



NEW YORK
STATE OF
OPPORTUNITY™

National Offshore Wind Research and Development Consortium

Overview | June 2019

National Offshore Wind R&D Consortium



DOE's Goal: Facilitate a nationally-focused, not-for-profit organization collaborating with industry on prioritized R&D activities to reduce levelized cost of energy (LCOE) of offshore wind in the U.S. and maximize other economic and social benefits

Desired Impacts:

- Innovations directly responsive to the technical and supply chain barriers faced by offshore wind project developers in the U.S.
- Build strong networks connecting technology innovators, investors, and industry
- Increase U.S. content and job opportunities

Administrator: (competitively awarded by DOE in 2018): New York State Energy Research and Development Administration (NYSERDA)

Project Value: \$41 M (\$20.5 DOE funds, matched by NYSERDA) – plus member contributions

Duration: 4 years under current funding (+ 3 years to complete all projects); goal is to become self sustaining indefinitely through research partner funding

National Offshore Wind R&D Consortium

An independent not-for-profit designed for long-term self-sufficiency

Members

Public Sponsors

- U.S. Department of Energy
- NYSERDA
- Virginia DMME
- Massachusetts CEC
- Maryland Energy Administration

Independent Members

- Bob Catell, *AERTC* (Chair)
- Jan Matthiesen, *the Carbon Trust* (Vice-Chair)
- Doug Pfeister, *Renewables Consulting Group*
- Sam Aronson, *director emeritus BNL* (Secretary)
- John Bruckner, *National Grid NY* (Treasurer)

Developer Members

- Avangrid
- EDF Renewables
- EDP
- EnBW North America
- Equinor
- Innogy
- Northland Power
- Ørsted
- Shell
- Vineyard Wind

Private Sponsors

- Anbaric

Advisory Groups

Research and Development
Advisory Group (RDAG)

Strategic Advisor Network (SAN)

Tech to Market Group (TTM)

Manufacturing, Supply Chain &
Service Council (MSSC)

Roadmap and Solicitation



- Prioritized **Research and Development Roadmap** published in November 2018
- PON 4124 supports three **Research Pillars:**
 1. **Offshore Wind Plant Technology Advancement**
 2. **Offshore Wind Power Resource and Physical Site Characterization**
 3. **Installation, O&M and Supply Chain Solutions**
- Go to: www.NYSERDA.ny.gov/Funding-Opportunities for complete details, and to submit your proposal!

Pillar 1 Technical Challenge Areas

Array Performance and Control Optimization

- ❑ modeling array effects
- ❑ wind plant controls
- ❑ increasing energy density

Cost-Reducing Turbine Support Structures for the U.S. Market

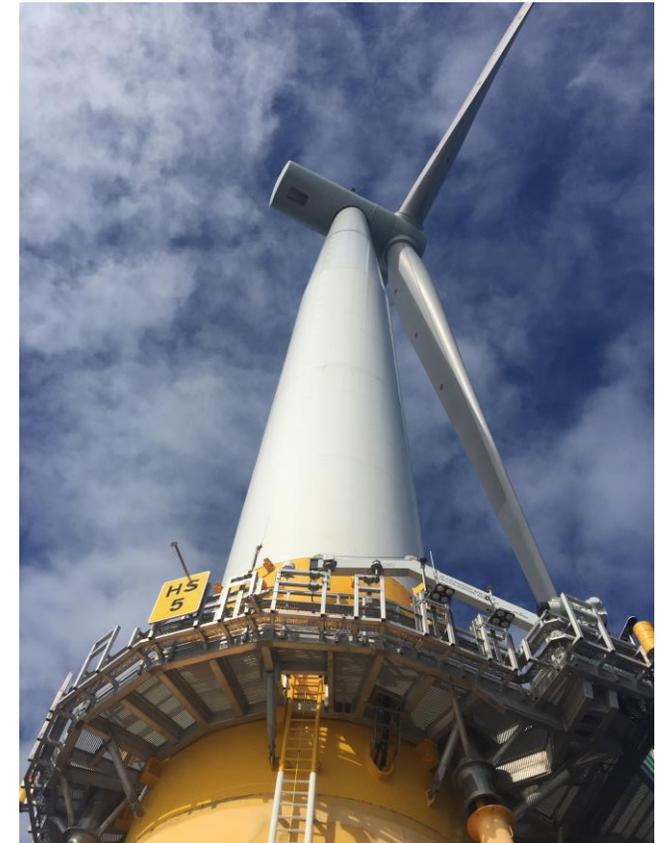
- ❑ Innovative substructure designs, and methods
- ❑ Reduce the dependency on foreign flagged or heavy lift vessels
- ❑ Life extension of the substructure

Floating Structure Mooring Concepts for Shallow and Deep Waters

- ❑ Addressing complexity of Atlantic siting in 50 m - 90 m depths
- ❑ Addressing issues with Pacific siting >500 m depths

Power System Design and Innovation

- ❑ Assessment of power system infrastructure barriers
- ❑ Innovative OSW power system technologies
- ❑ New cable technology or array power system technology

