Draft 20-Year Transmission Outlook

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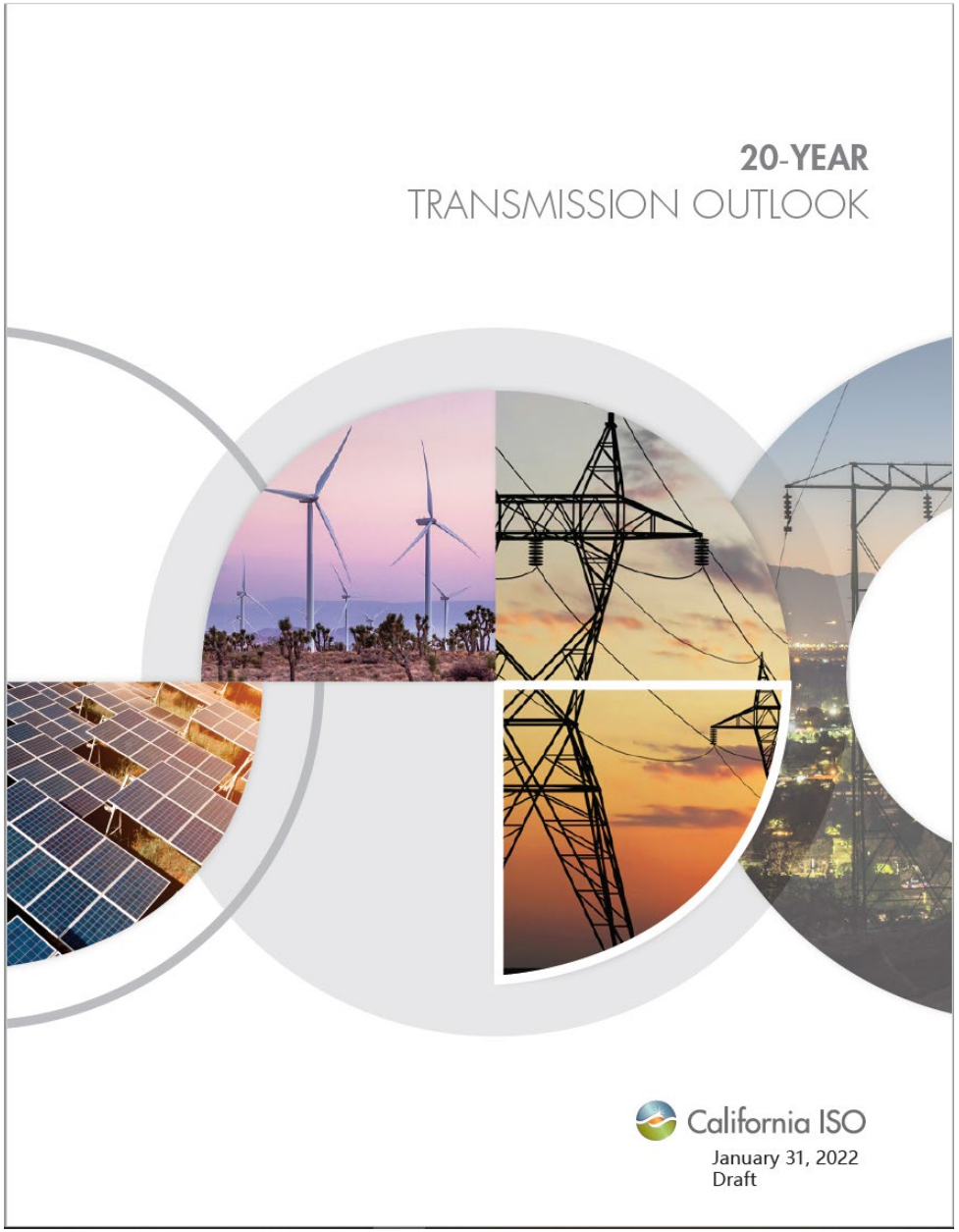
Draft 20-Year Transmission Outlook

