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| Docket Number: | 17-MISC-01 |
| Project Title: | California Offshore Renewable Energy |
| TN #: | 243708 |
| Document Title: | Presentation - Transmission Planning for Offshore Wind - June 27 AB 525 Workshop |
| Description: | Presentation from Jeff Billinton of California Independent Service Operator -Transmission Planning for Offshore Wind |
| Filer: | susan fleming |
| Organization: | California ISO |
| Submitter Role: | Public Agency |
| Submission Date: | 6/24/2022 4:47:31 PM |
| Docketed Date: | 6/24/2022 |



California ISO

Transmission Planning for Offshore Wind

Jeff Billinton

Director, Transmission Infrastructure Planning

June 27, 2022

CEC AB 525 Workshop on Offshore Wind Maximum Feasible Capacity and Megawatt Planning Goals for 2030 and 2045

Transmission Planning Process

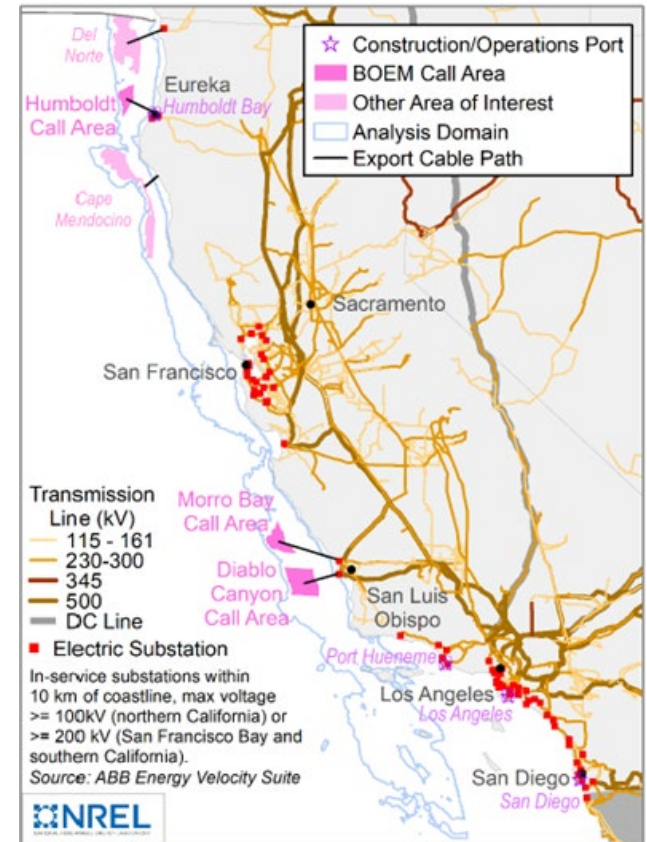
- The CAISO conducts an annual tariff based transmission planning process to assess needs and approve solutions for reliability, policy and economic driven transmission
 - Is currently conducted on a 10-year planning horizon but is not limited to 10 years
- The CAISO issued its first 20-Year Transmission Outlook in May 2022 that 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.

CAISO Offshore Wind Studies

- In the 2021-2022 transmission planning process the CPUC provided a sensitivity portfolio to assess the transmission development required to integrate offshore wind
 - 8.3 GW of offshore wind for detailed analysis
 - An addition 12.2 GW of offshore wind in North coast area for high level assessment
- In addition within the 20-Year Transmission Outlook the SB100 Starting Point scenario included 10 GW of offshore wind resources
 - Analysis based on 2021-2022 transmission planning process studies

