

#### **The WindFloat Solution**

#### A 3<sup>rd</sup> Generation Floater



- Life Extension (to 25 years)
- Larger Turbines
- Structural Optimization
- Equipment Optimization
- Quick Connect-Disconnect Cable
- Quick Connect-Disconnect Mooring

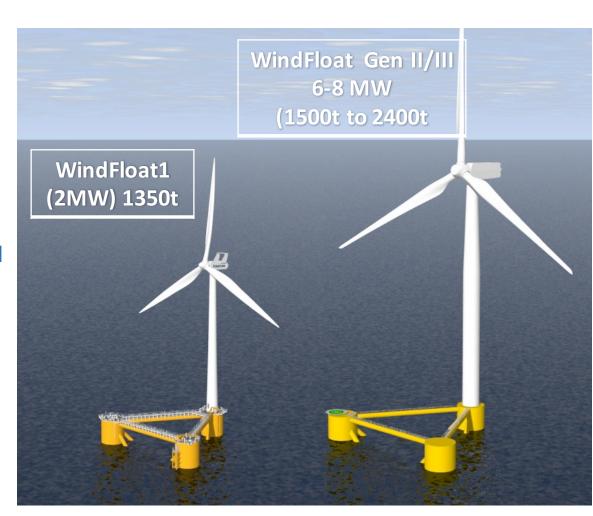
→ Smaller Floater in Proportion:

Typically 200-300t/MW depending on local site conditions.

• Capacity: X3-4

• Production: X4-5

Unit Cost: x1.75









# Floating is already large market → Close to 400 MW of Demos and 9 GW of Large Scale Projects in development

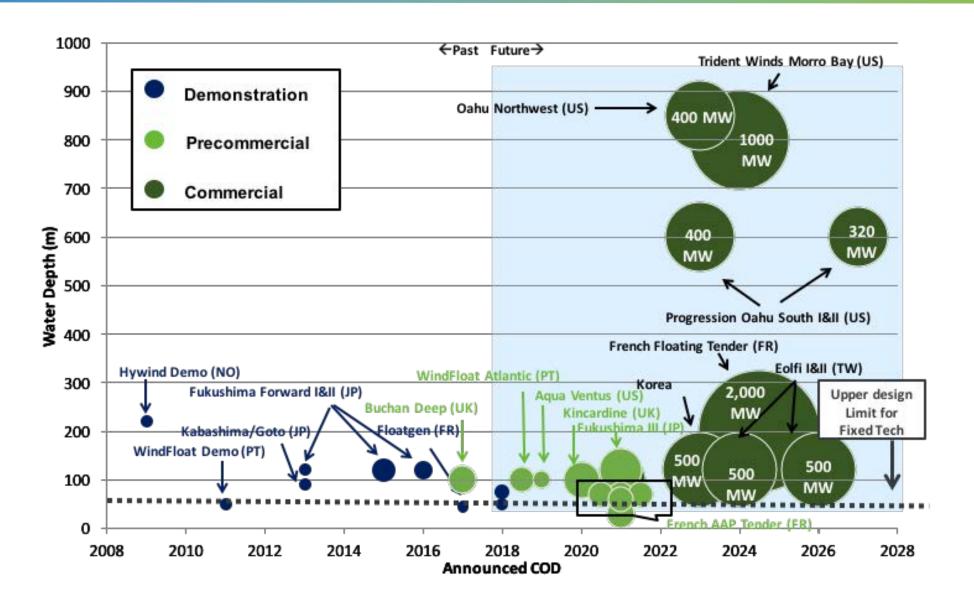


Current MW Installed: ~ 50MW	Current Floating Wind Farms (Announced) under Development			
	Demo Projects	Large Scale		
US	12 MW	> 2 GW in Hawaii and CA		
Europe	France, 100-150 MW UK, 80 MW Portugal, 25 MW	France, 3.5 GW with commercial tenders starting to be prepared		
Japan	Fukushima Forward and more: Up to 100 MW	TBD (Target 8GW by 2030, with mostly floating)		
Taiwan/Korea	Up to 30 MW	1.5 GW		

Source: Principle Power

# Worldwide Development: close to 400 MW of Demos and approx. 9 GW of Large Projects in Dev worldwide





### Demo-scale projects structured to: 1) Prove Bankability and 2) Advance LCOE => a Gateway to large commercial scale



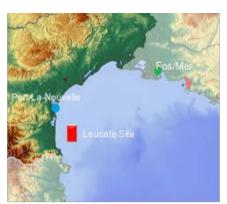
#### WindFloat Atlantic 25 MW, Portugal, Operational 2019