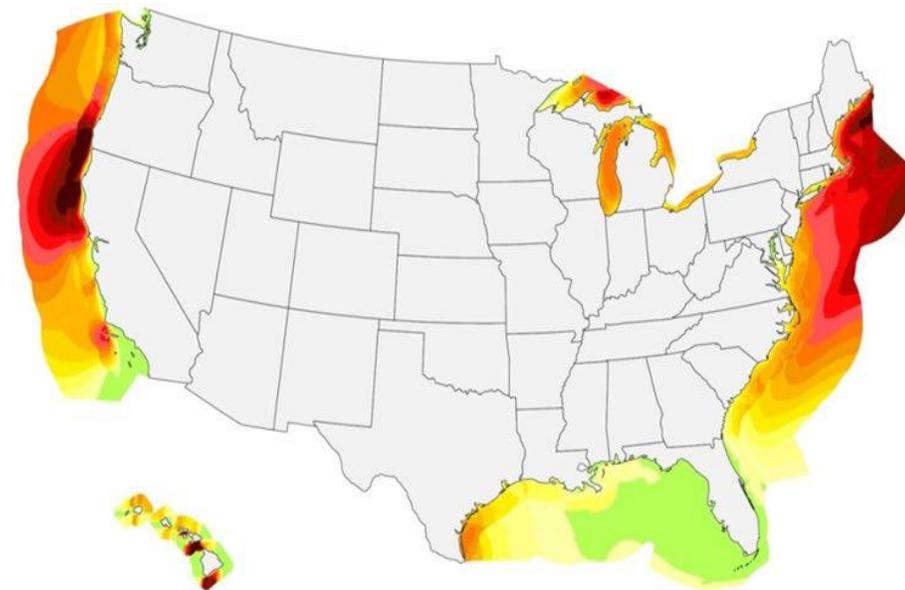


Pillar 2 Technical Challenge Areas

Comprehensive Wind Resource Assessment –

Addressing the uncertainties and inaccuracies of the current resource data bases for wind, extreme wave

Development of a Metocean Reference Site – Providing an ocean based reference site to calibrate and verify instrumentation for wind energy areas



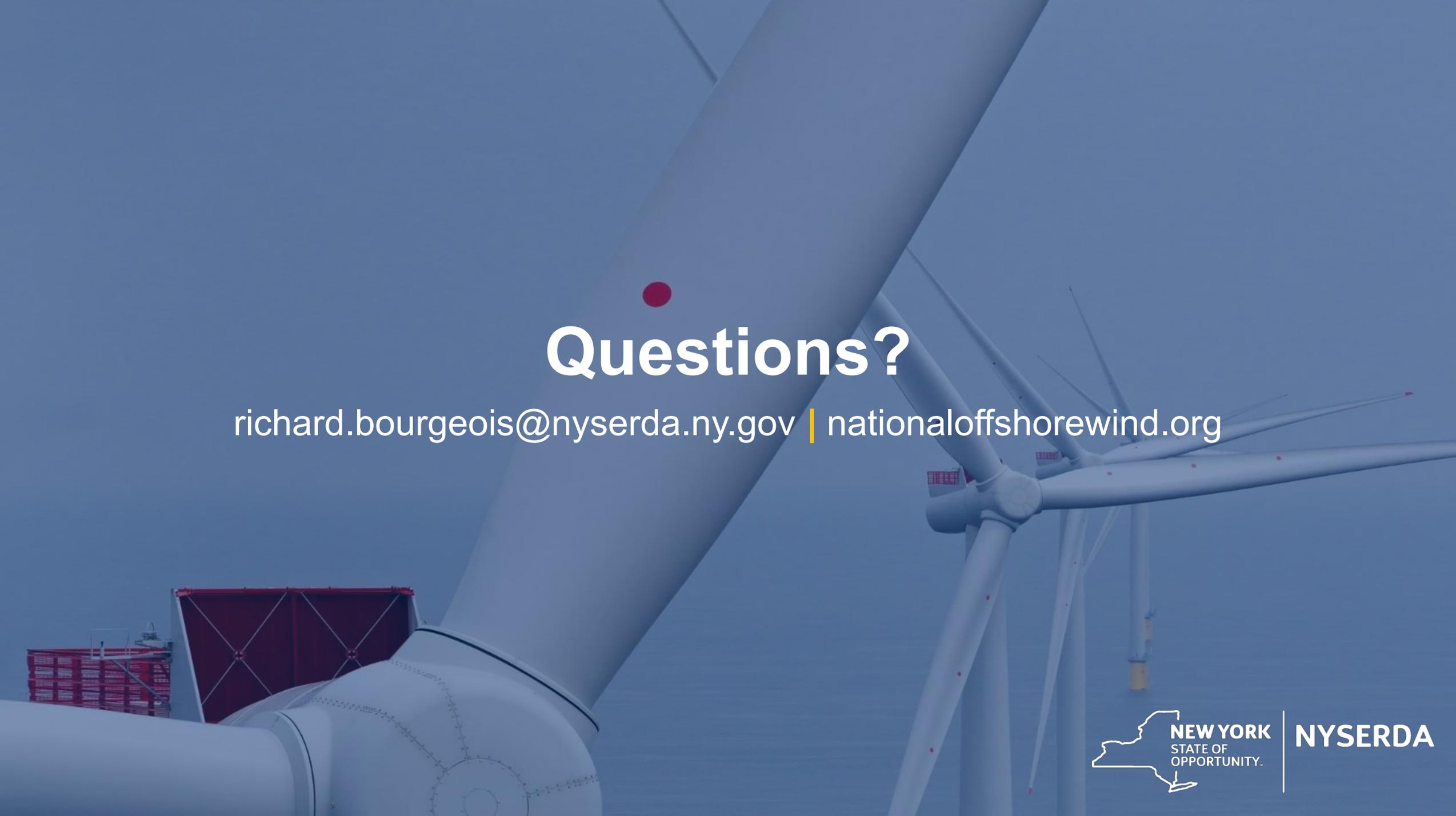
Data Source: AWS Truepower 0-50nm; NREL WIND Toolkit beyond 50nm.

