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Offshore Wind Energy Development off the California Coast: Maximum Feasible Capacity and Megawatt Planning Goals for 2030 and 2045

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Date: May 18, 2022

California's Climate and Clean Energy Policies

Offshore wind energy can advance California's progress toward its statutory renewable energy and climate mandates.

- Raise GHG emissions reduction targets to 40% below 1990 levels by 2030 (SB 32, 2016)
- Require all retail electricity to come from eligible renewable energy resources and zero-carbon resources by 2045 (SB 100, 2018)
- Increase the 2030 Renewables Portfolio Standard goal to 60% (SB 100, 2018)

California
Clean Electricity Resources

	Existing Resources	Projected New Resources	
	2019*	2030**	2045**
Solar (Utility-Scale)	12.5 GW	16.9 GW	69.4 GW
Solar (Customer)	8.0 GW	12.5 GW	28.2 GW
Storage (Battery)	0.2 GW	9.5 GW	48.8 GW
Storage (Long Duration)	3.7 GW	0.9 GW	4.0 GW
Wind (Onshore)	6.0 GW	8.2 GW	12.6 GW
Wind (Offshore)	0 GW	0 GW	10.0 GW
Geothermal	2.7 GW	0 GW	0.1 GW
Biomass	1.3 GW	0 GW	0 GW
Hydrogen Fuel Cells	0 GW	0 GW	0 GW
Hydro (Large)	12.3 GW	N/A†	N/A†
Hydro (Small)	1.8 GW	N/A†	N/A†
Nuclear	2.4 GW	N/A†	N/A†

Assembly Bill 525 Legislative Findings

- Advance climate and energy goals
- Diversify energy portfolio
- Realize environmental, economic, and workforce development benefits
- Contribute to grid reliability
- Advance workforce training opportunities
- Ensure protection of coastal and marine ecosystems
- Consider impacts to ocean users & communities.

Assembly Bill 525 Strategic Plan Priorities

- Emphasize near-term actions to accommodate jobs and economic development
- Strive for compatibility with harbor tenants and ocean users
- Ensure benefits compliment other local industries
- Improve port infrastructure to support land-based work for local workforce
- Consult with labor organizations and apprenticeship programs.

Assembly Bill 525 Strategic Plan Timeline

June 1, 2022
Evaluate and quantify maximum feasible capacity and establish megawatt planning goals for 2030 and 2045

