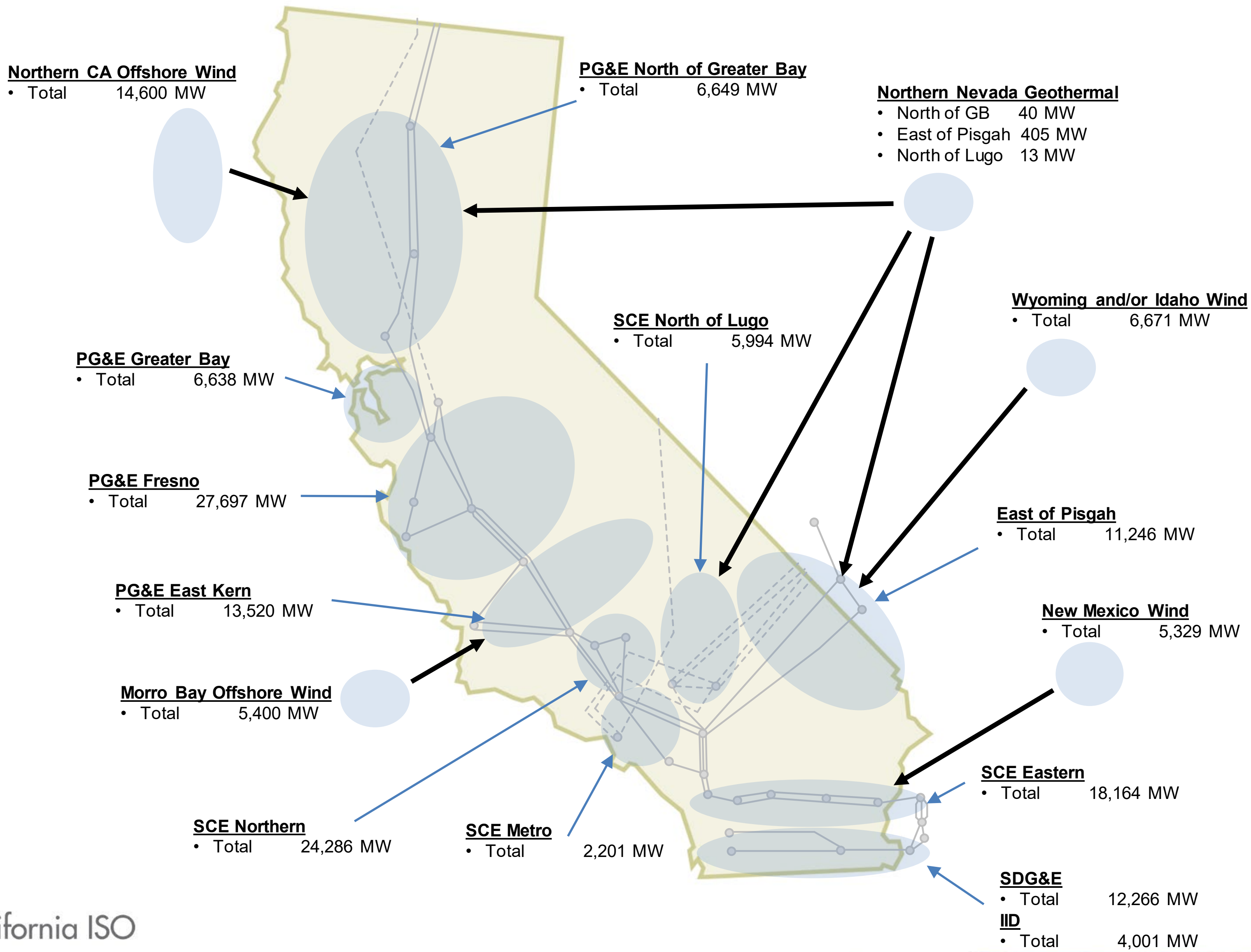
- The 20-year outlook requires geographically mapping of resources to specific locations, to the extent feasible
- Wherever possible, the mapping criteria aligns with the current CPUC integrated resource plan (IRP) portfolios being studied within the 2023-2024 TPP
- All MW values are assumed to occur by 2045
- Mapping of resources to substations within the transmission zones

Mapping Results of the 2045 Scenario for the update of the 20-year transmission outlook by substation and resource type

						20-year Outlook – Total Resources		
Transmission Area	CAISO Substation	Voltage	Out-of-CAISO Resource	Resource Type	RESOLVE Resource Area	FCDS (MW	EODS (MW	Total (MW
East of Pisgah Study Area	Beatty	138	In-CAISO	Geothermal	Southern_Nevada_Geothermal	500	-	**500**
SCE North of Lugo (NOL) Study Area	Control	115	In-CAISO	Geothermal	Inyokern_North_Kramer_Geothermal	40	-	**40**
SCE North of Lugo (NOL) Study Area	Control (Silver Peak Intertie)	115	NVEP substations	Geothermal	Northern_Nevada_Geothermal	13	-	**13**
East of Pisgah Study Area	Eldorado (Harry Allen Intertie)	500	NVEP Substations: Eagle 120 kV (NVEP), I	Geothermal	Northern_Nevada_Geothermal	225	-	**225**
East of Pisgah Study Area	Eldorado	230	NVEP substations	Geothermal	Northern_Nevada_Geothermal	100	-	**100**
PG&E North of Greater Bay Study Area	Fulton	230	In-CAISO	Geothermal	Solano_Geothermal	56	-	**56**
PG&E North of Greater Bay Study Area	Geysers	230	In-CAISO	Geothermal	Solano_Geothermal	83	-	**83**
East of Pisgah Study Area	Gondor (or other IPP Interties)	345	NVEP substations	Geothermal	Northern_Nevada_Geothermal	80	-	**80**
SCE Eastern Study Area	IID System (Mirage Intertie)	230	IID System: Bannister 230 kV (IID), Midw	Geothermal	Greater_Imperial_Geothermal	850	-	**850**
SDG&E Study Area	IID System (Imperial Valley Intertie)	230	IID System	Geothermal	Greater_Imperial_Geothermal	345	-	**345**
PG&E North of Greater Bay Study Area	Summit	115	NVEP substations	Geothermal	Northern_Nevada_Geothermal	40	-	**40**
SCE Northern Area	Antelope	230	In-CAISO	Onshore Wind	Tehachapi_Wind	3	-	**3**
PG&E North of Greater Bay Study Area	Birds Landing	230	In-CAISO	Onshore Wind	Solano_Wind	90	45	**135**
PG&E Fresno Study Area	Cabrillo	115	In-CAISO	Onshore Wind	Carrizo_Wind	99	-	**99**

https://efiling.energy.ca.gov/GetDocument.aspx?tn=251044&DocumentContentId=85982

Resources mapped to the transmission zones



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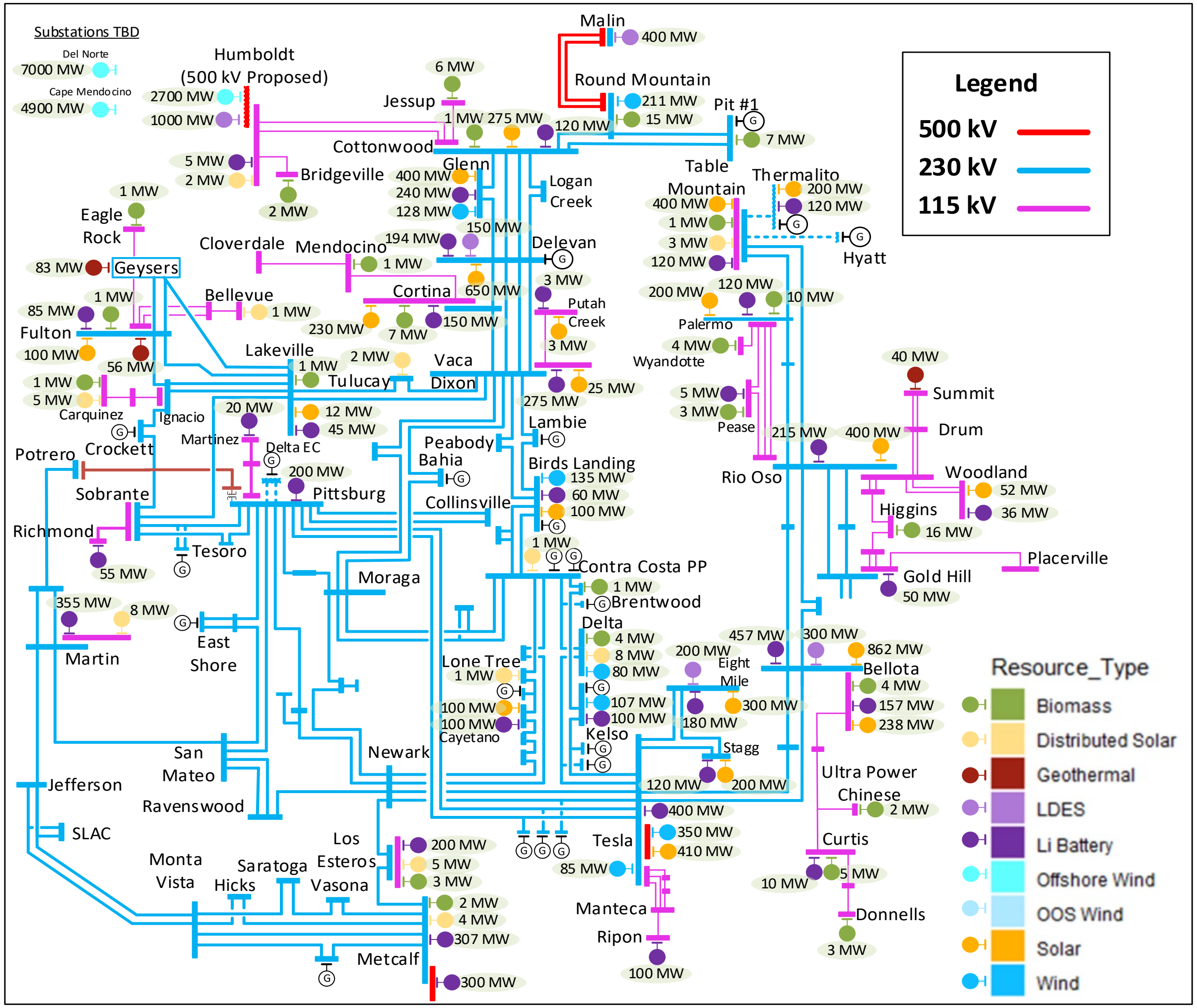
Portfolio Mapping

