California Offshore Wind Industry Report

November 2022

Offshore Wind California P.O. Box 955, Menlo Park, CA 94026 (510) 681-4483 offshorewindca.org

Executive Summary

In the fall of 2022, *Offshore Wind California*, along with individual member companies, worked together to prepare a report on progress and developments in the state's offshore wind power industry. This document updates a March 2021 document that addressed questions from staff at the California Public Utilities Commission (CPUC). Among the highlights of the 2022 update are:

1. Globally, offshore wind is expanding rapidly as a reliable, competitively priced source of clean energy.
More than 50 GW of offshore wind farms are up and running worldwide and there is more than 123 MW of installed floating offshore wind capacity. As of the end of 2021, 10 projects – in deep waters off Scotland, Portugal, Spain, Norway, France, and Japan – are using floating platform technology that would be deployed in California. Current global leaders in deployed offshore wind power are China (19.7 GW), the United Kingdom (12.2 GW), Germany (7.7 GW), and the Netherlands (3 GW).

2. In the U.S., the Biden Administration set a goal of 30 GW of offshore wind by 2030. On the East Coast, there are commitments to build 43 GW by 2040 on fixed-bottom foundations in shallower Atlantic waters.
Offshore wind power has taken off on the U.S. East Coast, where most projects are in shallow waters and use fixed-bottom foundations. Leading U.S. state commitments to offshore wind include New Jersey (11.0 GW), New York (9.0 GW), North Carolina (8.0 GW), Massachusetts (5.6 GW), Virginia (5.2 GW), Connecticut (2.1 GW), Maryland (1.6 GW), Rhode Island (1.0 GW), and Maine (0.012 GW). In 2022, the Department of Energy reported that the U.S. offshore wind project development and operational pipeline grew to a potential 40.1 GW.

3. California goes big on floating offshore wind, setting planning goals of up to 5 GW by 2030 and 25 GW by 2045, and BOEM announces the state's first offshore wind lease auction will be held on Dec. 6, 2022.
In September 2021, California's Legislature approved and Governor Newsom signed Assembly Bill (AB) 525 (Chiu), which advanced key provisions and a timeline for going big on floating offshore wind and responsibly developing this renewable energy resource as a major part of the State's diverse clean power portfolio. In August 2022, the California Energy Commission (CEC) adopted the law's first milestone, setting offshore wind planning goals of 2–5 GW by 2030 and a nation-leading 25 GW by 2045. Ambitious planning goals send an important signal to industry and agencies that California is committed to developing floating wind at commercial scale. A 25 GW goal positions California as a leader in the U.S. and Pacific Rim, and natural hub for supply chain, ports, and jobs. AB 525 directs the CEC to develop a Strategic Plan by June 30, 2023 to deploy offshore wind in federal waters. The Bureau of Ocean Energy Management (BOEM) set the first round of California lease sales for Dec. 6, 2022.

4. Floating offshore wind costs are declining rapidly, and a new Administration initiative is working to accelerate cost reductions by 70 percent and deploy 15 GW of floating offshore wind by 2035.
Costs for floating offshore wind farms are on a trajectory – similar to fixed-bottom offshore wind – to continue declining, driven by advances in technology and economies of scale. Industry analysts estimate the Levelized Cost of Energy (LCOE) for floating wind will drop globally below $100/MWh by 2025 and reach a cost-competitive $40/MWh or lower by 2050. In September 2022, the White House's new Floating Offshore Wind Shot™ set a goal to deploy 15 GW of floating offshore wind and accelerate cost reductions for floating technologies by more than 70 percent by 2035.

5. Building California's offshore wind will generate major clean energy, climate, and jobs benefits, but it will take time. Preparing a permitting roadmap is a critical early step.
Responsible deployment of floating offshore wind for California will require following federal and state permitting processes, governed by an array of laws, regulations and agency guidance. Many permits can be pursued concurrently, but could take as many as 5-6 years to complete. So, it's time to start planning now. As required by AB 525, the CEC, CPUC, California, Coastal Commission, State Lands Commission, and other agencies must coordinate and prepare a permitting roadmap by December 31, 2022 that will provide greater certainty for completing environmental and other necessary reviews for offshore wind in an efficient, timely manner.

6. It is also essential to start planning for offshore wind transmission upgrades as soon as possible.
According to the California Independent System Operator (CAISO), California has 5-6 GW of existing interconnection capacity on the Central Coast that will be available to provide transmission for up to 5 GW of offshore wind from the Morro Bay Wind Energy Area (WEA) when the Diablo Canyon nuclear plants are due to go offline, tentatively set for 2029 and 2030. Timing for this transition will be important. On the North Coast, offshore wind at the Humboldt WEA will require significant build-out of new transmission to reach electric load centers further south, via undersea or onshore cables. In both areas, it's crucial to begin necessary planning now so transmission upgrades and capacity are ensured and offshore wind can meet California's goals of up to 5 GW by 2030 and 25 GW by 2045.

7. Like economies of scale, procurement at scale will be essential for California offshore wind success.
For offshore wind, economies of scale are essential to spur a sustainable industry, drive down costs, deliver competitively priced power, and encourage supply chain businesses and jobs to locate in state. Likewise, procurement at scale is critical to provide market confidence for developers and lower costs for load-serving entities and ratepayers in the purchase of energy from the multi-gigawatt projects to meet California's offshore wind goals. To achieve this, the state should pursue a more centralized procurement process for long lead-time renewable energy resources like offshore wind, either through a regulatory approach that utilizes the processes and authority of the CPUC, or a legislative solution to create a procurement mechanism that is suitable for offshore wind resources.

8. Moving forward with offshore wind now can save California ratepayers billions of dollars, thanks to the new Inflation Reduction Act (IRA) Investment and Production Tax Credits.
In August 2022, Congress passed and the President signed the Inflation Reduction Act (IRA), which extends Investment Tax Credits (ITC), Production Tax Credits (PTC) and other measures for renewable energy projects and climate initiatives. For offshore wind in California, the law effectively extends the ITC with a phase out that begins in 2045, according to a September 2022 modeling analysis by the CPUC. This federal law could reduce the LCOE by up to 30 percent or more for California to move ahead with its planning goal to deploy 25 GW off the Central and North Coast, and save California ratepayers billions of dollars over the life of the offshore wind farms.

9. California will benefit from big advances in floating offshore wind technology & research.
Offshore wind advances – including floating platform technologies – are showing dramatic progress. As floating offshore wind moves from demonstration to full-scale projects by the mid-2020s, research and technology will be critical to unlock cost savings and economies of scale. Advances in technology will spur not just overall GWs from projects, but also efficiencies in component development, including floating substructures, dynamic cables, and wind turbine size, which is expected to exceed 15 MW per turbine when California projects are built.

10. California must develop its port infrastructure and plan a multi-port strategy to enable floating offshore wind deployment and realize local benefits.
Adequate port infrastructure – for offshore wind assembly, construction, and maintenance – is critical to enable floating wind in California. With five ongoing port and waterfront studies and a $45 million commitment from the State budget, California is in the planning stages to assess and guide investments to upgrade port and waterfront facilities. The results of these studies, including the AB 525 Ports Assessment due December 31, 2022, will facilitate a multi-port strategy and enable domestic component manufacturing so port infrastructure can meet the needs of this dynamic new industry.

11. Offshore wind power can generate tens of thousands of new jobs, tens of billions of dollars in GDP and supply chain investments, and significant growth in state revenues from supporting a strong green economy.
As California scales up to meet the state's offshore wind planning goals of up to 5 GW by 2030 and 25 GW by 2045, near-term investments and workforce planning will be essential to facilitate rapid build-out in future years. Responsible offshore wind development that incorporates local protections, community benefit agreements, and leasing bid credits can bolster California jobs, workforce development, supply chain growth and investment, and state revenues that will result from and support a strong green economy. Offshore wind will also help California meet its climate goals by reducing greenhouse gas emissions, and improve environmental justice and health conditions for local communities by reducing the state's reliance on fossil-fueled power plants.

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Section 1: Global Offshore Wind Expanding Rapidly

Introduction

Globally, offshore wind is expanding rapidly as a reliable, competitively priced clean energy source, with more than 50 GW of offshore wind farms in operation worldwide. For floating offshore wind in deeper coastal waters, there were 123 MW of projects operating globally as of 2021, with over 90 percent located in Europe and most of the remaining output in Asia.[1] Project development of floating offshore wind is increasing rapidly across the globe. In 2020, the Global Wind Energy Council (GWEC) forecast 6.5 GW[2] of floating offshore wind by 2030. In 2021, that projection increased to 18.9 GW.[3]

Two hundred and fifteen offshore wind farms are in operation worldwide and 48 more are under construction.[4] China (19.7 GW) has surpassed the U.K. (12.2 GW) in installed offshore wind capacity, followed by Germany (7.7 GW), and the Netherlands (3 GW).

Floating offshore wind is quickly evolving from pilot and demonstration projects to full-scale commercial projects to be in operation as early as 2025, following a similar trajectory as fixed-bottom offshore wind.[5] The increasing size of projects and turbine size, as well as a strong interest in utilizing deep water offshore wind capacity, are strong signals that floating offshore wind will follow a similar large-scale commercialization pathway. Increasing global commitments, like in Scotland,[6] are leading to further market acceleration.

Figure 1.1. Kincardine 47.5-MW floating offshore wind plant. Photo courtesy of Principle Power.

[1]U.S. Department of Energy Offshore Wind Market Report: 2022 Edition.
[2]1 gigawatt (GW) = 1,000 megawatts (MW), enough to power 750,000 homes.
[3]GWEC, Floating Offshore Wind – A Global Opportunity, March 2022.
[4]Global Offshore Wind Report 2021, World Forum Offshore Wind.
[5]U.S. Department of Energy Offshore Wind Market Report: 2021 Edition, August 2021.
[6]Scotland awarded seabed rights totaling 25 GW of capacity in 2022, 15 GW of which will be floating offshore wind. See: Recharge, "'Floating wind's breakthrough': renewables industry hails ScotWind as new offshore era", January 2022.

Status and Pipeline of Global Floating Offshore Wind Development

Of current offshore wind farms, 10 projects are using floating platforms in deep waters off the coasts of the U.K. (Scotland), Portugal, Spain, Norway, France, and Japan.[7] Floating wind technology will be used in California due to deep waters off the Outer Continental Shelf on the U.S. West Coast. California now has established planning goals for floating offshore wind of 2-5 GW by 2030 and 25 GW by 2045. Globally, more than 60 GW of floating offshore wind power is currently in the project pipeline, with 3.6 GW expected to come online by 2027.[8]

Global pipeline of floating offshore wind projects through 2030:[9]

- Installed (123 MW)
- Under construction (125 MW)
- Financial close (40 MW)
- Approved (30 MW)
- Permitting (221 MW)
- Planning (60 GW), including plans for 2 and 3 GW projects[10]

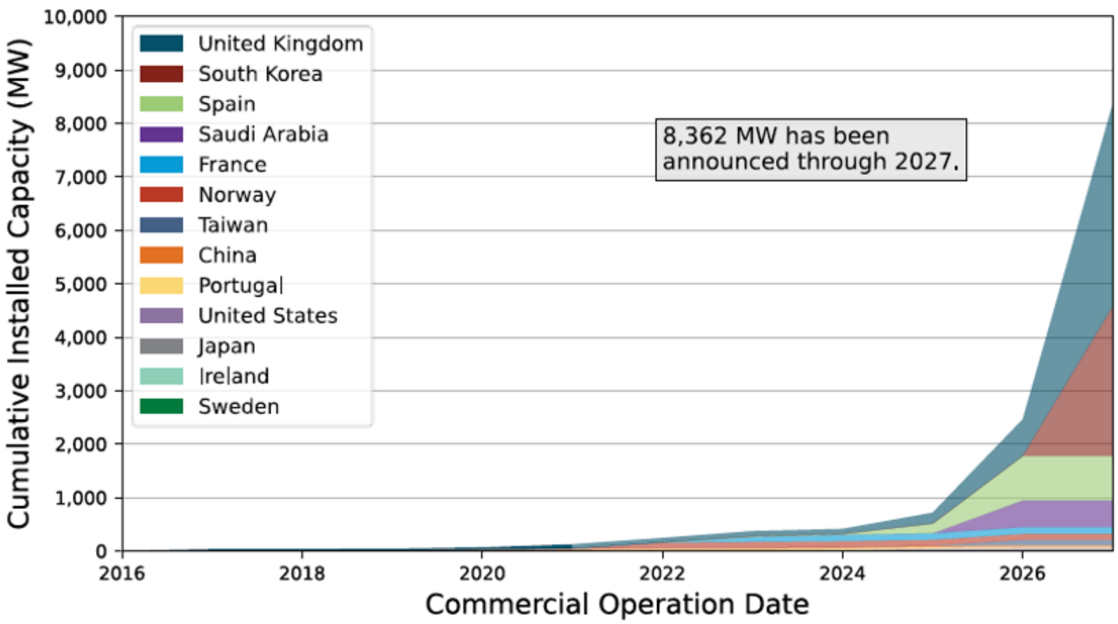


Figure 1.2. Cumulative floating offshore wind capacity by country based on announced COD through 2027.[11]

[7] U.S. Department of Energy Offshore Wind Market Report: 2022 Edition.
[8] Utility Dive, "Unleashing the economic power and reliability potential of West Coast offshore wind," July 2022.
[9] U.S. Department of Energy Offshore Wind Market Report: 2022 Edition.
[10] A joint venture between Shell and ScottishPower, MarramWind Limited and CampionWind Limited secured leases for a 3 GW and 2 GW offshore wind projects off the east and northeast coasts of Scotland. See: offshoreWIND.biz, "Shell, ScottishPower Begin Next Chapter of Their 5 GW Floating Wind Story in Scotland," April 2022.
[11] From U.S. Department of Energy Offshore Wind Market Report: 2022 Edition.

Country	Operating (MW)	Under Construction (MW)	Financial Close (MW)	Approved (MW)	Permitting (MW)	Planning (MW)	Total (MW)
China	5.5					25	31
France	2	35	25.2	30	28.5	506	627
Japan	5				16.8	2,500	2,522
Norway	5.9	88	10			6	110
Portugal	25						25
United Kingdom	80				110	8,891	9,081
Spain		2			33	2,332	2,367
South Korea			5			9,664	9,669
Ireland					10	6,550	6,560
United States					22	4,532	4,554
Australia						7,400	7,400
Brazil						6,507	6,507
Italy						2,793	2,793
Saudi Arabia						500	500
Sweden						2,200	2,200
Taiwan						5,800	5,800
Total	**123**	**125**	**40**	**30**	**221**	**60,206**	**60,746**

Table 1.1. Global Floating Offshore Wind Energy Pipeline through 2030[12]

[12] From U.S. Department of Energy Offshore Wind Market Report: 2022 Edition and California Energy Commission Offshore Wind Planning Goals, August 2022.

Section 2: U.S. East Coast Progress on Fixed-Bottom Foundations

Introduction

In April 2022, President Biden set a goal to deploy 30 GW of U.S. offshore wind energy by 2030,[13] with a further aim to deploy 110 GW or more by 2050.[14] While California recently set offshore wind planning goals for up to 5 GW by 2030 and 25 GW by 2045 through the AB 525 process, the East Coast has set the pace for its offshore wind development through state commitments.

Plans are in development on the U.S. East Coast for more than 43 GW of offshore wind by 2040 with the following state commitments: New Jersey (11.0 GW), New York (9.0 GW), North Carolina (8.0 GW), Massachusetts (5.6 GW), Virginia (5.2 GW), Connecticut (2.1 GW), Maryland (1.6 GW), Rhode Island (1.0 GW), Maine and (0.012 GW).[15, 16]

Almost all of these East Coast projects will be sited in shallow waters where depths are 60 meters or less and use fixed-bottom foundations.

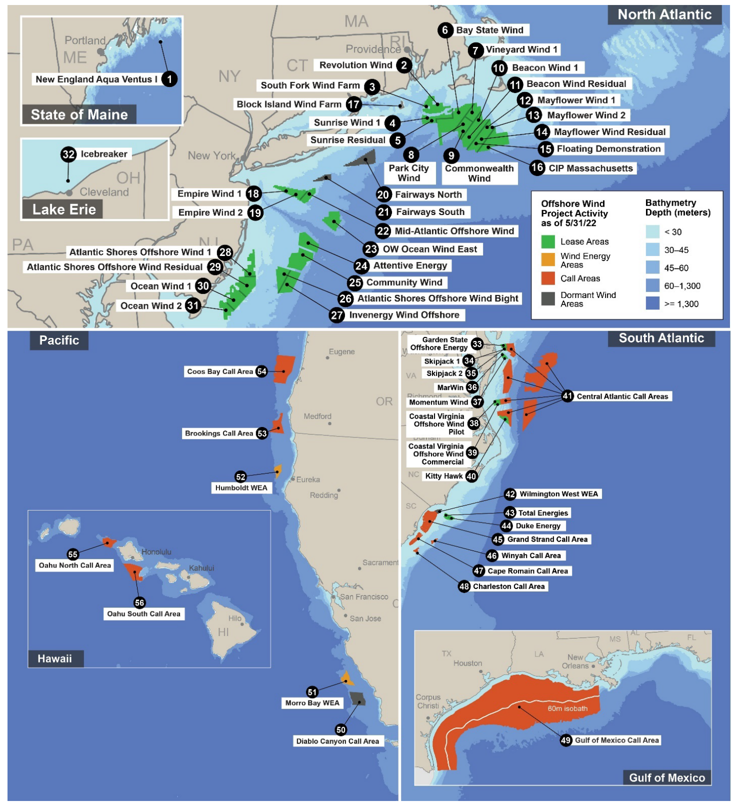


Figure 2.1. Locations of U.S. offshore wind pipeline activity and Call Areas as of May 31, 2022. *Map created by NREL.*[18]

East Coast Offshore Wind Goals, and Size and Timeline of Project Pipeline

In 2020, the U.S. project development and operational pipeline was a potential 35.3 GW.

In 2022, the Department of Energy reported the U.S. offshore wind project development and operational pipeline had grown to a potential 40.1 GW.

This includes two operating projects, a fully approved and contracted project, and 15 projects in the permitting or Construction and Operations Plan (COP) phase.

BOEM aims to complete permitting for 16 offshore wind energy projects by 2025.[17]

[13] U.S. Department of Interior Press Release – Biden-Harris Administration Advances Offshore Wind Energy Leasing on Atlantic and Pacific Coasts, April 2022.

[14] U.S. Department of Energy Press Release – From Potential to Power: Harnessing Offshore Wind Energy with Transmission, June 2022.