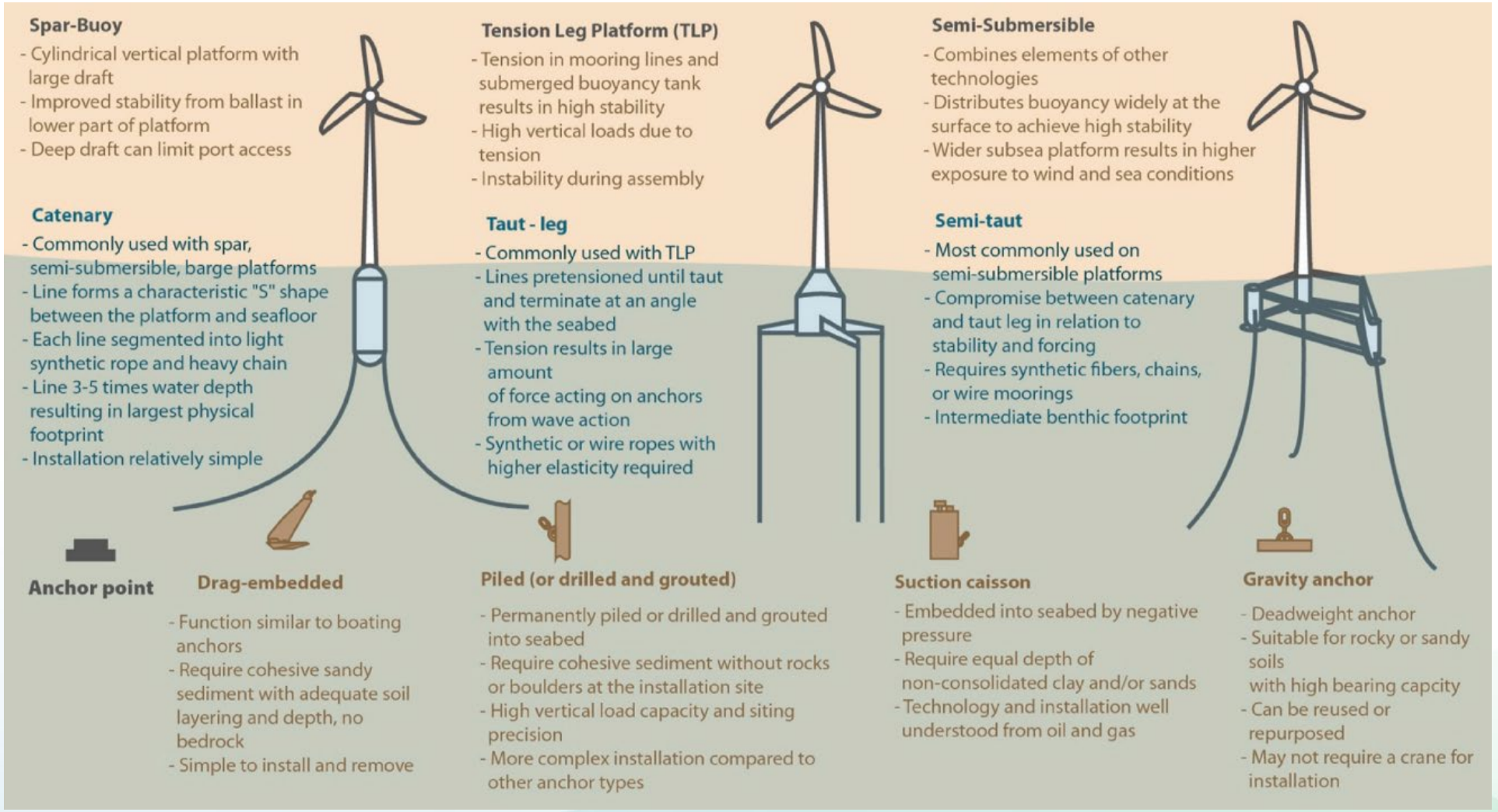
December 31, 2022
1) Complete and submit a preliminary assessment of economic benefits as they relate to seaport investments and workforce development needs
2) Complete and submit a permitting roadmap

June 30, 2023
Develop a strategic plan for offshore wind off the California coast in federal waters

Strategic Plan Chapters:

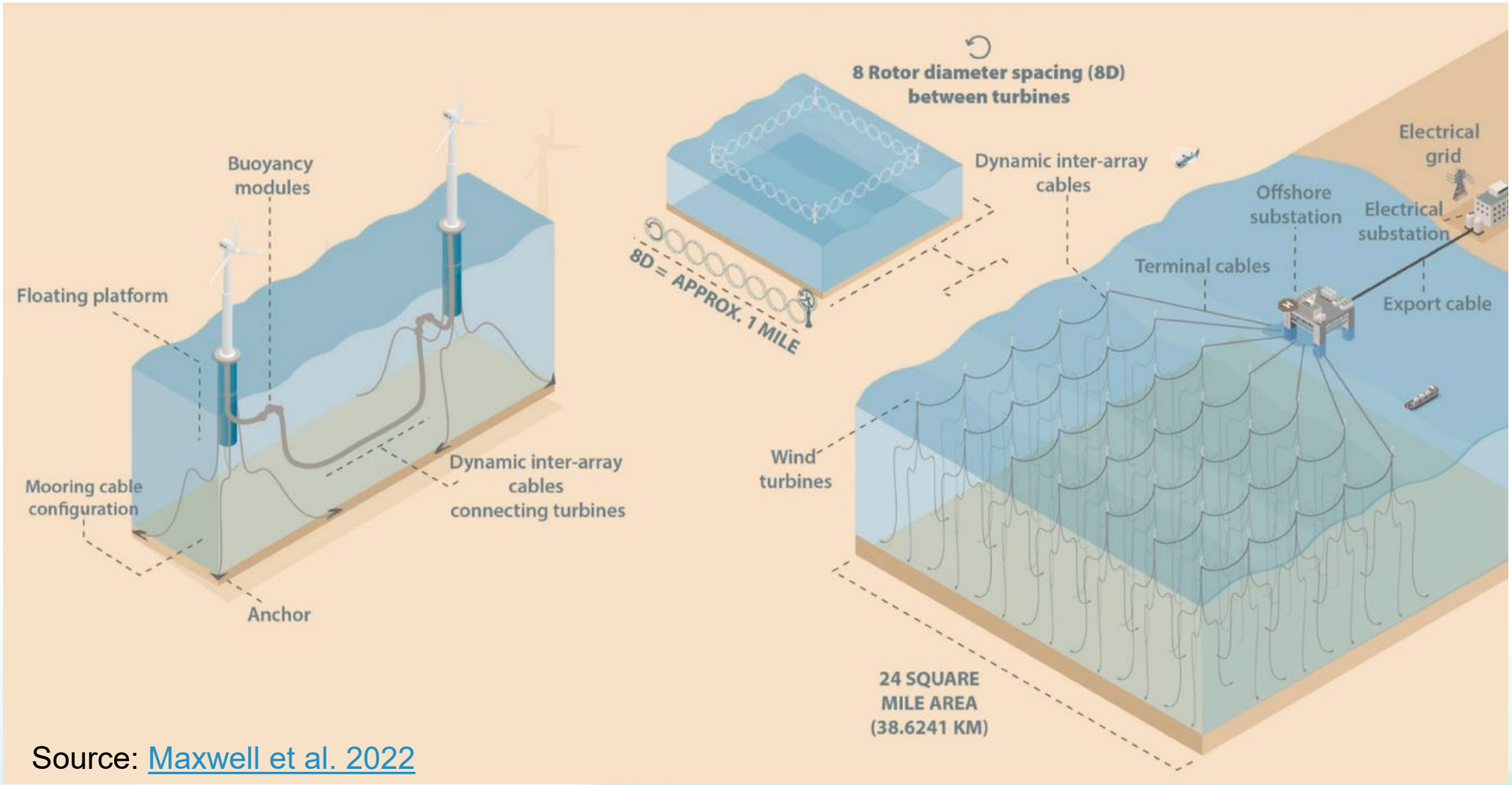
1. Identification of sea space
2. Economic and workforce development and identification of port space and infrastructure
3. Transmission planning
4. Permitting
5. Potential impacts on coastal resources, fisheries, Native American and Indigenous peoples, and national defense, and strategies for addressing them