- Final dashboard for the mapping results of the 2045 Scenario for the update to the 20-Year Transmission Outlook
  - https://efiling.energy.ca.gov/GetDocument.aspx?tn=251044&DocumentContentId=85982

- Updated mapping based on CAISO defined and studied Transmission Areas were presented in the ISO Stakeholder meeting on September 27, 2023
  - http://www.caiso.com/InitiativeDocuments/CAISOPresentation-2023-2024TransmissionPlanningProcess-Sep27-2023.pdf

2045 Scenario: PG&E Greater Bay and North of Greater Bay (example)



FCDS
24,274 MW

Total
27,927 MW

Out-of-State Wind Modelling Approach (1/2)

- 12,000 MW of Out of State wind is included in the 20-year outlook portfolio which is the same amount as the last 20-year outlook
- New transmission projects will be needed to bring 3,500 MW of Wyoming wind and ~2,900MW of New Mexico wind to the CAISO system

Study	Substation	Resource Type/ Location	Out-of-CAISO Transmission Utilized	Generation (MW)
2023-2024 TPP	Mead 230 kV	SW Wind Ext Tx	Existing Tx	300
	Palo Verde 500 kV	SW Wind Ext Tx	Existing Tx	119
	Eldorado 500 kV	SW Wind Ext Tx	Existing Tx	371
	Eldorado 500 kV	Wyoming Wind	New Tx (TransWest Express)	1,500
	Harry Allen 500 kV	Idaho Wind	New Tx (SWIP North)	1,000
	Palo Verde 500 kV	New Mexico Wind	New Tx (SunZia)	2,328
20-year outlook mapping additions	Unknown Substation(s)	Wyoming Wind	New Tx (TBD)	3,500
	Unknown Substation(s)	New Mexico Wind	New Tx (TBD)	2,882
			Total	**12,000**

Out-of-State Wind Modelling Approach (2/2)

- The new transmission projects could either bring the out-of-state wind to the border of the ISO system, requiring additional transmission within the ISO system, or could be brought to interconnection points within the ISO, such as Tesla and Lugo substations as examples.
- New transmission projects could potentially facilitate coordination with LADWP and BANC to bring in additional out-of-state wind that they may be required for their resource portfolios.
- A high level assessment on both alternatives will be performed as part of the 20-year outlook assessment

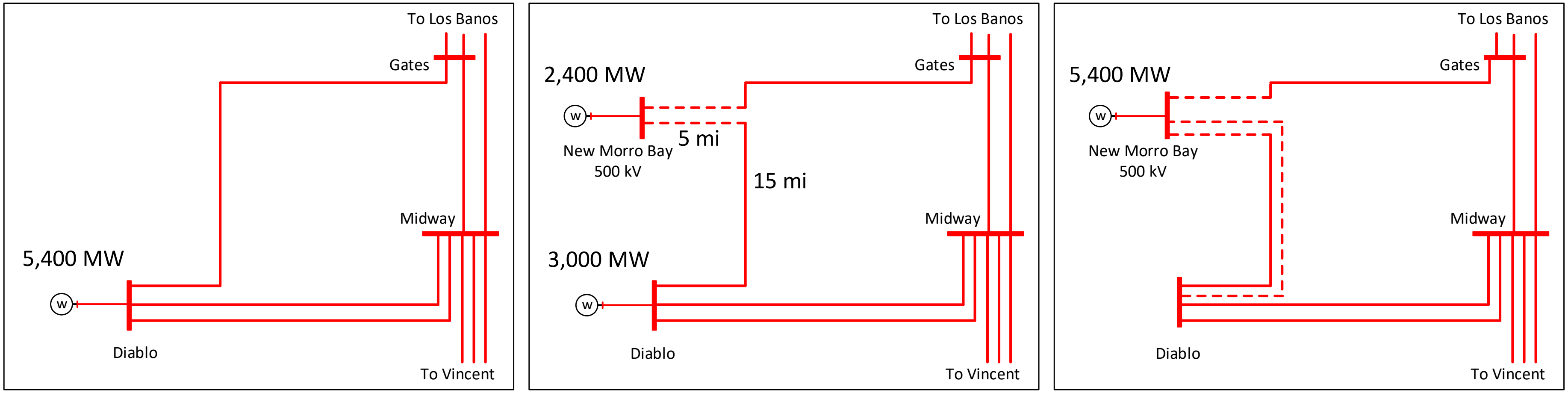
Offshore Wind Resources

- 20,000 MW of offshore wind is included in the 20-year outlook portfolio

CAISO Substation	Resource Area	Generation (MW)
Diablo 500 kV or proposed Morro Bay 500 kV	Morro Bay Offshore Wind	5,400
Humboldt 500 kV (Proposed)	Humboldt Bay Offshore Wind	2,700
Unknown Substation(s)	Del Norte Offshore Wind	7,000
Unknown Substation(s)	Cape Mendocino Offshore Wind	4,900
	Total	**20,000**

Central Coast Offshore Wind Interconnection

- 5,400 MW of offshore wind is mapped to Diablo or proposed Morro Bay 500 kV substations.
- With the retirement of Diablo Canyon Nuclear Power Plant, three potential alternatives to interconnect the 5,400 MW OSW in Central Coast could be considered

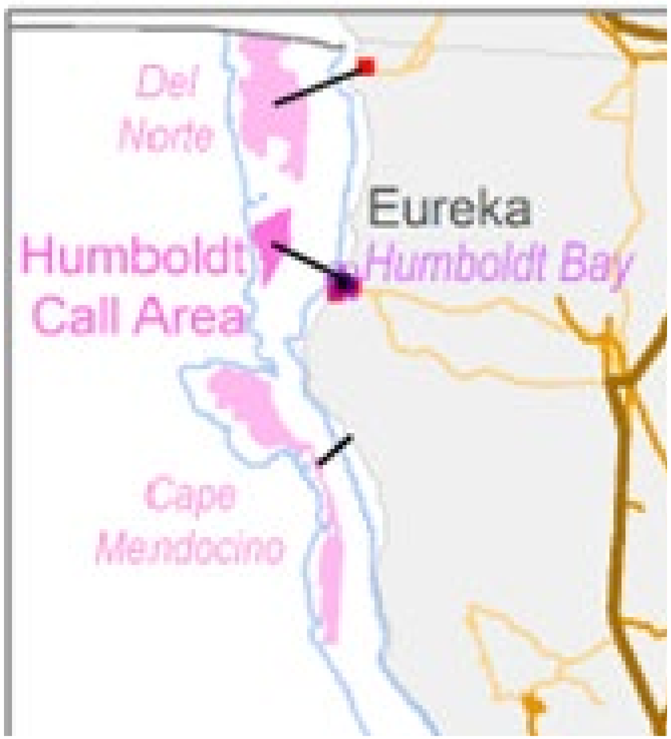


North Coast Offshore Wind Interconnection (1/2)

- 14,600 MW of north coast offshore wind is included in the portfolio
- Depending on the availability of floating offshore HVDC technology there are two high level interconnection approach:
  - HVAC or HVDC export cables connect each offshore wind plant to an onshore substation as POI
  - An offshore HVDC grid is developed to provide offshore POIs to wind plants
- The feasibility of floating offshore HVDC grid and export cables depends on such technologies to be commercially available at the time they are needed.

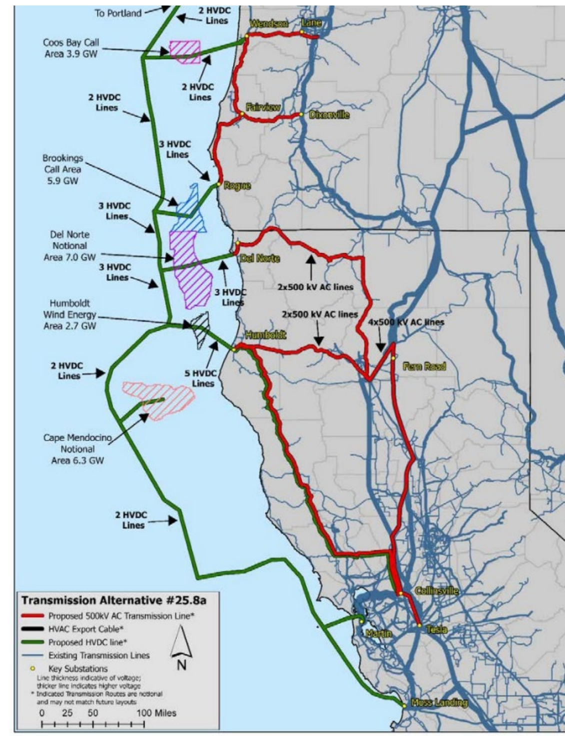
North Coast Offshore Wind Interconnection (2/2)

Export cables are connected to onshore POIs



Source: [The Cost of Floating Offshore Wind Energy in California Between 2019 and 2032 (nrel.gov)]

Offshore HVDC grid to provide offshore POIs



Source: Schatz Center - Northern California and Southern Oregon Offshore Wind Transmission study
https://efiling.energy.ca.gov/GetDocument.aspx?tn=252604

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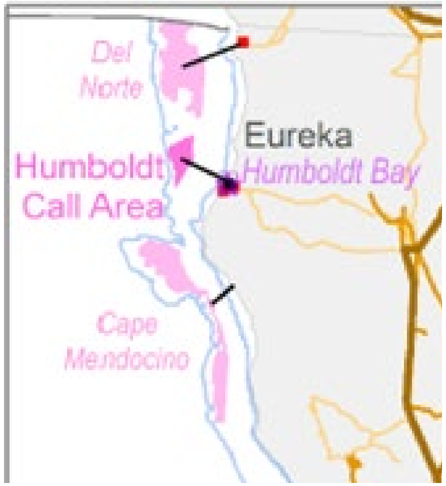
Interconnection to the onshore POI with AC export cables