[15] Pew Stateline, "Offshore Wind Takes Off at Last. State Have Been Counting on It." February, 2022.

[16] Special Initiative on Offshore Wind, University of Delaware, April 2020.

[17] From U.S. Department of Energy Offshore Wind Market Report: 2021 Edition, August 2021.

[18] DOE Offshore Wind Market Report, 2022 Edition.

Developers have reported the following schedule for U.S. offshore wind projects generating power:

Table 2.1. U.S. Offshore Wind Energy Pipeline (Pacific) through 2030.[19, 20]

No.	Geographic Location	Project Name	Developer	Estimated Commercial Operation Date	Capacity (MW)
1	CA	Diablo Canyon Call Area	-		Dormant
2	CA	**Morro Bay WEA**	-	2030	2,925
3	CA	**Humboldt WEA**	-	2030	1,607
4	OR	Brookings Call Area	-		
5	OR	Coos Bay Call Area	-		
6	HI	Oahu North Call Area	-		
7	HI	Oahu South Call Area	-		
	Regional Totals				**4,532**

Table 2.2. U.S. Offshore Wind Energy Pipeline (North Atlantic and Great Lakes).[21]

No.	Geographic Location	Project Name	Developer	Estimated Commercial Operation Date	Capacity (MW)
8	ME	New England Aqua Ventus I	Univ. of Maine/ Diamond Offshore/ RWE	2024	12
9	MA/RI	Revolution Wind	Ørsted and Eversource	2025	704
10	MA/RI	South Fork Wind Farm	Ørsted and Eversource	2023	132
11	MA/RI	Sunrise Wind 1	Ørsted and Eversource	2025	924
12	MA/RI	Sunrise Residual	Ørsted and Eversource	TBD	900
13	MA	Bay State Wind	Ørsted and Eversource	TBD	2,000
14	MA	Vineyard Wind 1	Avangrid and CIP	2024	800
15	MA	Park City Wind	Avangrid	2025	800
16	MA	Commonwealth Wind	Avangrid	2027	1,232
17	MA	Beacon Wind 1	Equinor and BP	2028	1,230
18	MA	Beacon Wind Residual	Equinor and BP	TBD	1,200

[19] U.S. Department of Energy Offshore Wind Market Report: 2022 Edition and California Energy Commission Offshore Wind Planning Goals, August 2022

[20] This table does not reflect California's offshore wind planning goal for 2045 (See section 3) nor the recent 2022 NREL Study that projects up to 5.4 GW in Morro Bay and 3.0 GW in Humboldt Bay due to increased density factors. See: Assessment of Offshore Wind Energy Leasing Areas for Humboldt and Morro Bay Wind Energy Areas, California.
Cooperman et al. 2022. NREL.

[21] Adapted from U.S. Department of Energy Offshore Wind Market Report: 2022 Edition.

Table 2.2. U.S. Offshore Wind Energy Pipeline (North Atlantic and Great Lakes) continued.

No.	Geographic Location	Project Name	Developer	Estimated Commercial Operation Date	Capacity (MW)
19	MA	Mayflower Wind 1	Ocean Winds and Shell	2025	804
20	MA	Mayflower Wind 2	Ocean Winds and Shell	2025	400
21	MA	Mayflower Wind Residual	Ocean Winds and Shell	TBD	800
22	MA	Floating Demonstration	Shell/ Kent Houston Offshore Engineering/Ocergy	TBD	10
23	MA	CIP Massachusetts	CIP	TBD	1,607
24	RI	Block Island Wind Farm	Ørsted	2016	30
25	NY	Empire Wind 1	Equinor and BP	2026	816
26	NY	Empire Wind 2	Equinor and BP	2027	1,260
27	NY	Fairways North	-	-	Dormant
28	NY	Fairways South	-	-	Dormant
29	NY/NJ	Mid-Atlantic Offshore Wind	CIP	TBD	523
30	NY/NJ	OW Ocean Winds East	EDPR and Engie	TBD	868
31	NY/NJ	Attentive Energy	Total Energies	TBD	964
32	NY/NJ	Community Wind	RWE and National Grid	TBD	1,387
33	NY/NJ	Atlantic Shores Offshore Wind Bight	Shell and EDF	TBD	924
34	NY/NJ	Invenergy Wind Offshore	Invenergy and Lighthouse Energy	TBD	934
35	NJ	Atlantic Shores Offshore Wind 1	Shell and EDF	2027	1,510
36	NJ	Atlantic Shores Offshore Wind Residual	Shell and EDF	TBD	1,000
37	NJ	Ocean Wind 1	Ørsted and PSEG	2025	1,100
38	NJ	Ocean Wind 2	Ørsted and PSEG	2028	1,148
39	OH	Icebreaker	LEEDCo	2042	21
	Regional Totals				**26,040**

Table 2.3. U.S. Offshore Wind Energy Pipeline (South Atlantic and Gulf of Mexico).[22]

No.	Geographic Location	Project Name	Developer	Estimated Commercial Operation Date	Capacity (MW)
40	DE	Garden State Offshore Energy	Ørsted	TBD	1,000
41	DE	Skipjack 1	Ørsted	2026	120
42	DE	Skipjack 2	Ørsted	2026	808
43	MD	MarWin	U.S. Wind	2024	248
44	MD	Momentum Wind	U.S. Wind	2026	846
45	VA	Coastal Virginia Offshore Wind–Pilot	Dominion Energy	2020	12
46	VA	Coastal Virginia Offshore Wind – Commercial	Dominion Energy	2026	2,640
47	NC	Kitty Hawk	Avangrid	2027	2,500
48	DE/MD/VA/NC	Central Atlantic Call Areas	-	-	
49	NC	Wilmington West WEA	-	-	Dormant
50	NC	Total Energies	Total Energies Renewables USA	-	667
51	NC	Duke Energy	Duke Energy Renewables Wind	-	670
52	SC	Grand Strand Call Area	-	-	
53	SC	Winyah Call Area	-	-	
54	SC	Cape Romain Call Area	-	-	
55	SC	Charleston Call Area	-	-	
56	LA/TX/AL/MS	Gulf of Mexico Call Area	-	-	
	Regional Totals				**9,511**

[22] U.S. Department of Energy Offshore Wind Market Report: 2022 Edition.

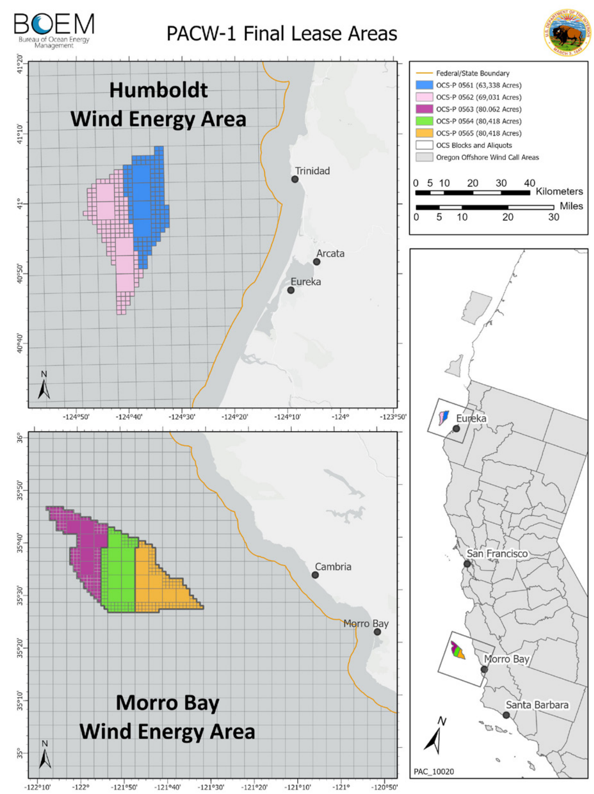
Section 3: California's 25 GW Goal for Floating Wind & Initial Lease Auction

Introduction

California's landmark Assembly Bill (AB) 525 (Chiu) – approved by overwhelming bipartisan majorities in the State Legislature and signed into law by Governor Newsom in September 2021 – advanced a series of key provisions and set a clear timeline for California to go big on floating offshore wind and jumpstart this renewable energy resource as a major part of the State's diverse clean power portfolio.

The law's first major milestone called for the California Energy Commission (CEC) to set 2030 and 2045 planning goals for responsibly developing offshore wind, which the CEC did in August 2022 by voting to adopt targets of 2–5 GW by 2030 and a nation-leading 25 GW by 2045.

On October 18, 2022, BOEM announced the state's first offshore wind lease auction will take place December 6, 2022 for the Humboldt and Morro Bay WEAs on the Outer Continental Shelf (OCS). This is a critical step to meeting California's planning goals and ensuring responsible development for this first set of WEAs. The Final Sale Notice (FSN) includes three lease areas on the Central Coast and two lease areas on the North Coast and will allow each winning bidder to acquire one lease. The FSN calls for bidding credits totaling up to 30 percent of the bid values to support workforce training, supply chain development, and community benefits agreements to mitigate potential impacts to stakeholders.[23, 24] There are also additional lease stipulations that pertain to impacted communities.[25] *(See Sections #5 and #11 for more information on the BOEM lease auction and bidding credits).*



By December 31, 2022, AB 525 requires the CEC to prepare a preliminary report of offshore wind's economic benefits related to seaport investments and workforce development. It also requires a permitting roadmap *(See Section #5)* with timeframes and milestones for an efficient, comprehensive, and coordinated process to permit offshore wind and associated electric and transmission infrastructure.

By June 30, 2023, AB 525 directs the CEC, in coordination with other agencies, to prepare a full California Offshore Wind Strategic Plan to develop this clean energy resource in federal waters off the California coast and share the plan with the Natural Resources Agency and the Legislature.

Importance & Timeline for Adoption of California's Offshore Wind Planning Goals

Industry trends and data all point to increased U.S. and global reliance on offshore wind, and to the growing benefits for California from including this renewable energy resource at large commercial scale to meet the state's clean power, climate, and jobs objectives.

[23] Potentially affected stakeholders include fishing communities, Tribal entities, and other coastal or marine stakeholders.
[24] BOEM Final Sale Notice for Commercial Leasing for Wind Power on the Outer Continental Shelf in California.
[25] Lease stipulations include reporting requirements for engagement with tribes, commercial and recreational fisheries, and other ocean users and coastal communities. Bidders are required to prepare a Fisheries Communications Plan (FCP) and make "every reasonable effort" to enter into project labor agreements and provide a Statement of Goals to support establishing a U.S.-based floating offshore wind industry.

Multi-gigawatt goals have proven their effectiveness in East Coast states and other markets in driving economies of scale that are essential for reducing costs and encouraging development of a strong local supply chain.

At its August 10, 2022 business meeting, the CEC voted to approve a final AB 525 report that set offshore wind planning goals of 2–5 GW by 2030 and 25 GW by 2045.

It is important to note these are planning goals, not mandates. The CEC's ambitious final planning goals represent an important milestone for the industry, and are essential to appropriately size and scale the other key elements necessary to deploy offshore wind – including transmission, port infrastructure, workforce development, and a sustainable supply chain.

At its October 2022 workshop, the CEC provided the following timelines for Workshops and Milestones supporting the preparation of the Strategic Plan.

Workshop/Milestone	Key Dates
Establish Offshore Wind Planning Goals for 2030 and 2045	August 10, 2022
Workshop on Preparing a Strategic Plan for Offshore Wind	October 6, 2022
Topical Workshops:	
• Sea Space	October 26, 2022
• Preliminary Economic Assessment	October 31, 2022
• Permitting Roadmap	Early November 2022
• Transmission Assessment	Early November 2022
Consideration of Preliminary Economic Assessment and Permitting Roadmap at CEC Business Meeting	December 31, 2022

Table 3.1. CEC Proposed Timeline on Offshore Wind Strategic Plan Development.[26]

California energy and transmission planning supports the need and grid benefits of high offshore wind deployment. Further, recent studies and technological developments support higher goals than those currently modeled in California agency studies and planning processes.

The final SB 100 Joint Agency Report prepared by the CEC, California Public Utilities Commission (CPUC), and California Air Resources Board (CARB) showed that at least 10 GW of offshore wind will be needed in California's 100 percent clean energy portfolio by 2045. The report suggested that offshore wind would result in almost $1 billion in total resource cost savings as compared to a portfolio without offshore wind. CAISO's 20-Year Transmission Outlook has analyzed transmission development and integration of up to 10 GW of offshore wind by 2040.[27] CAISO has also studied additional offshore wind areas, noted in its report to the CEC, that bring the total to more than 21 GW.

[26] CEC Workshop on Preparing a Strategic Plan for Offshore Wind Energy Development Staff Workshop, October 2022.

[27] CAISO 20-Year Transmission Outlook, May 2022.

National Renewable Energy Laboratory (NREL) shared updated findings at the June 27, 2022 CEC workshop[28] regarding improved density capacity of 5 MW/km2 already being deployed for offshore wind projects on the East Coast. Improved power densities increase the potential GW output of the existing Humboldt and Morro Bay call areas – to 2.7 and 4.9 GW, respectively. This would increase the total GW capacity in the Humboldt and Morro Bay lease areas from 4.5 to 7.6 GW.[29]

The industry is confident California can deploy the first 5 GW of offshore wind power by 2030, within existing lease areas at Morro Bay and Humboldt, without the need for any additional sea space. That's important to consider as the State strives to balance sea space needs. To reach 25 GW by 2045, there's ample time and sea space to consider in wind areas that NREL has studied on the North Coast and elsewhere.

A planning goal of 25 GW by 2045 also positions California as an offshore wind leader in the U.S. and Pacific Rim, and a natural hub for the supply chain, jobs and port facilities to deploy this renewable energy on the West Coast and beyond.

Photo of the WindFloat Atlantic project courtesy of Principle Power/Ocean Winds.

[28] Offshore Wind Research Summary – California Study Results, National Renewable Energy Laboratory (NREL), Walt Musial, Presentation to California Energy Commission Workshop, June 27, 2022, p. 8.

[29] Update on NREL's 2020 Offshore Wind Resource Assessment for the California Pacific Outer Continental Shelf, National Renewable Energy Laboratory, November 2022.

Section 4: Cost Projections Declining for Floating Offshore Wind

Introduction

Projected costs for floating offshore wind farms have been declining in recent years, driven by expected advances in technology and economies of scale. Industry analysts estimate that Levelized Cost of Energy (LCOE) levels could drop below $100 USD/MWh by 2025 and reach $40 USD/MWh or lower by 2050.[30]

In September 2022, the White House's new Floating Offshore Wind ShotTM set a goal to deploy 15 GW of floating offshore wind and accelerate cost reduction for floating technologies by more than 70 percent by 2035.[31]

Academic & Industry Research Project Further Offshore Wind Cost Reductions

NREL reports that economies of scale are a key driver of these cost reductions, resulting from bigger wind turbines and blades, optimization of substructures and logistics, and industrialization of component manufacturing.

U.S. Floating Offshore Wind Cost Trends[31]

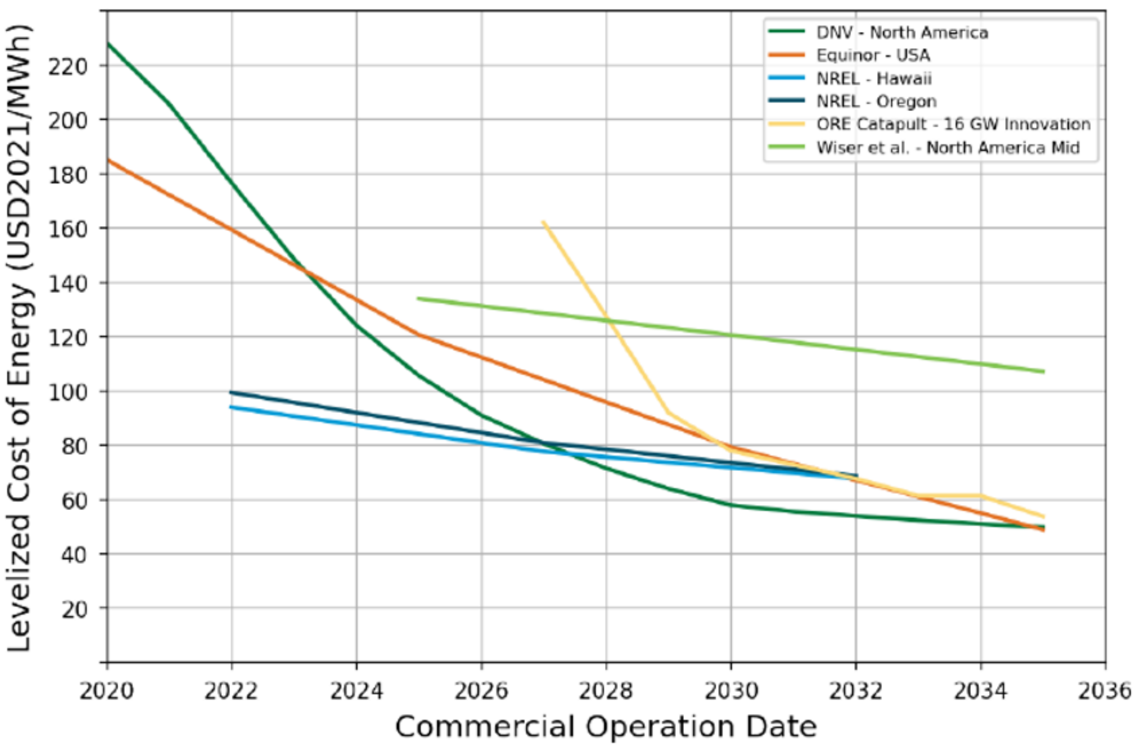


Figure 4.1. U.S. LCOE estimates for floating offshore wind technologies. From: DOE Offshore Wind Market Report. Sources: ORE Catapult (2021); Shields, Duffy, et al. 2021 (Hawaii), Musial, Duffy, et al. 2021 (Oregon); Wiser et al. (2021); Equinor (2021); DNV (2021)

DOE research indicates LCOE for U.S. floating offshore wind is estimated to decline from $200/MWh (2021) to $58-120/MWh (2030). Floating offshore wind costs have a high potential for cost reduction in the U.S. from early-stage technology advancements and efficiencies translated from fixed-bottom offshore wind systems.[33]

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[30] DNV Floating Offshore Wind: The Next Five Years. 2022.

[31] https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/15/fact-sheet-biden-harris-administration-announces-new-actions-to-expand-u-s-offshore-wind-energy/

[32] DOE Offshore Wind Market Report, 2022 Edition.