Pillar 3 Technical Challenge Areas

Heavy Lift Vessel Alternatives – Alternative, innovative vessel solutions realized through new ship designs or the repurposing of existing U.S.-flagged vessels. Vessel alternatives enabling quayside assembly and installation of 12 MW+ wind turbines. Includes vessels involved in offshore wind construction, cable laying, crew transfer, and service operation vessels.

Offshore Wind Digitization through Advanced Analytics - Reduce labor at sea through SCADA data analytics, machine learning, condition monitoring technologies, advanced sensors, artificial intelligence, turbine-based robotics, drones, autonomous vessels, and self-healing materials.

Technology Solutions to Accelerate U.S. Supply Chain - New technologies that accelerate the maturation of the U.S. supply chain and concepts that result in increased utilization of existing U.S. manufacturing, new manufacturing, and new system designs that favor local content.



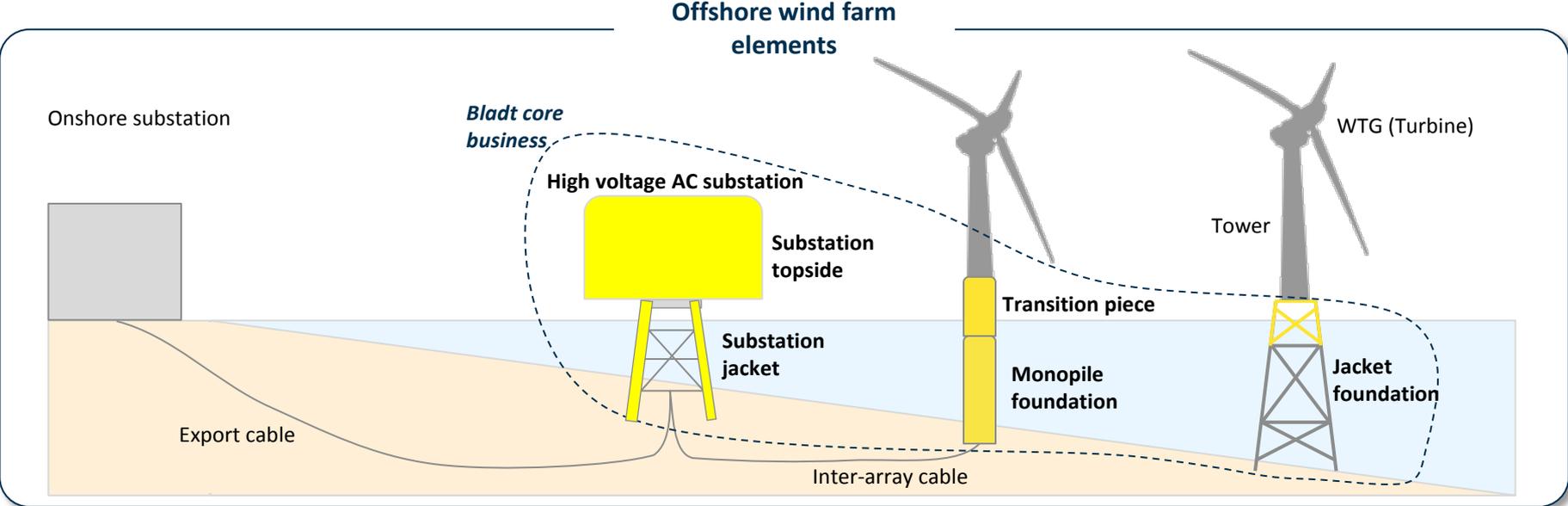
Questions?

