ALL AT SEA: MARITIME OPPORTUNITIES IN OFFSHORE WIND

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DNV GL Energy

OFFSHORE WIND POWER
Planning For America's Ocean Energy
SUNY Maritime College
September 26, 2019

Industry Focused Organization – with Local Competence and Global Reach

DNV GL Group

Headquarter: Oslo, Norway
Group President & CEO: Remi Eriksen

MARITIME	OIL & GAS	ENERGY	BUSINESS ASSURANCE	DIGITAL SOLUTIONS
Employees: 4,300 Headquarter: Hamburg, Germany	Employees: 2,700 Headquarter: Oslo, Norway	Employees: 2,300 Headquarter: Arnhem, Netherlands	Employees: 2,000 Headquarter: Milan, Italy	Employees: 700 Headquarter: Oslo, Norway

DNV
GL Group
GARRAD HASSAN
NOBLE DENTON
KEMA
ADVANTICA

150 years

400 offices

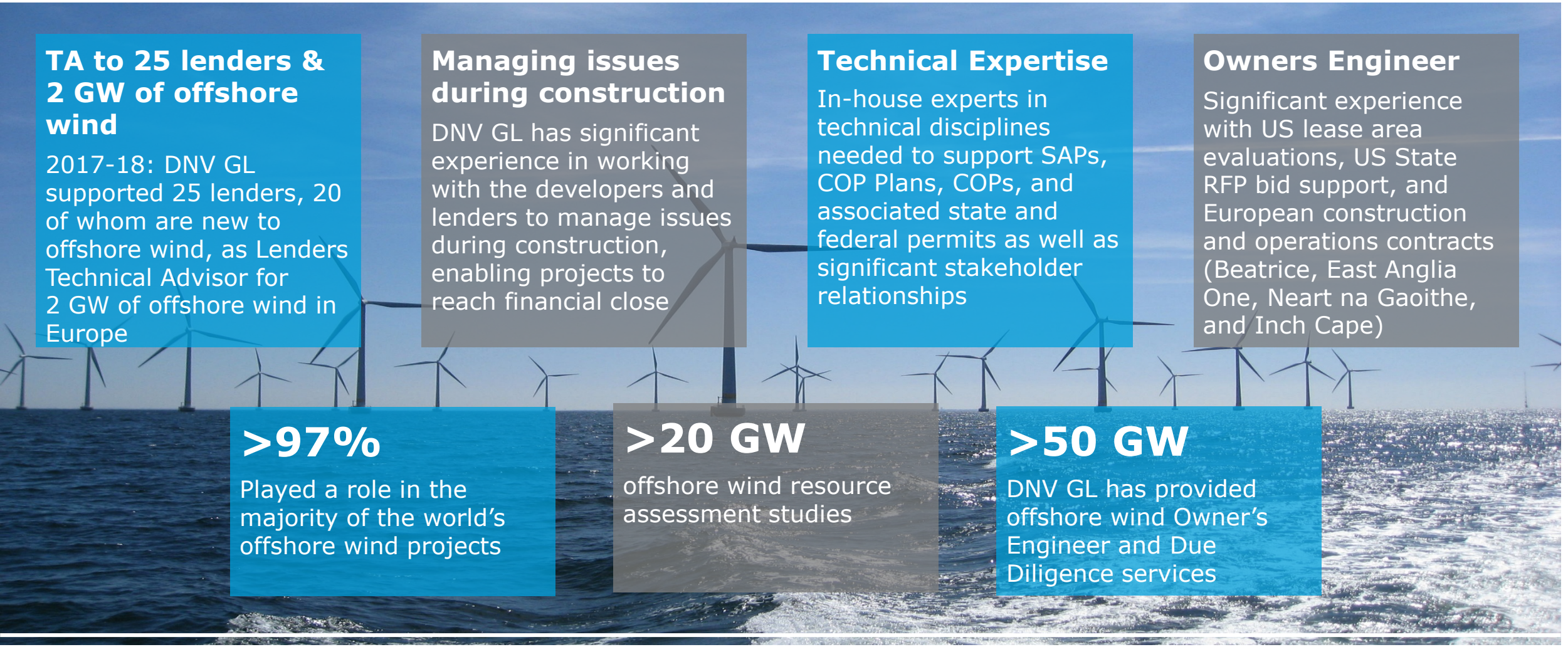
100 countries

13,500 employees

Local understanding forms a global perspective

More than 1,000 renewables staff in 50 locations across 27 countries

DNV GL's extensive global experience in offshore wind



TA to 25 lenders & 2 GW of offshore wind

2017-18: DNV GL supported 25 lenders, 20 of whom are new to offshore wind, as Lenders Technical Advisor for 2 GW of offshore wind in Europe

Managing issues during construction

DNV GL has significant experience in working with the developers and lenders to manage issues during construction, enabling projects to reach financial close

Technical Expertise