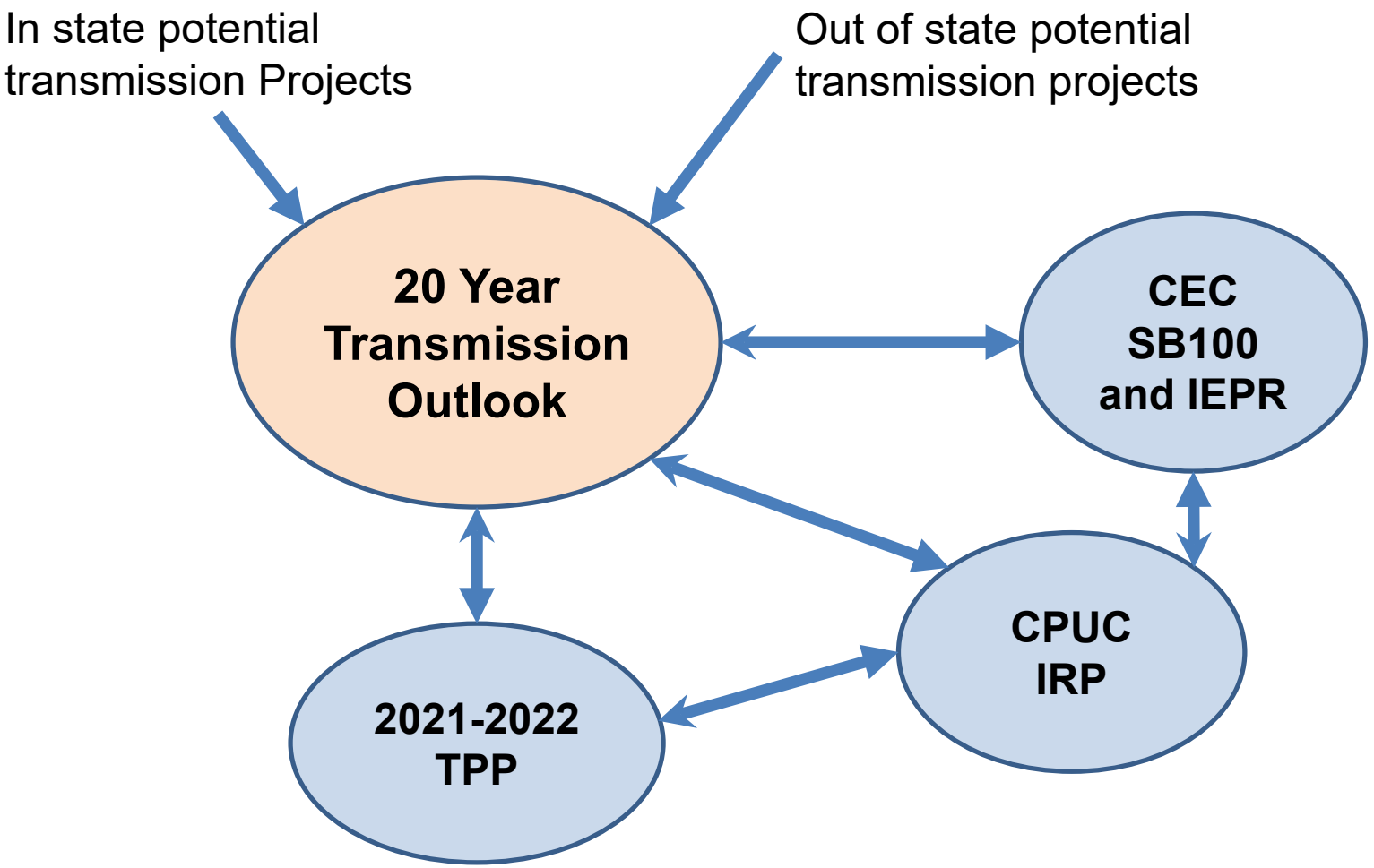
- The CAISO has produced its first ever 2-Year Transmission Outlook focused on providing a longer term view of transmission needed to reliably meet state clean energy goals
- Posted on CAISO website on January 31, 2022
  http://www.caiso.com/InitiativeDocuments/Draft20-YearTransmissionOutlook.pdf
- Is a draft and not as a final document – will be finalized in March in parallel with the 2022-2023 Transmission Plan



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

- Includes high level technical studies to test feasibility of alternatives, focusing on the bulk transmission system
- Used a "Starting Point" scenario docketed that:
  - has 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.
- Is intended to help:
  - scope the challenges we face,
  - help the state to further refine resource planning,
  - and provide longer term context for decisions made in the 10 year transmission plan process.