Offshore Wind Technology Overview



Source: Maxwell et al. 2022

Example of a Floating Offshore Wind Energy Development



Source: Maxwell et al. 2022

June 1, 2022, Requirement

- Evaluate and quantify the maximum feasible capacity of offshore wind to achieve reliability, ratepayer, employment, and decarbonization benefits

- Establish megawatt offshore wind planning goals for 2030 and 2045

Defining Maximum Feasible Capacity

- CEC's governing regulations define "feasible" as:

  "Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors."

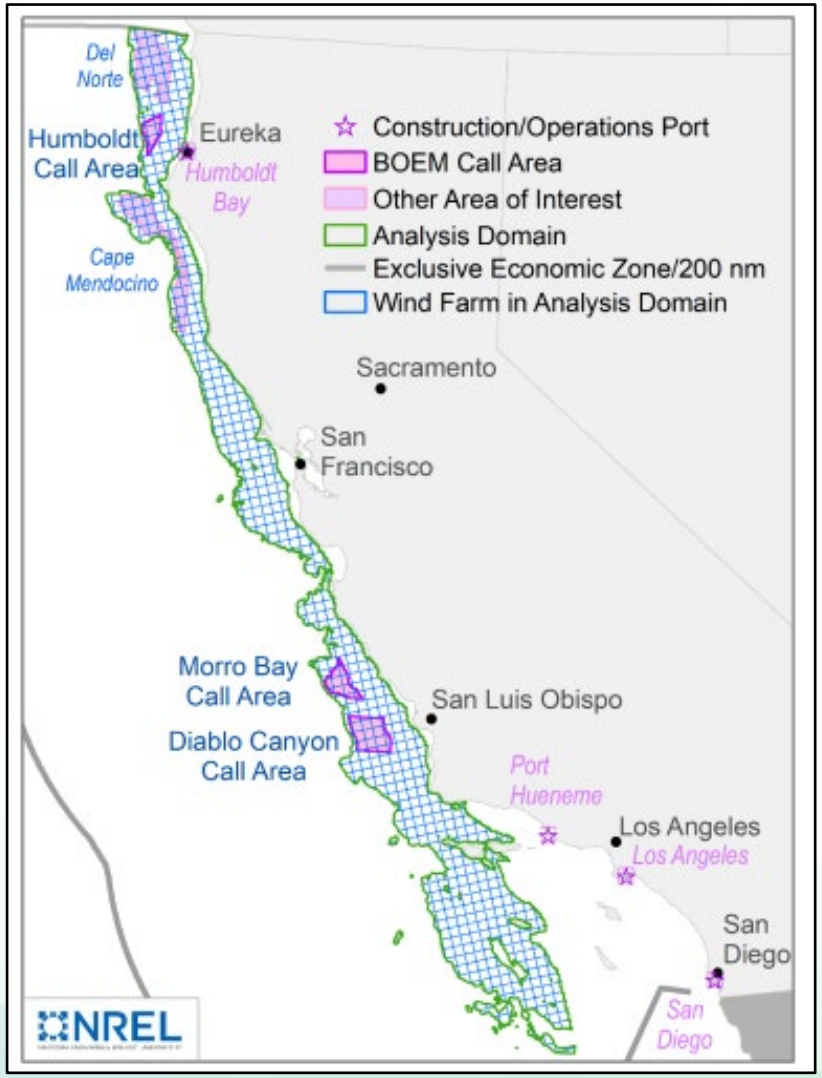
- Totality of the AB 525 legislative findings.