- Considering the depth of water, dynamic AC export cables are required for the interconnection. Dynamic AC cables are commercially available up to around 230 kV. Higher voltage dynamic cables are under development

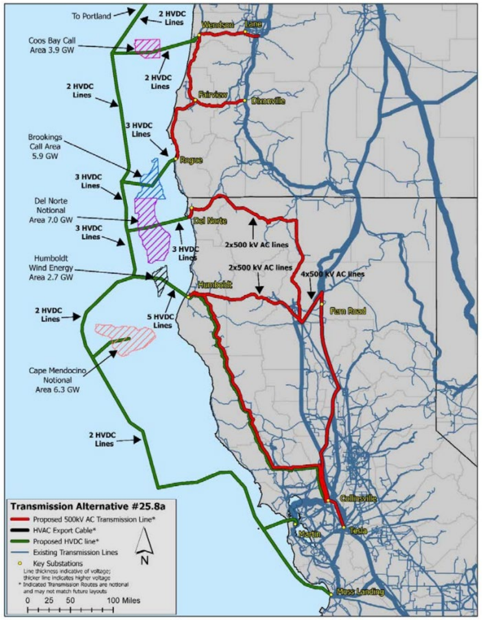
- Transferring 7,000 MW Del Norte OSW and 4,900 MW Cape Mendocino OSW to an onshore POI substation with 230 kV AC cables would require significant number of cables.



Source: The Cost of Floating Offshore Wind Energy in California Between 2019 and 2032 (nrel.gov)

Floating Offshore HVDC Technology

- The main impact of floating offshore HVDC technology will be on how the power is collected and transferred from the offshore wind plants to the onshore grid.
  - It enables HVDC export cables to transfer power to the shore with less number of cables.
  - It also enables the development of an offshore HVDC offshore grid to provide offshore POIs to wind plants.
- Using HVDC export cables or offshore HVDC grid does not have a significant impact on the required transmission enhancement of the onshore grid



Source: Schatz Center - Northern California and Southern Oregon Offshore Wind Transmission study
https://efiling.energy.ca.gov/GetDocument.aspx?tn=252604

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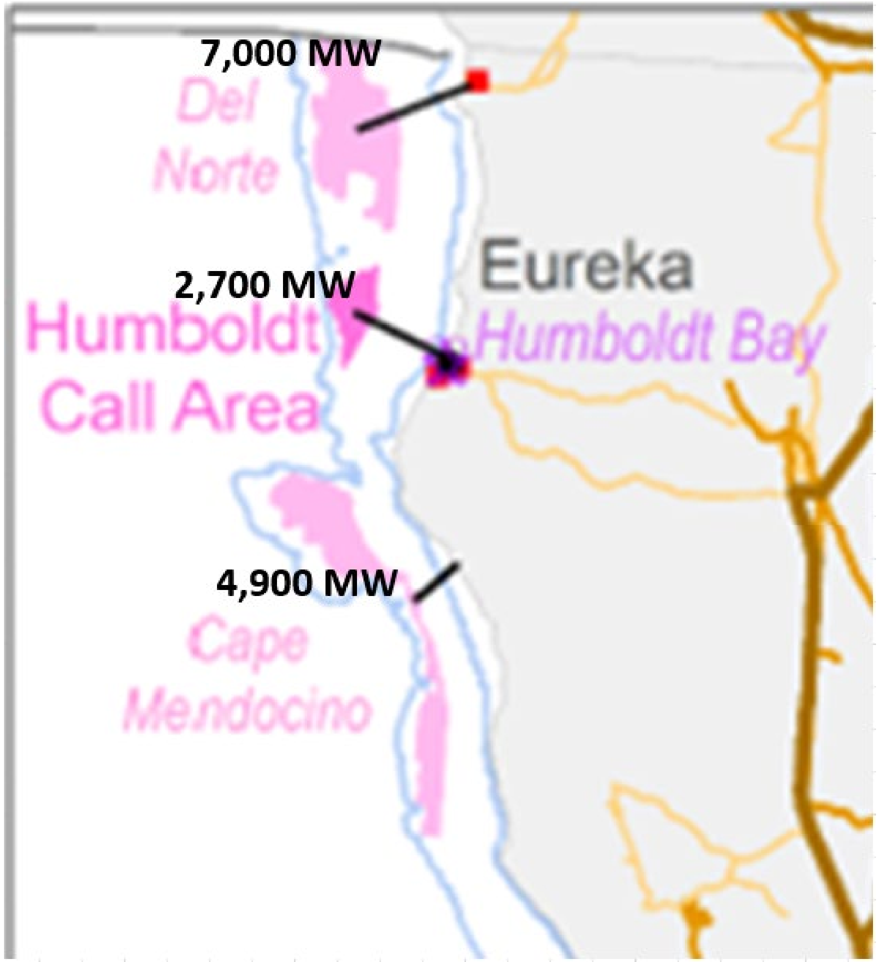
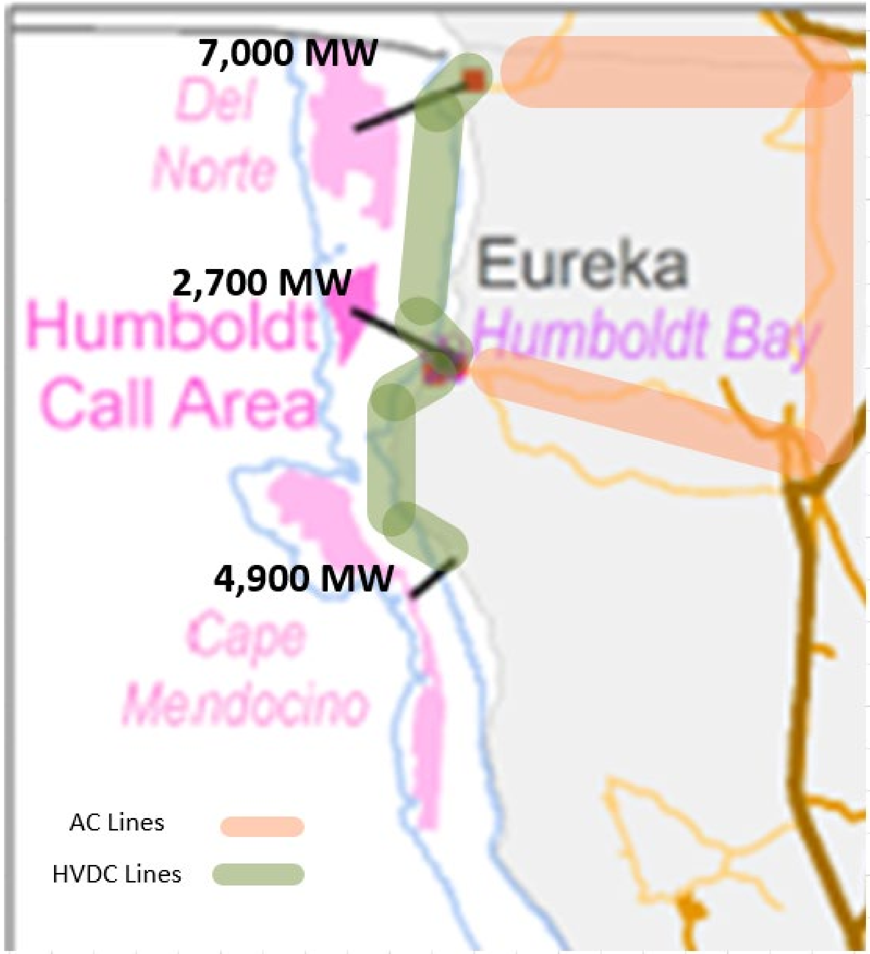
Interconnection Concepts for 14,600 MW OSW (1/3)

- Approach 1: It is assumed that:
  - The OSW at Humboldt, Del Norte, and Cape Mendocino are connected to a corresponding onshore POI substation with AC export cables. (no floating offshore HVDC)



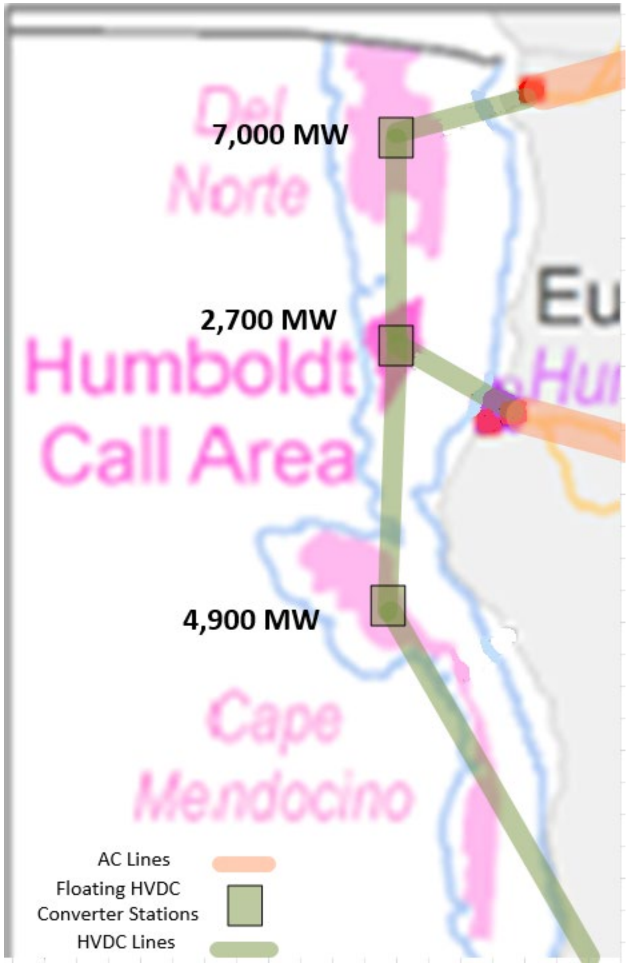
Interconnection Concepts for 14,600 MW OSW (2/3)

- Approach 1: It is assumed that:
  - The OSW at Humboldt, Del Norte, and Cape Mendocino are connected to a corresponding onshore POI substation with AC export cables. (no floating offshore HVDC)
  - HVDC converter stations will be built onshore and the DC line could be either underground or a sea cable.
- No new transmission lines is considered along the shore to Del Norte or Cape Mendocino to Humboldt POI substation.