Description of 2021-2022 transmission planning process Sensitivity 2 Portfolio

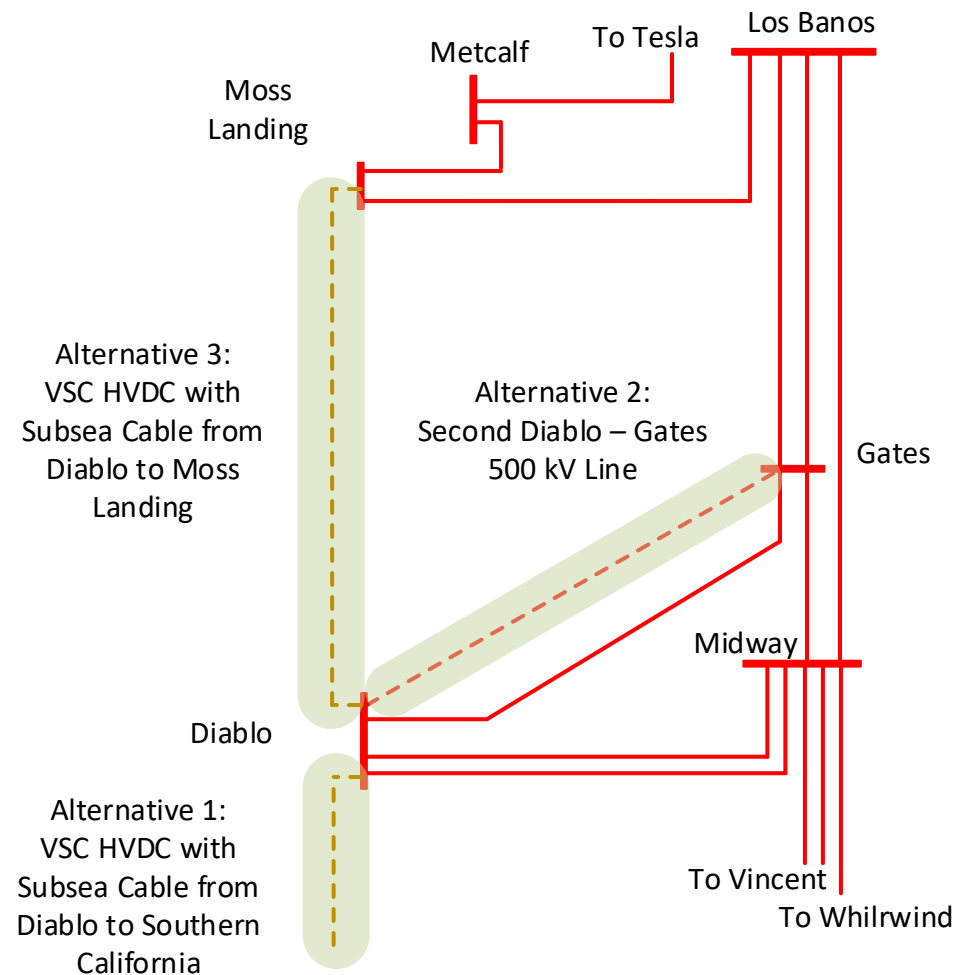
- Sensitivity 2 includes the following offshore wind resources:
 - Humboldt: 1.6 GW
 - Diablo Canyon: 4.4 GW
 - Morro Bay: 2.3 GW
- In addition, an outlook assessment was performed to accommodate the remaining offshore wind resource potential:
 - Del Norte: 6.6 GW
 - Cape Mendocino: 6.2 GW
- The total offshore wind in the outlook is 21.1 GW



Source: [The Cost of Floating Offshore Wind Energy in California Between 2019 and 2032 \(nrel.gov\)](https://www.nrel.gov/publications/the-cost-of-floating-offshore-wind-energy-in-california-between-2019-and-2032) (Page 39)