In-house experts in technical disciplines needed to support SAPs, COP Plans, COPs, and associated state and federal permits as well as significant stakeholder relationships

Owners Engineer

Significant experience with US lease area evaluations, US State RFP bid support, and European construction and operations contracts (Beatrice, East Anglia One, Neart na Gaoithe, and Inch Cape)

>97%

Played a role in the majority of the world's offshore wind projects

>20 GW

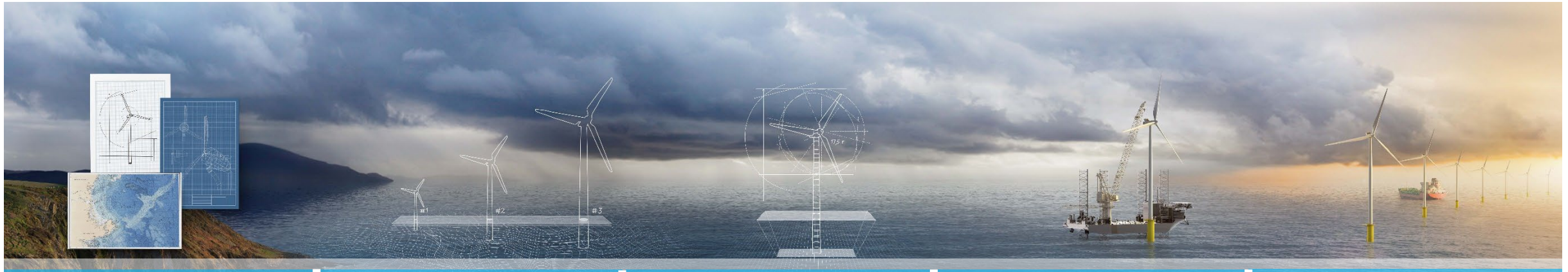
offshore wind resource assessment studies

>50 GW

DNV GL has provided offshore wind Owner's Engineer and Due Diligence services

Provides a full life-cycle approach

Typical offshore wind project lifecycle from feasibility to operations



FEASIBILITY	DEVELOPMENT	ENGINEERING	CONSTRUCTION	OPERATION

Renewables Advisory

- Permitting, environmental, stakeholder liaison
- Site & concept selection → Project optimization → Tender support → Construction monitoring → Operations & maintenance
- Technology evaluation → Technical due diligence
- Wind mapping → Measurements → Energy assessment → Operational assessment
- Market intelligence → Cost modelling → Market forecasts
- Digitalization, Software & training
- Project management → Marine warranty → Inspections

Renewables Certification

- Technology certification → Project certification
- Installation vessel classification → Operation & maintenance vessel classification