[33] DOE Offshore Wind Market Report, 2022 Edition.

An NREL report in 2020 estimated high net capacity factors ranging from 49-55 percent for floating offshore wind power generation at five sites off the North and Central California coast.[34] In November 2022, NREL updated its wind speed and gross capacity factor projections at the Humboldt and Morro Bay WEAs to compare 20-year CA20 and synthetic long-term-adjusted lidar data sets. The report found that gross capacity factors at Humboldt were 58.6 using CA20 data, compared to 55.6 with synthetic long-term-adjusted lidar data; while CA20 gross capacity factors in Morro Bay were 57.2 compared to 54.6 using long-term-adjusted lidar data (*See Table 4.1*).[35]

The projected cost declines for offshore wind are expected to follow the trajectory of cost reductions already observed for onshore wind (71 percent decrease from 2009 to 2020) and utility-scale solar (90 percent decrease from 2009 to 2020).[36] For fixed bottom offshore wind, average LCOE for projects commissioned in 2020 has declined to below $95/ MWh and a range of $78/MWh to $125/MWh globally. This represents a cost reduction trend of 28-51 percent since 2020 and continues the trend of declining prices since 2014.[37]

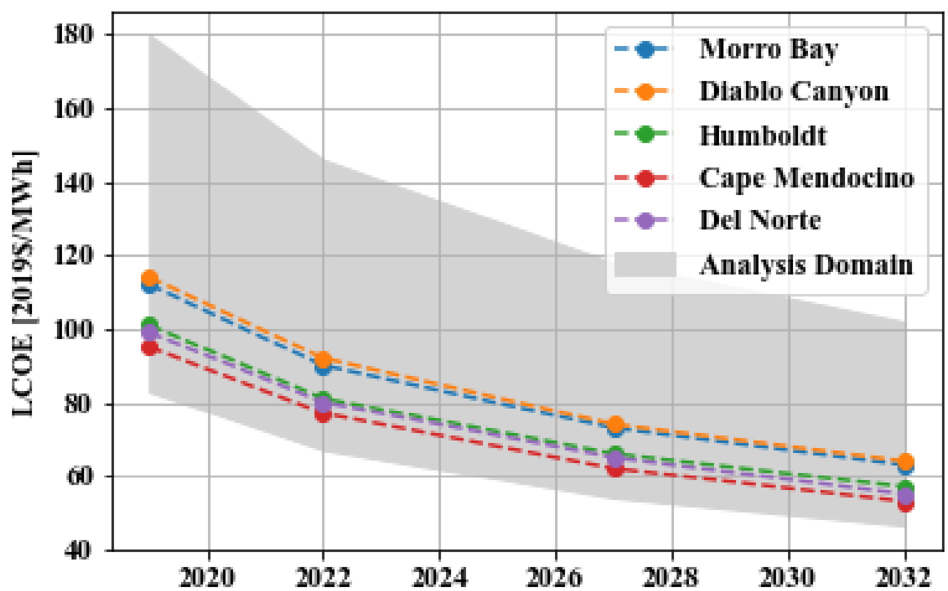

Figure 4.2: Estimated Levelized Cost of Energy Trajectory Between 2019 and 2032.[38]

Site	Mean 150-m Wind Speed (meters per second [m/s])		Gross Capacity Factor (%)	
	Synthetic Long-Term-Adjusted Lidar	CA20	Synthetic Long-Term-Adjusted Lidar	CA20
Humboldt	9.3	10.6	55.6	58.6
Morro Bay	9.0	10.0	54.6	57.2

Table 4.1: Comparison of Mean Wind Speeds and Gross Capacity Factor Values Derived from the CA20 and Synthetic Long-Term-Adjusted Lidar Data Sets. *Source: NREL.*[39]

[34] Cost of Floating Offshore Wind Energy in California Between 2019 and 2032, National Renewable Energy Laboratory, November 2020.

[35] Update on NREL's 2020 Offshore Wind Resource Assessment for the California Pacific Outer Continental Shelf, National Renewable Energy Laboratory, November 2022.

[36] Lazard Levelized Cost of Energy Analysis – Version 14.0, October 2020.

[37] U.S. Department of Energy Offshore Wind Market Report 2021, Edition, August 2021.

[38] The Cost of Floating Offshore Wind Energy in California Between 2019 and 2032, National Renewable Energy Laboratory, November 2020.

[39] Update on NREL's 2020 Offshore Wind Resource Assessment for the California Pacific Outer Continental Shelf, National Renewable Energy Laboratory, November 2022

Section 5: Timeline & Permitting to Meet California's Goals

Introduction

Deploying offshore wind for California will require following federal and state permitting processes, each governed by an array of laws, regulations, and agency guidance. Many of these can be pursued concurrently but could take as many as 5-6 years to complete. So, it's essential to start planning now.

AB 525 requires the CEC, Coastal Commission, State Lands Commission, and other agencies to coordinate and prepare a clear permitting roadmap – due December 31, 2022 – that provides greater certainty for completing environmental and other necessary reviews in an efficient, timely manner.

The AB 525 permitting roadmap should describe timeframes and milestones to increase the efficiency of the permitting process for wind energy facilities and transmission infrastructure. To be successful, the permitting roadmap will require political leadership, a clear schedule and sequencing, and funding to support agency permitting activities.

Specifically, the CEC should identify a responsible lead agency, such as GO-Biz,[40] with necessary resources to provide oversight to the permitting process. The permitting roadmap will provide a framework and provide certainty for the CEQA lead agency, likely the California State Lands Commission, to follow permitting steps to meet the proposed schedule.

The permitting roadmap should include a logical schedule of environmental reviews and permitting steps, as well as outline for when project proponents should engage responsible agencies and affected stakeholders. The roadmap should include a mechanism that commits all involved agencies to the proposed schedule and sequencing, such as a memorandum of understanding (MOU) or coordinated permitting plan (CPP). Lastly, the roadmap will require long-term sustained funding to provide sufficient agency capacity to ensure timely offshore wind siting and permitting.

Federal and State Permitting for California Offshore Wind

At the federal level, a number of steps can occur prior to the start of the formal federal permitting process, which includes the issuance of a lease and the in-depth analyses and studies that must be conducted by the lessee as part of the preparation of a Construction and Operation Plan (COP).

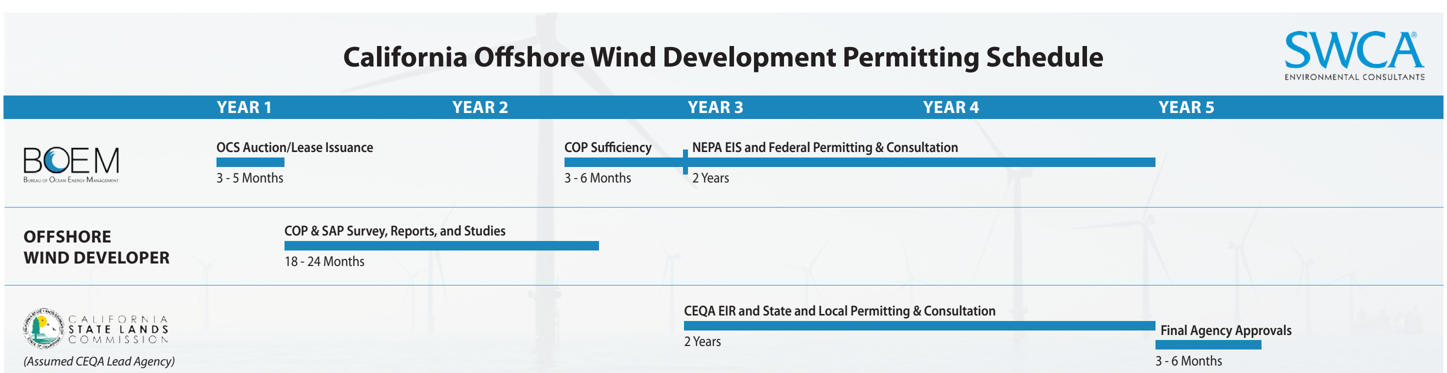

Figure 5.1. California Offshore Wind Development Permitting Schedule.

[40] California Governor's Office of Business and Economic Development.

Permitting for offshore wind can broadly be broken down into the BOEM processes leading up to lease issuance – including the initial National Environmental Policy Act (NEPA) process and lease auction. This is followed by offshore wind developers' site assessment activities to inform Construction and Operation Plans (COPs). This stage requires permits for site assessment and survey activities – including Electromagnetic Frequency (EMF) Assessment, Essential Fish Habitat (EFH) assessment, and Coastal Zone Management Consistency Certification, among others.

Once the COPs are deemed sufficient, developers must receive project-level federal and state permits, namely NEPA and CEQA Environmental Impact Statements (EIS/EIR), along with State Lands Commission Tidelands Lease and California Coastal Commission Federal Consistency Review and Coastal Development Permit, among others. See Figure 5.1 for further details.

Photo of the WindFloat Atlantic project courtesy of Principle Power/Ocean Winds.

The following section is a summary covering initial planning efforts through issuance of a permit to contract and operate an offshore wind farm.

Figure 5.2. California Offshore Wind Development Permitting Framework.

Initial Planning Process

Development of wind energy areas on the Outer Continental Shelf (OCS) typically begins with BOEM identifying potential offshore wind planning areas or wind energy areas (WEAs), and then identifying and reaching out to potentially impacted stakeholders, including the state(s) with adjacent coastal zones, local municipalities, affected parties, NGOs, etc. BOEM creates a Task Force made up of these stakeholders to help identify potential issues and constraints that may be encountered within a planning area. The Task Force and stakeholder outreach process is used to refine the potential lease areas prior to issuance of the Call for Nominations and Information (Call) that is published in the Federal Register.

The Call allows developers to document interest in obtaining wind energy lease areas and for the public to comment on the areas and their potential concerns. The Call for the California planning areas was issued in October 2018 and multiple developers, local and state agencies, concerned industries and NGOs provided public comment. In July 2021, BOEM issued an Expanded Call for the Morro Bay WEA which added acreage both on the East and West side of the WEA. The Humboldt WEA was unchanged from 2018. Ultimately, BOEM removed the proposed East expansion area for the Morro Bay WEA and left the expanded Western extension.

Once the proposed WEAs are defined, the next step is for BOEM to prepare a National Environmental Policy Act (NEPA) Environmental Assessment (EA) that analyzes lease issuance and reasonably foreseeable activities related to site assessment and site characterization (meteorological and environmental studies, geophysical and geotechnical (G&G) studies, etc.). Prior to issuing an EA, BOEM conducts scoping which provides an opportunity for the public including agencies, tribes, and other stakeholders an opportunity to provide input on issues and concerns they would like to have analyzed in the EA. BOEM conducted scoping for the Humboldt WEA in late summer 2021 and issued the Draft EA for Humboldt in January 2022. This was followed by public meetings and a public comment period of a minimum of 30 days. The final EA and Finding of No Significant Impact (FONSI) was issued for the Humboldt WEA in May 2022. Scoping for the Morro Bay WEA EA was initiated in November 2021. BOEM issued the Draft EA for Morro Bay in April 2022 and public meetings were held that month. The final EA and Finding of No Significant Impact (FONSI) was issued for the Morro Bay WEA in October 2022, clearing the way for BOEM's initial California offshore wind lease auction expected in late 2022.

During the NEPA stage, BOEM is required to prepare a Coastal Zone Management Act (CZMA) Consistency Determination for the leasing and associated site assessment activities and must receive California Coastal Commission (CCC) concurrence. Both the Humboldt and Morro Bay EAs received conditional concurrence to proceed from the CCC in April and June 2022, respectively.

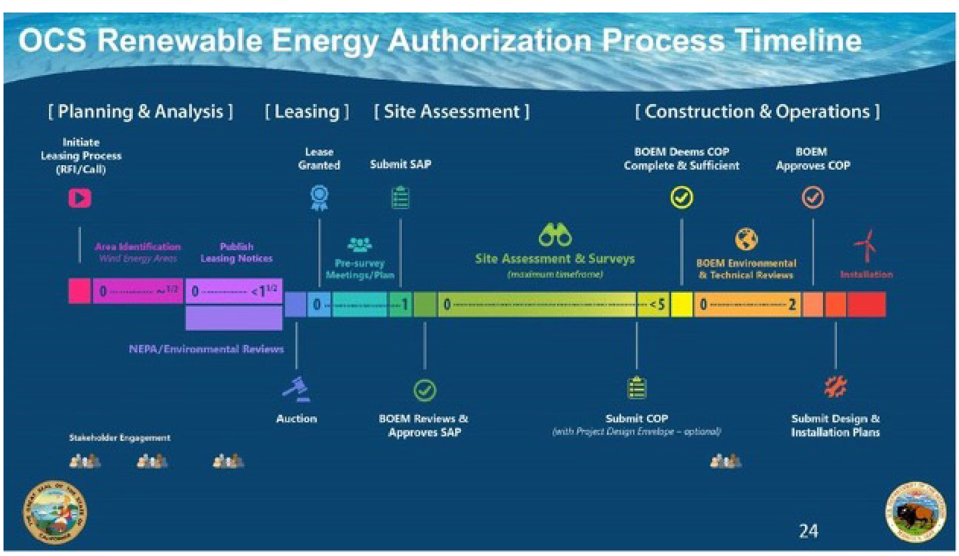

Figure 5.3. OCS Renewable Energy Timeline.

Leasing Process and Post-Lease Activities

The lease auction process begins with BOEM issuing a Proposed Sale Notice (PSN) that is posted in the Federal Register. This notifies interested parties that a lease sale is proposed to occur and provides an opportunity for the interested parties and stakeholders to comment with a 60-day minimum comment period. BOEM issued the PSN for the California Lease Auction in May 2022. Developers wishing to participate in the lease auction are required to submit quallifications to be eligible to bid (unless they have been determined eligible in a past auction). After BOEM reviews all comments and considers revisions to the PSN, the agency issues a Final Sale Notice (FSN) in the Federal Register. The FSN must be posted a minimum of 30 days before the lease auction can be held. It can then take 2-3 months for BOEM to execute a lease with the successful bidder(s). BOEM released the FSN for the Humboldt and Morro Bay Wind Energy Areas on October 18, 2022 and subsequent auction date of December 6, 2022.

Once the lease auction is completed and successful bidders have an executed lease, each lessee is required to complete multiple surveys and studies along with a Site Assessment Plan (SAP) and a geophysical and geotechnical (G&G) survey plan, which are submitted to BOEM for approval. Through the EA process, much of the SAP and survey plan associated activities are analyzed and typically permitted or have completed consultations (e.g., Endangered Species Act and Essential Fish Habitat Consultations). However, additional permits such as an Incidental Harassment Authorization (IHA) for marine mammals may be required for buoy deployment and G&G surveys. The G&G survey process can take 6-18 months, and may run concurrently with the other analyses and studies required by BOEM for submission of a COP.

Construction and Operation Plan

The COP is prepared by the lessee and provides a description of all proposed activities and planned facilities for a project under a commercial lease. The COP must include a description of all planned facilities (wind turbine generators size and locations, mooring design, layout, offshore substation(s), inter-array cables etc.), including onshore and support facilities (substation, generation tie-in, onshore transmission etc.), as well as anticipated project easement needs for the project. It must also describe the activities related to the project including construction, commercial operations, maintenance, decommissioning, and site clearance procedures.

The COP will provide the basis for the analysis of the environmental and socioeconomic effects and operational integrity of construction, operation, and decommissioning activities. The resource areas covered by the COP include marine, aquatic and coastal species and habitats, recreation, visual, socioeconomics, commercial fishing, cultural and historic resources, among others. Many resources analyzed in the COP are dependent on the data gathered during the G&G surveys. As noted above, a developer also needs to prepare and submit a SAP and survey plan for approval and permits such as an IHA for marine mammals, and a U.S. Army Corps of Engineers (USACE) Nationwide Permit for buoy deployment and for geotechnical borings on the seafloor may be required.

If a backup diesel generator is proposed for the meteorological (met) buoy, then a U.S. Environmental Protection Agency (EPA) OCS air permit may be required during the data gathering phase of the COP preparation. The data gathering process and development of a COP can take 18 months or longer. Once a COP is submitted to BOEM, it is reviewed for completeness and sufficiency. This process can take 3-6 months. During this time, BOEM may ask for additional or updated information which could extend the sufficiency review timeframe.[41]

[41] BOEM is in the process of developing formal guidance on the required information for COP submission to achieve a deemed complete submission. See: https://www.boem.gov/newsroom/notes-stakeholders/boem-seeks-public-comment-proposed-guidance-submission-offshore-wind.

Project NEPA Environmental Impact Statement (EIS)

Once the COP is deemed sufficient, BOEM regulations require an additional NEPA analysis specific to the proposed offshore wind farm, all offshore and onshore facilities, and associated activities. The EIS is prepared by a third-party NEPA contractor. The contractor is paid by the lessee but works for BOEM and supports them in every aspect of EIS development (document preparation, scoping meetings, public hearings, additional analyses as required, etc.). The contractor and the lessee are barred from interacting with one another on anything other than budget and scope changes.

There are several other agencies that are typically involved at the EIS stage. Federal agencies include the U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), the EPA and the U.S. Coast Guard (USCG). These agencies may be cooperating agencies to the NEPA EIS, which means there could be one decision document, a Record of Decision (ROD), that authorizes the project to proceed and includes the conditions of approval. About three months after an ROD, a project receives a COP Approval Letter and developers must submit the Facility Design Report and Fabrication and Installation Report for approval. In addition, developers must submit plans that are conditions of the COP approval and receive permits from a multitude of state agencies that have jurisdiction and authority over permitting of an offshore wind farm, detailed below.

Table 5.1. Federal, State, and Local Approvals for Offshore Wind Development Project.

AGENCY	LEGAL AUTHORITY	PERMIT/APPROVAL	TIMELINE*
FEDERAL			
Bureau of Ocean Energy Management (BOEM)	Outer Continent Shelf Lands Act (43 United States Code (U.S.C.), Chapter 29)	Finding of No Significant Impact (FONSI) for Lease Issuance	6 months from Notice of Intent (NOI) to FONSI per SO 3355
BOEM	Outer Continent Shelf Lands Act (43 United States Code (U.S.C.), Chapter 29)	COP Approval	3-6 months
BOEM	National Environmental Policy Act (42 U.S.C. Section 4321 et. seq.)	Record of Decision (ROD)	2 years for Project EIS per CEQ NEPA Guidelines may include all cooperating agencies and a single ROD (applicants may opt to be a FAST-41 project)
California Office of Historic Preservation	National Historic Preservation Act (16 U.S.C. Section 470 et. seq.)	Section 106 Consultation and Programmatic Agreement	Concurrent with NEPA Process, BOEM using NEPA Substitution
Native American Tribes	Native American Graves Protection and Repatriation Act (25 U.S.C. Section 3001 et. seq.) Required by BOEM as lease stipulation	Tribal consultation	Concurrent with NEPA Process
Federal Aviation Administration (FAA)	Title 14 of the Code of Federal Regulations (CFR) Part 77	Obstruction Evaluation/Airport Airspace Analysis	Concurrent with NEPA Process (may be separate permit/authorization or may be included in single ROD)

Table 5.1. Federal, State, and Local Approvals for Offshore Wind Development Project continued.