richard.bourgeois@nyserda.ny.gov | nationaloffshorewind.org



NYSERDA

Bladt produces critical components to the offshore wind industry



Bladt offshore wind products

Substation topsides and jackets



Monopile foundations



Transition pieces

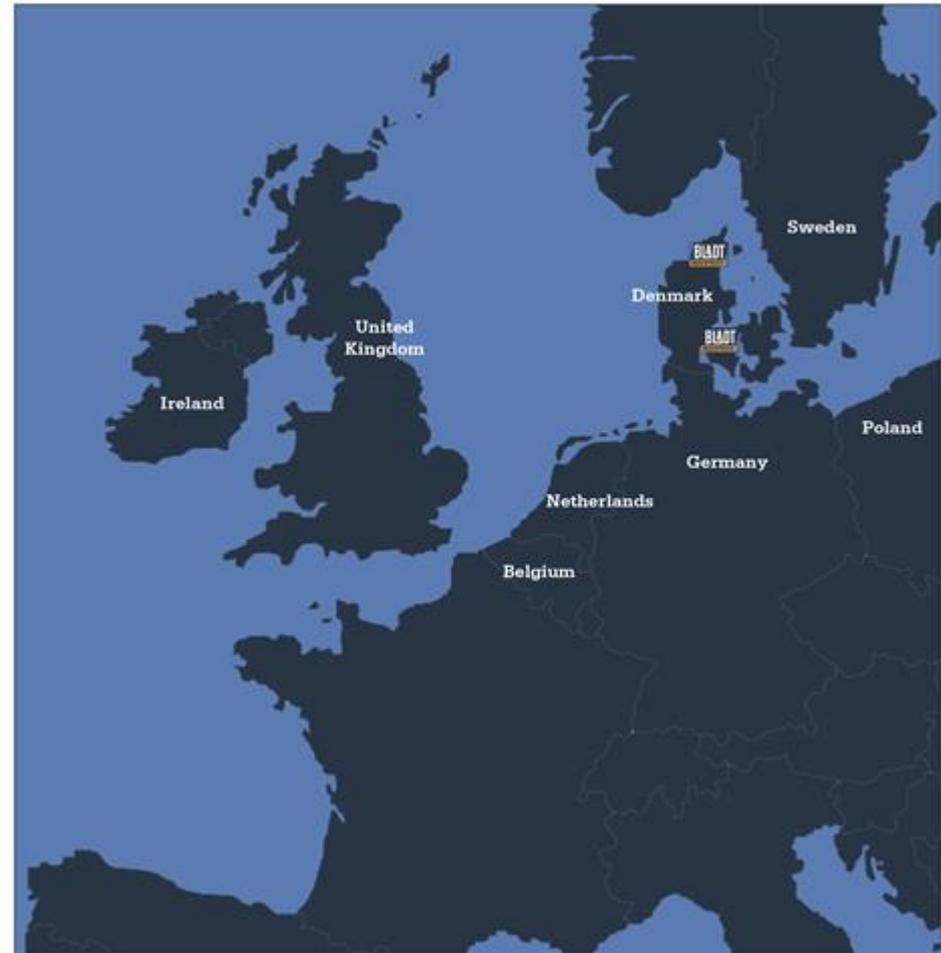


Jacket structure foundations



Bladt Industries A/S

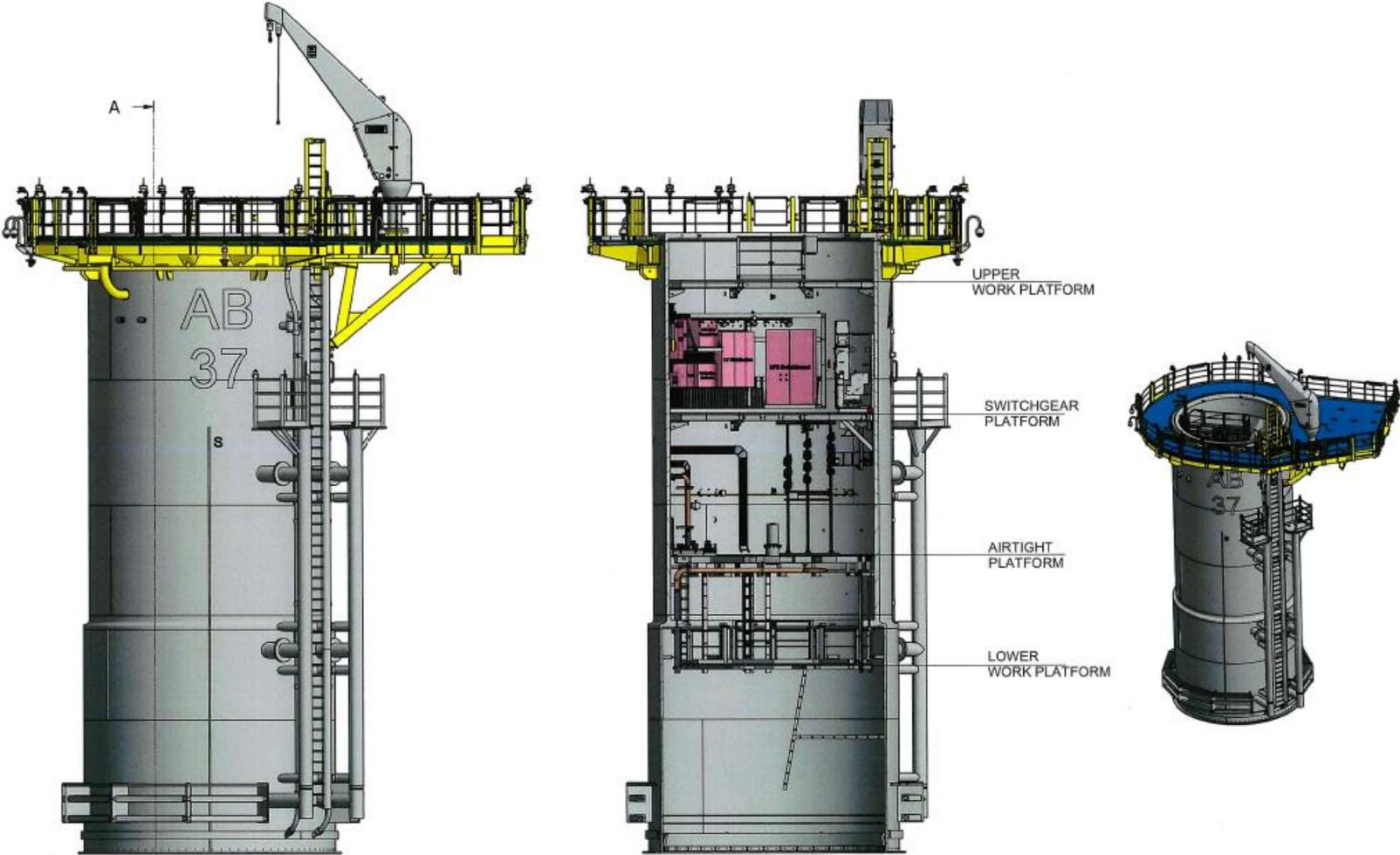
- Steel fabricator founded in 1965
- Locations: Denmark
Poland
Taiwan
(US)
- Employees: 1000
- Business areas: Offshore wind
Oil & Gas
Infrastructure



Wind Energy



Secondary steel components.