Offshore Wind State of Play: East Coast

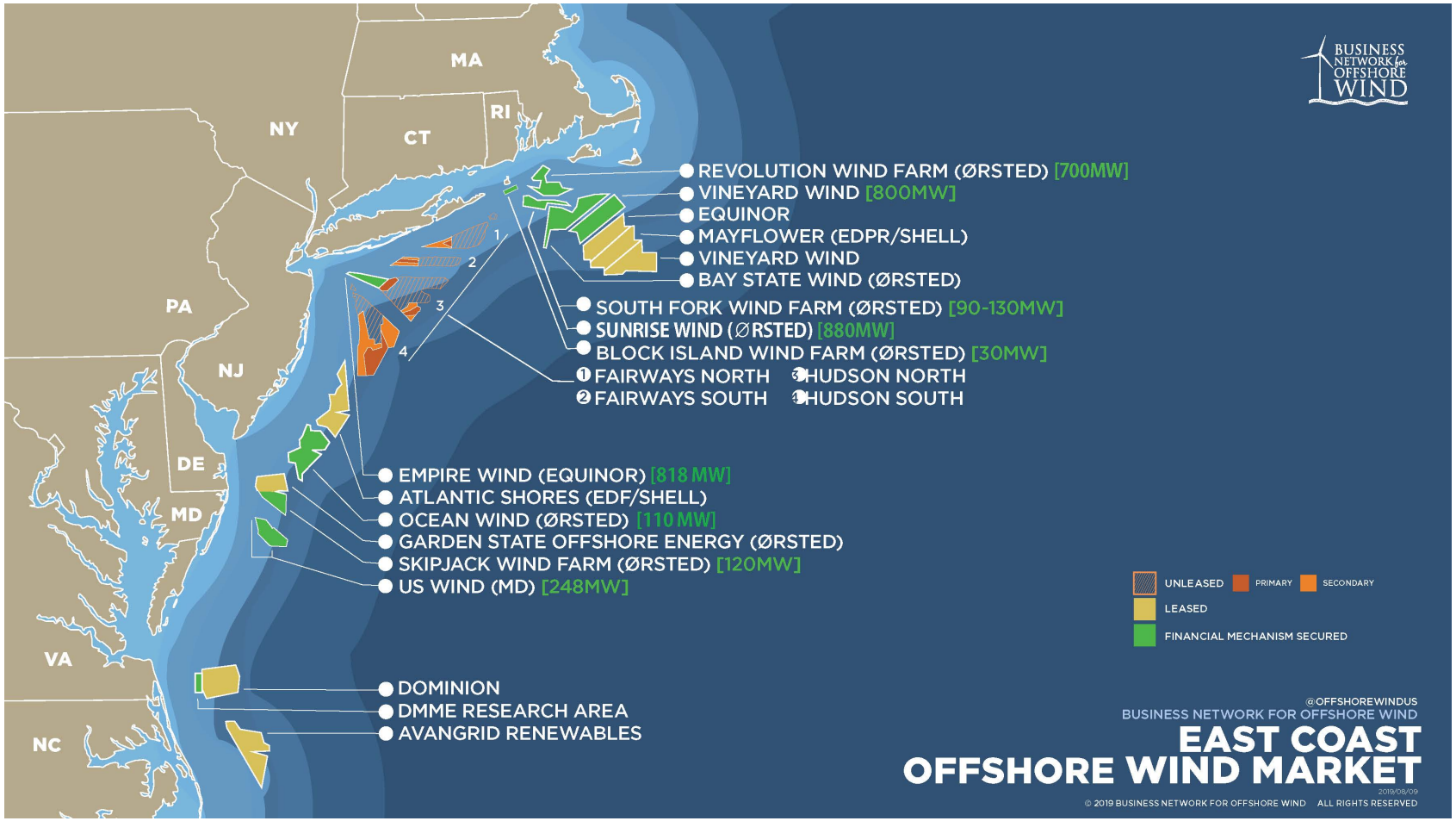