AGENCY	LEGAL AUTHORITY	PERMIT/APPROVAL	TIMELINE*
Department of Defense (DOD)	32 CFR Part 211; 49 U.S.C. Section 44718; Required by BOEM during the NEPA review and in leases	DOD Consultation	Concurrent with NEPA Process
U.S. Army Corps of Engineers	Section 404 of the Clean Water Act Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403)	Individual permit	Concurrent with NEPA Process (may be separate permit/authorization or may be included in single ROD)
U.S. Coast Guard	Title 33 of the CFR Part 66	Private Aids to Navigation Application	Concurrent with NEPA Process (may be separate permit/authorization or may be included in single ROD)
U.S. Environmental Protection Agency (note, this has been delegated to the San Luis Obispo Air Pollution District who would issue OCS permit for Morro Bay)	Clean Air Act Section 328 (40 CFR Part 55)	Outer Continental Shelf Air Permit	Concurrent with NEPA Process (may be separate permit/authorization or may be included in single ROD)
U.S. Fish and Wildlife Service	Endangered Species Act (16 U.S.C. Section 1531 et. seq.) Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c) Migratory Bird Treaty Act (16 U.S.C. 703-712) Marine Mammal Protection Act (16 U.S.C. 1361-1407)	Section 7 Consultation Incidental Take Permit(s)	Concurrent with NEPA Process (may be separate permit/authorization or may be included in single ROD)
National Marine Fisheries Service	Magnuson-Stevens Fisheries Conservation and Management Act (16 U.S.C. Chapter 38 Section 1801 et. seq.) Marine Mammal Protection Act (16 U.S.C. 1361-1407)	Essential Fish Habitat Consultation Incidental Take Authorization	Concurrent with NEPA Process (may be separate permit/authorization or may be included in single ROD)
CALIFORNIA			
State Lands Commission (assumed to be CEQA Lead agency for purposes of this table)	California Public Resources Code 6301-6314 California Environmental Quality Act (California Public Resources Code 21000-21189)	State Tidelands Lease Notice of Determination (NOD)	2-3 years for Environmental Impact Report (this table assumes separate NEPA EIS and CEQA EIR process)

Table 5.1. Federal, State, and Local Approvals for Offshore Wind Development Project continued.

AGENCY	LEGAL AUTHORITY	PERMIT/APPROVAL	TIMELINE*
California Department of Fish and Wildlife	California Department of Fish and Game Code Section 1600 California Endangered Species Act	Lake and Streambed Alteration Agreement Incidental Take Permit	Concurrent with CEQA Process, issued after NOD
California Office of Historic Preservation	Public Resources Code Sections 5024 and 5024.5	SHPO Consultation	Concurrent with CEQA Process
Native American Tribes	Assembly Bill 52 (Public Resources Code Section 5097.94)	AB 52 Tribal Consultation	Concurrent with CEQA Process
California Coastal Commission	California Coastal Act (Title 14 Natural Resources Division 5.5) Coastal Zone Management Act (16 U.S.C. Section 1451 et.seq.)	Coastal Development Permit Consistency Determination	Concurrent with CEQA Process, issued after NOD
Regional Water Quality Control Board (Central Coast for Morro and North Coast for Humboldt)	Clean Water Act Section 401 (33 U.S.C. Section 1341) Clean Water Act Section 402(p)	Water Quality Certification Construction General Permit	Concurrent with CEQA Process, issued after NOD
California Public Utilities Commission (CPUC)	CPUC General Order 131-D (Public Utilities Code)	Permit to Construct (if needed)	2-3 years; Dependent on role of CPUC in CEQA Process and whether Proponent's Environmental Assessment is required.
California Department of Transportation (CalTrans)	California Street and Highways Code Section 660	Encroachment Permit (if needed)	2-4 months
LOCAL			
Jurisdiction with Approval Authority (e.g., City of Morro Bay, County of San Luis Obispo; Humboldt Bay Harbor District)	California Constitution, Article XI, Section 7	Conditional Use Permit, Zoning Permit, Building Permit, etc.	6-9 months for Local Permitting

* = Assumes no appeals or project applicant or agency delays.

Federal and state permit approvals may occur after the BOEM EIS and SLC EIR decisions.

BOEM initiates the formal NEPA process by publishing a Notice of Intent (NOI) in the Federal Register. The NOI is also published in local newspapers and should include date(s) and location(s) of scoping meetings. BOEM develops the EIS based on the COP data, scoping comments, and inter-agency consultations with cooperating and other agencies. A draft EIS is issued for public comment (at least 45 days) and public hearing(s) are then conducted. BOEM prepares a final EIS based on the input from the public and issues a final EIS for public comment of at least 30 days. After the close of the comment period on the final EIS, they issue the ROD, which, if feasible per the Council of Environmental Quality (CEQ) NEPA regulations, will include decisions from cooperating agencies (e.g., NMFS, USFWS, EPA and USACE).

Under current CEQ NEPA regulations, although not required, the EIS process should be completed within two years. Lessees may choose to participate in FAST-41, which is a coordinated federal permitting process under the Federal Permitting Improvement Steering Council (FPISC). Infrastructure projects over $200 million can voluntarily be permitted under FPISC's FAST-41 process. The process has had success keeping projects on track from the federal side, as the process requires all federal agencies involved in the decision for the infrastructure project to adhere to an agreed upon timetable for the NEPA process.

State Permitting and the California Environmental Quality Act (CEQA)

In California, there are many state and local agencies from which an offshore wind farm must seek approval. In addition, the project must be reviewed under CEQA and for the anticipated level of impacts associated with a project of this magnitude, an Environmental Impact Report (EIR) will be necessary. It is worth noting that it is possible for a joint EIR/EIS to be prepared that complies with CEQA and NEPA; whether that is likely for an offshore wind project is unclear. This summary and the associated permitting schedule and table assume these processes would be conducted separately.

The EIR requires a Lead Agency, and at this time, it is believed that the State Lands Commission (SLC) would act as that lead agency given their permitting authority to issue a State Tideland Lease. The Lead Agency is the public agency with the greatest responsibility for supervising or approving the project as a whole or which will act first on the project. In addition to the SLC, the following agencies have jurisdiction or permitting authority over an offshore wind farm:

- **California Coastal Commission**
- **California Department of Fish and Wildlife**
- **California Regional Water Quality Control Board**
- **California Department of Transportation**
- **California Historic Preservation Office**
- **California Public Utilities Commission**, if an investor-operated utility must develop or upgrade transmission or substation infrastructure.
- **Local county/municipality** where onshore activities would occur.

CEQA requires state and local government agencies to inform decision makers and the public about the potential environmental impacts of proposed projects, and to reduce those environmental impacts to the extent feasible. An EIR contains in-depth studies of potential impacts, measures to reduce or avoid those impacts, and an analysis of alternatives to the project. A key feature of the CEQA process is the opportunity for the public to review and provide input on proposed projects. The CEQA process is likely to take a minimum of 2 to 2.5 years and begins with a posting of a Notice of Preparation (NOP) on the Governor's Office of Environmental Planning (OPR) CEQAnet Web Portal that is also posted locally with the County Clerk and other public locations and in newspapers in the vicinity of the proposed project.

There are a number of steps needed to complete the CEQA process, including the need for responsible and/or trustee agencies as identified by the OPR to respond to the NOP, at least one scoping meeting for projects of statewide importance, issuance of a draft EIR for public comment, public hearing(s), preparation of a final EIR, and response to comments and issuance of a Notice of Determination (NOD). Typically, it takes several months after the NOD for the pertinent State agencies to issue their permits, which can add another 3-6 months to the 2-to-2.5-year timeframe for CEQA and State permitting completion.

Once the lease is issued, with surveys and COP preparation (which takes 1.5 to 2 plus years) it could take 3.5 to 4.5 years to get to a ROD for the federal permitting. Under a typical CEQA process for a project of this size and scope, it can take 3-5 years for the CEQA process to be completed and to secure the subsequent state agency permits discussed above. While there may be opportunities to speed up this timeframe at the margins (e.g., the COP may be prepared in less than 18 months), it may be challenging to do so.

As noted earlier, in September 2021, the California Legislature approved AB 525 which directs the CEC, in coordination with specified agencies, to develop a strategic plan for offshore wind energy developments installed off the California coast in federal waters and submit it to the Natural Resources Agency and the Legislature by June 30, 2023. AB 525 also directs the CEC to prepare a permitting roadmap that "describes time frames and milestones for a coordinated, comprehensive, and efficient permitting process for offshore wind energy facilities and associated electricity and transmission infrastructure off the California coast." The permitting roadmap is due December 31, 2022. It is anticipated that it will help to make offshore wind permitting by the State of California more efficient and concurrent with the BOEM NEPA process.

Photo of the WindFloat Atlantic project courtesy of Principle Power/Ocean Winds.

Table 5.2. Linear Permitting Timetable.

SWCA ENVIRONMENTAL CONSULTANTS

		Year 1				Year 2				Year 3				Year 4				Year 5				Year 6			
Permitting Framework*		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
BOEM Auction/Lease	■																								
Site Investigation and Construction and Operation Plan Preparation (assumes lease issuance 3 months after lease auction)																									
Applicant Conducts Surveys/Prepares COP**			■	■	■	■	■	■	■	■																
BOEM Construction and Operation Plan (COP) Sufficiency Review											■	■													
BOEM Deems COP Sufficient/Complete												■													
CEQA and State Permitting																									
Notice of Preparation of an Environmental Impact Report													■												
Prepare Draft Environmental Impact Report													■	■	■	■									
Notice of Availability of Draft Environmental Impact Report																	■								
Prepare Final Environmental Impact Report/Response to Comments																	■	■	■	■					
Notice of Availability of Final Environmental Impact Report/Response to Comments																					■				
Issuance of a Notice of Determination (NOD)																					■				
CDFW Section 1600 Streambed Alteration Agreement																	■	■	■	■	■	■			
CDFW Incidental Take Permit																	■	■	■	■	■	■			
CCC Consistency Certification (Coastal Development Permit)																	■	■	■	■	■				
CSLC Tidelands Lease												■	■	■	■	■	■	■	■	■	■	■			
National Pollutant Discharge and Elimination System (NPDES) Construction General Permit																						■			
Regional Water Quality Control Board Clean Water Act Section 401 Permit																	■	■	■	■	■	■			
State Parks easement (beach crossing)																	■	■	■	■	■	■			
Assembly Bill (AB) 52 Tribal Consultation													■	■	■	■	■	■	■	■	■	■			
State Agency Coordination/CEQA Review Participation (to facilitate the Roadmap)*			■	■							■	■	■		■	■			■	■						
BOEM NEPA EIS and Federal Permitting (Applicant Project)																									
NEPA EIS Notice of Intent and Scoping													■												
Prepare Draft Environmental Impact Statement (EIS)													■	■	■	■									
Draft EIS Notice of Availability and Comment Period																	■								
Prepare Final EIS																	■	■	■	■					
Notice of Availability of Final Environmental Impact Statement																					■				
Record of Decision (BOEM USACE, NMFS are signatories)																					■				
USFWS/NMFS Endangered Species Act Section 7 Consultation														■	■	■	■	■	■	■	■				
Applicant Prepares Biological Assessments														■	■	■	■								
Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) Section 305(b) Essential Fish Habitat Consultation														■	■	■	■	■	■	■					
National Historic Preservation Act Section 106 Consultation														■	■	■	■	■	■	■	■				
CCC Consistency Certification (see State Process)																									
Bald and Golden Eagle Protection Act Incidental Take Permit, Migratory Bird Treaty Act Compliance														■	■	■	■	■	■	■	■				
US Coast Guard Private Aids to Navigation Application																		■	■	■	■				
Individual Permit pursuant to Section 10 of the Rivers and Harbors Act of 1899														■	■	■	■	■	■	■	■				
Individual Clean Water Act (CWA) Section 404 Permit														■	■	■	■	■	■	■	■				
Clean Air Act Outer Continental Shelf Permit														■	■	■	■	■	■	■	■				
Marine Mammal Protection Act (MMPA) IHA Permit														■	■	■	■	■	■	■	■				

*This timeline is presented to illustrate the complexities of permitting an offshore wind project in the State of California and the need for a coordinated state and federal process.

**Note, there are several permits/consultations required at the site investigation stage not depicted here for activities in State Waters (e.g. consultation with SHPO, G&G survey permit from CSLC, etc.). In addition, many state agencies will want to weigh in on specific requests they have for site investigation and COP contents to meet their regulatory needs. Individual projects may not require all permits/approvals listed here and/or other permits/approvals may apply.

***This row is intended to illustrate the multiple points at which state agency coordination will be needed from site investigation/early engagement through the completion of the CEQA process.

Section 6: Transmission to Connect Offshore Wind to California's Grid

Introduction

Transmission infrastructure is essential for bringing energy from offshore wind projects onshore to load centers and must be sited and constructed in time to meet the pace of offshore wind deployment.

According to the California Independent System Operator (CAISO), California has 5-6 GW of existing interconnection capacity on the Central Coast that should be available to provide transmission for up to 5 GW of offshore wind power from the Morro Bay WEA when the Diablo Canyon nuclear power plants are due to go offline, tentatively set for 2029 and 2030. Timing of this transition will be important.

On the North Coast, offshore wind power at the Humboldt WEA will require significant build-out of new transmission to reach electricity load centers further south, via undersea or onshore cables. In both areas, it is crucial for the state to begin necessary planning now so transmission upgrades and available capacity are ensured and offshore wind can meet California's goals of 5 GW by 2030 and 25 GW by 2045.

The CPUC and CAISO have regulatory authority over transmission development and will be key stakeholders to build out necessary infrastructure to meet the needs of offshore wind deployment.

Figure 6.1. Illustrative map of candidate points of interconnection to integrate offshore wind resources to meet SB 100 high electrification load projection by 2040.[42]

[42] CAISO 20-Year Transmission Outlook, May 2022.

Background on California Transmission Planning

The California transmission system will need to be proactively planned and expanded to meet newly approved state renewable energy goals, including the near- and long-term goals for offshore wind. The existing California transmission system was built to largely connect thermal power plants to electric load and provide some transfer capability between regions. Under the past CAISO planning process, the transmission system was not designed and built with significant excess capability or to create a system that builds new lines for future generation. Instead, it has historically been constructed to serve a 10-year projected load growth given current generation topology. While this process has been sufficient in the past, the growth of onshore and offshore renewables that are often located in areas remote from where energy is utilized – including at sea – has resulted in a transmission system that has not been designed to incorporate the significant amounts of renewable energy identified as necessary to meet California's SB 100 goals.

Efforts to address these transmission planning limitations include the State Legislature's enactment in September 2022 of SB 887, which requires CAISO to extend its planning time horizon for renewables from 10 to 15 years. Also, in February 2022, CAISO issued its first 20-year draft transmission outlook, prepared with the CEC and CPUC, offering a planning preview of what the state would need to do to add 120 GW of new renewable energy resources, including offshore wind, solar, storage and others, to its power portfolio by 2040.

These same ISO/RTO planning issues are also present in the Eastern U.S. RTO regions, where several states have utilized the tariff public policy process to direct their regional grid operator to proactively identify and plan new projects, as in the case of the overland transmission in New York State. Other states have enabled the use of state-directed RFPs for new transmission, as seen with Massachusetts' direct solicitation of a new overland hydro-power transmission line from Canada to Maine. Additional examples include New Jersey's direct solicitation for an offshore wind transmission system, supported by PJM as a technical advisor and facilitator, and five of the six New England states with the issuance of a RFI for an offshore transmission system. In these states, work has occurred over the past few years to ensure that legislation is in place to allow for direct state procurement of off- and onshore transmission to enable offshore wind.

CAISO Transmission Planning

CAISO is currently undergoing its 2022-2023 Transmission Planning Process (TPP) and targeting CAISO board approval in March 2023. In its current, second phase, CAISO is conducting technical studies including a reliability analysis and policy-driven analyses – among others – that consider offshore wind and other renewable generation resources and related transmission planning. The CPUC and CEC have recommended CAISO consider the 2021 Integrated Energy Policy Report (IEPR) Additional Transportation Electrification scenario in the TPP base and sensitivity portfolio as well as a 30 million metric ton (MMT) High Electrification policy-driven scenario, indicating increased electricity demand and necessity for reliable renewable generation like offshore wind.

In its 20-Year Transmission Outlook, noted above, CAISO has already analyzed the transmission development and integration of up to 10 GW of offshore wind by 2040, including 2.3 GW in the existing Humboldt and Morro Bay call areas. In addition, CAISO indicated at the CEC's June 27, 2022 Offshore Wind Workshop that it has studied additional potential offshore wind resources off California's North Coast, which raises the total offshore wind potential CAISO has studied in its outlook to 21.1 GW.[43]

The CPUC's 2022-2023 TPP High Electrification Policy-Driven Sensitivity Portfolio RESOLVE Results include 4.7 GW of offshore wind generation by 2035.

[43] CAISO Presentation - Transmission Planning for Offshore Wind - AB 525 CEC Workshop, June 27, 2022.

This information will feed into a future California Integrated Resource Plan (IRP) cycle (e.g., the 2022-2023 cycle) and inform offshore wind resource cost assumptions. If this and other adjustments result in more offshore wind being selected as part of a Reference System Plan (RSP), which is then transferred as part of the reliability and policy base case for a future TPP, then CAISO could authorize appropriate levels of new transmission or system upgrades to meet the state's new offshore wind planning goals. Once authorized, it could take 10 years or longer[44] for a new transmission line to be constructed. Thus, it is essential to begin planning for offshore wind transmission upgrades as soon as possible.

An alternative to this incremental approach would be to encourage proactive planning for a transmission system that could be built in modular sections but permitted up front to reduce delays and ensure timely installation for future wind farms, as well as more certainty for onshore transmission needs – or avoided needs – and investment by generation developers. This approach could be pursued along two paths. The first would be for the state to direct CAISO to engage in its FERC-approved public policy planning process for an offshore wind system capable of collecting and integrating 25 GW of offshore wind energy. Other policy goals and details could be folded into such a planning request. The second would be for California to designate a lead procurement agency to solicit an offshore wind transmission system, supported by CAISO for technical analysis and process logistics.