- 3x 8.3 MW MHI Vestas
- 20 km out; 100 m deep
- Local Shipyard Construction
- Certified by ABS
- Feed-In Tariff
- Equity Financing complete w/ strong international sponsors
- First Non-Recourse Project Finance of a Floating Wind Farm



#### Golfe du Lion 24 MW, France, Operational 2020/21

- 4x 6 MW GE
- 18 km out; 70-100 m deep
- Local Shipyard Construction
- Certified by BV
- Feed-In Tariff (through competitive process)
- Very strong consortium with major energy companies and industrials
- Major innovations to advance technology to the next level of competitiveness





































# WindFloat Atlantic under construction: fabricating columns for 8MW+ turbine foundation



# Scotland: first retrofit of a floating wind turbine to be followed by 48MW more; world's largest available turbines



Project Overview Total capacity: 50MW capacity)

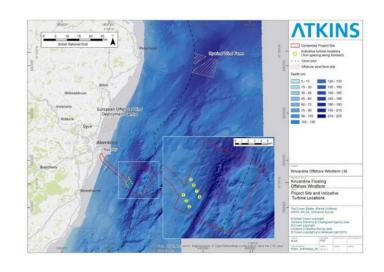
■ Location: 15 km off Aberdeen; ~60m depth

■ Fabrication: TBD

Status:

Phase 1: Installation Summer 2018

 Phase 2: Adv. Engineering and Procurement Installation 2020









## Next Generation WF has been engineered with all major offshore wind turbine manufacturers



Project	Turbine OEM	Turbine Model	Power	Diameter	Status
WF1 prototype	Vestas.	V80	2MW	80m	Decommissioned and Sold to another Project
WindFloat Atlantic	Vestas.	V164	8.3MW	164m	Approved for Construction (Finalizing)
France / Golfe du Lion		Haliade 150-6MW	6MW	150m	FEED
France / Golfe du Lion	∆dwen	AD 8-180	8MW	180m	preFEED
WindFloat Pacific	SIEMENS	SWT6.0-154	6MW	154m	FEED
WindFloat Pacific	Vestas.	V164	8MW	164m	FEED
NEDO project	HITACHI	HTW5.0-126	5MW	126m	FEED
NEDO project	SENVION wind energy solutions	6.2M 152	6.2MW	152m	FEED



# Senvion-led ReaLCOE Project provides early opportunity to optimize next-gen WTG for the floating future

Next Generation 12+MW Rated, Robust, Reliable and Large Offshore Wind Energy Converters for Clean, Low Cost and Competitive Electricity (ReaLCOE)

- Design, demonstrate and optimize 12+ MW WTG
- Prototype scheduled to be deployed in 2020
- Consortium involves 15 Consortium members representing full lifecycle: customers, suppliers, contractors, academics



ReaLCoE

































This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 791875

# Proving the industry is technically viable; now showing economic and financial viability to be commercial end of decade





## **Phase 1** Technology

Demonstration

- Technology Development and patents
- Successful fabrication, installation and operation

## Phase 2 Pre-Commercial

- Building demonstration scale farms in 1 or more geographies to prove concept financially and economically
- Focus on technology Roadmap and Levelized Cost of Energy Reduction