Secondary steel structures.

Secondary Steel structures including concrete platform.

Per one foundation is to be used:

- | | | | | |
|--|----------------------|---|-------------|------------------------|
| ✓ Internal platform. | Steel. HDG. | 15 tons | Ø = 7 mtr. | H = 8 mtr. |
| ✓ Airtight Platform. | Steel. Painted. | 6 tons | Ø = 7 mtr. | H = 0,5 mtr |
| ✓ Anode Cages. | Steel. Alu and Zinc. | 18 tons | Ø = 12 mtr. | H = 3 mtr |
| ✓ Boat Landing Platform. | Steel. Painted. | 16 tons | W = 4 mtr. | L = 14 mtr. H = 2 mtr. |
| ✓ External platform. | Steel. Painted. | 25 tons | W = 10 mtr. | L = 13 mtr. H = 2 mtr. |
| ✓ External platform. | Concrete structure. | 130 tons | W = 10 mtr. | L = 13 mtr. H = 2 mtr. |
| ✓ Total tonnage per foundation approx. | | 80 tons steel structures. | | |
| - or | | 55 tons steel + 130 tons concrete structures. | | |

US Fabricator Certifications

CSR, COC, Quality, health, safety and environment are all factors that we keep at the highest priority at our preferred fabricators.

Bladt Industries carry out full scale audit according to:

- ✓ **CSR. UN Global compact**
- ✓ **COC. Code Of Conduct**
- ✓ **EN/ISO 9001 or IATF 16949**
- ✓ **OHSAS 18001/ ISO 45001 or similar**
- ✓ **EN 1090: Declaration method? 1, 2, 3**
- ✓ **ISO 3834**
- ✓ **DIN 18800**
- ✓ **EN/ISO 14001 or similar**

We need US fabricators to certify and implement accordingly.

US Fabricator Audit Process

Bladt Industries provides a step-by-step roadmap to become a preferred supplier.

Road map to be added onto Bladt list of preferred suppliers.	Slow track:	Fast track:
✓ Screening meeting on site.	Week 1	Week 1
✓ Two Questionnaires to be submitted.	Week 3	Week 1
✓ RFQ's to be submitted.	Week 5	Week 2
✓ Full scale audit.	Week 10	Week 5
✓ LOF. List of findings to be closed one by one.	Week 36	Week 6
✓ Re-Audit if needed.	Week 39	Week 8
✓ Added onto Bladt Industries list of preferred suppliers.	Week 40	Week 8
✓ First possible contract.	Nine months	Two months

Facilities – Aalborg, Denmark



Total area:	35 hectares
Covered shops:	27,000 m ²
Covered painting areas:	7,400 m ²
Max units u/cover	70x30x15 m
Office facilities:	2,000 m ²
Quay strength:	5,000 tonnes
Water depth:	9.4 m

Facilities – Lindø, Denmark



Total area:	93,000 m ²
Workshop 1:	11,220 m ²
Workshop 2:	10,566 m ²
Workshop 3:	5,747 m ²
Paint shop 4:	2x1,350 m ²
Stock:	2,000 m ²
Quay depth:	7,5 m



steel solutions
built for
the future



NEW YORK OFFSHORE WIND SUPPLIER FORUM 2019

Jørgen Scheel - 5 June 2019

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SIEMENS Gamesa
RENEWABLE ENERGY