Primary Paths for Coordination with Other Initiatives



20 Year Outlook – SB100 Starting Point Scenario

	Portfolios for 2020-2021 Plan (2030)	Portfolios for 2021-2022 Plan (2031)	*Authorized near and mid term (2025) procurement*	*Proposed Decision Preferred System Plan (2025)*	Proposed Decision Preferred System Plan (2032)	SB 100 Starting Point Scenario (2040)
Solar	6,763	13,044	*12,800 **	*11,000*	17,506	53,212
Wind	992	4,005		*3,531 in state* *0 OOS* *0 offshore*	3,531 in state 1,500 OOS 1,708 offshore	2,237 in state 12,000 OOS 10,000 offshore
Battery storage	1,376	9,368		*11,317*	13,571	37,000
Gas-fired						
Biomass				*107*	134	
Geothermal	0	651	*1,000 likely beyond 2026*	*114*	1,160	2,332
Pumped Hydro / Long Duration	1,256	627	*1,000 likely beyond 2026*		1,000	4,000
Total	**10,387**	**27,695**	***14,800***	***26,069***	**40,110**	**120,781**
Gas retirements	0	0			~1,000	-15,000

* NQC value as opposed to installed capacity

Table does not include behind-the-meter resources and supply-side demand response

Integration of the resources in SB100 Starting Point

Study cases

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

High electrification load scenario development

- SB 100 Core statewide high electrification load projection of 82,364 MW in 2040
- CEC 2020 IEPR Mid-Mid (1-in-2 weather) scenario for 2031 statewide load is 64,076 MW.
- 18,288 MW (28.5 percent) increase from the IEPR 2020 load forecast in 2031 to the high electrification forecast base of the SB 100 Core scenario in 2040
- SB 100 Core scenario statewide behind-the-meter PV (BTM-PV) in the state of California to reach 33,807 MW in year 2040

Load and Installed BTM-PV	State	CAISO
CEC peak consumption forecast in 2031	64,076	57,498
SB-100 peak consumption in 2040	82,364	73,909
BTM-PV installed capacity in CEC 2031 forecast	25,092	22,655
BTM-PV in SB-100 in 2040	33,807	30,336

Dispatch and high level technical studies

- Hourly CEC load profile in year 2030 are used to estimate the load and behind-the-meter PV generation for the three study cases

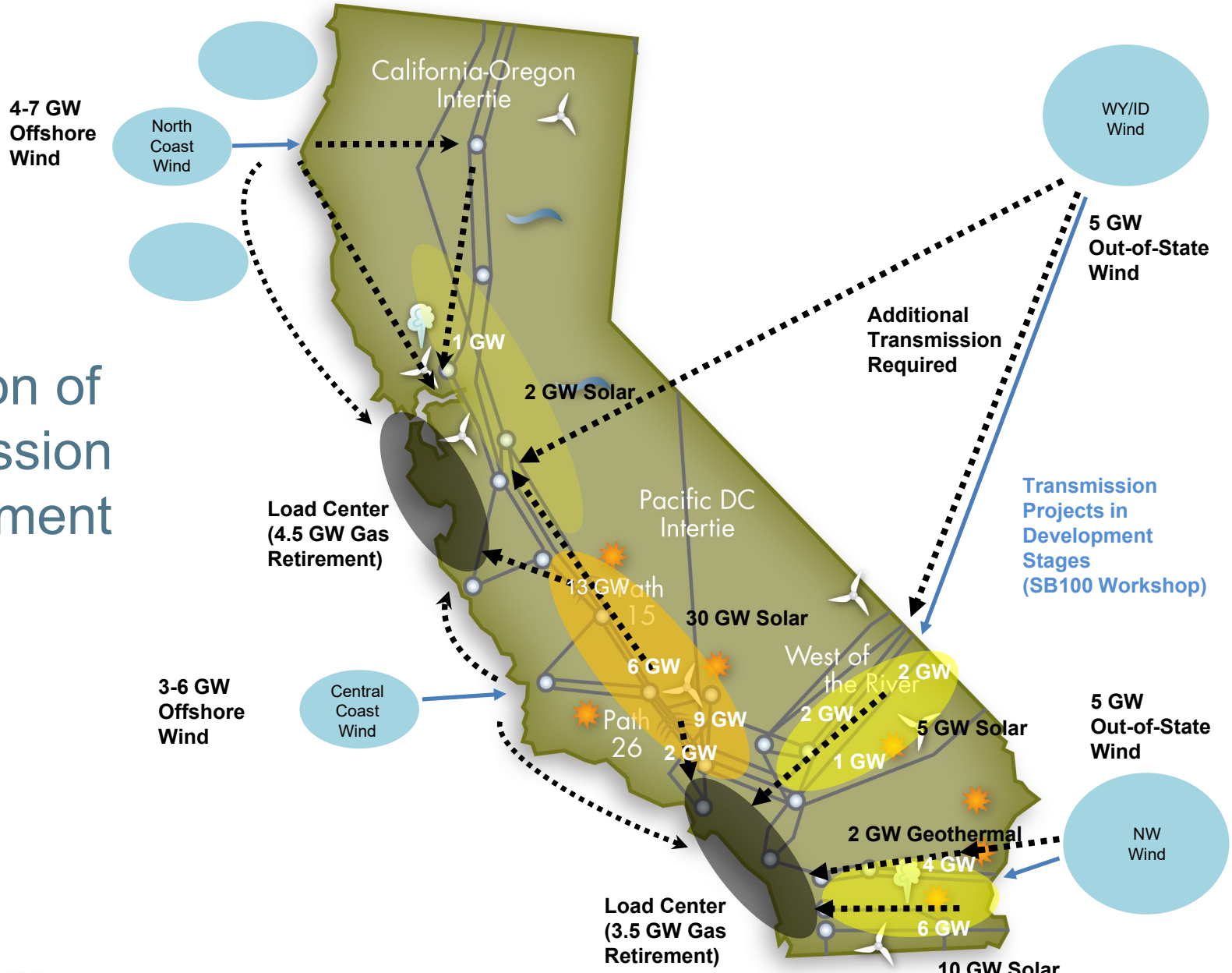
- Resource dispatch based upon dispatch in policy studies in 2021-2022 transmission planning process for different study cases