Phase 3
Commercial

 Competing in the Marketplace with other technologies and sources of energy

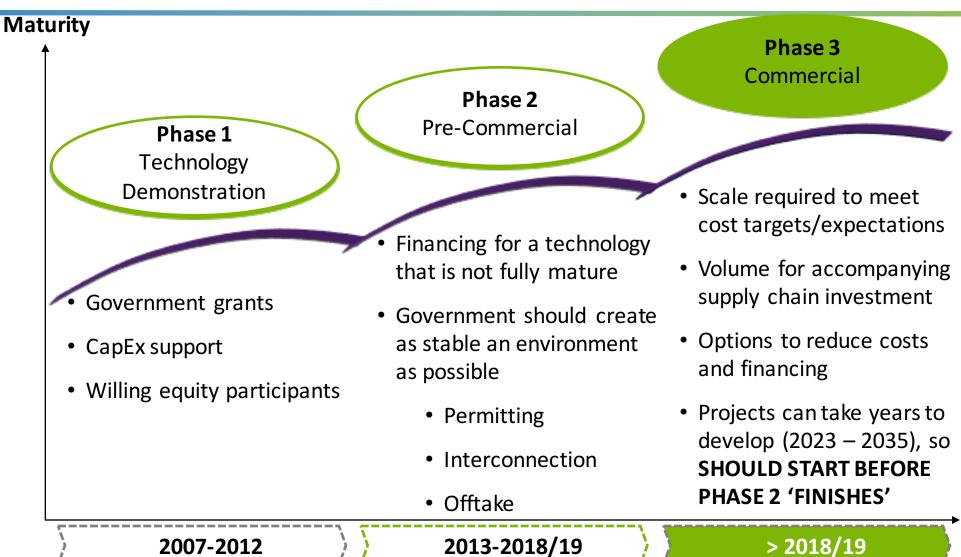
2007-2012

2013-2018/19

> 2018/19

# Different stages of technology development require different types of support; floating ready to move to Commercial

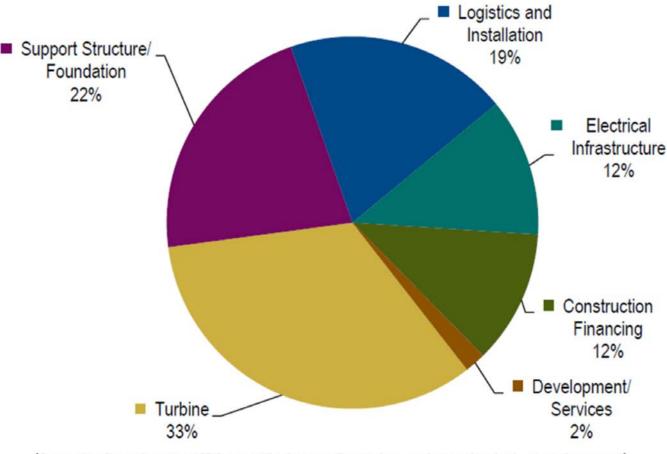




## Floating offshore wind is still offshore wind and is heading in the same direction on cost

- Floating offshore wind concepts like Semi-subs and Spars are different from fixedbottom, but it's still offshore wind
- Mature floating foundations make up >30% of OSW LCOE
- Additional deployments accelerate cost reduction through economies of scale and learning effects
- commercialized floating technology will leverage this progress, resulting in even lower costs than currently projected

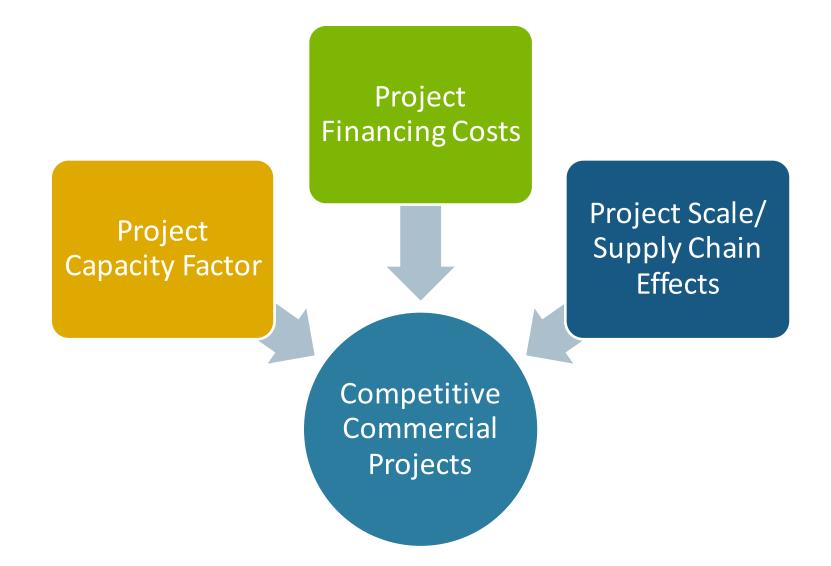




(from Navigant's U.S. Offshore Wind Manufacturing and Supply Chain Development)