This latter approach would set in motion a process to plan needed transmission holistically, which has been shown to materially reduce the number of offshore transmission cables needed, e.g., 18 1.4 GW cables vs. 10 2.6 GW cables – and could move many onshore upgrades offshore with transfer paths to optimal points of interconnection that are near load.[45] These approaches can: 1) save billions in consumer costs, 2) materially reduce the environmental impacts and footprint of the transmission system, 3) reduce permitting and siting risks and delays, and 4) result in a transmission system that is more seismic and wildfire resilient, can transfer power from off- and onshore generation around the state with increased reliability, and reduced losses from curtailment.

This alternative step would require, as it has in Eastern states, new legislation – similar to proposed legislation to direct more efficient procurement at scale for offshore wind.

CPUC Role in Transmission Planning

The CPUC has a responsibility to assess the most cost-effective near-term and long-term solutions to achieve reliability and climate objectives. OWC recommends that the CPUC take the following steps, starting as soon as possible, in support of these goals, and to properly assess and plan for a future with more offshore wind:

Near Term

1) Consider AB 525 Planning Goals: At its business meeting on August 10, 2022, the CEC adopted expanded offshore wind planning goals to generate 2-5 GW from offshore wind by 2030 and 25 GW by 2045. The state's offshore wind policy advances demonstrate a need to proactively ensure transmission is planned to allow for these goals to be met. California should consider both regulatory and legislative options to ensure timely transmission deployment. CAISO could plan for the transmission needed to meet the CEC's higher AB 525 offshore wind planning goals for 2030 and 2045 through its public policy planning process, or the legislature should consider new state legislation allowing for state procurement, supported by CAISO, of the needed enabling offshore wind transmission.

[44] https://www.tanc.us/news-article/how-long-does-it-take-to-permit-and-build-transmission-to-meet-californias-policy-goals/
[45] From Theodore Paradise, see Anbraic/Brattle Group study on Offshore Transmission in New England: The Benefits of a Better-Planned Grid, May 2020 https://newengland.anbaric.com/wp-content/uploads/2020/07/Brattle_Group_Offshore_Tranmission_in_New-England_5.13.20-FULL-REPORT.pdf and National Grid ESO UK's Analysis in Planning for Offshore Network to Meet Clean Energy Goals, February 2021. Slide 5. https://newenglandenergyvision.files.wordpress.com/2021/02/bstojkovska-02-02-2021-draft.pptx?force_download=true.

2) NREL Density Factor: Generation capacity and transmission needs in existing wind energy areas should be updated to reflect NREL's latest findings[46] regarding offshore wind capacity and power density that should be included in this TPP cycle. These figures, shared by NREL at the CEC offshore wind workshop on June 27, 2022, indicate a higher offshore wind generating capacity of 4.9 GW for the Morro Bay WEA, and 2.7 GW for the Humboldt WEA. NREL noted that its updated density assumptions are based in part on updated East Coast wind farm data. This is significant as the total GW capacity in the Morro Bay and Humboldt lease areas would increase from 4.5 to 7.6 GW. NREL reports that offshore wind developers on the East Coast are already utilizing power densities at this or higher ranges. This significant shift in offshore wind industry norms should be factored into CAISO's ongoing analysis and planning for offshore wind in the State's clean power portfolio.

3) Regarding the approved extension of the planned shutdown of the Diablo Canyon nuclear power plants, CAISO previously estimated that there is 5-6 GW of available transmission capacity at the location. Due to the State's new statute, SB 846, Diablo Canyon's two nuclear power plants will now continue operations for another five years, which will reduce available transmission to 2.8-3.8 GW until 2030. This should still leave sufficient capacity for much of the initial build of almost 5 GW that NREL estimates in projected offshore wind generating capacity at the Morro Bay WEA, which could begin coming online as early as 2028-2030. CAISO should work with the offshore wind industry and other stakeholders to manage the timing of this transition and reduce any potential delay between the Diablo Canyon power plant shutdown and the interconnection of offshore wind. A more proactive transmission plan through either the CAISO public policy planning process or through new legislation allowing for a state-directed procurement could factor in existing transmission uses and availability.

4) In the normal course, OWC encourages CAISO to manage the TPP sensitivity analysis to maximize the value of this review. This includes considering requesting scenarios with different assumptions regarding retention of PG&E transmission deliverability and scenarios where fewer gas resources are retained in the Los Angeles (LA) Basin.

Medium Term

5) As proposed in its ISO Transmission Planning Process Enhancements,[47] CAISO has been considering a process for approvals for long lead-time transmission projects beyond the 10-year planning horizon and retaining policy-driven transmission upgrade capacity for specific policy purposes. As noted above, in September the California Legislature approved and Governor Newsom signed SB 887, which requires CAISO to extend is planning horizon from 10 to 15 years. CAISO should implement these new changes, particularly in the context of offshore wind, which is a long lead-time resource that would benefit from reserved additional transmission capacity and is currently at a potential disadvantage waiting for the interconnection queue. In addition, transmission planning on a longer time horizon will greatly aid the scaling of offshore wind between 2030 and 2045.

6) Make larger improvements to the IRP process, which would better account for the value of offshore wind, and thus how much offshore wind is selected as part of the State's Preferred System Portfolios (PSP). Key changes include differentiating the Effective Load Carrying Capability (ELCC) in the Resource Adequacy proceeding by geography to account for the tremendous time-of-day benefits of offshore wind, adjusting assumptions about gas retirement in key load centers, and properly accounting for the costs of keeping gas facilities online in development of new portfolios.

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[46] CAISO 20-Year Transmission Outlook, May 2022.
[47] CAISO Issue Paper: ISO Transmission Planning Process Enhancements, July 2022.

Longer Term

7) Work with the CAISO and the CEC to create a special process for evaluation and potential approval of transmission solutions for offshore wind. This process may be impacted by the ISO Transmission Planning Process Enhancements listed above. Start by acknowledging SB 100 results which call for diverse renewables and new transmission. Transmission planning for new or significantly upgraded long-distance lines to optimize renewable resource build will be an intensive process that needs to be initiated now. Standard processes (IRP portfolios, interconnection requests, and cluster studies) are not likely to address the questions that need answering and the transmission system the State needs to plan for. A special planning process for offshore wind may be warranted. Alternatively, this planning could be part of a Renewable Energy Transmission Initiative (RETI) 3.0 process that looks at multiple renewable resources and resource zones, with the intent of identifying least-regrets solutions in the 2035-2045 timeframe.

Viable routes for Central Coast and North Coast projects interconnection

On the Central Coast, utilizing existing capacity with projects interconnecting at Morro Bay is the most viable first option. However, additional transmission capacity may be needed to maximize development of the Morro Bay offshore wind resource, which could support up to 4.9 GW total, given the existing capacity to interconnect at Morro Bay currently, as well as limits to deliverability in the transmission system (Path 26) to the LA Basin. See map of the Central to Southern California CAISO system below. Deliverability to the LA Basin would allow offshore wind to supply local resource adequacy, enabling reduced reliance on local fossil resources.

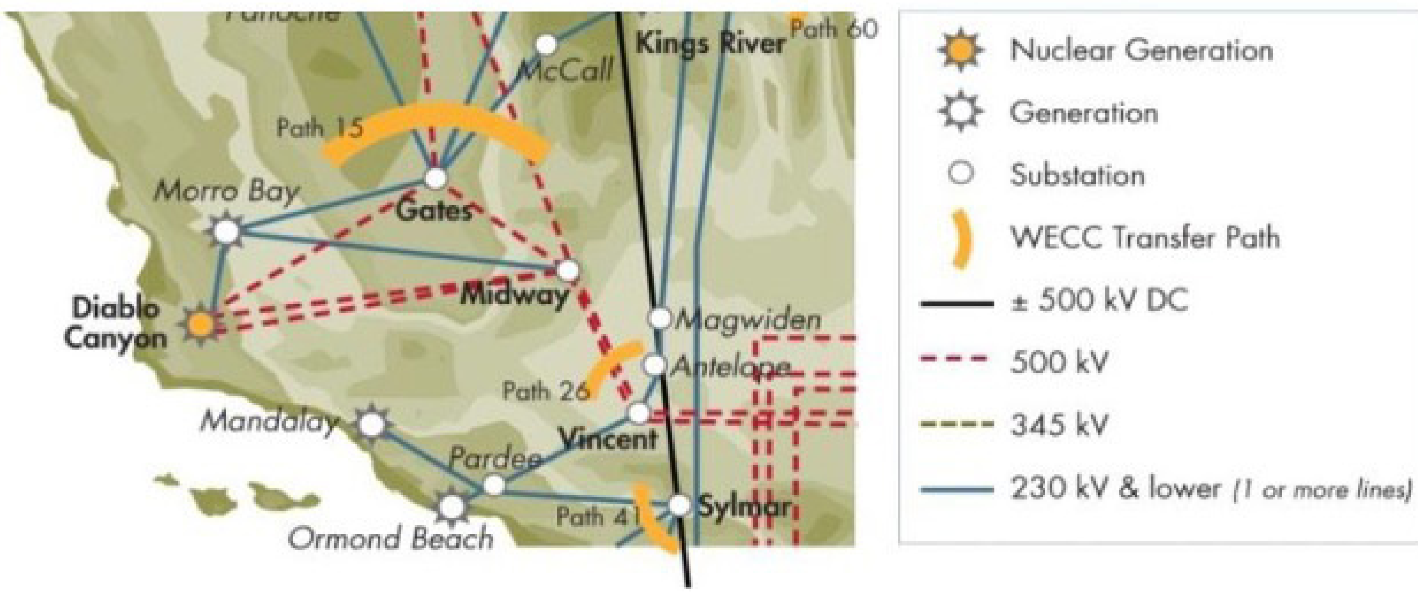

Figure 6.2. Central to Southern California CAISO system

To add transmission capacity to the LA Basin, a subsea transmission line from the central coast to the LA Basin may be a viable option. However, assumptions about the quantity of natural gas generation resources retained in the basin will affect the cost-benefit analysis associated with this, or other options to connect to the LA Basin.

Regarding North Coast transmission, the Schatz Energy Research Center[48] has examined multiple transmission pathways to the southeast, and south from the Humboldt call area:

1) Interconnection into the Round Mountain Substation and upgrades to the 500 kV lines south to the Bay Area;
2) Interconnection at the Vaca-Dixon Substation; and
3) Interconnection at a new Bay Area substation via a new subsea line (two routes). See map below:

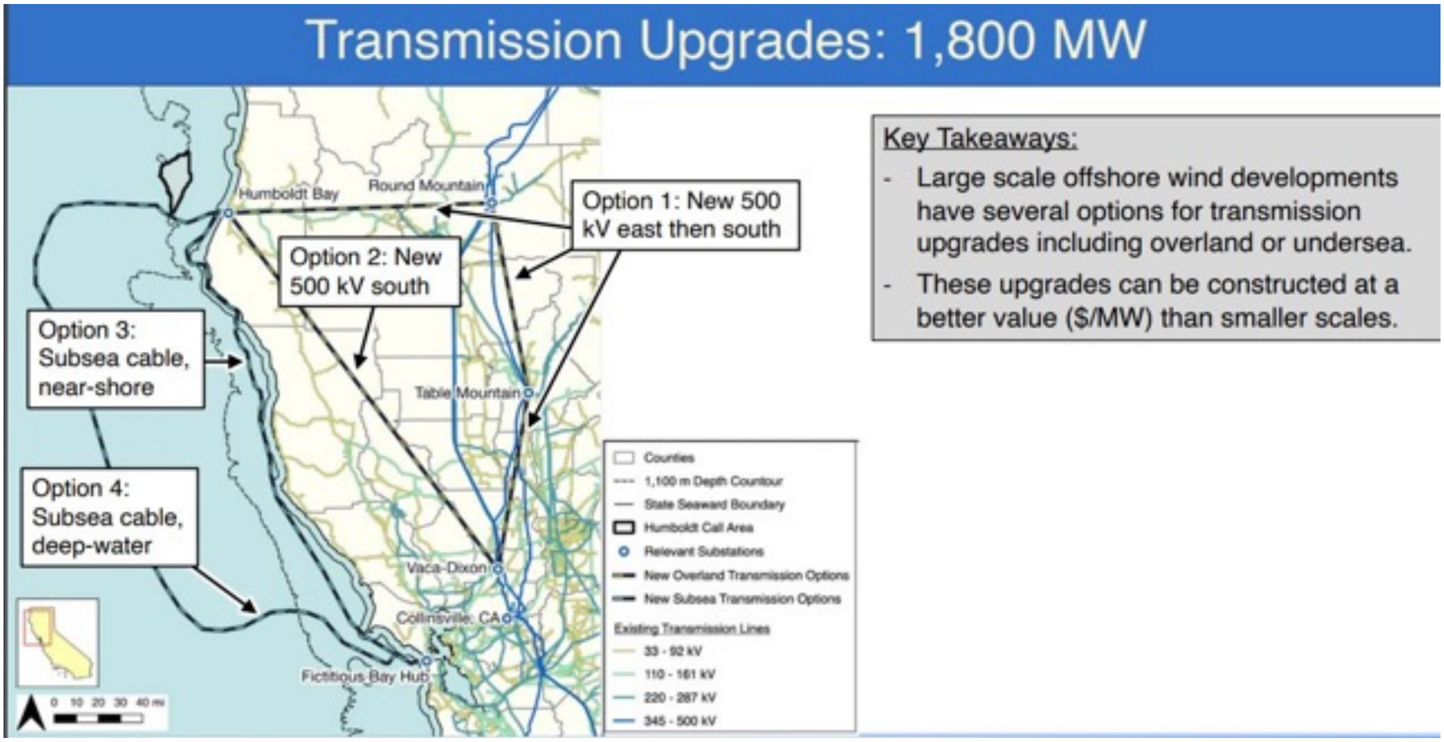

Figure 6.3. Transmission Upgrades: 1,800 MW.

In addition to these options, there may be opportunities to upgrade transmission to utilize existing rights-of-way or to repurpose pipeline rights-of-way. Finally, there may be options to route transmission east and then feed into the southern intertie system via substations at the California-Oregon border. All of these transmission options may work to interconnect floating offshore wind. Without further study of the transmission network capabilities and benefits, costs and system benefits, as well as environmental and cultural resource assessments, it would be premature to conclude one pathway is more viable than another.

In its 2022-2023 TPP Update, CAISO has identified alternatives for interconnection for both Central Coast and Humboldt offshore wind. For the Central Coast, initial analysis indicates 5.3 GW of resources can connect to the 500 kV system in Diablo/Morro Bay (See Diablo Canyon discussion above). Alternatives to increase the capacity to 6.4 GW include: 1) A VSC HVDC with Subsea Cable from Diablo to Southern California, 2) Second Diablo – Gates 500 kV line ($0.11 billion), or 3) VSC HVDC with Subsea Cable from Diablo to Moss Landing. For Humboldt offshore wind, 1.6 GW interconnection alternatives include: 1) 500 kV AC line to Fern Road 500 kV substation ($2.3 billion), 2) VSC-HVDC subsea cable to a converter station in the Bay Area with 3 AC connections to Potrero, East Shore, and Los Esteros ($4.0 billion), or 3) HVDC Bipole to Collinsville 500/230 kV substation ($3.0 billion).[49] Cost estimates for potential transmission development for offshore wind totals $8.11 billion and compare favorably to $11.65 billion required for out-of-state wind.[50]

[48] http://schatzcenter.org/pubs/2020-OSW-R4.pdf
[49] CAISO Presentation - Transmission Planning for Offshore Wind - AB 525 CEC Workshop, June 27, 2022.
[50] CAISO 20-Year Transmission Outlook, May 2022.

The planned 21 GW offshore wind outlook assessment in the next TPP cycle may provide further information on the viability of different transmission options. As indicated by the findings of the Schatz Energy Research Center, it is likely that the most optimal transmission solution from the North Coast will be larger than the capacity of the Humboldt WEA alone, and instead will serve multiple offshore wind project areas. Transmission planning for offshore wind to meet the State's new AB 525 offshore wind planning goal of 25 GW by 2045 would further this assessment.

The Energy Division has an important role in directing the CAISO's studies on transmission options for offshore wind through the resources selected in the base case IRP portfolio, GHG targets driving selected portfolios, decisions about gas fleet retention assumptions, and in proposed policy-based resource sensitivities.

Assessment of Existing Capacity

On the North Coast, studies from the Schatz Energy Research Center and CAISO analysis indicate there is limited current capacity to connect offshore wind. A small project of 100-200 MW requires some level of upgrades. Larger projects will require new transmission. The Schatz report also emphasized the importance of scale in determining the cost-effectiveness of a future project. The 22 GW outlook scenario in the 2021-2022 TPP cycle will help determine the optimal transmission solution from the North Coast.

On the Central Coast, CAISO has indicated that 3-4 GW of offshore wind could interconnect to the CAISO grid.[51] In other conversations with industry, CAISO staff has indicated 5-7 GW of offshore wind could be interconnected. In a presentation during a Modeling Advisory Group webinar of the IRP (August 2020), CPUC staff, examining CAISO's white paper for the 2019- 2020 IRP cycle assumptions, estimated that 5 GW of deliverable capacity is available in the Central Coast for offshore wind.

Factors that affect how much transmission is known to be available in the Central Coast are as follows:

1) The CAISO hasn't done a full assessment of offshore wind interconnection and deliverability, including power-flow analysis to fully assess capacity for offshore wind resources interconnecting at Morro Bay or Diablo Canyon in the Central Coast. This is a primary reason for the more thorough 8 GW offshore wind sensitivity analysis that was part of the 2021-2022 TPP.

2) The range is affected by assumptions about whether PG&E will retain its deliverability rights associated with Diablo Canyon for three years (to 2028), or whether the CPUC could compel PG&E to relinquish those rights. Without this 2 GW of deliverability capacity, the lower end of the range (3 GW) is more likely, according to CAISO staff. See discussion of Diablo Canyon in the "Near Term" section above.

3) There are projects in the interconnection queue for Diablo Canyon and Morro Bay interconnection today that may be able to come online sooner and could use up some of the transmission capacity that would otherwise be available to offshore wind.

Conclusion

As described above, the CPUC can facilitate determination of the best offshore wind transmission solutions through its role in setting assumptions and targets for the IRP, its direction to the CAISO in the Transmission Planning Process, and by leading and engaging in broader, more holistic assessments of long-term transmission solutions needed to achieve SB 100 goals and for large-scale offshore wind.