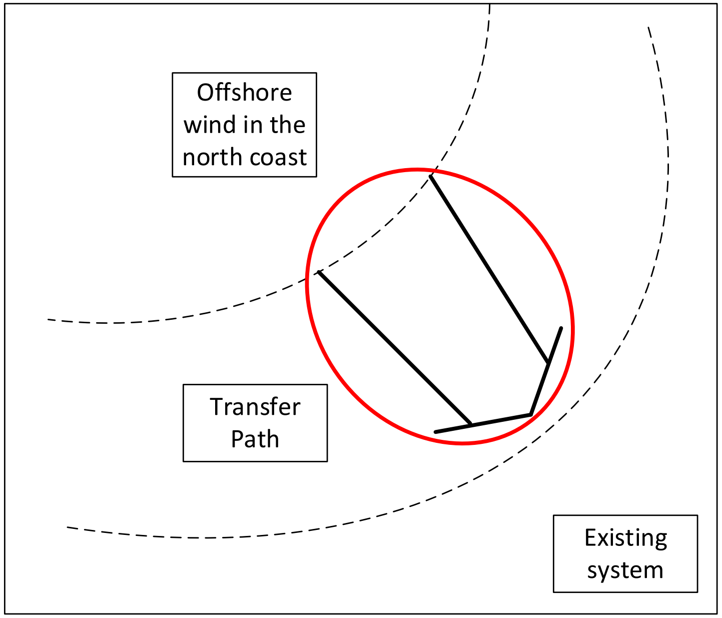
Interconnection Concepts for 14,600 MW OSW (3/3)

- Approach 2: It is assumed that:
  - Floating offshore HVDC platforms are available
  - The OSW at Humboldt, Del Norte, and Cape Mendocino are connected to the AC side of the corresponding offshore floating HVDC converter stations
  - POI substation are connected to an onshore converter station or to each other through HVDC lines
- No new transmission lines is considered along the shore to Del Norte or Cape Mendocino to Humboldt POI substation.



Transmission Technology Assumptions for the Transfer Path to Interconnect 14,600 MW OSW in the North Coast

Technology	Normal Rating Assumptions (MVA)	Emergency Rating Assumptions (MVA)
500 kV AC line to Fern Road	3,500	4,500
Onshore overhead VSC-HVDC to Collinsville Substation	3,000	3,500
Offshore sea cable VSC-HVDC to a Substation in the Bay Area	2,000	2,500

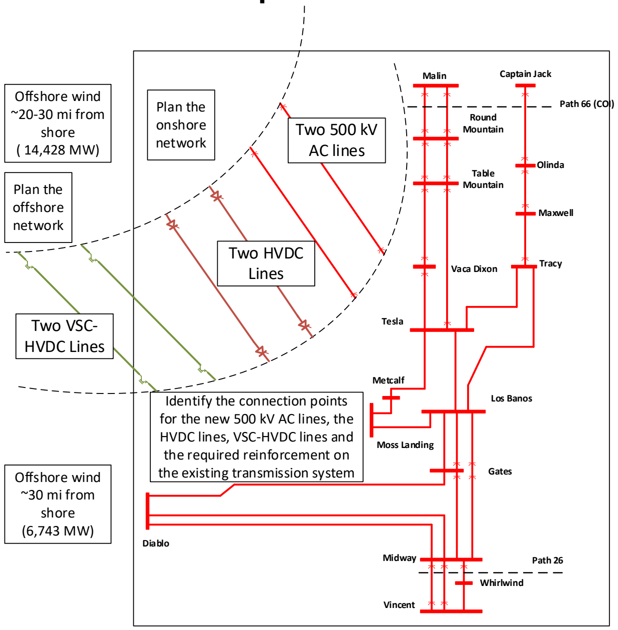


- Based on ISO Planning Standards
  - Maximum generation tripping under N-1 contingency is 1,150 MW
  - Maximum generation tripping under DCTL (N-2) is 1,400 MW

Transfer Path for North Coast OSW in the 20-year Outlook (1/2)

- In the offshore wind sensitivity study in the 2021-2022 Transmission Plan a hybrid solution was evaluated to integrate 14,428 MW of OSW in the North Coast
- Same solution is expected to provide sufficient capacity as the transfer path for the 14,600 MW North Coast OSW in the portfolio for the updated 20-year outlook

High level assessment of a hybrid transfer path	
500 kV AC line to Fern Road	2
Onshore overhead VSC-HVDC to Collinsville	2
Offshore sea cable VSC-HVDC to Bay Area	2



Reference: 2021-2022 Transmission Plan (page 255)
http://www.caiso.com/Documents/ISOBoardApproved-2021-2022TransmissionPlan.pdf

Transfer Path for North Coast OSW in the 20-year Outlook (2/2)

Normal and Contingency Conditions	Total Path Capacity [1] with Hybrid Solution (2x 500 kV AC + 2 x onshore HVDC + 2 x offshore HVDC)
N-0	2 x 3,500 + 2 x 3,000 + 2 x 2,000 = 17,000 MW
N-1 of one 500 kV AC line	1 x 4,500 + 2 x 3,500 + 2 x 2,500 = 16,500 MW
Path N-2 capacity (Loss of an onshore bipole HVDC)	2 x 4,500 + 1 x 3,500 + 2 x 2,500 = 17,500 MW
Path N-1-1 capacity (after the first contingency of one 500 kV AC line, the total wind generation should be reduced in preparation for the contingency of the second 500 kV AC line)	0 x 4,500 + 2 x 3,500 + 2 x 2,500 + 1,200 Curtailment + 1,400 RAS = 14,600 MW

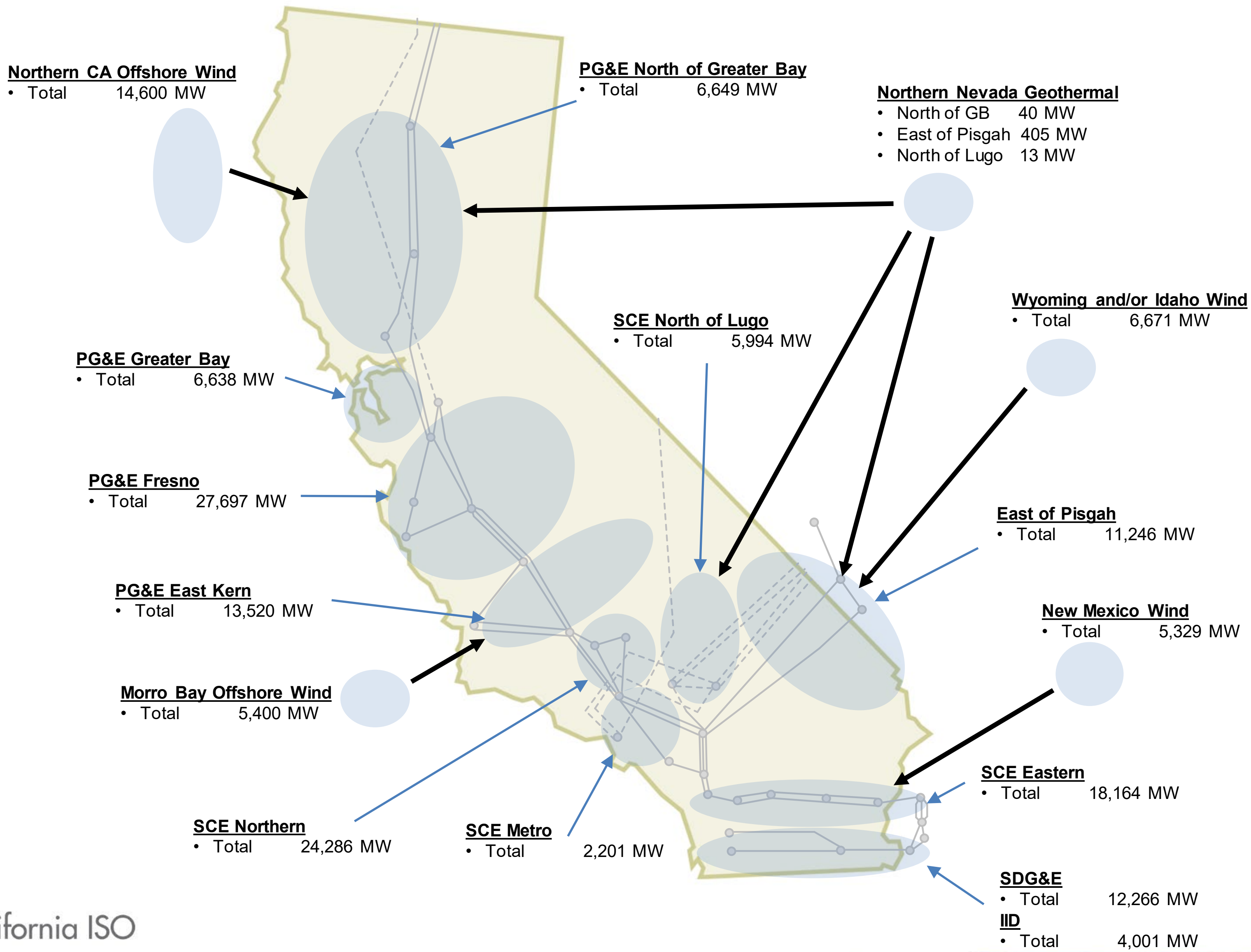
Transfer path capabilities are estimated based on a high level assessment with simplifying assumptions considering the maximum generation tripping allowed under N-1 and N-2 contingencies, not taking into account the system losses and the overloads in the rest of the system