Achieving Reliability, Ratepayer, Employment, and Decarbonization Benefits

Reliability	• Complementary generation profile to other renewables • Variability a potential challenge to grid integration • Considerations from CPUC's Integrated Resource Plan (IRP)
Ratepayer	• A projected 44% decline in levelized cost of energy, on average, due to technology innovation, economies of scale, and industry learnings • Considerations from CPUC's IRP and the California Independent System Operator's 2021-2022 Transmission Planning Process
Employment	• Increased in-state manufacturing substantially increases employment and economic benefits • Industry recommendation that 8 gigawatts over the next 10-years likely to encourage investments in manufacturing and supply chain
Decarbonization	• Expands the diversity of the renewable energy portfolio • Potential reduction of need for gas-fired power plants in evening hours • Considerations from SB 100 and CPUC's IRP

Maximum Feasible Capacity Report Findings

- References 21,800 megawatts (21.8 GW) of **technically feasible** offshore wind potential
- Does not represent the quantification of maximum feasible capacity for offshore wind; it is the total capacity that has been studied in existing reports
- Sets a reference point for AB 525 strategic plan evaluations of:
  - Sea space
  - Impacts
  - Transmission
  - Waterfront facilities and port infrastructure
  - Workforce and supply chain



Source: NREL, November 2020

Offshore Wind Megawatt Planning Goals

Preliminary planning goals do not fully account for impacts on coastal resources and ocean users.

Required Factors for Establishing Megawatt Offshore Wind Planning Goals

1. **Findings from the Joint Agency 2021 SB100 Report**
2. **Need to initiate long-term transmission and infrastructure planning**
3. **Need for renewable energy to accommodate California's shifting peak load**
4. **Generation profile of offshore wind off the coast of California**
5. **Potential impacts on coastal resources, fisheries, Native American and Indigenous peoples, and national defense and strategies to address them**
6. Potential to attract supply chain manufacturing for components in the Pacific region
7. Need for economies of scale to reduce costs of floating offshore wind
8. NREL finding that California has 200 GW of offshore wind technical power potential
9. Need to develop skilled and trained offshore wind workforce
10. Availability of federal tax incentives
11. Opportunity for California to participate in federal offshore wind megawatt goals
12. Executive actions from the Governor

1. Findings from the 2021 Joint Agency SB 100 Report

Key Findings:

- Includes 10 GW of OSW in 2045
- Need for sustained record setting build rates of new renewable and zero-carbon resources
- Diversifying resource portfolio could save $1 billion in total resource cost
- Additional work is needed to understand the potential of emerging technologies including offshore wind

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2. Need for Long Term Infrastructure Planning

CAISO 20 Year Outlook

10 GW of Offshore Wind : North Coast (4 GW) and South-Central Coast (6 GW)

CPUC

- IRP: 8.3 GW of Offshore Wind:
  - Humboldt 1.6 GW
  - Morro Bay 2.3 GW
  - Diablo Canyon 4.4 GW
- CPUC's preferred system planning identified 1.7 GW by 2032