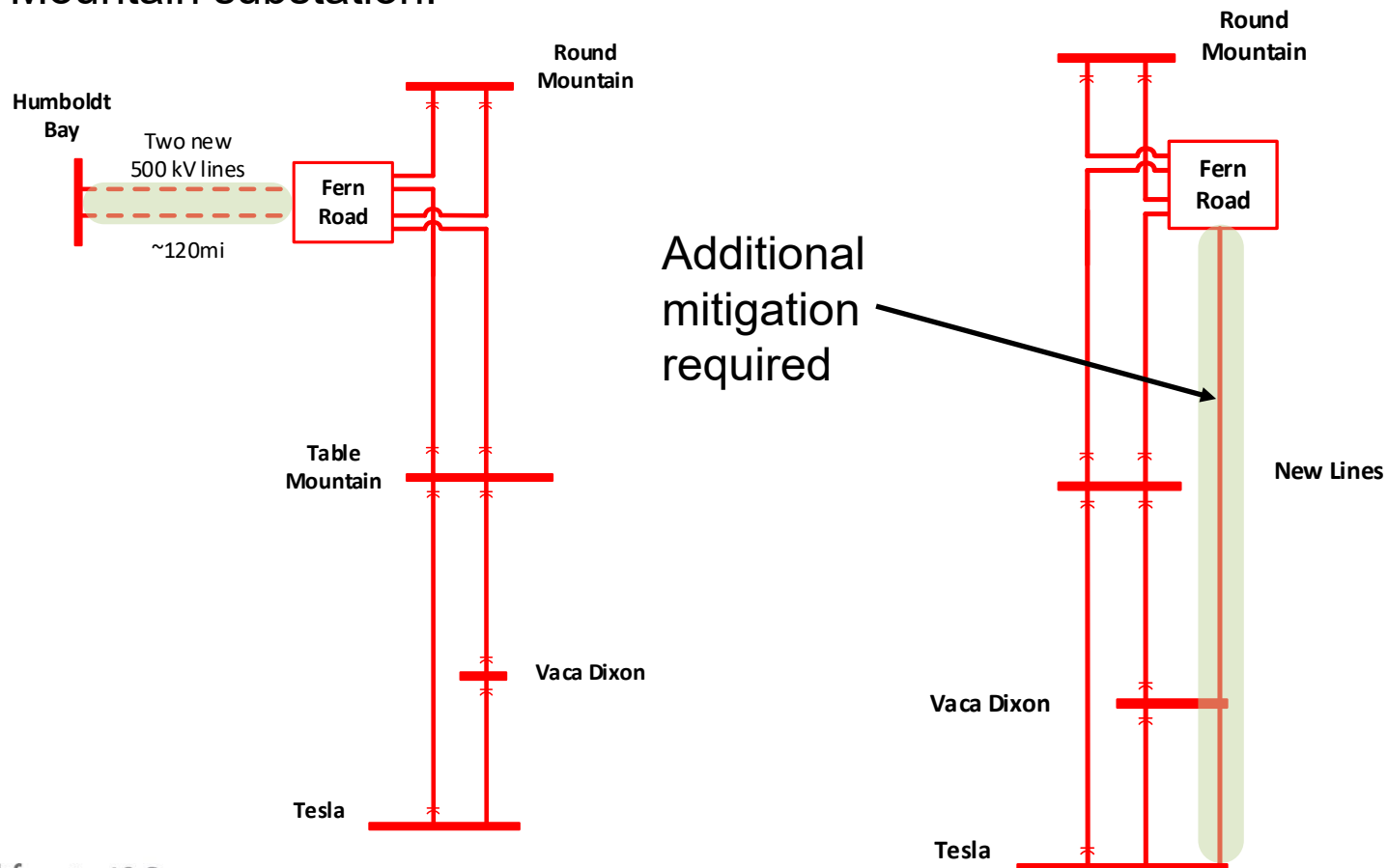
Central Coast – Offshore Wind

- The analysis identified that 5.3 GW of resources can connect to the 500 kV system in the Diablo/Morro Bay area after the retirement of the Diablo Nuclear Power Plant
- To increase the offshore capacity to the 6.4 GW included in sensitivity portfolio three alternatives were considered.