High Level Technical Assessment

Study Scenarios

- Three base cases will developed for the contingency analysis to identify the potential transmission enhancement requirements.
  - Net Peak (HSN)
    - based on the HSN in deliverability studies and reflects the system in early evening summer conditions
  - Peak consumption (SSN)
    - based on the SSN in deliverability studies and reflects the system in early afternoon summer conditions
  - Off Peak
    - reflects the system in the middle of the day in spring when electricity consumption is low while the solar and BTM PV generation is high

Resources mapped to the transmission zones



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Load Forecast in 2045

Study Scenario	Date/Time	TAC Area	Baseline_ Consumption	BTM_PV	BTM_ Storage	LDV3	MDHD3	AAEE3	AAFS3	System Load (1-in-2)	System Load (1-in-5)
Net Peak Load (HSN)	9/5/2045 HE19	PG&E	24,520	-45	-647	3,546	828	-1,402	732	27,532	28,758
		SCE	26,612	-2	-363	3,190	698	-1,600	412	28,948	30,279
		SDG&E	5,163	0	-156	652	63	-290	32	5,464	5,723
		CAISO	56,450	-46	-1,166	7,388	1,589	-3,291	1,176	62,100	**64,923**
Peak Consumption (SSN)	9/5/2045 HE14	PG&E	26,043	-15,980	36	5,804	1,383	-1,452	302	16,136	17,438
		SCE	30,503	-10,439	-1	4,824	1,239	-1,986	307	24,445	25,970
		SDG&E	5,653	-3,642	2	1,588	200	-376	33	3,459	3,741
		CAISO	62,356	-30,061	37	12,216	2,822	-3,815	642	44,197	**47,315**
Off Peak	4/15/2045 HE13	PG&E	13,993	-16,744	34	3,615	1,134	-935	358	1,455	1,455
		SCE	12,683	-11,550	3	3,110	1,015	-1,027	290	4,524	4,524
		SDG&E	2,737	-3,944	-2	942	163	-215	29	-291	-291
		CAISO	29,489	-32,238	35	7,666	2,312	-2,177	677	5,764	**5,764**

- The forecast installed BTM-PV in 2045 is ~41,000 MW
- The load forecast under HSN condition in 2045 is 13%-14% higher than 2035
- Starting with 2035 base cases developed in the 2023-2024 TPP, the baseline and load modifiers will be scaled to match the 2045 forecast

Dispatch and high level technical studies

- Resource dispatch based upon dispatch in policy studies in 2023-2024 transmission planning process for different study cases

- Contingency analysis will be performed based on the following methodology and assumptions:
  - N-0 base case with no contingency
  - 500 kV contingencies were evaluated for N-1 and N-1-1 analysis
  - 230 kV contingencies were evaluated for N-1 analysis across the system and only for Bay Area and LA Basin for N-1-1 analysis
  - No RAS action was modelled in this study
  - Generators were not re-dispatched before or after the contingencies
  - Only power flow analysis was performed focusing on thermal overloads.
  - It is assumed that local area overloads are addressed with local transmission upgrades

Preliminary Results of HSN Scenario

Generation scenarios for HSN

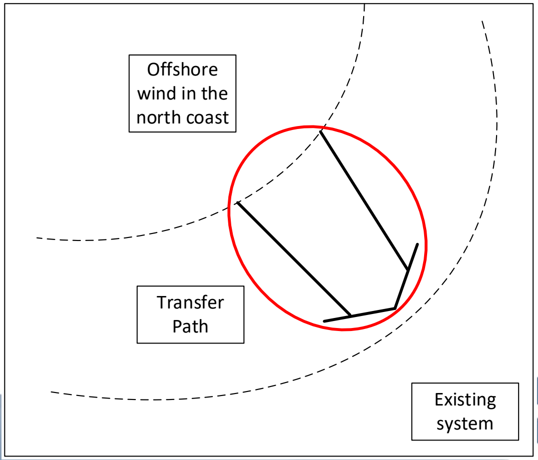
- The high level assumptions on HSN generation scenarios
  - The CAISO load is around ~65,000 MW
  - No solar generation and no BTM-PV under HSN scenario
  - The remaining gas will only be dispatched when wind and other resources are not sufficient to supply the load
  - Other generation such as hydro are kept at the same level as the starting point base case (2035 summer peak case)

	Wind	**Import**	**BESS**	**Gas**
2045-HSN_00	High	Ave	Ave	~0
2045-HSN_01	High	Low	High	~0
2045-HSN_02	High	Low	Ave	As needed
2045-HSN_03	Low	Low	~Max	As needed

Offshore Transmission Scenarios

- The north coast offshore transfer path includes two offshore sea cable VSC-HVDC to the Bay Area.
  - Scenario 1:
    - One VSC-HVDC link to a Bay Hub converter station with 3 x 230 kV AC cables to Potrero, East Shore, and Los Esteros substations
    - One VSC-HVDC link to Moss Landing 500 kV substation
  - Scenario 2:
    - One VSC-HVDC link to a Bay Hub converter station with 3 x 230 kV AC cables to Potrero, East Shore, and Los Esteros substations
    - One VSC-HVDC link to a Bay Hub converter station with 3 x 230 kV AC cables to Mona Vista, San Mateo, and Newark substations
- The mitigation measure of a new 500 kV line from Fern Road to Tesla was modeled in the starting case

Transfer path to for north coast OSW	
500 kV AC line to Fern Road	2
Onshore overhead VSC-HVDC to Collinsville	2
Offshore sea cable VSC-HVDC to Bay Area	2



Summary Results HSN Scenario

- The results of the HSN scenario are summarized for the followings:
  - Offshore wind
  - Out of state wind
  - Greater Bay area
  - LA Basin Area

	Wind	Import	BESS	Gas
2045-HSN_00	High	Ave	Ave	~0
2045-HSN_01	High	Low	High	~0
2045-HSN_02	High	Low	Ave	As needed
2045-HSN_03	Low	Low	~Max	As needed

California ISO

Load and Generation in GBA and LA Basin

	Greater Bay Area		LA Basin	
Base Case	**Load**	**Generation**	**Load**	**Generation**
2035 SP	12,804	5,949	20,937	6,221
2045-HSN-00	14,166	3,255	23,692	2,964
2045-HSN-01		3,732		4,592
2045-HSN-02		5,838		4,817
2045-HSN-03		4,949		6,449

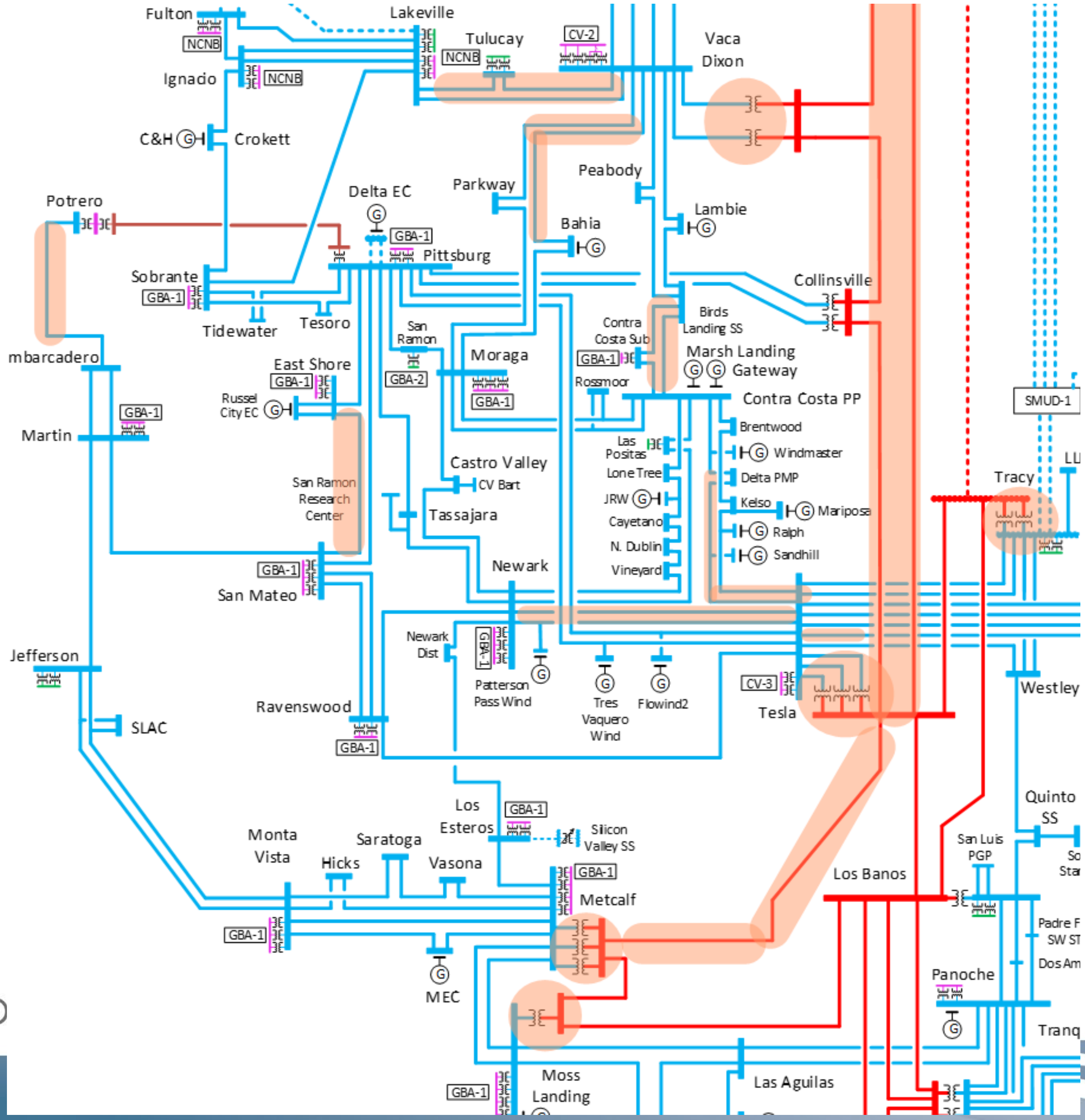
	Wind	Import	BESS	Gas
2045-HSN_00	High	Ave	Ave	~0
2045-HSN_01	High	Low	High	~0
2045-HSN_02	High	Low	Ave	As needed
2045-HSN_03	Low	Low	~Max	As needed