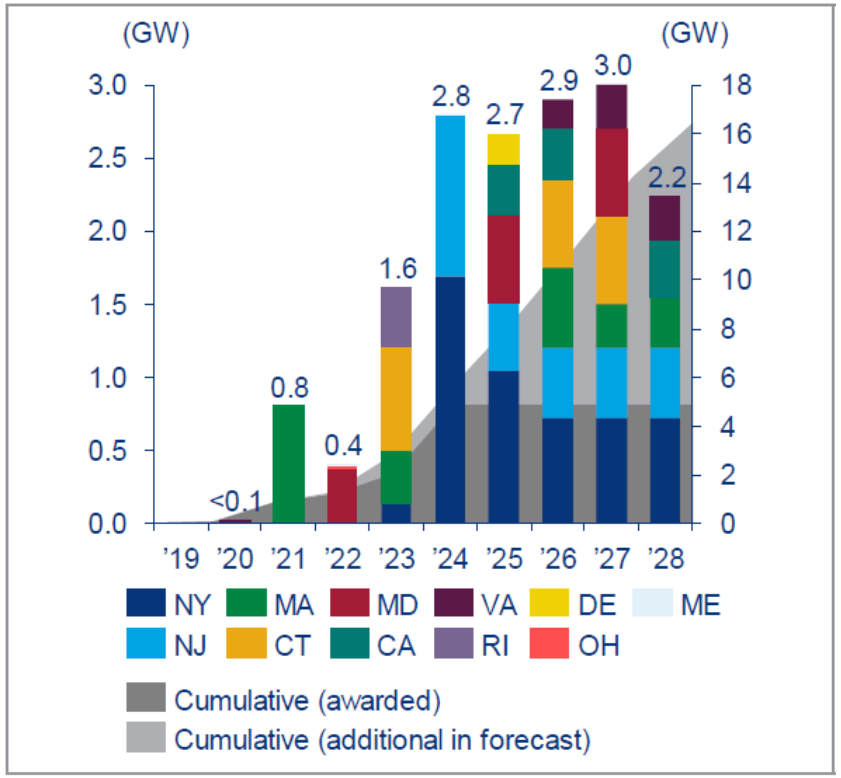
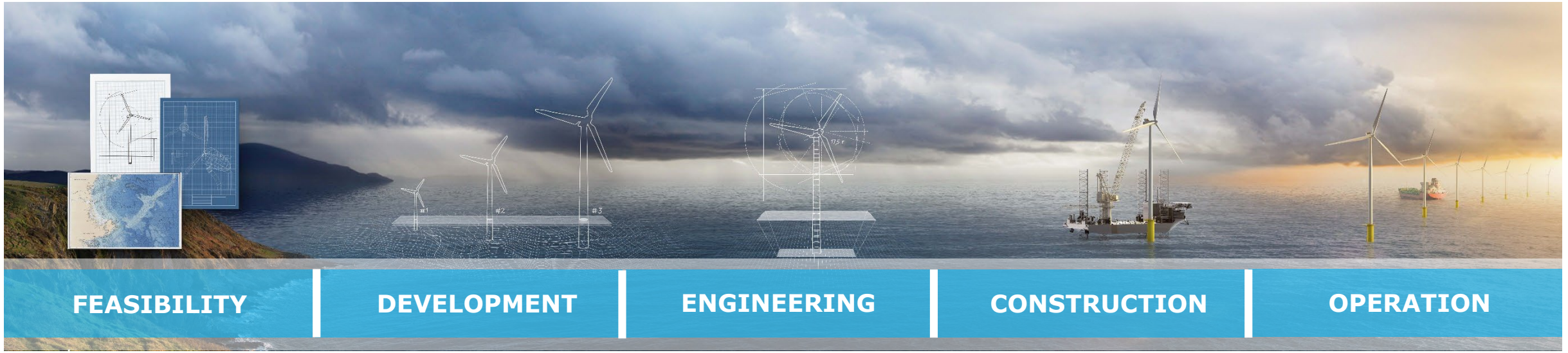