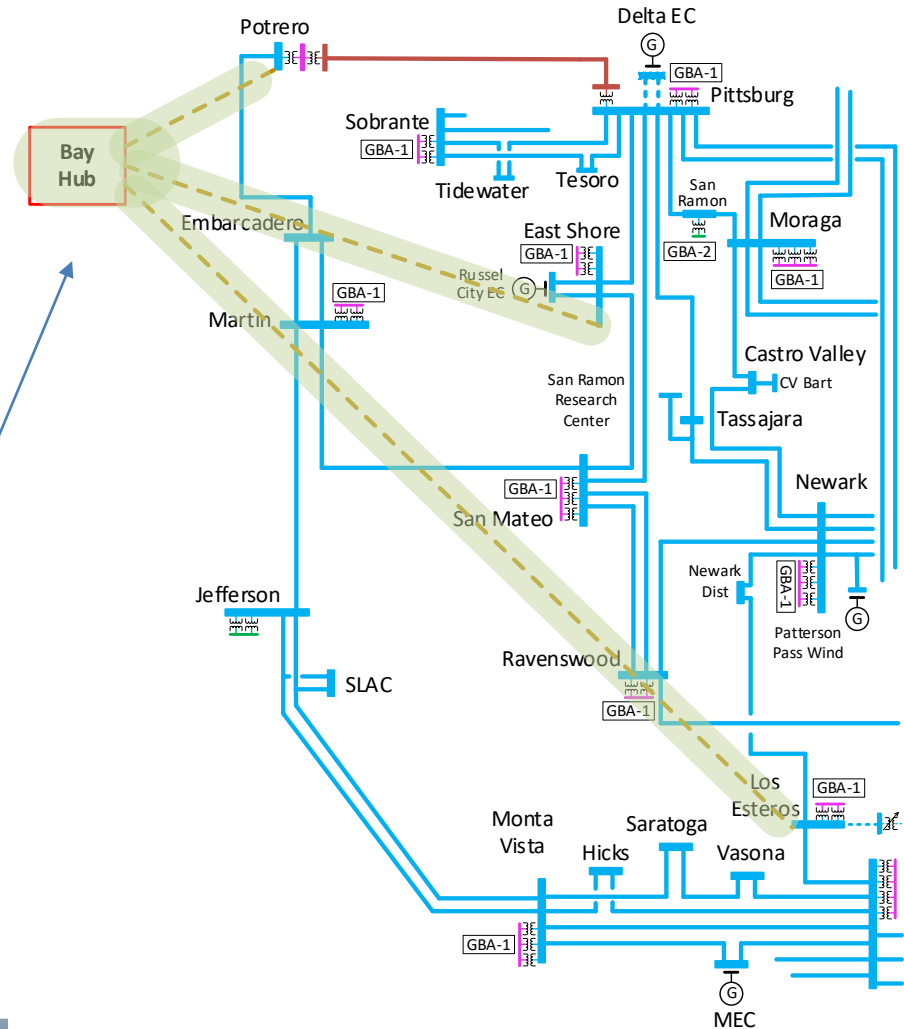
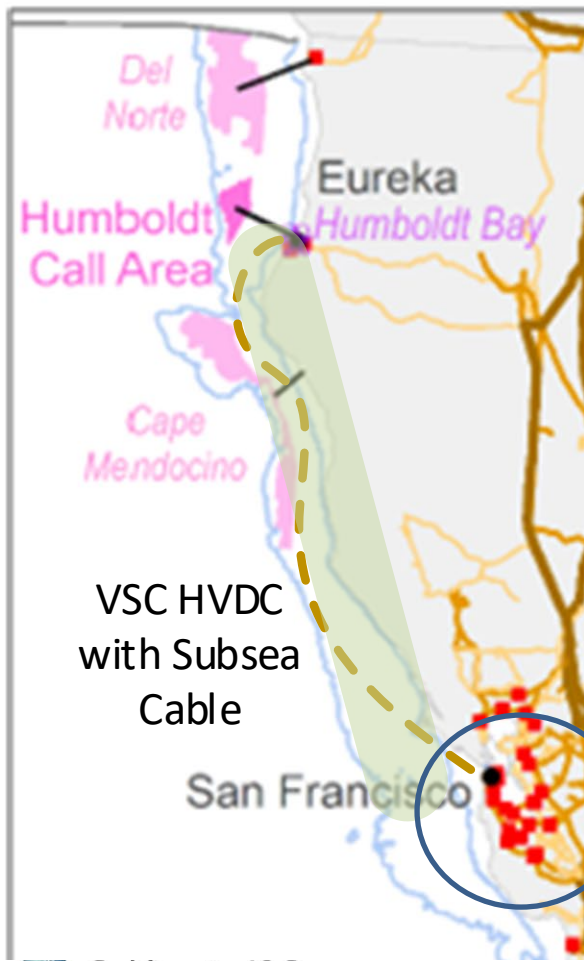
Humboldt 1.6 GW Interconnection Alternatives(1/3)