[51] CAISO Presentation at 2019 IEPR Workshop: https://efiling.energy.ca.gov/GetDocument.aspx?tn=229915&DocumentContentId=61375

Section 7: Procurement of Offshore Wind at Scale

Introduction

Going big is one of the most important keys to achieve success with offshore wind – in California and other U.S. and global energy markets. Economies of scale are essential for spurring a sustainable industry, driving down costs, delivering competitively priced clean power, and encouraging supply chain businesses and jobs to locate in California.

9.5 MW floating wind turbine deployed at Kincardine Offshore Wind project off coast of Aberdeen, Scotland. Photo courtesy of Principle Power

Likewise, procurement of long lead-time resources like offshore wind at scale is critical for increasing market confidence for developers and lowering costs for load-serving entities (LSEs) and ratepayers in the purchase of energy from the multi-gigawatt projects California is proceeding with at Morro Bay and Humboldt off the state's Central and North coast. It is not clear, however, whether the state's existing process for energy procurement is appropriately suited to provide for the efficient and commercial-scale purchase of long-lead time renewable resources like offshore wind.

The California PUC has recognized that there are limitations to the state's existing procurement mechanism through the Integrated Resource Planning process that goes "order by order" and acknowledges the current process can be unpredictable for LSEs (e.g., utilities)[52] and leave long lead-time resources like offshore wind at a disadvantage. To address these limitations, the CPUC has recently filed a staff paper which outlines options for the design of a new Reliable and Clean Power Procurement Program and has outlined goals for the development of a programmatic approach to offshore wind procurement.

In comparison, a 2020 NREL study on offshore wind procurement across the U.S. found that states on the East Coast use one of two procurement instruments. In the first, utilized by Massachusetts, Rhode Island, and Connecticut, each state mandates utilities to enter into power purchase agreements (PPAs) with offshore wind generators. The second procurement instrument, utilized by New Jersey, Maryland, and New York, involves competitive bidding for offshore wind renewable energy certificates (ORECs) that are used to comply with renewable portfolio standard provisions. NREL concludes both of these actions de-risk the revenue profile and creates certainty that aids in securing long-term project financing.[53]

For California, there are multiple pathways for providing more certainty in the process for procuring long lead-time resources like offshore wind, through regulatory and legislative mechanisms, or a combination of both.

California Public Utility Commission's Procurement Authority on Offshore Wind

A legal policy analysis of CPUC procurement authority by the California office of Davis Wright Tremaine describes the mechanisms by which the CPUC has, in the past, ordered resource-specific procurement. The CPUC exercises its procurement authority in its IRP proceeding as codified in SB 100. The IRP requires the CPUC to pursue a "diverse portfolio" with "best-fit and least cost" resources. The current IRP Proceeding initiated in May 2020 (R.20-05-003) includes consideration of procurement issues for long lead-time resources like offshore wind.

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[52] Energy Division Workshop on Reliable & Clean Power Procurement Program Staff Options Paper, September 20, 2022.
[53] Comparing Offshore Wind Energy Procurement and Project Revenue Sources Across U.S. States, NREL, June 2020.

CPUC staff acknowledges that, despite cost and long lead-time, resources like offshore wind may be found in an optimal resource portfolio to meet reliability and other system needs.

In the mid-term reliability decision (D.21-06-035), the Commission acknowledges it has exercised its authority in past procurement orders for specific clean energy resources—namely solar, biomass, and storage to provide system reliability benefits. In the case of energy storage, complementary legislation (AB 2154) "…ordered the CPUC to consider appropriate energy storage procurement mandates, if any, for 2015 and 2020."[54]

For offshore wind, CPUC Decision 22-02-004, adopting the state's 2021 Preferred System Plan outlines the Commission's most recent position on procurement for long lead-time resources like offshore wind. The CPUC is aiming to include offshore wind as a candidate resource in its modelling efforts as soon as possible and is expected to advance these efforts in 2022 and 2023. The Preferred System Plan and 2022-23 TPP base case both currently include 1.7 GW of offshore wind, but these levels are expected to increase as CAISO completes its offshore wind sensitivity portfolio that will evaluate transmission needs to interconnect 8 GW of offshore wind.[55]

The CPUC acknowledges the necessity to evaluate procurement for higher levels of offshore wind and is pursuing actions within their authority to take a programmatic approach that better plans and accounts for offshore wind development. These include preserving transmission deliverability rights for offshore wind on the Central Coast and exploring procurement approaches that include the "development or selection of an appropriate entity to conduct offshore wind procurement." These actions will consider procurement impacts on ratepayers and provide additional confidence and expectations for developers about contracting opportunities.[56]

The CPUC has outlined goals for the development of a more programmatic approach for offshore wind procurement. These include ensuring that LSEs can more regularly update their IRP procurement and need allocations based on changing demand forecasts that are driven by high electrification or other scenarios. In addition, the CPUC has stated that this programmatic approach to complement the existing Resource Adequacy (RA) and Renewable Portfolio Standard (RPS) programs by filling a gap related to mid-to-long-term procurement for resources with longer lead times like offshore wind.[57]

The CPUC expects this work to include additional workshops, public comment opportunities, program adoption by mid-2023, and a first compliance year of 2024.[58] In September 2022, the CPUC and Energy Division Staff held a workshop on Reliable & Clean Power Procurement Program Staff Options Papers to discuss progress on developing a new programmatic approach to procurement that helps the IRP's goals of achieving reliability, GHG reductions, and least-cost procurement. Staff indicated at this workshop that actions specific to procuring offshore wind would run in parallel with this process, and that the Commission will engage on offshore wind procurement later in 2022 and determine the impacts of a set-aside or resource-specific needs.[59]

California's electricity planning ecosystem is complex and must manage requirements and inputs from multiple agencies and legislative goals. The CPUC plays the major role in procurement through its IRP process that establishes GHG targets for LSEs to ensure they are pursuing optimal portfolios to meet state policy objectives. In addition, the CPUC orders procurement and oversees compliance for planned and contracted resources. CPUC planning processes also feed into CAISO's TPP.[60]

[54] Davis Wright Tremaine, Legal Policy Analysis of CPUC Procurement Authority. October 2022.
[55] CPUC D.22-02-004 Decision Adoption 2021 Preferred System Plan, February 10, 2022.
[56] CPUC D.22-02-004 Decision Adoption 2021 Preferred System Plan, February 10, 2022.
[57] CPUC D.22-02-004 Decision Adoption 2021 Preferred System Plan, February 10, 2022.
[58] CPUC D.22-02-004 Decision Adoption 2021 Preferred System Plan, February 10, 2022.
[59] Energy Division Workshop on Reliable & Clean Power Procurement Program Staff Options Paper, September 20, 2022.
[60] The CPUC's Integrated Resource Planning Process, CPUC, Presentation to California Energy Commission Workshop, June 27, 2022, p. 3.

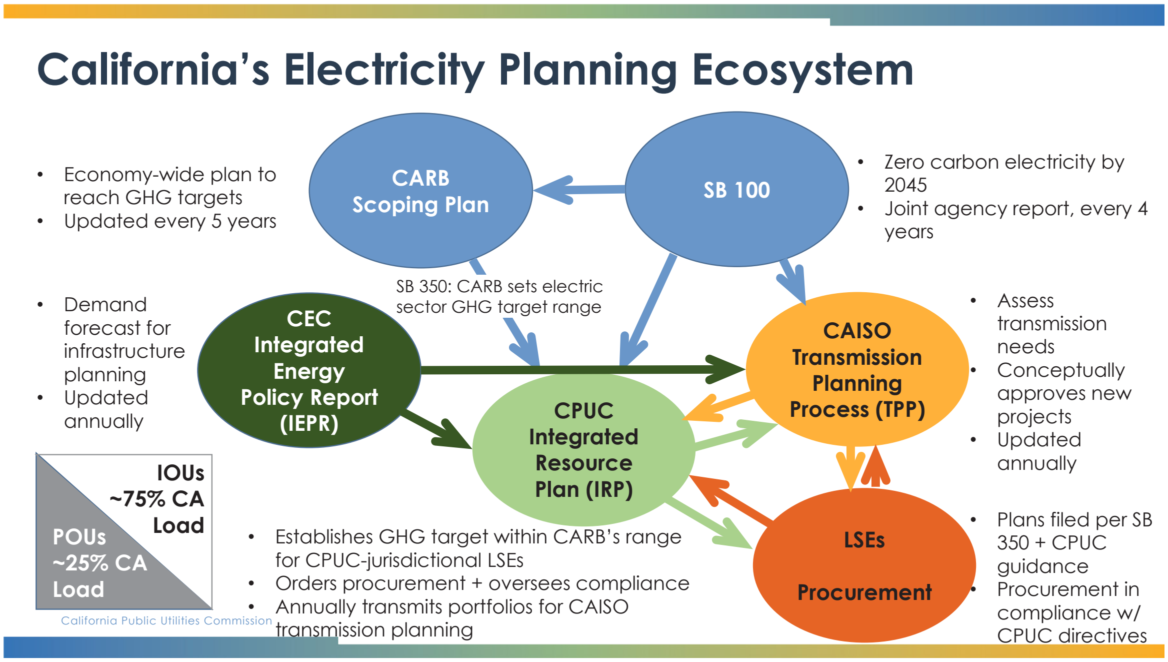

Figure 7.1. California Electricity Planning Ecosystem.[61]

9.5 MW floating wind turbine being towed to Kincardine Offshore Wind project off coast of Aberdeen, Scotland. Photo courtesy of Principle Power

[61] The CPUC's Integrated Resource Planning Process, CPUC, Presentation to California Energy Commission Workshop, June 27, 2022, p. 3.

Section 8: Federal Initiatives to Reduce Costs & Save Ratepayers Billions

Introduction

Recent federal actions to support offshore wind development, including the Inflation Reduction Act (IRA) in August 2022 and the Biden Administration's Floating Offshore Wind Shot™ in September 2022, will result in significant cost reductions and help accelerate offshore wind development in California and elsewhere in U.S. coastal waters.

The IRA extends federal Investment and Production Tax Credits to reduce costs and bolster domestic component manufacturing for offshore wind and other renewable energy projects. For California, this measure could reduce the LCOE by up to 30 percent or more as the state moves ahead with its planning goal to deploy 25 GW of offshore wind by 2045 off the Central and North Coast, and save California ratepayers billions of dollars over the life of the offshore wind farms.[62]

The Floating Offshore Wind Shot™ sets a national goal of 15 GW of floating wind and aims to drive LCOE down 70 percent by 2035, among other initiatives to encourage technology advances.[63] These programs will accelerate offshore wind development, provide certainty and federal backing for offshore wind production, and result in ratepayer savings through lower costs.

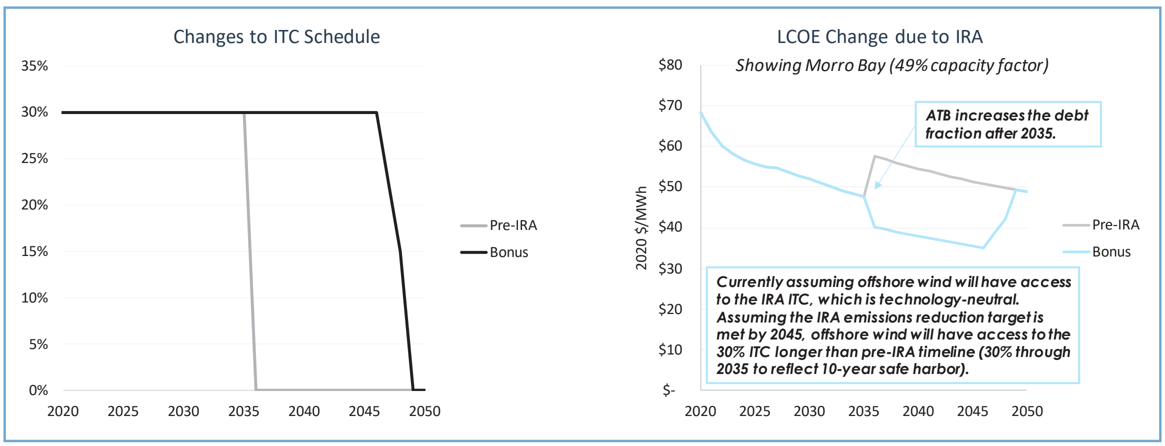

Figure 8.1. Inflation Reduction Act Impact on LCOE for Offshore Wind. From CPUC.[64]

Inflation Reduction Act (IRA) Investment and Production Tax Credits

In December 2020, Congress passed and the former President signed the Consolidated Appropriations Act, 2021.[65] In Section 204, "Extension of energy credit for offshore wind facilities," a 30 percent Investment Tax Credit (ITC) was created for offshore wind.[66] This extension was set to expire at the end of 2025.[67] However, IRS guidance on Offshore Wind ITC, Notice 2021-05 enabled a safe harbor for projects placed into service within 10 years of the start of construction.[68]

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[62] CPUC Inputs and Assumptions Modeling Advisory Group (MAG) Webinar, September, 2022. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/iamag09222022.pdf.

[63] White House Fact Sheet: Biden-Harris Administration Announces New Actions to Expand U.S. Offshore Wind Energy, September 2022.

[64] CPUC Inputs and Assumptions Modeling Advisory Group (MAG) Webinar, September, 2022. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/iamagsep2209222022.pdf

[65] https://www.govtrack.us/congress/bills/116/hr133/text

[66] US Congress Passes Five-Year Offshore Wind Tax Credit, by Nadja Skoplijak, offshoreWIND.biz, December 23, 2020.

[67] Offshore wind, renewable energy figures prominently in US coronavirus stimulus package, Renewables Consulting Group, January 4, 2021.

[68] Beginning of Construction for Sections 45 and 48; Extension of Continuity Safe Harbor for Offshore Projects and Federal Land Projects, Internal Revenue Service, Notice 2021-05, December 31, 2021. https://www.irs.gov/pub/irs-drop/n-21-05.pdf.

In August 2022, Congress passed and the President signed the Inflation Reduction Act (IRA). Among other climate investments, the IRA extends Investment Tax Credits (ITC) and Production Tax Credits (PTC) for clean energy development. For offshore wind projects, the IRA provides for energy and clean electricity ITCs of up to 30 percent or more that phase out in 2032 or once greenhouse gas emissions (GHG) reduction targets are achieved, whichever comes later.[69, 70]

For California offshore wind, according to a September 2022 analysis by the CPUC (*see Figure 8.1*), the new federal law will effectively extend the ITC for another decade past 2035 with a phase-out that begins in 2045, when the state is expected to achieve its GHG emissions reduction targets. Based on the CPUC's modeling scenario for Morro Bay, offshore wind projects in California will have access to the 30 percent ITC beyond the pre-IRA timeline of 2035, and LCOE will continue declining through 2045 as benefits from the ITC and continuing advances in technology and economies of scale are realized.

Credits in the IRA from the ITC range from 6 percent up to 30 percent, and can also provide "bonuses" up to 50 percent under a number of scenarios, including U.S. domestic content, meeting prevailing wage and apprenticeship guidelines, and if projects are located in "energy" or "environmental justice" areas. These credits vary based on when the projects start construction and applicable percentage of total cost of components manufactured in the U.S., for example.[71, 72]

In addition to the ITC, the IRA provides a new tax credit for domestic production related to offshore wind. The PTC for offshore wind vessels is 10 percent of the sale price, and other offshore wind components – including blades, nacelles, towers, and platforms – that are also eligible for credits. These credits vary based on the type of component and capacity rating of the project.[73]

An analysis of the pre-IRA Investment Tax Credit included in the 2021 version of this report concluded that the earlier ITC would reduce the LCOE for 3 to 4 GW of offshore wind off the central coast of California by 15–20 percent. That LCOE reduction would have saved California ratepayers $3.6 to $7.8 billion over the life of the wind farm(s). The new ITCs and PTCs in the IRA extends these cost reductions over another decade, for 25 GW of offshore wind, which will likely save California ratepayers billions of dollars more in avoided costs.

The Floating Offshore Wind Shot™

In September 2022, the Biden-Harris Administration announced a series of agency actions to expand and accelerate the U.S. offshore wind industry. Programs administered through the Departments of Energy, Interior, Commerce, and Transportation aim to deploy 15 GW of floating offshore wind, power 5 million homes, and significantly lower costs by 2035.

The Floating Offshore Wind Shot™ will accelerate innovation in manufacturing and engineering of offshore wind components. The initiative aims to reduce the LCOE of floating offshore wind by 70 percent down to $45/MWh by 2035. Additionally, the Administration announced a new prize competition for floating offshore wind platform technologies.[74]

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[69] Congressional Research Service, "Offshore Wind Provisions in the Inflation Reduction Act". September, 2022.
[70] Inflation Reduction Act Benefits U.S. Offshore Wind Development, JD Supra, September 30, 2022 https://www.jdsupra.com/legalnews/inflation-reduction-act-benefits-u-s-6341197/#_ftnref21.
[71] Congressional Research Service, "Offshore Wind Provisions in the Inflation Reduction Act". September, 2022.
[72] CPUC Inputs and Assumptions Modeling Advisory Group (MAG) Webinar, September, 2022. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/iamagsep2209222022.pdf.
[73] Congressional Research Service Offshore Wind Provisions in the Inflation Reduction Act, September 2022.
[74] White House Fact Sheet: Biden-Harris Administration Announces New Actions to Expand U.S. Offshore Wind Energy, September 2022.

Section 9: Technology & Research – Going Big with Floating Wind

Introduction

Bringing offshore wind to market in California – and realizing its substantial climate, clean energy, and workforce benefits as quickly as possible – will require scale, speed, and sustained support from federal, state, local, and other key stakeholders. Decades of industry experience and academic study have demonstrated that going big is one of the most important keys to achieving success with offshore wind.

Economies of scale are essential to establish a sustainable offshore wind industry, drive down costs, deliver competitively priced clean power, and encourage suppliers, other businesses, and jobs to locate in California. As floating technologies move from demonstration and pilots to full-scale projects mid-decade, research and technology will be critical to unlock cost savings and economies of scale. Technology advancement will unlock not just overall GWs from projects, but also efficiencies from component development, including turbine sizes, floating substructures, and dynamic cables.

Increases in turbine size to 15 MW and beyond is accelerating output of offshore wind.