- Contingency analysis
  - N-0 base case with no contingency
  - Only 230 kV and 500 kV contingencies were evaluated for N-1 analysis
  - Only 500 kV contingencies were evaluated 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

Transmission assumptions

- Previously approved projects transmission planning process
- Projects Recommended in draft 2021-2022 Transmission Plan
  - Manning 500/230 kV Project
  - Collinsville 500/230 kV Project
  - Newark – Los Esteros – NRS HVDC
  - Metcalf – San Jose B HVDC
  - Mesa – Laguna Bell Reconductor
  - GLW Proposed Upgrades
- System Upgrades Required for Starting Point Generation Interconnection
  - Wheeler Ridge – Kern 230 kV DCTL Project
  - Kramer – Victor – Lugo Path Upgrade Project

Illustration of Transmission Development



Transmission upgrades to existing CAISO footprint

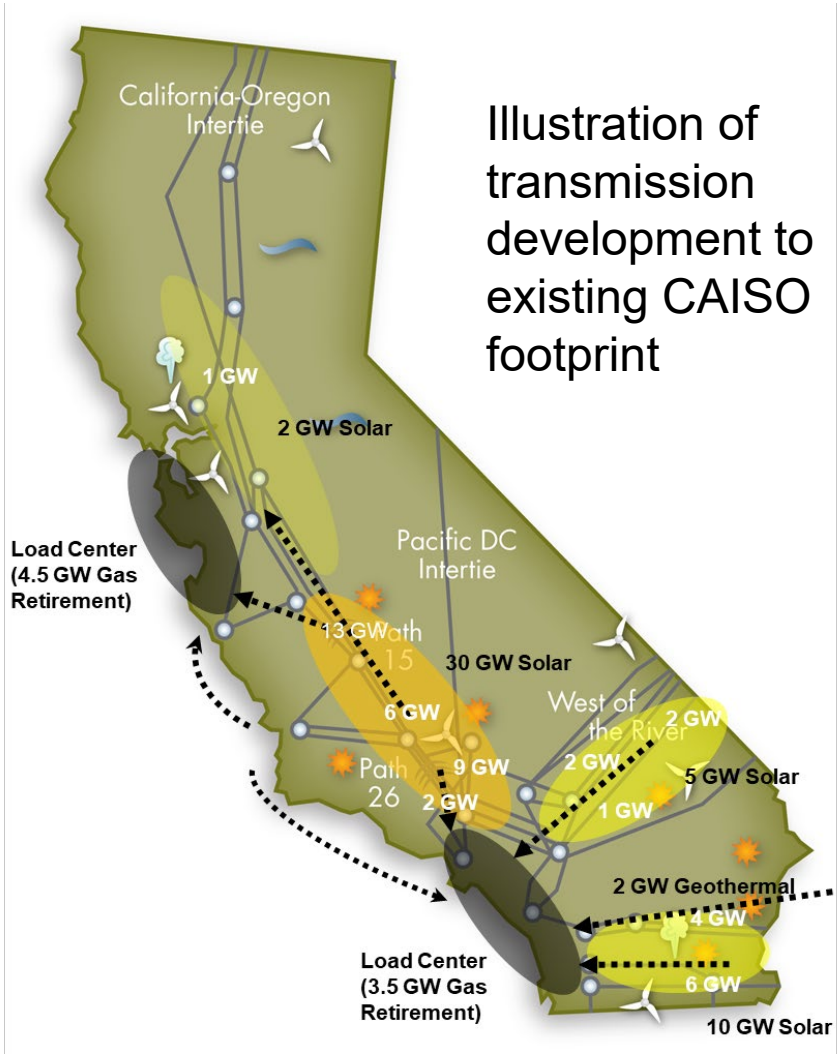
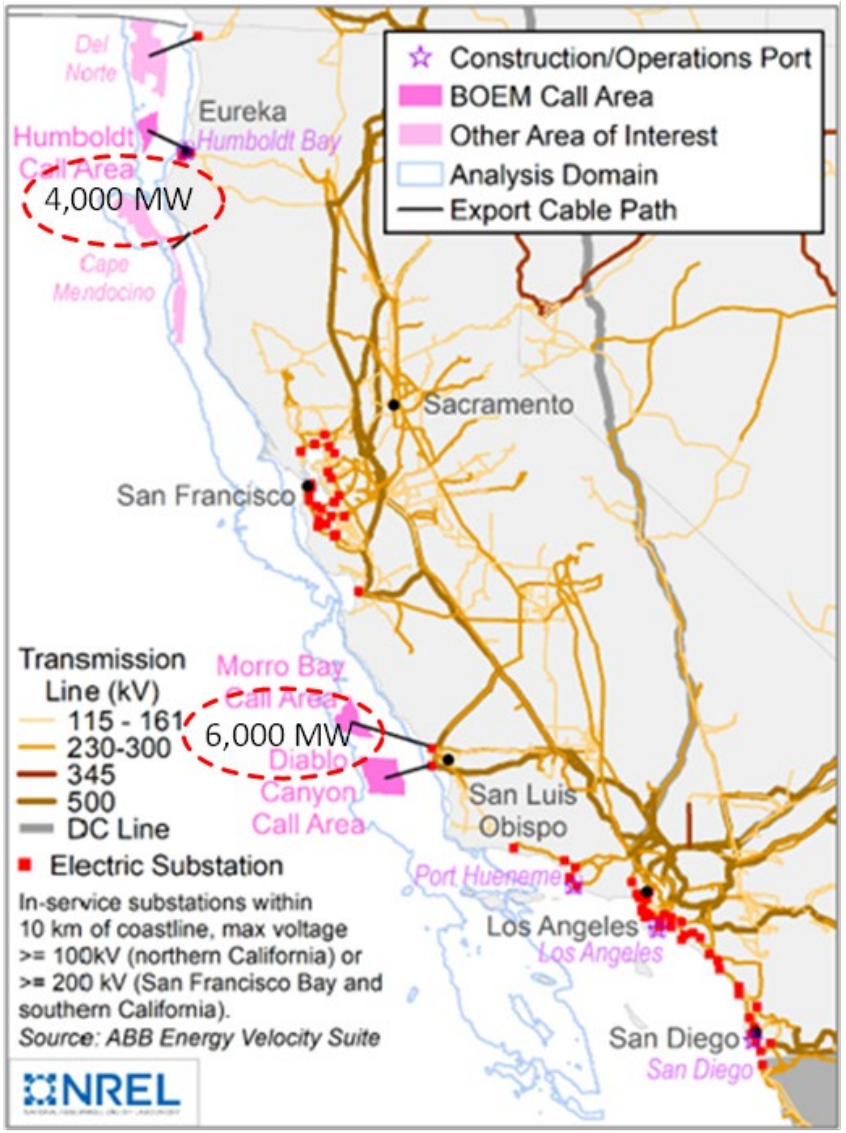