Figure 3.1 Anticipated US offshore wind capacity additions by procuring state, 2019 to 2028



Source: Wood Mackenzie

Taking it to the sea!



- Site Assessment
- Deployment of Oceanographic Equipment
- Permitting and Engineering Surveys

- Equipment transportation
- Installation Vessels
- Support Vessels (anchor handling, CTV, etc.)

- Crew transfer vessels
- Crew hotel vessels
- Vessels for major maintenance

DEVELOPMENT

Development

Site Assessment and Deployment of Oceanographic Equipment

- Metocean Assessments (wind and waves)
- Geophysical and Benthic Habitat Survey

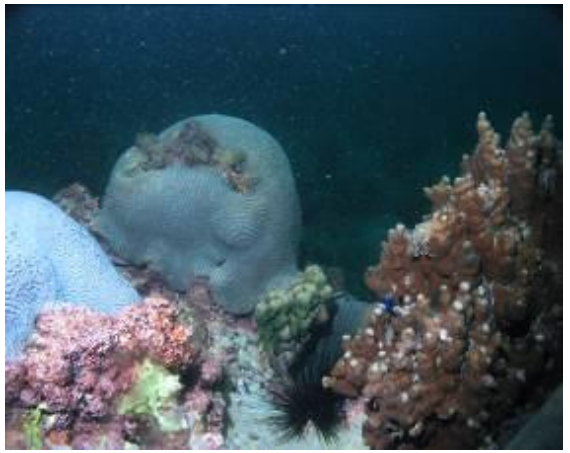
Engineering and Permitting Surveys

- UXO Survey
- Avian and Bat Monitoring
- Geotechnical Investigation

Development

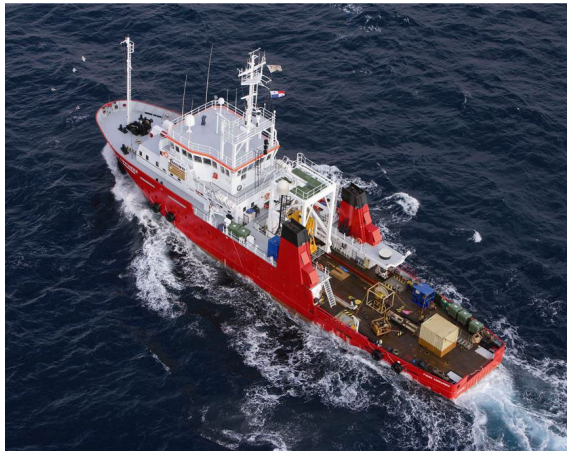
Site Assessment and Deployment of Oceanographic Equipment

- Metocean Assessments (wind and waves)
- Geophysical and Benthic Habitat Survey



Engineering and Permitting Surveys

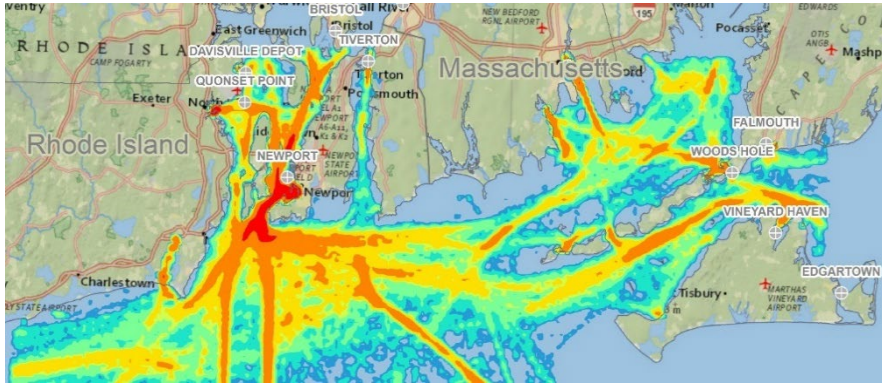
- UXO Survey
- Avian, Bat, Marine Species Monitoring
- Geotechnical Investigation



Development activities

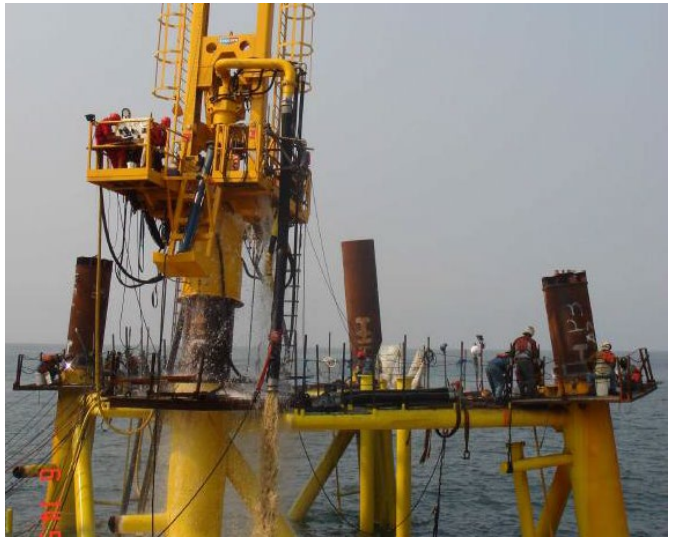
- Underwater acoustic assessments and construction compliance monitoring
- Avian and wildlife study
- Visual simulations and visual impact assessments
- Water quality and sediment transport analysis
- Metocean and resource assessment studies
- Navigation risk assessment and USCG consultation
- Safety management systems, emergency response and oil spill planning
- Manufacturing and transportation planning
- Construction and installation planning
- Operations planning