Unrestricted

A leading provider of wind power solutions to customers around the globe

 **Offshore**

- #1 in global Offshore market

 **Onshore**

- #4 in global Onshore market
- #1 in India and LATAM

 **Service**

- #2 in service backlog
- #2 in serviced fleet size

Top 3 market share* position in several main countries



* Based on MW installations

Source: MAKE Global Wind Turbine OEM 2016 Market Share

Key facts



Order Book
€~20.4 bn



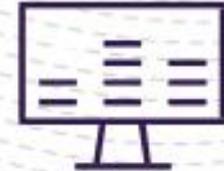
Annual revenue
€~11.5 bn



Installed capacity worldwide
~80 GW



Employees worldwide
> 25.000

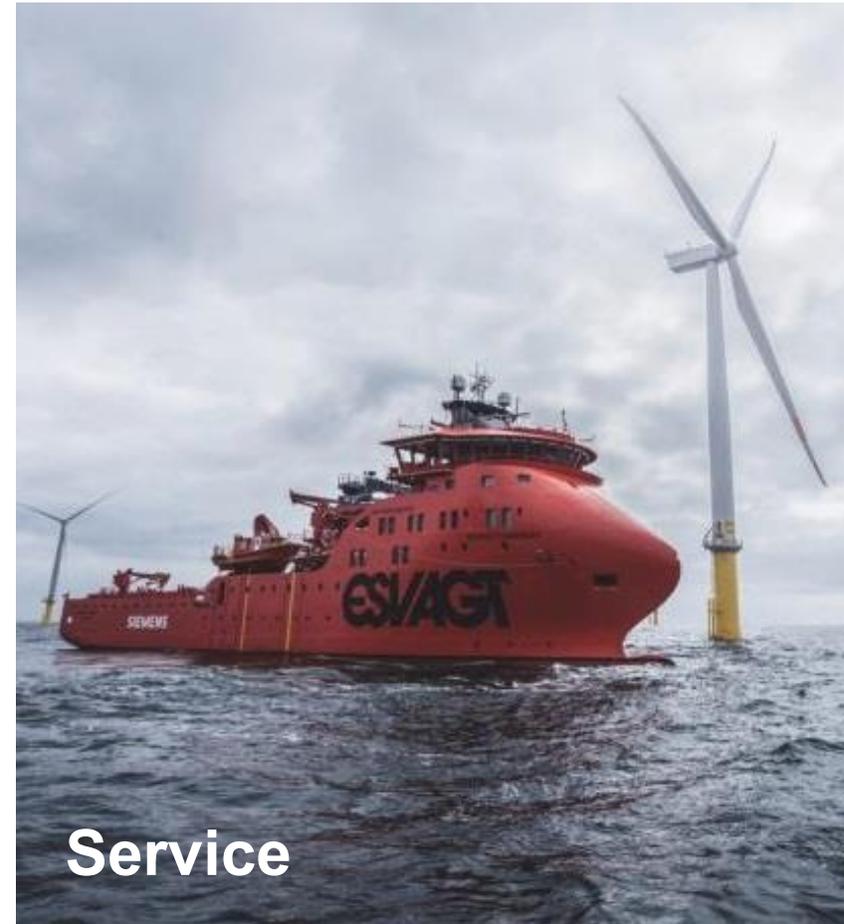


Market capitalization
€~8.2 bn¹

Figures as of June 2017

¹Calculated based on share price on October 17, 2017

Shaping the renewable industry – A broad portfolio

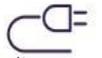


Key Facts



~ 3,000 WTG's installed so far

installed in Denmark, UK, Germany, Norway, Sweden, Finland, Netherlands, Belgium, China and Taiwan



~ 12.5 GW installed base = (in total 18,5GW ~ 70%)



~ 52 Offshore Projects executed or in execution



Our accumulated Contribution (since 1991)



88 billion kWh of clean energy generated

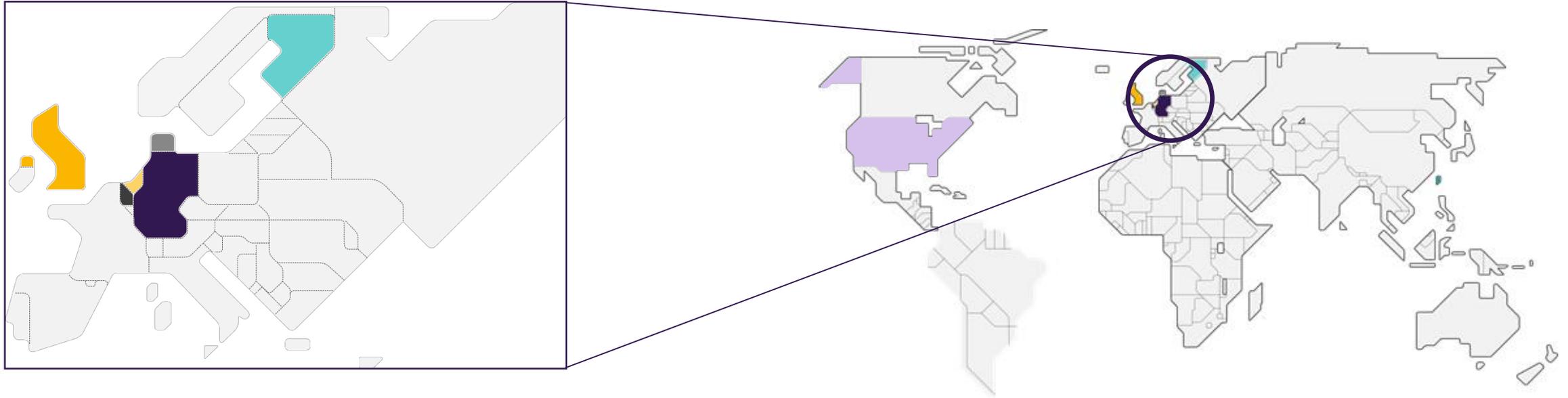


67 million tons of CO₂ emissions avoided



267 billion liters of water saved

Many projects under installation and to come First order secured in the US and an ambition to have market leadership



	Arkona, DE 60x SWT-6.0-154
	Albatros, DE 16x SWT-7.0-154
	Hohe See, DE 71x SWT-7.0-154

	Coastal Virginia, US 2x SWT-6.0-154
	Danish Kriegers Flak, DK 72x SG 8.0-167 DD
	Vesterhav Projects, DK 41x SG 8.0-167 DD

	East Anglia ONE, UK 102x SWT-7.0-154
	Beatrice, UK 84x SWT-7.0-154
	Hornsea Two, UK 171x SWT-7.0-154