Illustration of transmission development to existing CAISO footprint

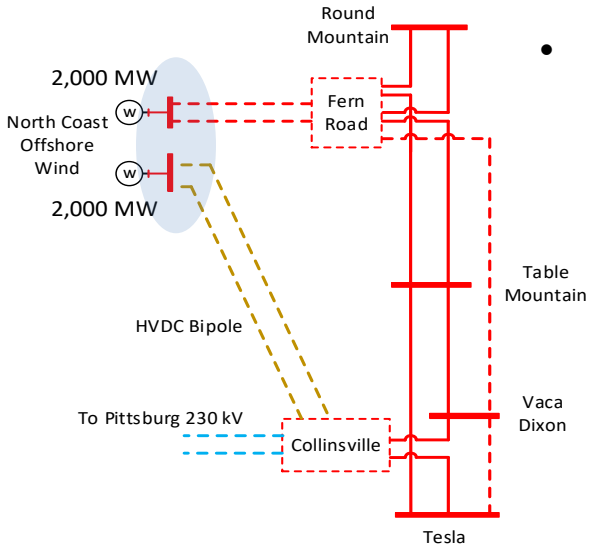
Transmission Development	Description	Cost Estimate
Upgrades to existing CAISO footprint		**10.74**
Eldorado – Lugo 500 kV line	- 180 mi of 500 kV line - Series compensation in number of locations	$1 B
Colorado River – Devers 500 kV line	- Devers – Red Bluff 500 kV line - Ref Bluff – Colorado River 500 kV line	$1.2 B
North Gila – Imperial Valley 500 kV line	- 85 mi of 500 kV line - Series compensation	0.5 B
Westland 500/230 kV station	- 50 mi of 500 kV line - New 500/230 kV substation with two transformers ($200M)	0.5 B
Second Los Banos – Tracy 500 kV line	- 67 mi of 500 kV line	$0.33 B
Third Collinsville – Pittsburg 230 kV cable	- 230 kV cable	$0.14 B
Manning – Moss Landing 500 kV line	- 78 mi of 500 kV line - New 500/230 kV substation with two transformers ($100M)	$0.50 B
Devers – La Fresa HVDC	- 100 mi of DC cables - Two VSC HVDC converter	$1.2 B
Lugo – LA Basin HVDC	- 80 mi of DC cables - Two VSC HVDC converter	$1.0 B
Sycamore – Alberthill HVDC	- 82 mi of DC cables - Two VSC HVDC converter	$1.0 B
Diablo – South HVDC	- Four VSC converter stations - 250 miles HVDC cables	$1.85 B
Diablo – North HVDC	- Four VSC converter stations - 200 miles HVDC cables	$1.60 B
Round Mountain 500/230 kV Transformer	- Add one 500/230 kV transformer	$0.1 B
Lugo 500/230 kV Transformers	- Add one 500/230 kV transformer	$0.1 B

Offshore Wind

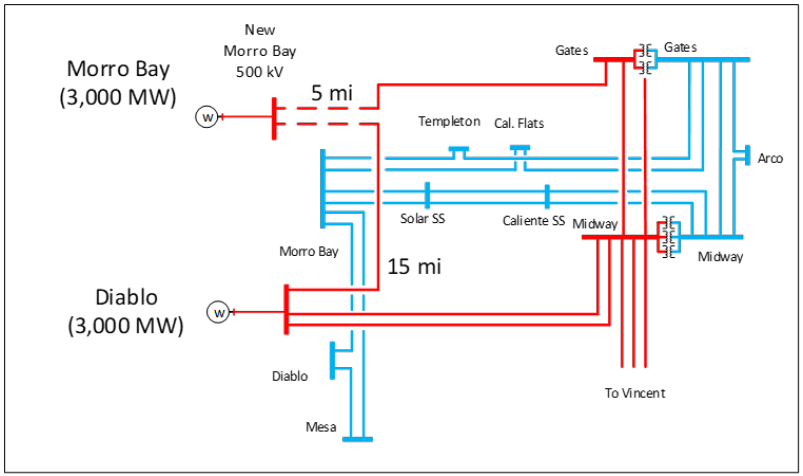
- 10 GW of offshore wind
  - 6 GW in central coast
  - 4 GW in north coast
- Current areas of environmental and leasing development at Bureau Ocean Energy Management (BOEM)
  - Humboldt call area
  - Morro Bay call area