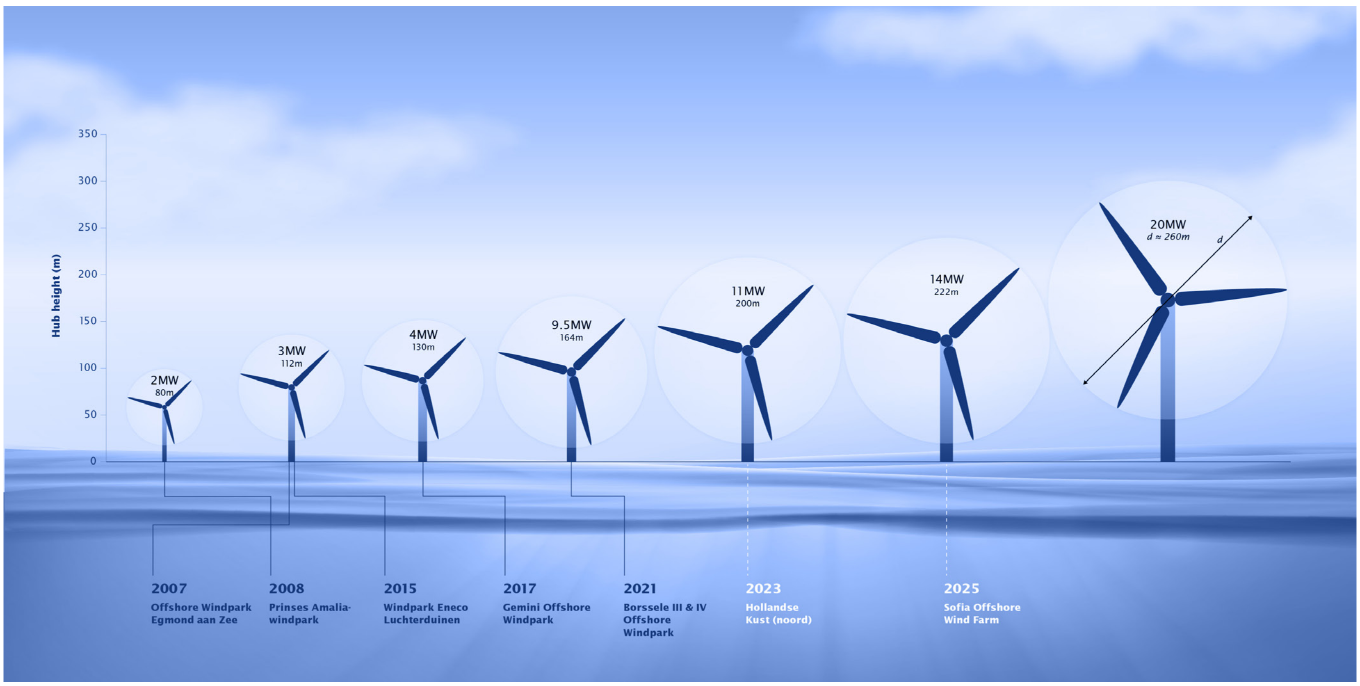

Figure 9.1. Height and MW Output of Offshore Wind Turbines.[75]

GE, Siemens, Vestas, and MingYang Smart Energy have all announced plans for 15-16 MW scale floating offshore wind turbines.[76] Considering this rapid market development, by the time California projects will be built, the standard turbine size is expected to be at least 15 MW. Turbine spacing is a factor of turbine size, so larger distances between turbines may be required to optimize operations. Due to the larger turbine generator size, fewer turbines may be installed to reach the intended project capacity.

[75] Van Oord, Height of Wind Turbines, 2021. https://www.vanoord.com/drupal/media//data/default/2021-10/van-oord-orders-mega-ship-height-wind-turbines.jpg?undefined.
[76] 2022 DOE Offshore Wind Market Report, August 2022.

Floating Offshore Wind Substructures

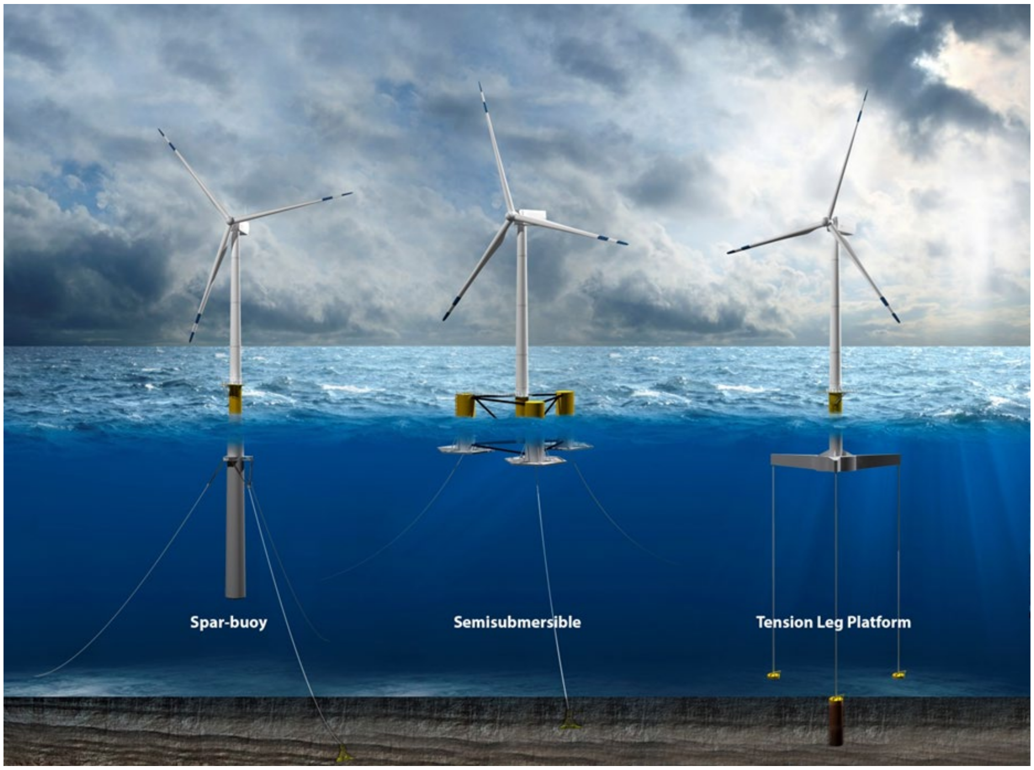

Figure 9.2. Substructure archetypes for floating offshore wind systems including the spar buoy, semisubmersible, and tension leg platform. Illustration by Josh Bauer, NREL.[77]

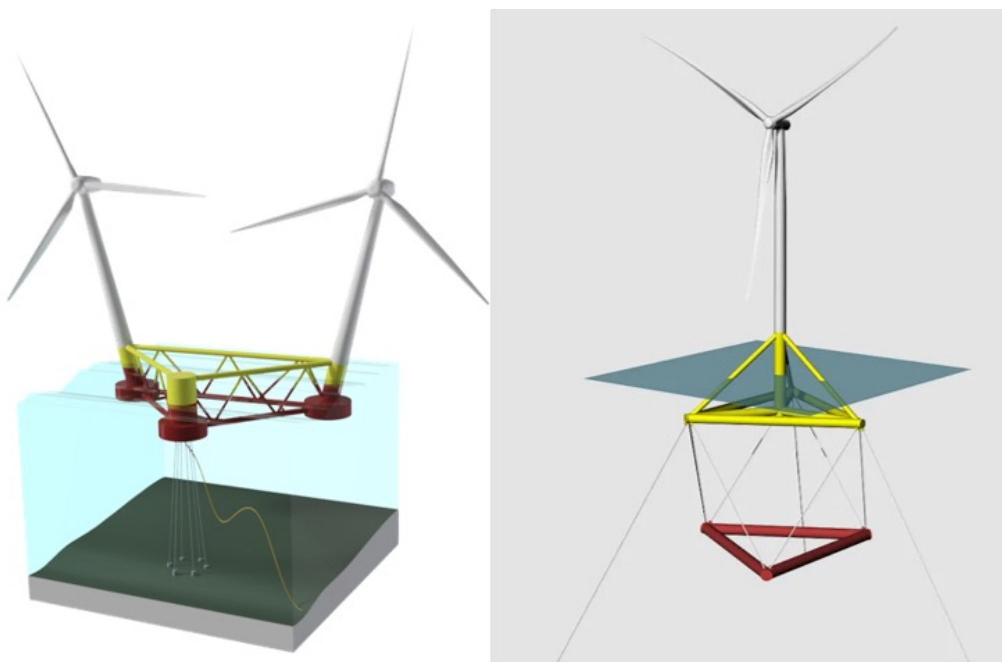

Figure 9.3. Variations of floating foundations. Image credit: Hexicon (left) and Stiesdal TetraSpar (right).

Current floating offshore wind technology includes several foundation substructure archetypes, each with its relative pros and cons. They differ in terms of commercial availability, labor costs, ability to be assembled quayside, impact of surface wave action, interactions with mooring lines, seabed impacts, etc. Currently, semi-submersible

[77] NREL, The Cost of Offshore Wind Energy in California Between 2019 and 2032, Novembers 2020.

substructures are the most common, accounting for 89 percent of projects that have announced their choice of substructure configuration.[78] Technology development for substructures includes hybridizations that combine aspects of the major archetypes for cost and operational benefits[79] and multiple turbines per floating foundation.

Dynamic cables – Low Voltage (LV) dynamic cables

All of the first prototypes and proof of concept floating wind projects are small enough and close enough to shore to use 22-66kV dynamic cables, for which there is existing technology available on the market.

Medium Voltage (MV) dynamic cables

Large-scale commercial floating wind farms in Wind Energy Areas such as Humboldt and Morro Bay will require power to be transmitted using higher voltage cables (130-250kV). In recent years, there has been major interest from various entities that are funding the advancement of power systems for offshore wind farms. These include dynamic HV power cable qualifications as part of the Carbon Trust awards that are bringing in expertise from the oil and gas industry to support the design, testing and qualification of 130kV to 250kV power cables to optimize the power transmission system and power to shore solutions.

The UK Carbon Trust Joint Industry Partnership has identified a gap in the market for suitable High Voltage (HV) dynamic cables. State-of-the-art work on dynamic cabling is a current focus for the industry. More information is available in the Phase II delivery report from the UK Carbon Trust Joint Industry Partnership (JIP)[80] while the Phase IV report also looks at dynamic cable failure rates.[81] Prysmian Group will be constructing a cable plant in the U.S. to supply Vineyard Wind with three core cables (HVAC 275 kV).[82]

Companies are also working on developing floating substations and subsea substations to harness power generation from deep-water, far-from-coast offshore sites that have high wind resource potential. Other technology development opportunities include companies looking to advance the subsea wet-mate connector technology to 66kV that enables subsea substations, and some exciting field optimizations that minimize impacts to the fishing industry by placing more equipment underwater.

Research Centers and Funding Opportunities

The U.S. Department of Energy (DOE) issued various funding opportunities and requests for information in 2020-21 regarding the advancement of offshore wind technologies[83] with an ongoing request for information on social science research needs.[84] The European Commission completed the Horizon 2020 – Research and Innovation Framework Programme, which created a funding opportunity to demonstrate innovative technologies for floating wind farms, develop the next generation of renewable energy technologies, and provide additional funding through Horizon Europe Cluster 5 and other programs.[85] With these recent funding opportunities, including the Carbon Trust award for qualifying dynamic HV power cables, there will be considerable advances, in the not-too-distant future regarding moving cables from floating offshore wind farms to land-based interconnection locations. There is still a need for funding to evaluate long-distance transmission opportunities with HVDC power systems like the Trans Bay Cable that consists of a 53-mile submarine HVDC cable to bring power to the San Francisco area.

[78] NREL, The Cost of Offshore Wind Energy in California Between 2019 and 2032, Novembers 2020.
[79] NREL The Cost of Offshore Wind Energy in California Between 2019 and 2032, Novembers 2020.
[80] https://www.carbontrust.com/resources/floating-wind-joint-industry-project-phase-2-summary-report.
[81] https://www.carbontrust.com/our-projects/floating-wind-joint-industry-programme-jip/floating-wind-jip-phase-iv.
[82] GWEC Global Offshore Wind Report 2022, June 2022.
[83] DE-FOA-0002236 and DE-FOA-0002389 at US DOE EERE Funding Opportunity Exchange, https://eere-exchange.energy.gov/.
[84] DE-FOA-00002695 at US DOE EERE Funding Opportunity Exchange, https://eere-exchange.energy.gov/.
[85] https://energy.ec.europa.eu/topics/renewable-energy/financing/eu-funding-offshore-renewables_en

The Offshore Renewable Energy (ORE) Catapult Centre has been instrumental in the growth of the UK's offshore wind sector and is also increasingly influential globally. The center undertakes R&D and innovation projects to further the work of the sector, publishing in-depth reports and also educational materials about offshore wind. The ORE Catapult Centre published a study in January 2021 looking at the costs of developing floating offshore wind,[86] and have also worked extensively to study the offshore wind supply chain.

The California Energy Commissions (CEC) Electric Program Investment Charge (EPIC) 2021-2025 Investment Plan includes projects related to offshore wind R&D, from optimizing designs for cost, to operational efficiency and environmental impact assessment and minimization. California's efforts will be important to advance regionally specific projects; developers will also consider demonstration projects that have been completed outside the US.

While technology improvement, learning and innovation will be ongoing, as with any technology, there is no need to delay planning and implementation for offshore wind before additional research questions have been addressed. Indeed, such delays in progress would slow the pathway to large-scale projects, which are essential to achieving competitive prices. What industry needs most is comprehensive statewide planning towards achieving California's now established long-term deployment planning goals of up to 5 GW by 2030 and 25 GW by 2045.[87]

9.5 MW floating wind turbine for Scotland's Kincardine Offshore Wind project at assembly dock in The Netherlands.
Photo courtesy of Principle Power

[86] https://ore.catapult.org.uk/press-releases/uk-floating-offshore-wind-subsidy-free-2030/.
[87] American Clean Power – California submitted comments to the CEC on the EPIC research proposal and report in 2020 (available upon request).

Section 10: Planning a Multi-Port Infrastructure Strategy

Introduction

Adequate port infrastructure – for offshore wind assembly, construction, and maintenance – is critical for enabling floating offshore wind deployment in California. With five ongoing port and waterfront infrastructure studies and a recent $45 million investment, California is in the planning stages to assess and guide investments to upgrade port and waterfront facilities. The results of these studies, including the AB 525 Ports Assessment, will facilitate and guide the build-out of a multi-port strategy and enable domestic component manufacturing so that port infrastructure can meet the needs of the growing offshore wind industry.

California State Planning and Investments for Port Infrastructure to Support Offshore Wind

In September 2022, Governor Newsom signed two pieces of legislation that advance port infrastructure development to support offshore wind. AB 179, the Budget Act of 2022, includes nearly $45 million in funding for these offshore wind port infrastructure improvements. AB 209, the Energy Budget Trailer Bill, requires the CEC to establish a program to support offshore wind infrastructure improvements for ports and waterfront facilities to support the buildout of offshore wind. Activities that can receive funding include regional retrofit concepts and investment plans, final design, engineering, and construction of retrofits.[88]

While initial work is underway at the Port of Humboldt Bay on the North Coast, California does not currently have port capacity necessary to support the construction of multiple commercial-scale offshore wind farms, especially on the Central Coast, where there is available sea space and transmission necessary to build as much as 5 GW of offshore wind at the Morro Bay WEA by 2030. The state must move forward expeditiously with planning to address issues of port improvements, as well as sea-space, environmental permitting, transmission, supply chain, and workforce training. Without an urgent and focused effort, lack of port infrastructure could

Figure 10.1. Example illustration of Humboldt Bay port infrastructure to support floating offshore wind.
Image credit: Humboldt Bay Harbor, Recreation, and Conservation District.

[88] https://leginfo.legislature.ca.gov/faces/billHistoryClient.xhtml?bill_id=202120220AB179

hinder development of offshore wind and a robust supply chain, reducing its economic and environmental benefits. As such, it is critical to advance a multi-port strategy, backed with sufficient funding for port infrastructure upgrades, that identifies available port areas that can support offshore wind development.[89]

A multi-port strategy for offshore wind development would utilize several ports along the West Coast based on key characteristics and functions that different ports can offer. Key characteristics include channel and berth depth, quayside length, storage and staging acreage, and crane lifting capacity. Port functions include near-facility component production, and storage and infrastructure readiness for operation and maintenance activities. The multiple ports would then, together, support the construction, operation, and maintenance of offshore wind facilities in California. California's major ports that may contribute to a multi-port strategy include: San Pedro Bay Ports (Los Angeles and Long Beach), and Ports of Humboldt Bay, Hueneme, Oakland, Redwood City, Richmond, San Diego, San Francisco, Stockton, and West Sacramento[90] as well as potential greenfield and brownfield sites along the coast.

In March 2022, the CEC approved $10.5 million to support early upgrades at the Port of Humboldt Bay to deploy offshore wind off California's North Coast. This funding will help to advance the development of a new Humboldt Bay Offshore Wind Heavy Lift Marine Terminal to support large heavy cargo vessels, floating platform development, and other maritime activities.[91] Additional funding will be needed to develop a comprehensive multi-port strategy to meet the AB 525 offshore wind planning goals.[92]

Ongoing Studies of California Port Infrastructure to Support Offshore Wind

AB 525 contains multiple requirements related to seaport investments. First, a California Offshore Wind Strategic Plan – due June 30, 2023 – requires the CEC to include a chapter on identification of port space and infrastructure. To further this work, by December 31, 2022, the CEC will submit a **preliminary assessment of economic benefits from offshore wind as it relates to seaport investment and waterfront facilities** – including construction, assembly, and operations and maintenance. This Ports assessment will consider competing uses, land and marine terminal availability, infrastructure feasibility, and potential impacts, among other considerations.