## Floating offshore wind is still offshore wind; the same features effect cost





# The WindFloat is on track to compete with conventional power, other renewables, and fixed offshore wind

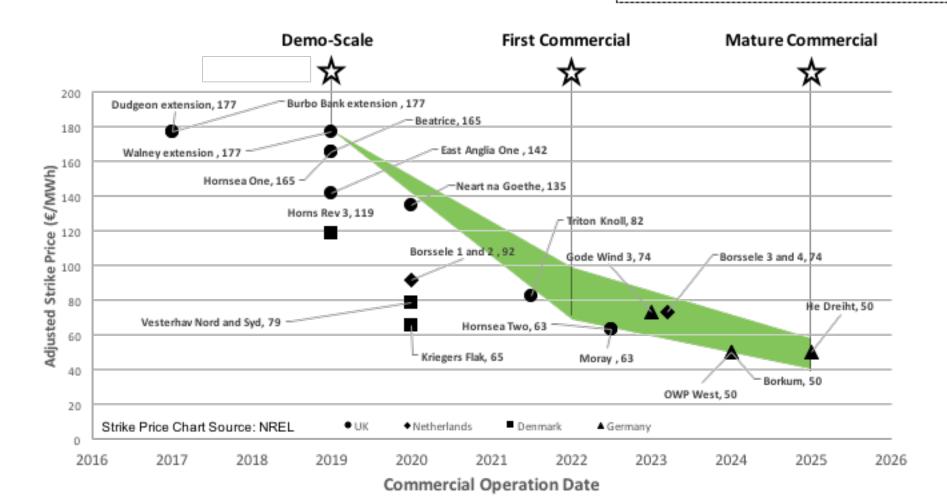


#### Adjusted Strike Price (EUR/MWh)

Announced Fixed Projects vs WindFloat

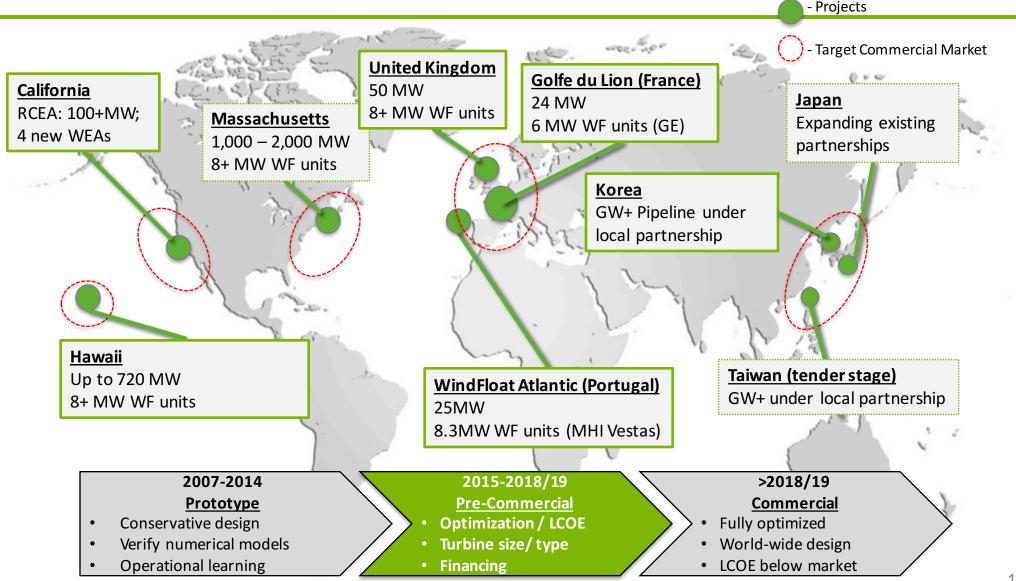
Demo-Scale: 25-30 MW, 8 MW Turbines

First Commercial: 300 MW, 9-10 MW Turbines Mature Commercial: 500 MW, >10 MW Turbines



## Technology Demo Completed, Now Proving Economic Viability

### → Develop Projects In Key Global Markets to promote Adoption



## Korea: Strong goals require offshore wind



- RE goal calls for 30 GW new solar by 2030 (2.5 GW/year)
- Wind

	Onshore Wind	Fixed Bottom Offshore Wind	Floating Offshore wind	
Target	3.5 GW new capacity	13 GW new capacity by 2030		
Resource	Wind resource only 5-5.5 m/s = low capacity factors	Wind resource only 5.5-6.5 m/s = low capacity factors	Wind resource 7.0-8.5 m/s	
Siting	Mountainous terrain means difficult to build projects at scale High population density (519 people/km²)	<ul> <li>Limited by water depth</li> <li>West and South of Korea</li> <li>Low wind resource</li> <li>Close to shore</li> <li>Challenging seabed</li> </ul>	<ul> <li>Flexible siting, irrespective of water depth</li> <li>Can develop best wind resource</li> <li>Can minimize conflict through considered siting process</li> </ul>	
Permitting	Challenging permitting due to local opposition	High conflict due to close proximity to shore (Fishing, Environmental / NGO, Visibility, military/radar)	Low conflict due to siting flexibility	
Business Case	Okay for projects that can get permits	Weak under current incentives (advocating for increase REC multiplier)	Strong under current incentives	