- Option 1: 500 kV AC line to Fern Road 500 kV substation.
 - Fern Road 500 kV substation is planned to be in service by June 2024 as part of Round Mountain DRS project and is located 11 miles south of Round Mountain substation.



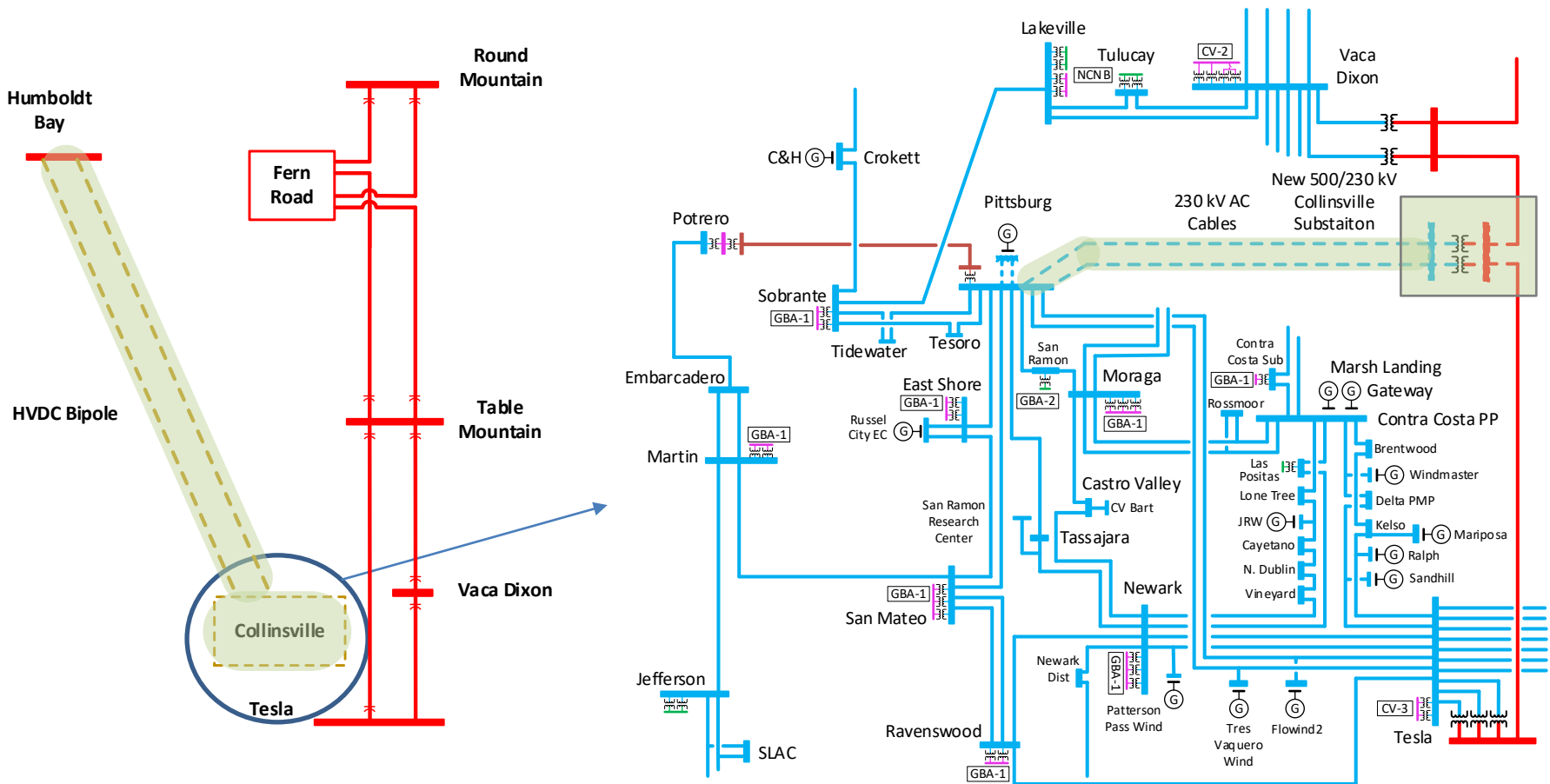
Humboldt 1.6 GW Interconnection Alternatives (2/3)