BOEM is conducting a **California Floating Offshore Wind Regional Ports Assessment** due in December 2022. The study will address near-term California port needs by creating deployment scenarios, identifying port requirements concurrently with oil & gas decommissioning activities, and assessing physical, operational, and regulatory capability and constraints of port facilities.[93] This assessment will build off a 2016 BOEM report on Infrastructure Needs to Support Offshore Wind and Marine Hydrokinetic Facilities on the Pacific West Coast and Hawaii.[94]

The California State Lands Commission (SLC) is conducting a study, **Alternative Port Assessment to Support Offshore Wind**, which is expected in November 2022. The study will include a feasibility analysis, fatal flaw assessment of port locations, and assess alternative locations other than major ports, including greenfield and brownfield sites between the San Francisco Bay and Los Angeles to support offshore wind activity to support offshore wind activities in California.[95]

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[89] American Clean Power, Offshore Wind California, CAPA, and Business Network for Offshore Wind letter to California Senate and Assembly Budget Committee Members, April 2022.
[90] California Association of Port Authorities, accessed August 2022. https://californiaports.org/.
[91] https://www.energy.ca.gov/news/2022-03/state-approves-105-million-prepare-port-humboldt-bay-offshore-wind
[92] American Clean Power, Offshore Wind California, CAPA, and Business Network for Offshore Wind letter to California Senate and Assembly Budget Committee Members, April 2022.
[93] Gilbane, Lisa (BOEM), e-mail message to author, August 2022.
[94] https://espis.boem.gov/final%20reports/5503.pdf
[95] https://www.slc.ca.gov/renewable-energy/rfq-2021-12/

REACH, a Central Coast-based regional economic development non-profit, is conducting a **study to assess waterfront infrastructure in Santa Barbara and San Luis Obispo Counties**. The study will cover potential siting and upgrades, estimated costs, and governance issues to inform decision-making and help unlock additional funding on the Central Coast. The study is expected in the Fall of 2022.[96]

The U.S. Department of Energy (DOE) and NREL announced in September 2022 the launch of a **West Coast Ports Strategy Study** to analyze West Coast port scenarios, coordinate with key decision makers, and produce a final report. The analysis will coordinate existing port assessments and analyze cost-benefit tradeoffs of port strategies. The report is expected in Summer 2023.[97]

Past and Related Studies on Port Infrastructure and Navigation.

On August 25, 2022, the US Coast Guard released a draft of the Pacific Coast Port Access Route Study (PAC-PARS) for public comment.[98] The purpose of the study is to evaluate the usage of coastal waterways for vessel traffic to determine if existing navigation protocols along the Pacific Coast are adequate. This document includes an analysis and summary of vessel traffic including fishing, recreational, passenger, tug and tow, cargo, and tanker vessels. The study notes increased fishing, recreational, passenger, 'other' ships, and cargo and tanker vessel activities in 2021.[99]

The California Ocean Protection Council (OPC) commissioned the Schatz Energy Research Center at Humboldt State University to produce a California North Coast Offshore Wind Studies Port Infrastructure Assessment report that was published in December 2020. The study found there is no existing marine terminal within Humboldt Bay that can support floating offshore wind assembly. They identified, through conceptual engineering, a new high-capacity wharf structure in Redwood Marine Terminal (RMT) areas I or II that would also likely require berth dredging and yard ground improvements. Navigational infrastructure improvements identified include the potential widening and modification of the Federal Navigation Channel at the entrance channel. Additional analysis considered capital costs, operations, and infrastructure buildout schedule.[100]

While not specific to California, the 2022 Coos Bay Offshore Wind Port Infrastructure Study provides insight on port infrastructure needs on the Pacific Coast to support offshore wind development. This included identification of constraints, opportunities, and needs for ports to support offshore wind in Southern Oregon. The report found that the Port of Coos Bay has favorable physical characteristics for offshore wind such as a deep-draft navigation channel and availability of waterfront acreage but would likely require navigational channel improvements and additional investments to support a new wharf, storage yard, and berth dredging.[101]

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[96] https://reachcentralcoast.org/one-study-two-industries/
[97] https://www.nrel.gov/wind/west-coast-ports.html
[98] USCG Port Access Route Study: The Pacific Coast from Washington to California – Vessel Traffic Coastal Analysis.
[99] USCG Port Access Route Study: The Pacific Coast from Washington to California – Vessel Traffic Coastal Analysis.
[100] Schatz Energy Research Center, Port Infrastructure Assessment Report, December 2020.
[101] Mott MacDonald, Coos Bay Offshore Wind Infrastructure Study, February 2022.

Section 11: California Jobs, Workforce & Supply Chain

Introduction

Image Source: NYSERDA[102]

Offshore wind development presents an excellent opportunity for California to create tens of thousands of new jobs, spur workforce development, and bolster domestic supply chain component manufacturing.

As California scales up to meet the state's planning goals of up to 5 GW by 2030 and a nation-leading 25 GW by 2045, near-term investments and workforce planning will be essential to facilitate rapid offshore wind buildout in future years.

Responsible offshore wind development that incorporates local protections, community benefit agreements, and bid credits can bolster jobs, workforce, and supply chain growth in the state that supports a strong green economy.

State and Federal Support for Jobs, Workforce, and Supply Chain Development: AB 525 and Lease Auction Bid Credits

State legislation, namely AB 525, and federal action, through BOEM's auction parameters, are important levers that will guide job, workforce, and supply chain investments to support offshore wind development in California. Legislative and regulatory actions provide market certainty for labor and industry to invest in projects, train workforces, and plan for necessary supply chain investment to meet state planning goals.

AB 525's legislative findings indicate that offshore wind can attract investment capital and realize community economic and workforce development – including a skilled and trained construction workforce, long-term operation and maintenance jobs, and an offshore wind energy supply chain. AB 525 requires the CEC to submit to the Legislature a "preliminary assessment of the economic benefits of offshore wind as they relate to … workforce development needs and standards" by the end of December 2022. In addition, AB 525 requires that a California Offshore Wind Strategic Plan – due by June 30, 2023 – include a chapter on economic and workforce development. This chapter will incorporate information on skilled and trained workforce, curriculum for apprenticeship safety training, and recommendations for workforce standards for offshore wind energy facilities and associated infrastructure. This could include prevailing wage, local hiring, and hiring standards to ensure equitable economic development.[103]

At the federal level, BOEM – through its lease auction format and bid credits – will provide potential benefits to domestic workforce and supply chain investments. As included in the Final Sale Notice (FSN) for leasing activities in Humboldt and Morro Bay in October 2022, BOEM is pursuing a multi-factor auction to be held on December 6, 2022. Workforce development and supply chain investments include a 20 percent bidding credit for commitments to advance workforce training and supply chain development, along with a requirement that lessees make "every reasonable effort" to enter into Project Labor Agreements. Bidders may develop workforce training or supply chain development investments, or a combination of both. The workforce training must result in a better trained workforce and/or a larger workforce including contributions to union apprenticeships, workforce training and partnerships, maritime training, and Tribal workforce development, among others. To receive

[102] https://www.nyserda.ny.gov/All-Programs/Offshore-Wind/Focus-Areas/Supply-Chain-Economic-Development/Workforce-Development
[103] Assembly Bill 525 (Chiu, Chapter 231, Statutes of 2021).

credit for domestic supply chain developments, they must result in overall benefits to potential purchases, an increase in domestic capacity, or a more robust domestic supply chain that reduces upfront capital costs from large component manufacturing. Bidders would include a conceptual strategy in their financial forms.[104]

As currently outlined, contributions to workforce training would include one or more of: contributions to support union apprenticeships and technical training programs, maritime training, training for skills and techniques to manufacturer or assemble offshore wind components, or other contributions necessary for planning, design, construction, operation, maintenance, or decommissioning of offshore wind projects.

Domestic supply chain contributions would include one or more of contributions to: a domestic supply chain including component manufacturing or assembly, technical assistance grants, contributions to Jones Act-compliant vessels, new or existing bonding support or revolving fund, and other contributions to supply chain.[105]

BOEM's FSN includes additional bidding credits, up to 10 percent, that apply to other impacted stakeholders.

Summary of Findings from Existing Studies on Offshore Wind Workforce & Supply Chain

"Offshore Wind Market Report: 2022 Edition" – US Department of Energy (DOE), August 2022
DOE's latest offshore wind market report projects that between 12,300 and 49,000 annual, full-time equivalent manufacturing jobs could be created for a domestic supply chain for major component manufacturing as the U.S. works towards a national offshore wind goal of 30 GW by 2030. This could generate from $1.6 billion to $6.2 billion in economic value added every year to meet the demand for over 2,000 wind turbines and foundations, and the array and export cables and offshore substations to support them.

"U.S. Offshore Wind Quarterly Market Report – 2022 Q3," Business Network for Offshore Wind (BNOW), October 2022
BNOW's first quarterly offshore wind market report finds that U.S. "supply chain development continued at a measured pace as the quarter saw most activity in domestic shipbuilding and port redevelopment." BNOW's Supply Chain Connect database saw 4 percent growth in the third quarter, with 99 new businesses and other entities, and a current total of 2,848 business and other entities, expressing their willingness and ability to perform offshore wind services, with at least one from all 50 states. BNOW identified 52 new offshore wind supply chain contracts, a 5 percent growth rate for the quarter, total contracts of 1,137 for the U.S. market, and major supply chain wins for the third quarter in shipbuilding, port development, and workforce development.

"California's Offshore Wind Electricity Opportunity" – USC Schwarzenegger Institute, August 2021
Another report, by the USC Schwarzenegger Institute, estimates job gains for California from developing 10 GW by 2040 would total 97,000-195,000 job-years through 2040 for construction of wind facilities and 4,000-4,500 annual operation and maintenance jobs, which translates into an additional 120,000-180,000 job-years of employment. The study says offshore wind has the potential to produce expansive direct jobs associated with offshore wind development, while construction and operations & maintenance jobs will have multiplier effects throughout the economy. These benefits would likely promote income equality in areas with lagging economic opportunity.

The report cites a number of other studies that estimate varying economic and jobs benefits. These include the American Job Project estimate of up to 185,000 job-years for 18 GW of offshore wind buildout by 2045. Cumulative GDP impacts from construction alone could range from $16.2 billion to $39.7 billion in California with 135,000 to 327,000 job-years between 2020 and 2050. More regional studies focusing on San Luis Obispo County estimate job creation of up to 72,162 full-time equivalent job-years.

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[104] BOEM Final Sale Notice for Commercial Leasing for Wind Power on the Outer Continental Shelf in California.
[105] https://www.regulations.gov/document/BOEM-2022-0017-0001

The USC Schwarzenegger report also emphasizes the quality and high pay of these jobs. The wage rate for construction-related laborers would be about $50 per hour, $40 per hour for technicians and environmental scientists, and around $60 per hour for managers and supervisors. Further, there is a potential benefit of developing a wind energy manufacturing cluster in the U.S. where domestic turbine component production could account for between 40-60 percent of global market share and increased GDP between $2.3 billion and $7 billion.

"Supply Chain Contracting Forecast for U.S. Offshore Wind Power" – Special Initiative on Offshore Wind (SIOW), October 2021

A 2021 analysis by the Special Initiative on Offshore Wind estimates that building 30 GW of offshore wind power on the East Coast would generate $109 billion in total supply chain expenditures by 2030. The figure below shows cumulative total expenditures by sub-category in the U.S. These estimates are conservative, as additional public and private expenditures for local fabrication, port investments, and vessel constructions are not included.

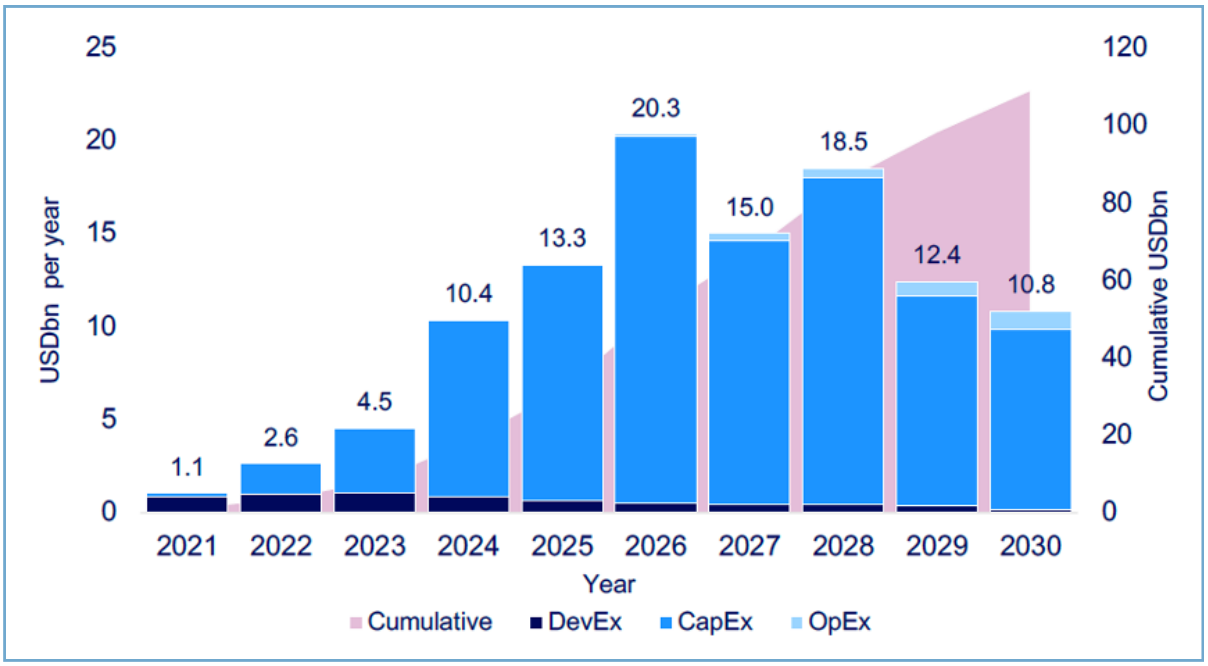


Figure 11.1. U.S. Offshore Wind Annual and Cumulative TOTEX Activity by Sub-category. Source: SIOW.

"California Offshore Wind: Workforce Impacts & Grid Integration" – UC Berkeley Labor Center, September 2019

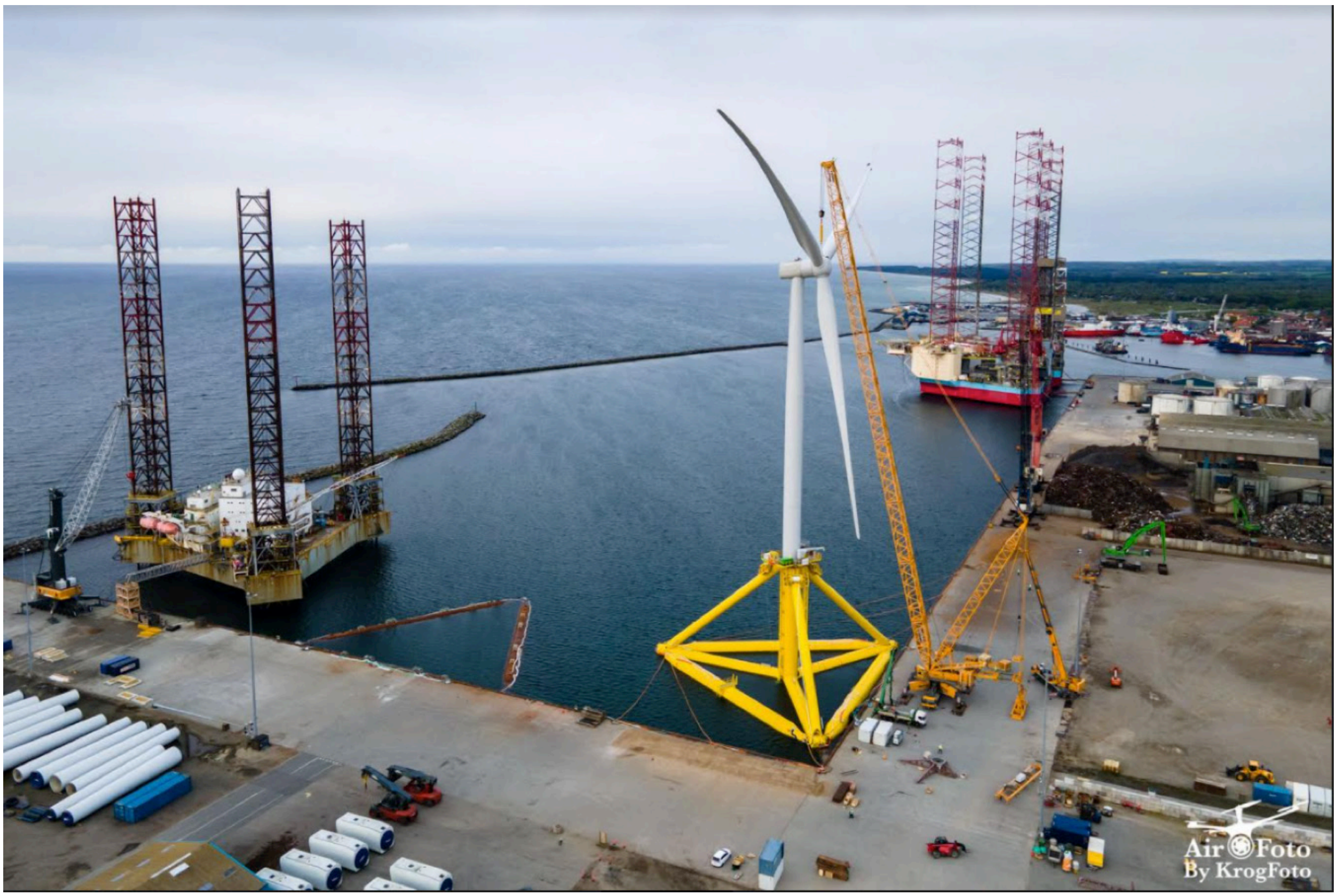
This report conducts a qualitative analysis of workforce impacts and lessons learned from the offshore wind industry elsewhere. The study finds that the most significant economic benefits from offshore wind would occur if the state invests in in-state supply chain hubs for primary components and floating platforms. This would lead to thousands of manufacturing and construction jobs that could be unlocked if California strategically plans to build out its local supply chain capacity.

For workforce requirements, High-Road Training Partnerships (HRTPs) could fill gaps in the current workforce and broaden access to offshore wind jobs. Published economic impact projections for an 18 GW buildout by 2045 would create as many as 13,620 direct annual jobs in manufacturing, construction, and installation. Operations and maintenance could result in up to 4,330 additional permanent jobs.

"Floating Offshore Wind in California: Gross Potential for Jobs and Economic Impacts from Two Future Scenarios" – National Renewable Energy Laboratory (NREL), April 2016

NREL reports that building 10 GW of offshore wind power in California by 2050 would create 18,000 jobs, including 15,000 annual construction jobs and nearly 3,000 long-term operations jobs. In addition, NREL found that installing 10 GW of offshore wind would generate $20 billion in GDP for California.

NREL projects that increasing the offshore wind buildout to 16 GW by 2050 would generate 28,000 jobs and $48 billion in GDP for the state from the construction and operations phases of deployment. The report adds: "Establishing an in-state supply chain that can provide even a modest portion of the material and labor for floating offshore wind installations can dramatically increase the economic impact of offshore wind deployment within California."



Floating wind turbine with TetraSpar foundation being prepared for tow out. Credit - Air Foto by KrogFoto