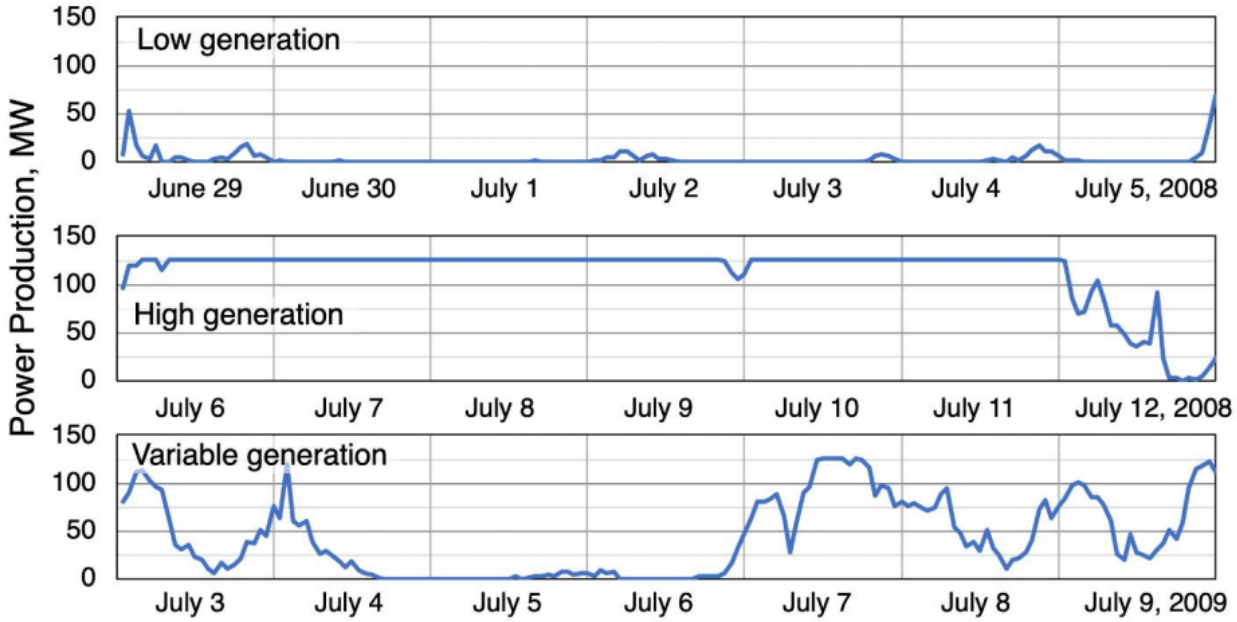
Humboldt State University

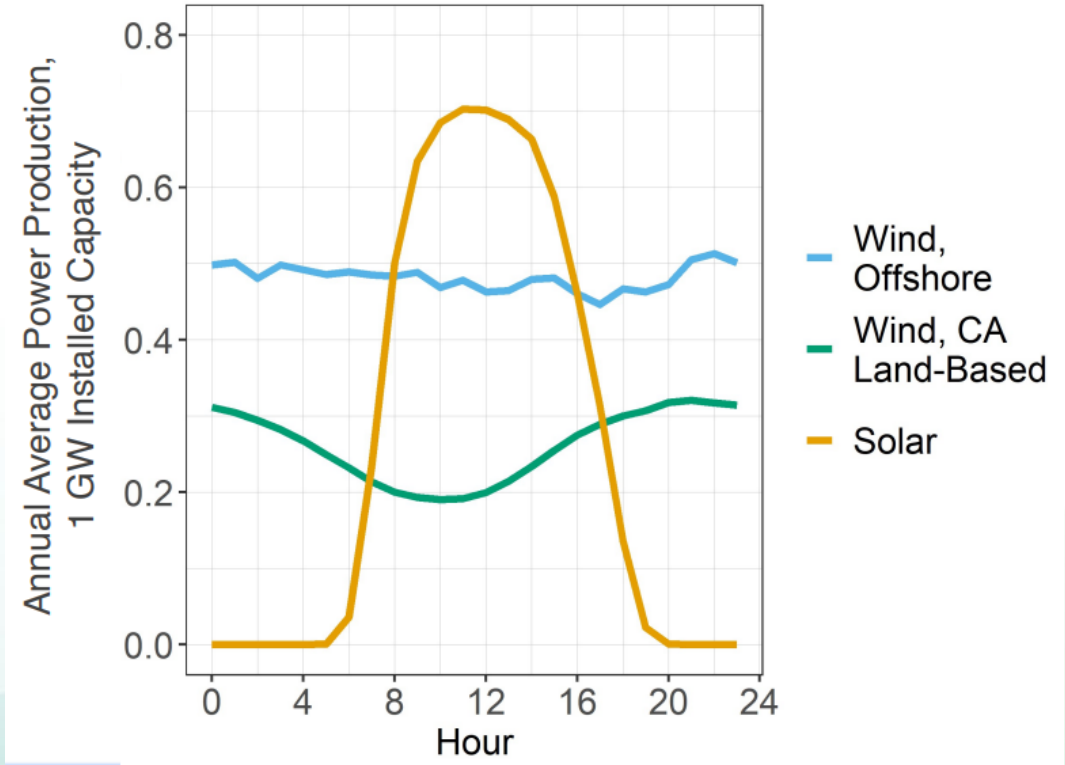
- Humboldt Call Area:
  - Evaluated project scenarios 30 MW to 1.86 GW
  - 2030 estimated load
  - Transmission upgrades required for fully deliverable