The Government is looking for large-scale solutions that can be delivered rapidly – advantages of floating wind recognized



#### Japanese market - tremendous potential for floating offshore wind

#### MOE study finds abundant offshore wind resource:

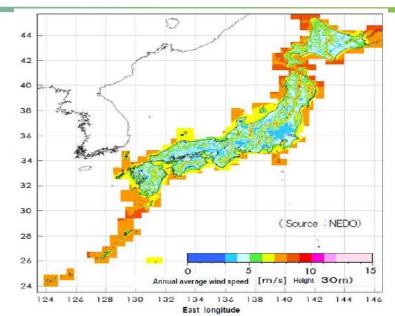
- 1600 GW (technical potential)
- Economic potential of ~141 GW under some scenarios

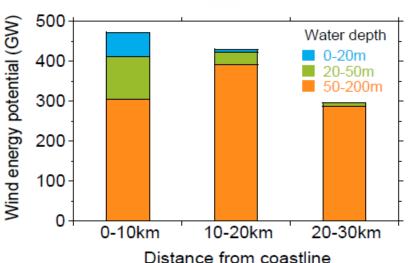
#### Currently 57 MW of offshore wind capacity installed:

- 41 MW Fixed-bottom (mostly in ports); 16 MW Floating
- However, much of the resource located in deep water (>50 m), which has slowed market growth

#### Very attractive market fundamentals

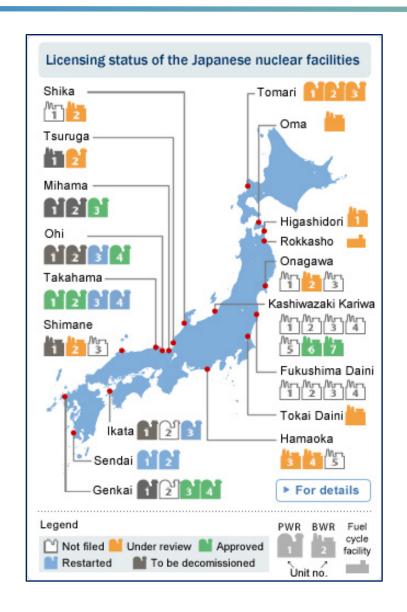
- Strong power market demand, high electricity rates, and limited domestic options to grow electricity supply following the Great East Japan Earthquake
- Feed-in Tariff set to 36 JPY/kWh for offshore wind
- Modification of Harbor Law (2016) for fixed project shows political support for the industry
- New offshore regulations expected Q2/Q3 2018