- Option 2: VSC-HVDC subsea cable to a converter station in the Bay area with 3 AC connections to Potrero, East Shore, and Los Esteros



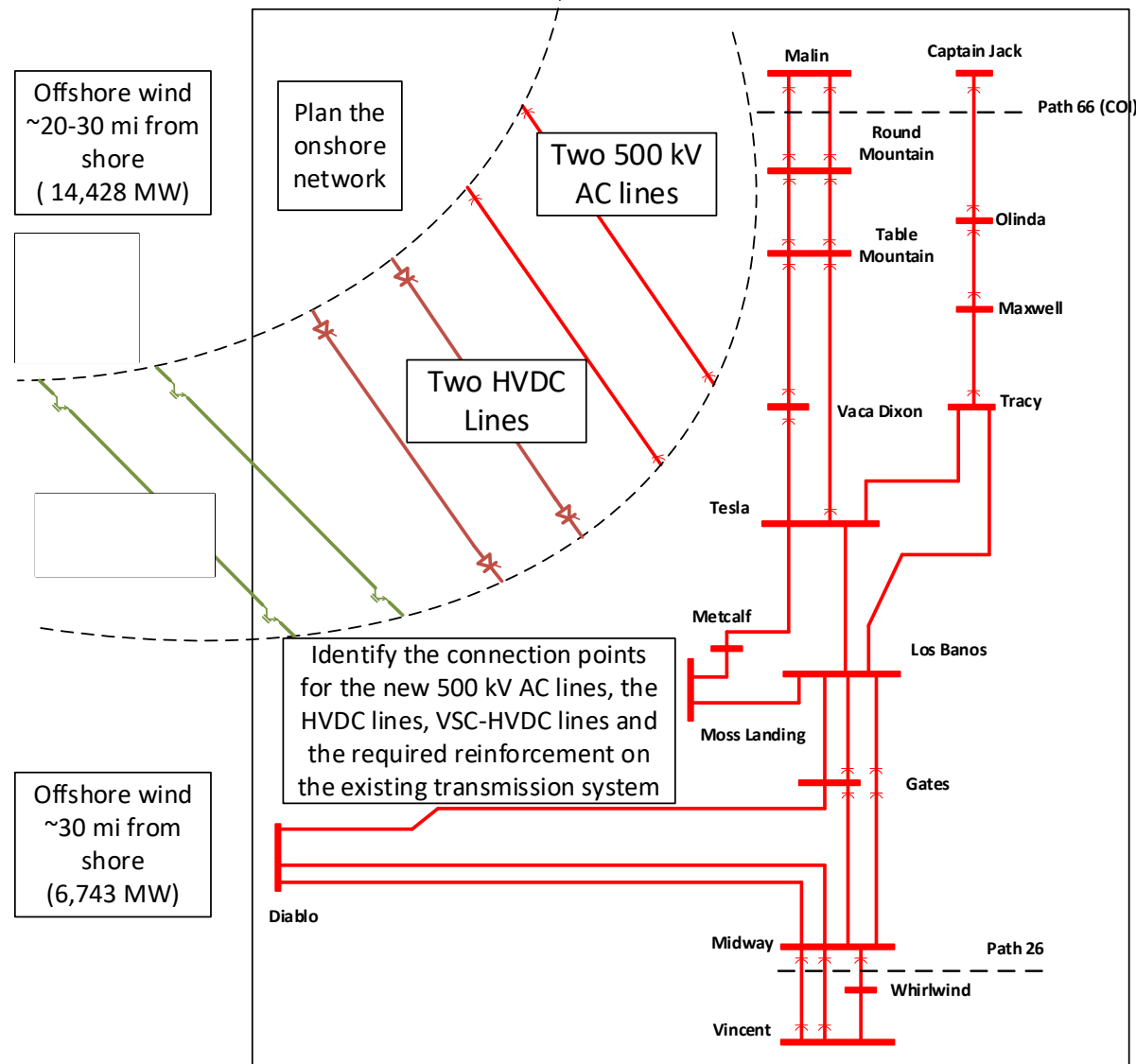
Humboldt 1.6 GW Interconnection Alternatives (3/3)