3 & 4. California's Shifting Peak Load and Offshore Wind Generation Profile

On average offshore wind complements solar both daily and seasonally but can be variable.

Example of Variability in Offshore Wind Power Generation Profile Scenario for the Humboldt Call Area (Assuming 144 MW Nameplate Capacity)





Source: Schatz Energy Research Center

5. Potential Impacts to Consider and Address (con't)

- Requires the CEC to consider potential impacts to:
  - Coastal resources
  - Fisheries
  - Native American and Indigenous peoples
  - National defense
- And strategies to address those impacts

Establishing Offshore Wind Planning Goals
Factors 6-12

6. Need to develop a skilled and trained offshore wind workforce
7. Potential to attract supply chain manufacturing for components in the Pacific region
8. Need for economies of scale to reduce costs of floating offshore wind
9. Availability of federal tax incentives
10. NREL finding that California has 200 GW of offshore wind technical power potential
11. Opportunity for California to participate in federal offshore wind megawatt goals
12. Executive actions from the Governor

Maximum Feasible Capacity and Offshore Wind Megawatt Planning Goals

Preliminary Planning Goal	Preliminary Nameplate Capacity *(Proposed)*
Maximum feasible capacity of offshore wind to achieve reliability, ratepayer, employment, and decarbonization benefits	Maximum *feasible* capacity to be determined in strategic plan, but nearly 21,800 megawatts (21.8 GW) of studied technical potential is the current reference point for AB 525 strategic plan
Offshore wind megawatt planning goal for 2030	3,000 megawatts
Offshore wind megawatt planning goal for 2045	10,000-15,000 megawatts

Preliminary planning goals do not fully account for factors including impacts on coastal resources and ocean users.

Public Comments from the March 3, 2022 Workshop

- Provided a range for suggested planning goals, starting at 3 GW in 2030 and scaling to between 10-18 GW by 2045.
- Emphasized the importance of the planning goals in sending market signals necessary to drive investments
- Suggested goals should be robust enough to drive economies of scale
- Recommended goals align with environmentally and socially responsible offshore wind development – avoid, minimize, or mitigate adverse impacts

Public Comments Received on Draft Report

- Overall supportive of proposed planning goals
- Expand definition of maximum feasible capacity
- Establish maximum feasible capacity following the sea space analysis
- Increase 2045 planning goal to 20 GW or higher

Next Steps for Draft Report

Milestone	Key Dates
First Public Workshop	March 3, 2022
Release Draft Report	May 6, 2022
Written Comments on Draft Report Due	May 16, 2022
Public Workshop on Draft Report	May 18, 2022
Draft Report Revisions from Feedback	May 18-23, 2022
Consideration at CEC Business Meeting	May 24, 2022

AB 525 Interim Requirements Next Steps

Next Steps	Starting June 1, 2022	June - October, 2022	October - December, 2022
Establish State Agency Technical Working Groups Continue Work on December Interim Requirements	Focus on Additional AB 525 Requirements: Sea Space/Impacts Analysis Transmission Ports/Waterfront Facilities Workforce	Ongoing Outreach and Workshops Including Stakeholder Meetings and State Agency Technical Working Group Meetings	Finalize Interim Requirements: Preliminary Economic Assessment and Permitting Roadmap

Thank You