Offshore transmission development



- Central coast offshore wind interconnecting to existing 500 kV in Diablo/Morro Bay area
- North coast offshore wind requires transmission development to interconnect to existing system
  - 500 kV AC interconnection to Fern Road
  - HVDC line to Collinsville
  - interconnect 500 kV AC and HVDC systems together and the offshore wind farms in two wind development areas
  - Potential for offshore grid development and strengthening of interconnection to Pacific Northwest



Transmission Development	Description	Cost Estimate
Offshore Wind		**$8.11 B**
Humboldt Bay Offshore wind area	Total of 4,000 MW offshore wind connected through two of the following options: - Option 1 (Fern Road): $2.3 B - Option 2 (Bay Hub): $4.0 B - Option 3 (Collinsville): $3.0 B Facilities required to interconnect the transmission options connecting to the different offshore wind areas: $0.5B-$1.0 B.	$5.8 B–$8.0 B
Diablo – Morro Bay Offshore wind area	- Total of 6,000 MW offshore wind. Connected to Diablo 500 kV and the new Morro Bay 500 kV substation. - The cost estimate is only for a 500 kV switching station and looping in the existing Diablo – Gates 500 kV line into it.	0.11 B

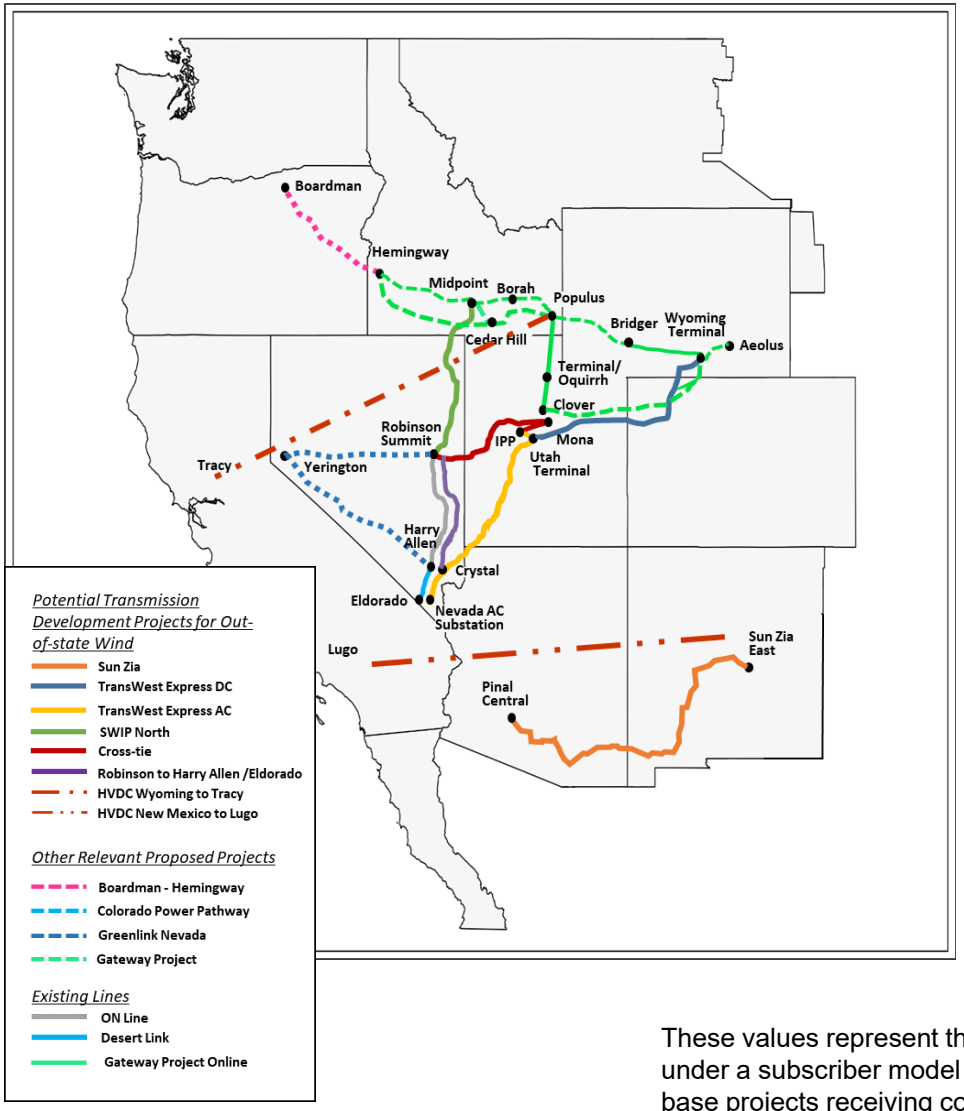
Out-of-state wind

- 12,000 MW of out-of-wind identified in SB 100 Starting Point scenario
  - On new transmission
    - Wyoming 4,685 MW
    - New Mexico 5,215 MW
  - On existing transmission
    - Northwest 1,500 MW
    - Baja California 600 MW

- Transmission projects presented at SB100 workshop by developers can accommodate approximately 6,000 MW of out-of-state wind

Transmission Development Project	Wind Area	Capacity (MW)
SunZia Project • Plus scheduling rights on existing lines from Pinal Central to Palo Verde connecting to the CAISO system	New Mexico	2,000 – 3,000
TransWest Express • Also provides potential for 1,500 MW to LADWP	Wyoming	1,500
SWIP-North • With upgrades and scheduling rights On Line from Robinson to Harry Allen	Idaho	1,000
Cross-tie • Would require additional 500 kV line between Robinson to Eldorado	Wyoming	1,000

Transmission development for out-of-state wind



Transmission Development	Description	Cost Estimate
Out-of-State Wind		**$11.65 B**
SWIP-North	275 mile 500 kV line from Midpoint to Robinson substation with upgrades to On Line from Robinson to Harry Allen to access Idaho wind resources	$0.64 B
Cross-Tie	214 mile 500 kV line from Robinson to Mona/Clover to access Wyoming wind resources	$0.67 B
Robinson-Eldorado	500 kV transmission line from Robinson to Harry Allen/Eldorado	$0.64 B