- Option 3: HVDC Bipole to Collinsville 500/230 kV substation.



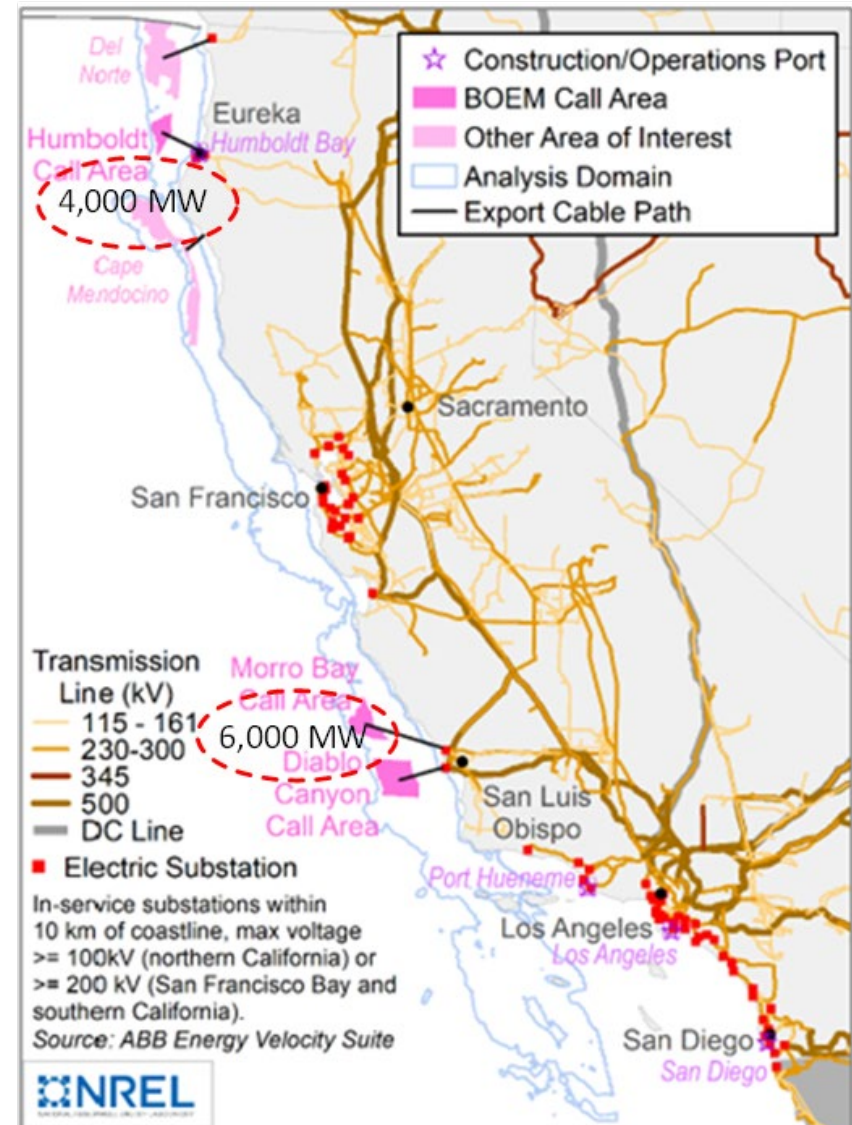
Outlook Assessment with 14.4 GW OSW in North Coast