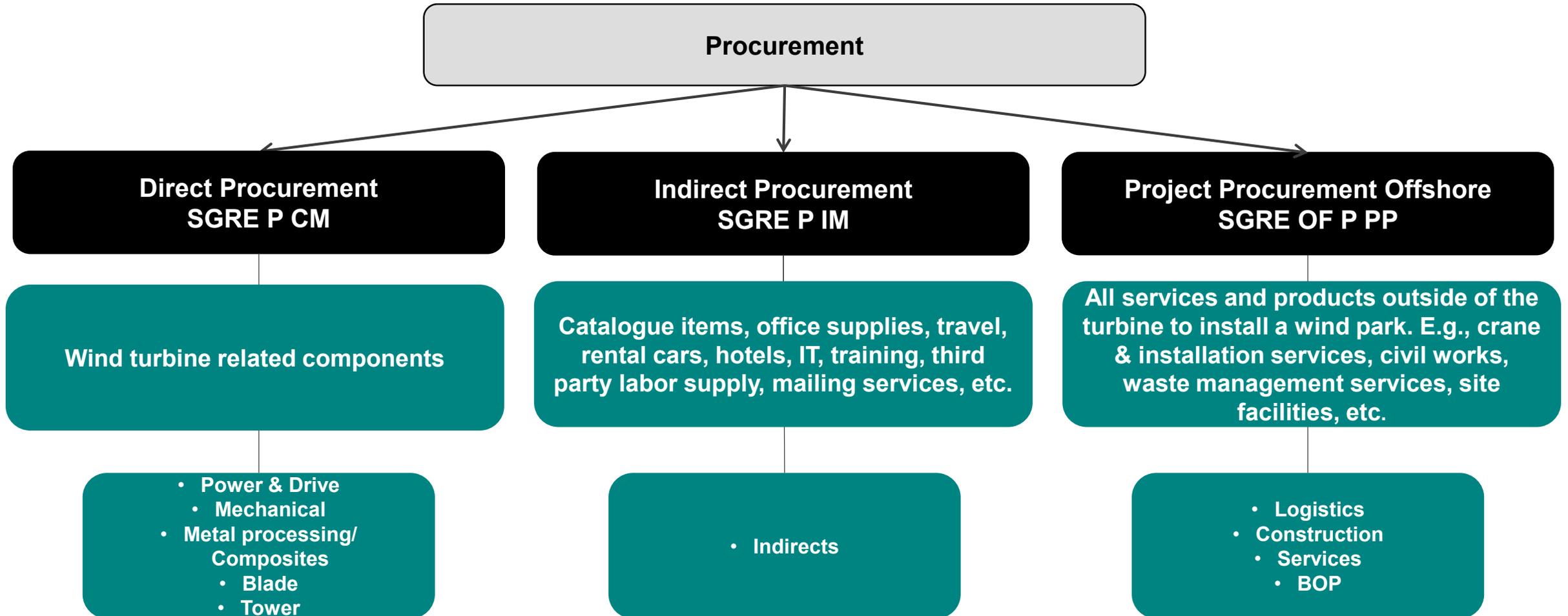
	Borssele 1+2, NL 94x SG 8.0-167
	Formosa 1, Phase 2, TW 20x SWT 6.0-154
	Rentel, BE 42x SWT-7.0-154

SGRE Typical Scope of Supply

- Wind turbines
- Transport
- Pre-assembly
- Installation
- Commissioning
- O&M Services



Overall Procurement organization and sub-units within SGRE Offshore



Supplier Qualification



Siemens Gamesa is committed to using local suppliers wherever possible.

It makes sense commercially and technically.

These are the criteria which would qualify a supplier as “ready for business” (R4B)

Approach to
Health, Safety and
the Environment

Reliable Delivery

Competence &
Quality

Value for money

Offshore Overview – Some Examples

Sea Transport

- Sea transport of main components (tower sections, nacelles, blades) from port of manufacturing to port of pre-assembly
- Provision of vessels, bunker, stevedores and agents
- Activities before and during preassembly activities



Cranes

- Provision of equipment and personnel for transport and lifting activities at pre-assembly port
- Transport of main components (tower sections, nacelles, blades) at pre-assembly port
- Lifting and stacking of tower sections for pre-assembly on quayside



Crew Transfer Vessels

- Provision of CTV charter for the transfer of technicians, tools and equipment supporting offshore operations
- Includes provision of vessel crew, maintenance and fuel
- For activities spanning installation, O&M and major component repair/exchange



Offshore Overview – Some Examples

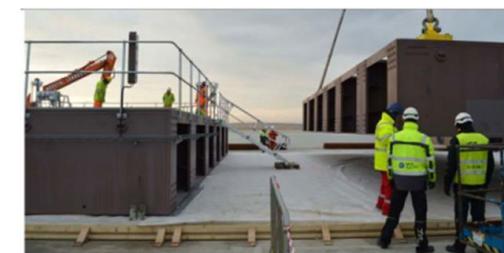
Ports

- Provision of preassembly ports suitable for inbound logistics, storage, pre-assembly and installation vessel loading
- Ensure heavy duty and well prepared storage and quays
- Ensure suitable swift and easy setup for Installation vessels



Quayside Equipment

- Provision of equipment for quayside and vessel including sea-fastening like compact tower frames and bolts
- Sourcing of turnkey providers for fabrications; including the production of quayside equipment and sea-fastening as well as related mobilization and demobilization services



Manpower – Field Services

- Provision third party labor providers and labor for Offshore service activities
- HV techs, statutory inspectors, site related labor,
- Provision of project certifications



Operations and Maintenance Overview – Some Examples

O&M Facilities

- Design, construct and manage service base facilities to support O&M activities and potential helicopter operations
- Quayside improvements to support offshore mobilization such as port side cranes and pontoons
- Waste management and bunkering activities



Vessels and Logistics

- Crew Transfer Vessels
- Service Operation Vessels (SOVs)
- Jack Up Vessels
- Helicopters
- Marine and Aviation Coordination



Manpower – Field Services

- Supplemental workforce to our O&M organization
- Specialized workforce such as rope access and high voltage
- Specialized consultants – port survey, engineering studies, etc.
- Training providers - GWO certified programs