Preliminary N-0 and N-1 Study Results

Offshore wind and Bay area Preliminary Results

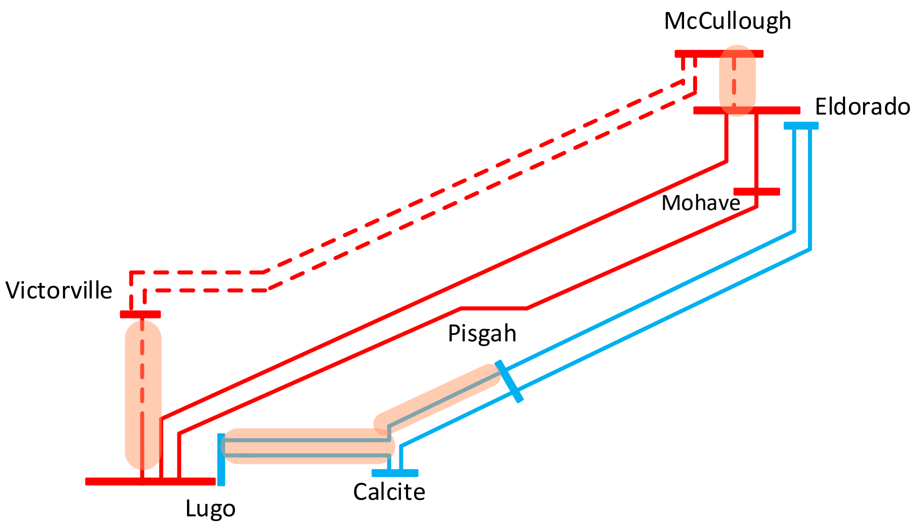
<table>
<tr><th>Overload</th><th>Comments</th><th>Potential Mitigation</th></tr>
<tr><td>Fern Road to Tesla 500 kV lines</td><td>N-0, N-1 under high OSW</td><td>Reconductor/rebuild existing lines
or build a second Fern Road - Tesla line</td></tr>
<tr><td>Vaca Dixon 500/230 kV Txes and the 230 kV lines out of Vaca Dixon (Lakeville, Bahia, Parkway)</td><td>N-1 in all, N-0 in no gas, average BESS (HSN-00)</td><td>A combination of transmission enhancements and adding BESS</td></tr>
<tr><td>Tesla 500/230 kV Txes</td><td>N-0 in all, N-1 in all but average gas, high BESS (HSN-03)</td><td>Transmission enhancements/BESS</td></tr>
<tr><td>Metcalf 500/230 kV Txes</td><td rowspan="2">N-1 in all scenarios with HVDC to Moss Landing</td><td rowspan="2">Upgrade/add transformer or two HVDC to Bay Hub option</td></tr>
<tr><td>Moss Landing 500/230 kV Tx</td></tr>
<tr><td>Tracy 500/230 kV Txes</td><td rowspan="3">N-1 only in no gas, average BESS (HSN-00)</td><td>Transmission enhancements/BESS</td></tr>
<tr><td>Round Mountain - Cottonwood 230 kV</td><td rowspan="2">Rebuild the line or create offshore wind – COI nomogram</td></tr>
<tr><td>Table Mountain - Palermo 230 kV</td></tr>
<tr><td>Tesla - Metcalf 500 kV</td><td rowspan="3">N-1 only in no gas scenarios (HSN-00, HSN-01)</td><td rowspan="4">Transmission enhancements/BESS</td></tr>
<tr><td>Tesla - Sand Hill - Delta, Tesla - Newark, Tesla - Eight Mile</td></tr>
<tr><td>Birds Landing – Contra Costa</td></tr>
<tr><td>Embarcadero - Potrero 230 kV</td><td>N-1 under high OSW</td></tr>
<tr><td>East Shore - San Mateo</td><td>N-1 under average gas, average BESS (HSN-02)</td><td>Transmission enhancements/BESS
or two HVDC to Bay Hub option</td></tr>
</table>

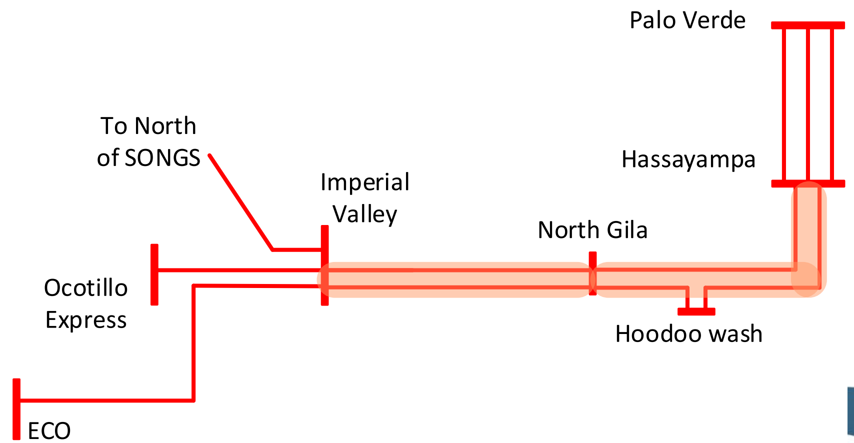
Offshore wind and Bay area Preliminary Results (2/2)



Out of State Wind Interconnection Impact

Overload	Comments	Potential Mitigation
Eldorado - McCullough 500 kV	OOS wind at Eldorado	Upgrade the short line or interconnect OOS wind to a substation in the north such as Tesla
Hassayampa - North Gila - Imperial Valley	Only in high wind, average import (HSN-00)	Rebuild the lines, or interconnect the OOS wind at Lugo/Imperial Valley, or implement OOS vs. import nomogram
Lugo - Victorville 500 kV	Only in high wind, average import (HSN-00)	Build another line (Trout Canyon/Eldorado – Lugo), or terminate the OOS wind at Lugo, or implement OOS wind vs. Import nomogram
Pisgah - Lugo 230 kV	N-1, Only in high wind, average import (HSN-00)	
Calcite - Lugo 230 kV	N-0, N-1, Only in high wind, average import (HSN-00)	

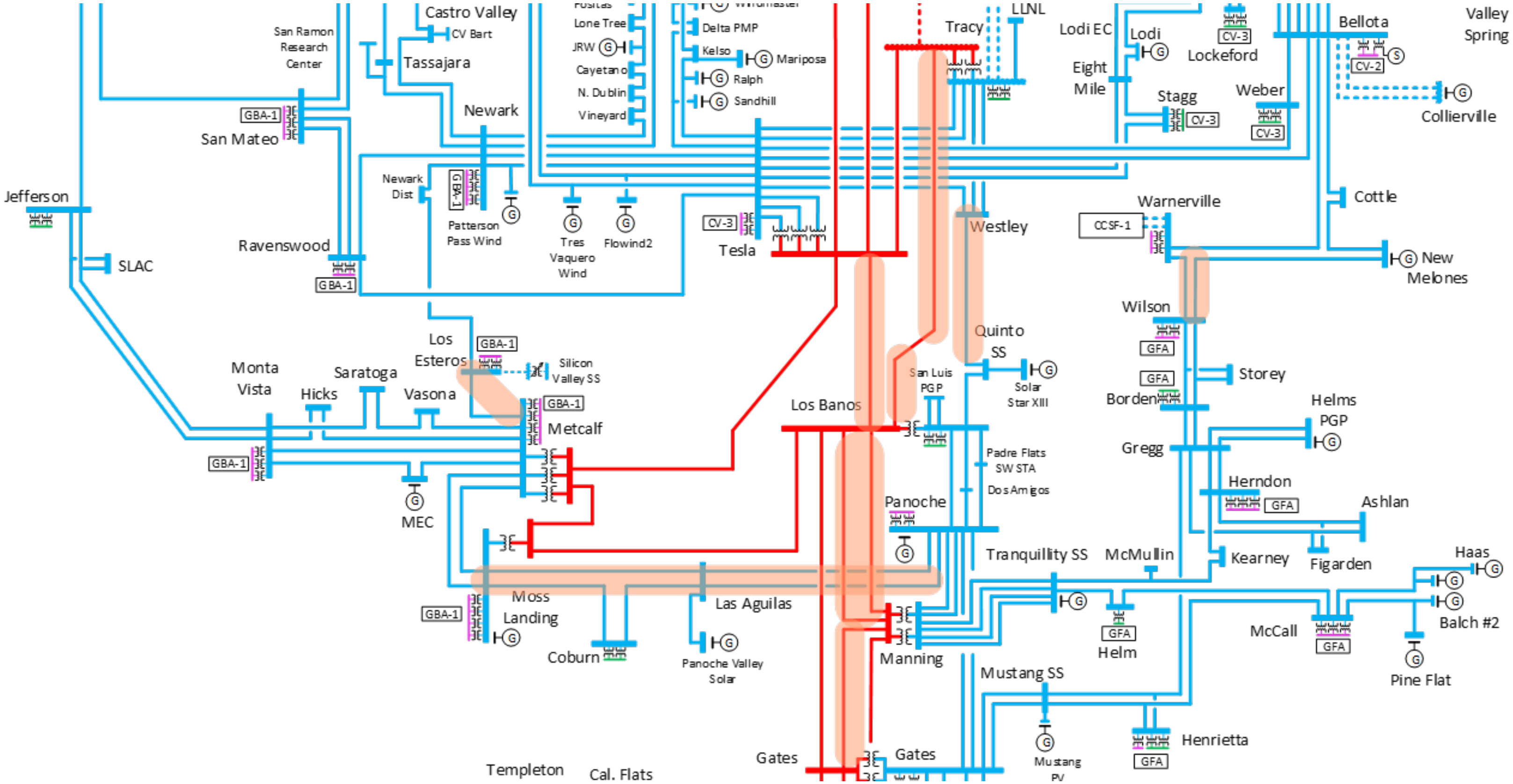




Overloads under low wind, low import, max BESS (HSN-03)