- Considering the study results with 1.6 GW at Humboldt, further evaluations were performed for interconnection of 14.4 GW of wind under outlook assessment.
- A review of possible technology options and configurations was performed to integrate 14.4 GW of offshore wind in the north coast.



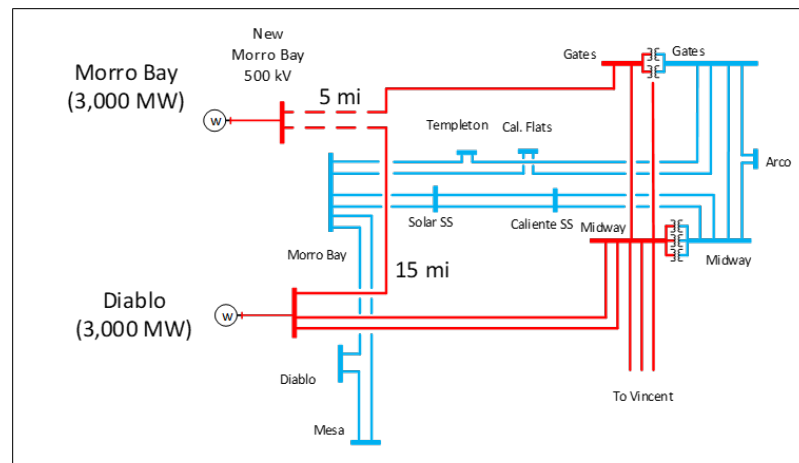
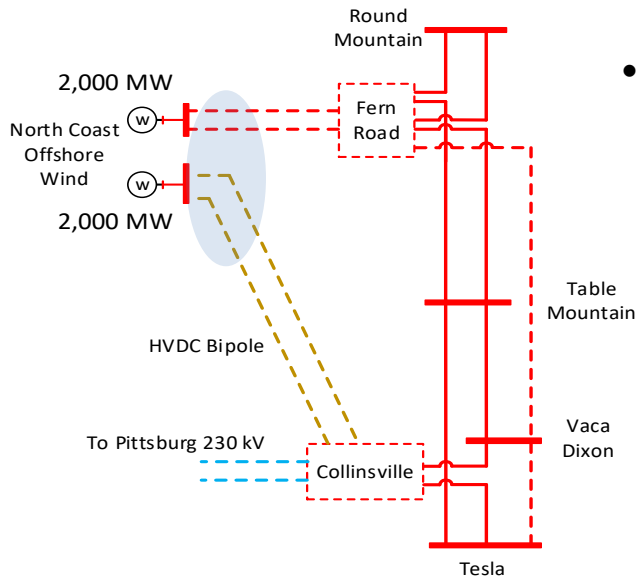
20-Year Transmission Outlook - Offshore Wind

- 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 |
|---------------------------------------|--|-----------------|
| 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 | 0.11 B |

2022-2023 Transmission Planning Process

- Base portfolio includes 1,708 MW of offshore wind
 - 1588 MW from the Morro Bay BOEM call area
 - 120 MW from Humboldt BOEM call area (as energy only resources)
- The CAISO will be conducting a sensitivity study based upon a portfolio provided by the CPUC that is based on the CEC's adopted high transportation electrification scenario. A stakeholder call is scheduled for July 6.