…and more!

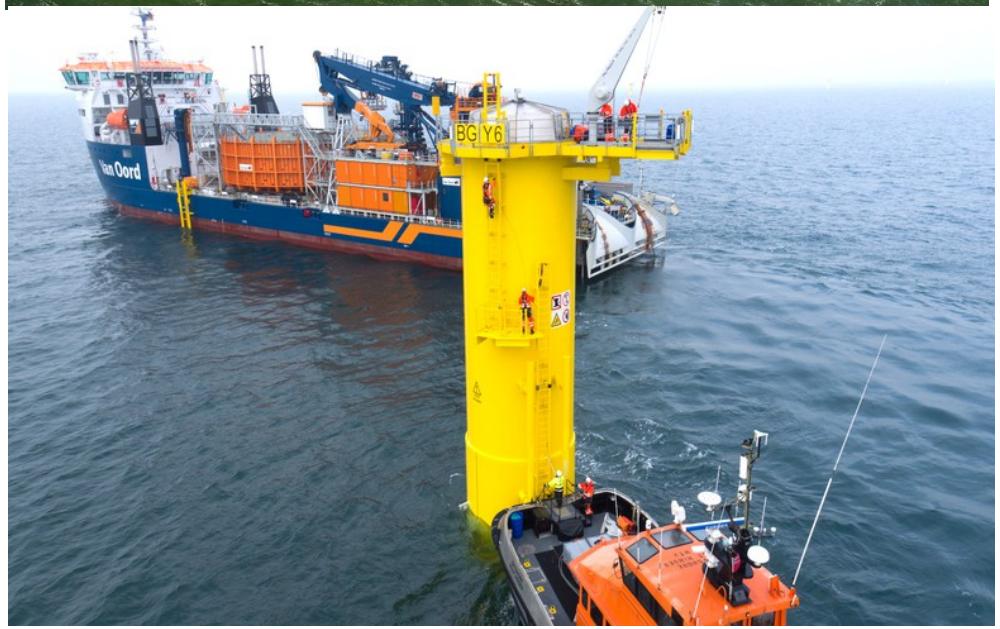


CONSTRUCTION

Construction Activities: Foundation loud out, transportation, and installation



Construction Activities: Substation and Subsea Cable Installation



Construction Activities: Turbine load out and TIV jacking

Construction Activities: Turbine Installation

Unless it’s floating…

Construction Challenges and Opportunities in the U.S.

Current Snapshot

- Manufacturing and fabrication
  - Turbines – none in U.S.
  - Foundations
    - Steel – jacket fabrication, transition pieces in Gulf; no capabilities for monopile rolling
    - Concrete – dependent on size of facility/proximity to port
- Staging facilities/ports
  - Limited port facilities suitable to support offshore wind project execution
  - Obvious constraints: overhead air draft, water depth, lay down area
- Installation
  - No U.S. flagged turbine installation vessels exist

OPERATATIONS

DNV·GL

Operations: Illustrative examples

Crew Transfer Vessel

- Nearer shore applications
- Inexpensive CAPEX
- Crew transfer via ladder

Service Operation Vessel

- Further offshore – servicing potentially multiple projects
- Expensive CAPEX; crew liveaboard
- Crew transfer via “walk-to-work” motion compensated gangway

OFFSHORE WIND = OFFSHORE OPPORTUNITIES

THANK YOU!

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SAFER, SMARTER, GREENER