Overload	Comments	Potential Mitigation
Tesla - Los Banos	N-0, N-1 Only in low wind, low import, max BESS (HSN-03)	Manning – Moss Landing line (AC or DC)
Manning - Los Banos		
Warnerville - Wilson 230 kV		
Moss Landing - Las Aguilas – Panoche 230 kV		
Los Banos - Westly 230 kV		
Tracy - Los Banos 500 kV		
Metcalf – Los Esteros 230 kV		Rebuild the line or dispatch Bay Hub HVDC with no wind
Gates – Manning 500 kV		Add series compensation to Gates – Los Banos #3, Loop in Midway – Manning 500 kV line into Gates substation

Overloads under low wind, low import, max BESS (HSN-03)



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N-1-1 Study Results

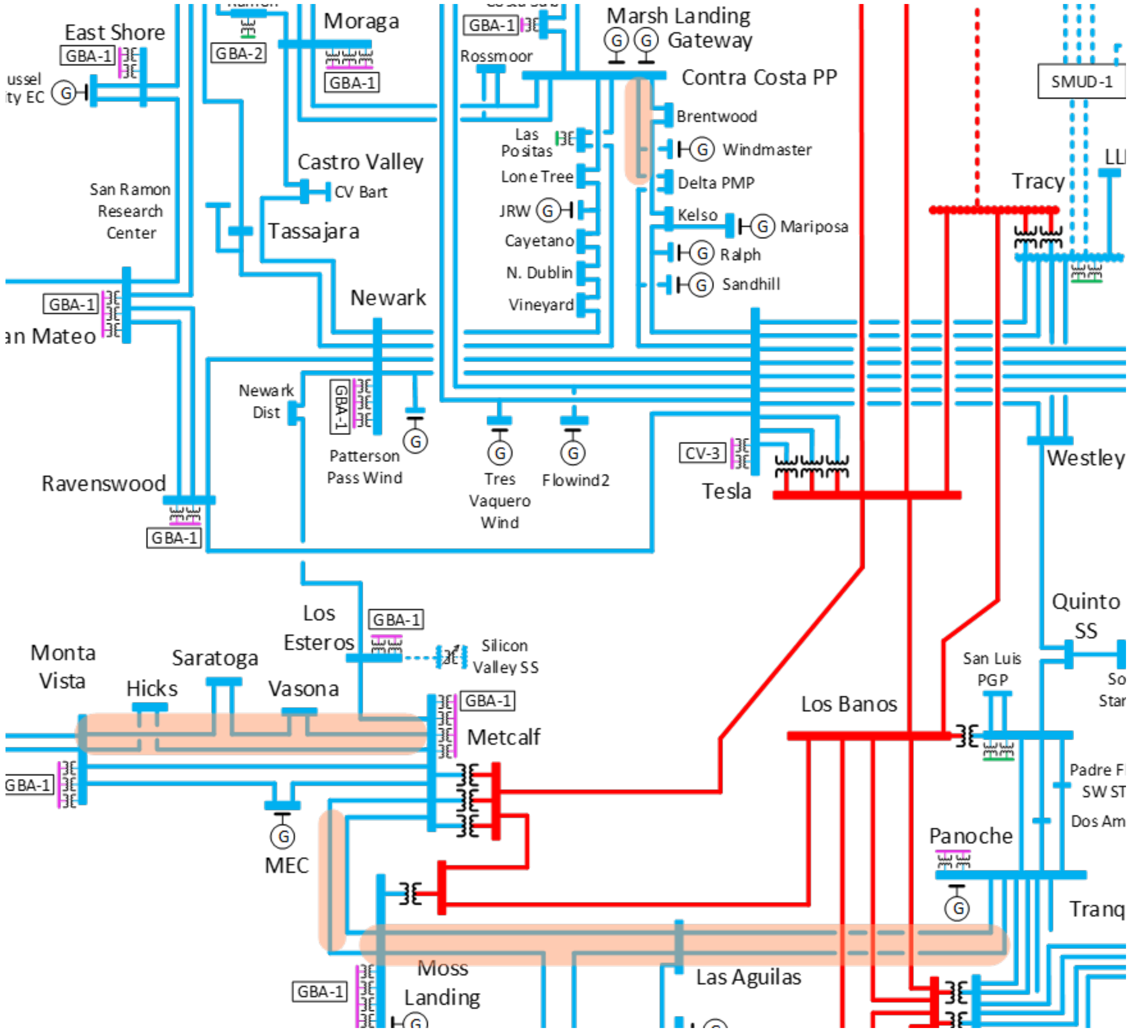
High Level Summary

- There are many overloads identified under N-0 and N-1 conditions in Bay Area which could be potentially more severe under N-1-1 conditions
- Some of the N-1-1 overloads could be addressed by generation redispatch after the first contingency
- This analysis is to gain an initial insight into system performance under N-1-1 conditions for different generation scenarios.
- Final N-1-1 assessment will be performed on cases with potential mitigations for N-0 and N-1 modeled in the case

Greater Bay Area (N-1-1 Analysis)

Overload	Contingency/Scenario	Potential Mitigation
Panoche - Las Aguilas - Moss Landing 230 kV lines	Tesla - Metcalf and Los Banos - Moss Landing in low wind, low import, max BESS (HSN-03)	Manning - Moss Landing 500 kV line
Monta Vista - Hicks, Saratoga - Vasona, Metcalf - Hicks	Metcalf - Monta Vista 230 kV lines in all scenarios	Rebuild the lines, or build two Bay Hub HVDC, or redispatch after the first contingency
Delta - Contra Costa 230 kV line	Birds Landing - Contra Costa 230 kV lines in no gas scenarios (HSN-00 and HSN-01)	A combination of rebuilding the line and adding BESS, or redispatch after the first contingency
Metcalf - Moss Landing 230 kV #1 or #2	Metcalf - Moss Landing 230 kV #1 or #2 and Metcalf - Moss Landing 500 kV in no gas, average BESS (HSN-01) and no wind, max BESS (HSN-03)	Rebuild the lines or trip the remaining 230 kV line with SPS, or redispatch after the first contingency

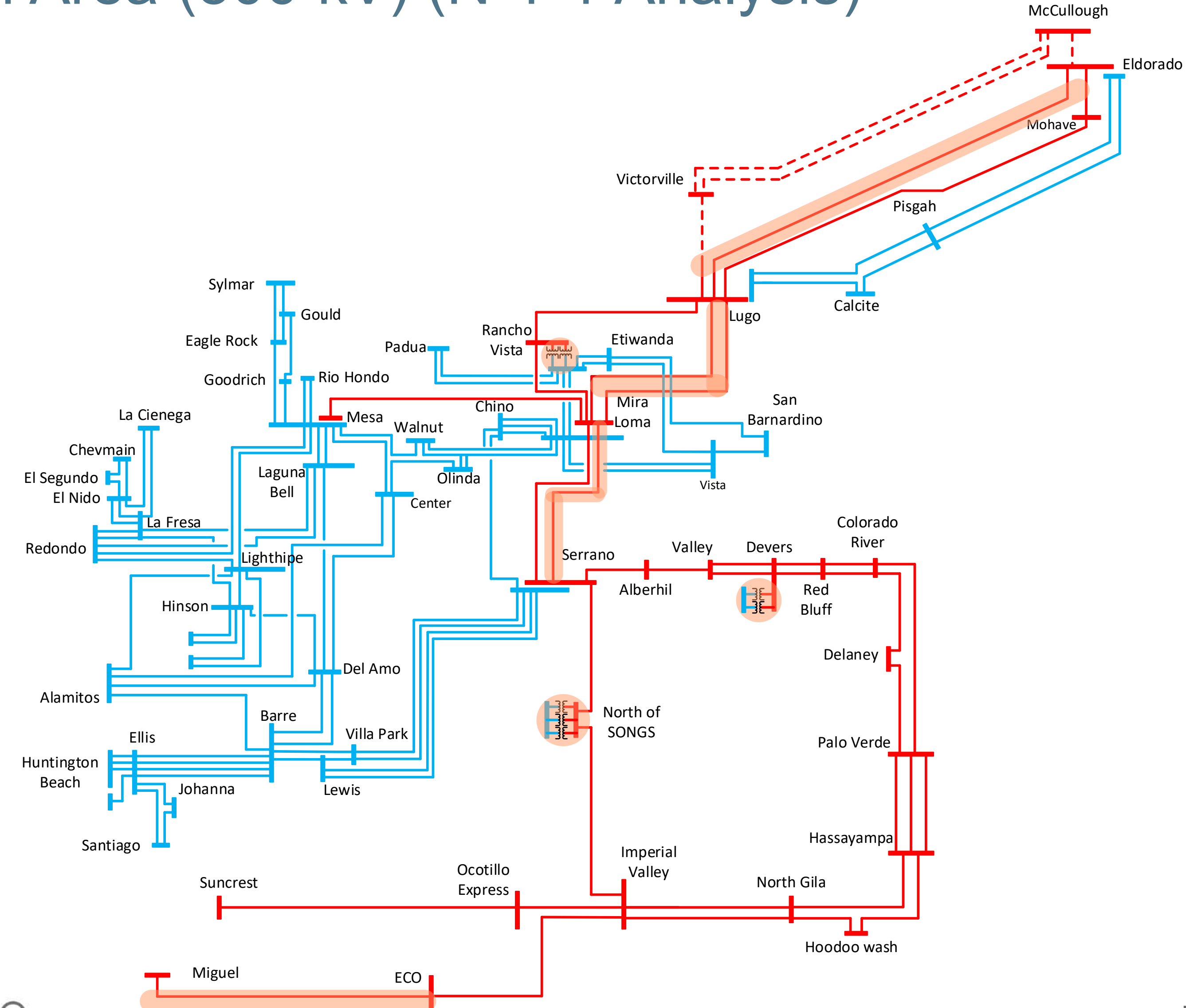
Greater Bay Area (N-1-1 Analysis)