TransWest Express	732 Mile transmission system consisting of HVDC and 500 kV facilities to access Wyoming wind. Project is designed to potentially provide 1500 MW to LADWP at the IPP facilities in Utah and 1500 MW to the CAISO at Harry Allen/Eldorado	$2.1 B
SunZia	530 mile HVDC line and 35 mile 500 kV AC line plus scheduling rights on existing lines from Pinal Central to Palo Verde connecting to the CAISO system to access New Mexico wind resources	$2.6 B
Additional transmission for additional wind resources from Wyoming/Idaho area	HVDC transmission line from the wind resource area to northern California (Tesla area)	$2.5 B
Additional transmission for additional wind resources from New Mexico area	HVDC transmission line from the wind resource area to southern California (Lugo area)	$2.5 B

These values represent the capital cost of the identified projects; several are currently being developed under a subscriber model – with the transmission costs incorporated into the energy costs – and not rate-base projects receiving cost-of-service cost recovery that would be added to CAISO transmission access charges.

Transmission Development Estimated Cost

Transmission Development	Estimated Cost ($ billions)
Upgrades to existing CAISO footprint consisting of: • 230 kV and 500 kV AC lines • HVDC lines • Substation upgrades	$ 10.74 B
Offshore wind integration consisting of: • 500 kV AC lines • HVDC lines	$ 8.11 B
Out-of-state wind integration consisting of: • 500 kV AC lines • HVDC lines	$ 11.65 B
Total estimated cost of transmission development	**$ 30.5 B**

These values represent the capital cost of the identified projects; several are currently being developed under a subscriber model – with the transmission costs incorporated into the energy costs – and not rate-base projects receiving cost-of-service cost recovery that would be added to CAISO transmission access charges.

Conclusions and next steps

- The 20-Year Transmission Outlook provides a long-term conceptual plan of the transmission grid in 20 years, meeting the resource and electric load needs aligned with state agency input on integrated load forecasting and resource planning, as the basis for further dialogue.
- After finalizing this draft in March, the CAISO intends to:
  - Look for discussion of the findings in ongoing SB 100 processes and perhaps additional stakeholder sessions
  - Collect input on issues and parameters that could be considered and refined in a future outlook development cycle – thinking about 2023
  - Provide industry an update on the 20-Year Outlook activities and communicate intentions going forward, by year end.

Comments
Draft 20-Year Transmission Outlook

- Comments due by end of day February 22, 2022

- 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