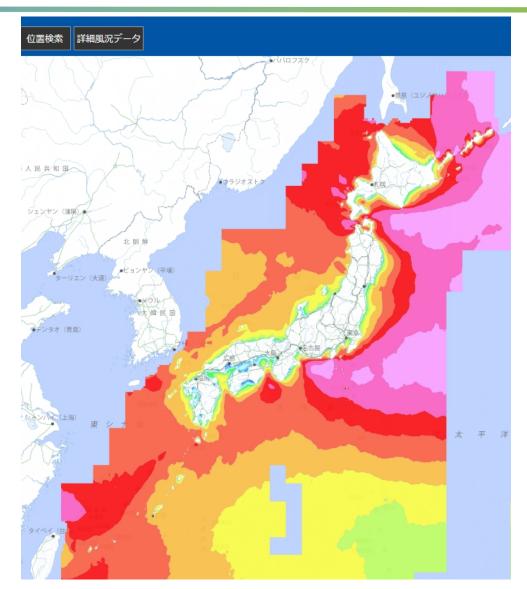




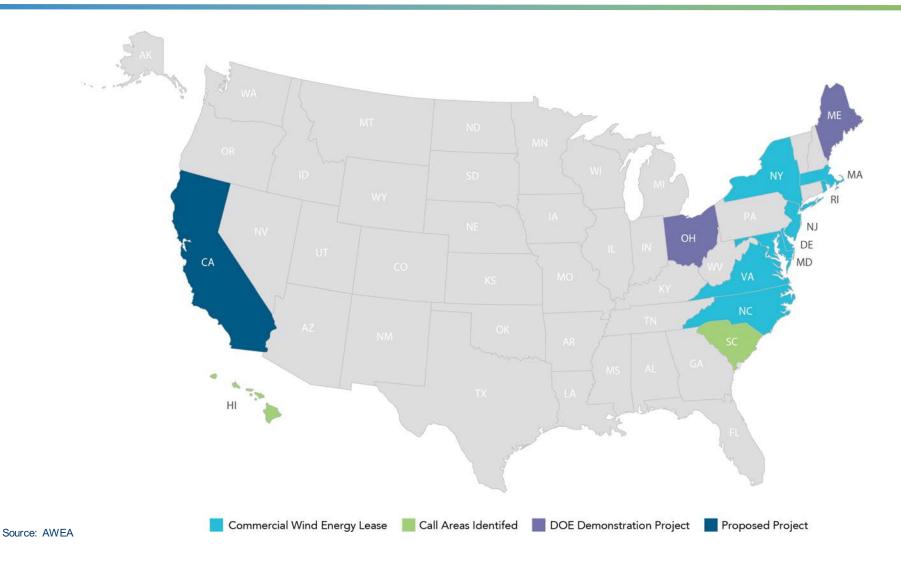
# Shuttering Nuclear plants creates interconnection opportunities for floating







#### The US has turned the corner: states with offshore wind activity PRINCIPLE POWER



# Northern California: Redwood Coast offshore wind energy project



Extensive engagement with the Humboldt County Community, starting with RCEA summer 2018

Competitive process run by RCEA to select partners in winter and spring 2019

Dozens of community meetings to determine the site

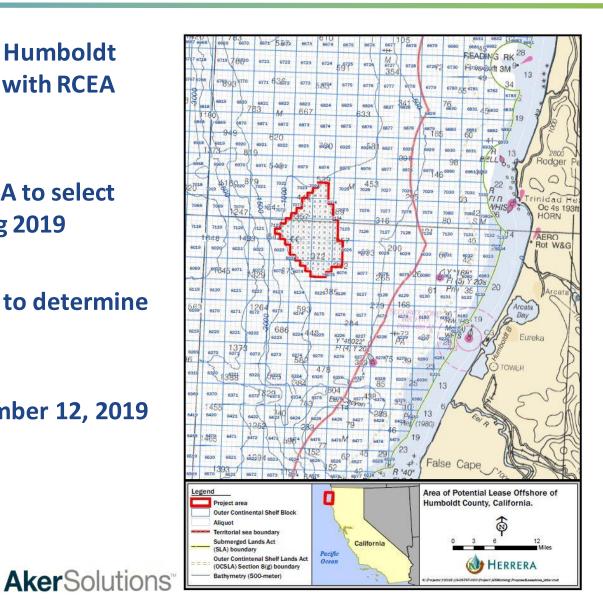
Lease request submitted September 12, 2019

**100 – 150 MW project** 



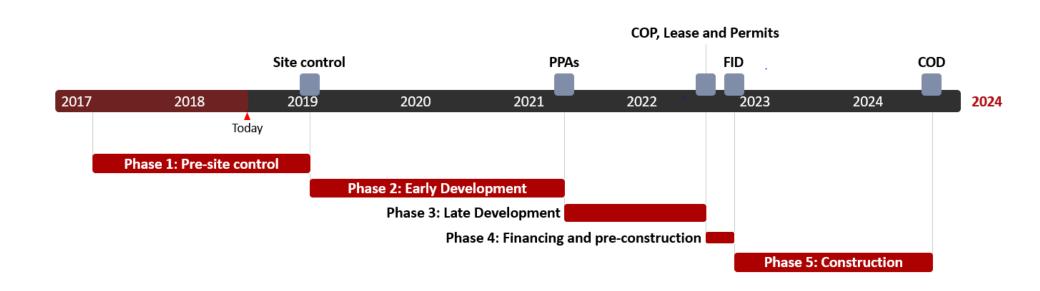








#### Redwood Coast offshore wind energy project schedule



## **Upcoming Activities**





#### **Future Activities:**

- Draft Call to Task Force members early/mid October
- Publication of the Call in the Federal Register (60-day comment period due to holiday season)
- Area Identification
  - Review comments received during Call
  - Refine Area(s) based on input
  - Identify Wind Energy Areas (WEAs)
- Conduct NEPA on WEA(s)
- Publish Proposed Sale Notice (60-day comment period)
- Publish Final Sale Notice (at least 30-days before sale date)
- Hold Auction



### **THANK YOU!**

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