LA Basin Area (500 kV) (N-1-1 Analysis)

Overload	Contingency/Scenario	Potential Mitigation
Eldorado - Lugo 500 kV	Lugo - Victorville and Imperial Valley - N. of SONGS 500 kV. Only in high import, high OOS (HSN-00)	Build Trout Canyon – Lugo line, or terminate the OOS wind at Lugo, or implement OOS wind vs. Import nomogram, or Redispatch after the first contingency
Lugo - Mira Loma #2 or #3 500 kV	Lugo - Mira Loma #2 or #3 and Lugo - Rancho Vista 500 kV in all scenarios but HSN-03 (no OOS wind, low import, max BESS)	Redispatch after the first contingency
Eco - Miguel 500 kV	Imperial Valley - N. SONGS and Imperial Valley - Ocotillo or Ocotillo-Suncrest only in high import, high OOS (HSN-00)	Redispatch after the first contingency or implement OOS wind vs. Import nomogram
Serrano - Mira Loma #2 500 kV	Serrano or Valley - Alberhill and Serrano - Mira Loma #1 500 kV in no gas scenarios (HSN-00, HSN-01)	Redispatch after the first contingency
Devers 500/230 kV Tx #1 or #2	Devers 500/230 kV Tx #1 or #2 and Alberhill - Serrano or Valley 500 kV in no gas scenarios (HSN-00, HSN-01)	Redispatch after the first contingency
Rancho Vista #3 or #4 500/230 kV Tx	Rancho Vista #3 or #4 500/230 kV Tx and Rancho Vista - Mira Loma 500 kV in all scenarios but HSN-03 (no OOS wind, low import, max BESS)	Redispatch after the first contingency
Third Transformer at N. SONGS	Two transformers at N. SONGS in no gas scenarios (HSN-00, HSN-01)	Redispatch after the first contingency

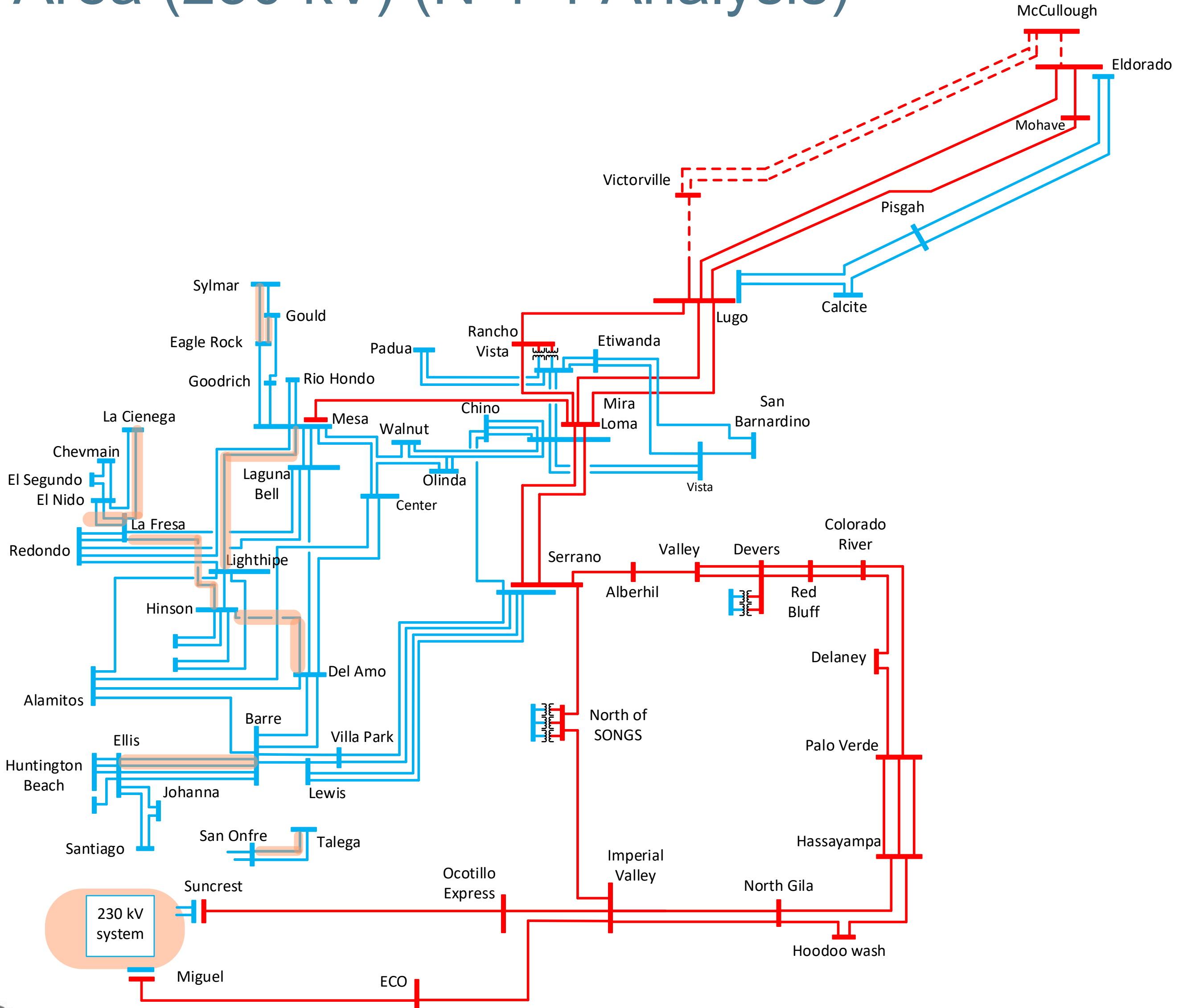
LA Basin Area (500 kV) (N-1-1 Analysis)



LA Basin Area (230 kV) (N-1-1 Analysis)

Overload	Contingency/Scenario	Potential Mitigation
Talega - S. ONOFRE #2	Talega - S. ONOFRE #1 and Imperial Valley - ECO or ECO – Miguel only in no gas, average BESS (HSN-00)	Since no overload is identified in the average gas, high BESS scenarios, most likely redispatch generation after the first contingency would meet address identified overloads (Charging capability needs to be assessed)
Barre - Ellis #1 or #2	Barre - Ellis #1 or #2 and Imperial Valley –N. of SONGS or Barre – Lewis only in no gas (HSN-00, HSN-01)	
Eagle Rock - Gould and Eagle Rock - Sylmar 230 kV	Lugo - Victorville 500 kV and Sylmar - Gould 230 kV in all scenarios but HSN-03	
La Fresa - El Nido #3 or #4 230 kV	La Fresa - El Nido #3 or #4 and La Fresa – La Cienega 230 kV in no gas (HSN-00, HSN-01)	
Del Amo - Hinson 230 kV	Lighthipe - Mesa and Del Amo - Alamitos 230 kV only in no gas, average BESS (HSN-00)	
La Fresa - Hinson 230 kV	La Fresa - Laguna Bell #1 and Mesa to Redondo 230 kV only in no gas (HSN-00, HSN-01)	
La Fresa - La Cienega 230 kV	El Nido - La Fresa #3 and #4 230 kV only in no gas (HSN-00, HSN-01)	
Lighthipe - Mesa 230 kV	Laguna Bell - Mesa - Redondo 230 kV in all scenarios but HSN-03	
Overload on the underlying 230 kV	Imperial Valley - Suncrest and Imperial Valley to Miguel 500 kV only in no gas (HSN-00, HSN-01)	

LA Basin Area (230 kV) (N-1-1 Analysis)



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Summary and Conclusions of HSN Analysis

- Offshore wind and Bay area
  - A new Fern Road – Tesla 500 kV line would be required and the existing Fern Road to Tesla 500 kV path would require upgrade
  - Overloads are identified on Vaca Dixon and Tesla 500/230 kV transformers and the 230 kV lines from them to the rest of the Greater Bay Area under most scenarios with N-0 overload under certain scenarios
  - Transmission enhancement would be required for no gas to enable BESS charging
- LA Basin
  - No major overload issues under N-0 and N-1. No major overload issues under N-1-1 with remaining gas and portfolio BESS dispatched
  - Transmission enhancement would be required for no gas to enable BESS charging
- Out of state wind
  - Interconnecting OOS wind to substations closer to the load centers will reduce the need for upgrading the Eldorado – Lugo and Palo Verde – Imperial Valley 500 kV paths.

Next Steps

- Test the mitigation measures on HSN scenarios including alternative interconnection points for OOS wind
- Coordinate with 2023-2024 TPP Policy Study on selecting the preferred alternative for the offshore wind interconnection
- Study SSN and off peak scenarios and if required develop mitigation measures
- Run P7 contingencies across the 500 kV and 230 kV system
- Provide high level cost estimate for the interconnections and mitigation measures
- Post the draft plan on March 31, 2024

20-Year Transmission Outlook - Update

- CEC Docketed "Final Staff Paper for the 2045 Scenario for the 20-Year Transmission Outlook" – July 13
- ISO stakeholder call – August 16
- The ISO provided updates at the 2023-2024 transmission planning stakeholder meetings:
  - September 26 and 27
- ISO stakeholder call – January 4, 2024
  - Comments due January 18, 2024
- Draft 20-Year Transmission Outlook – March 31, 2024
- Finalize 20-Year Transmission Outlook – May 2024

Next Steps

Kaitlin McGee
Stakeholder Engagement and Policy Specialist

January 4, 2024

Comments

- Comments due by end of day January 18, 2024
- Submit comments through the ISO's commenting tool, using the template provided on the process webpage:
  https://stakeholdercenter.caiso.com/RecurringStakeholderProcesses/20-Year-transmission-outlook-2023-2024

Comments will be submitted to the ISO using the online stakeholder commenting tool

- Ability to view all comments with a single click.
- Ability to filter comments by question or by entity.
- Login, add your comments directly to the template and submit.
  - You can save and return to your entry anytime during the open comment period.

NOTE

Submitting comments in the tool will require a one-time registration.

Find a video on how to use the commenting tool on the Recurring Stakeholder Processes landing page.