Operations and Maintenance Overview – Some Examples

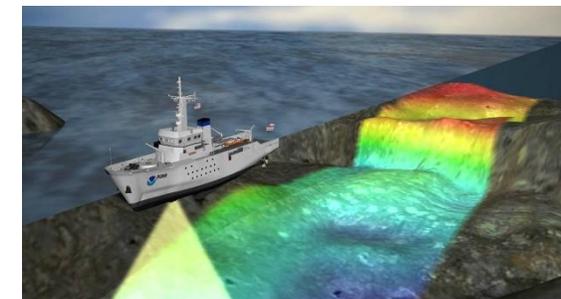
Substation

- HV asset integrity maintenance
- HV switching operations
- Facility management to include:
 - Air conditioning equipment
 - Fire suppression equipment
 - Overall building integrity



Underwater Survey

- Export and inter-array cable burial surveys
- Scour protection surveys
- Monopile ROV work
- Substation substructure ROV work
- Protection species observers



Tooling, parts and equipment

- Hydraulic and electrical torque and tension tooling
- Calibrated equipment and associated calibration services
- Local procurement of consumables such as cleaning supplies, oil, greases, filters, potable water, etc.



Some of our initial requirements



Details of any QHSE accreditations

HSE performance including TRIR rates

Details of experience in Offshore wind or relevant experience from complimentary sectors

How to Engage



- **Contact one of our team at the event today**
- **Use our Contact Form**

Thank You



HALIADE-X 12MW

NYSERDA OSW Supplier Forums
5th/6th June

Paul Deaton
Supply Chain Localization Leader



Focusing portfolio for growth & shareholder value creation

GE GOING FORWARD



AVIATION
\$30.6B



POWER
\$27.3B



RENEWABLE ENERGY
\$15B

← Digital, Additive, and
financing expertise of GE Capital →

- ✓ Leading franchises solving tough problems with advanced technology
- ✓ Technology is the DNA of the company
- ✓ Valuable installed base with track record of increasing asset productivity & improving margins

\$ Revenue from 2018 Annual Report



UNLOCKING VALUE



TRANSPORTATION
\$3.9B

- ✓ Merging with Wabtec to create global leader for rail equipment, services and software
- ✓ Positioned to grow ... diversified transportation business with large installed base



HEALTHCARE
\$19.8B

- ✓ Leading healthcare solutions provider
- ✓ Enabling precision health with leadership in diagnostics, therapeutics and monitoring

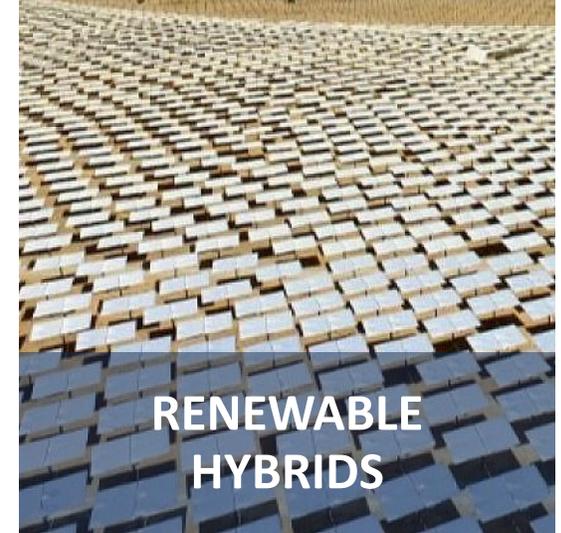
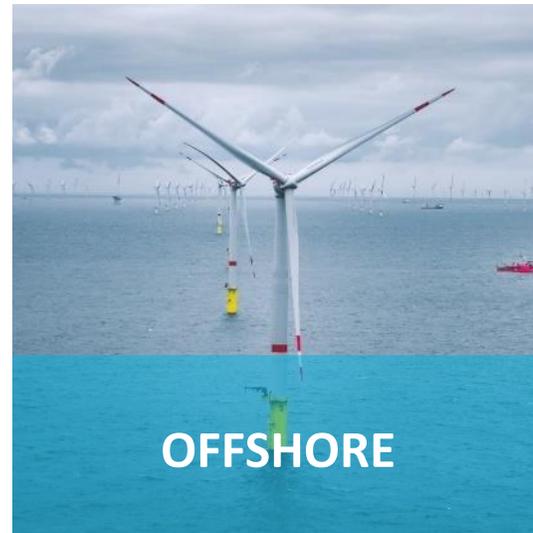
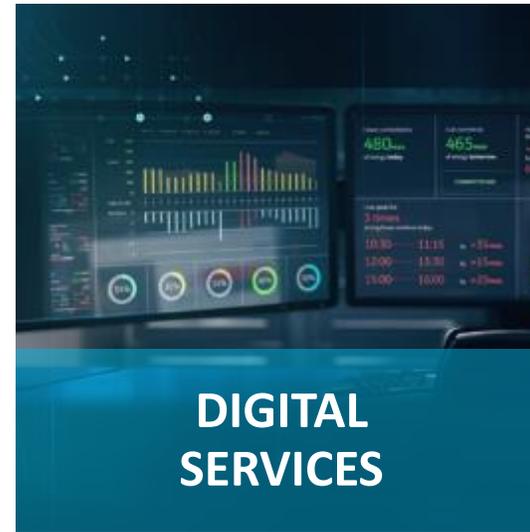


BAKER HUGHES
\$22.9B

- ✓ Full-stream oil & gas company for land and offshore solutions
- ✓ Supported by digital solutions backbone

GE Renewable Energy

\$15B revenue • 40,000 employees



Broadest portfolio in the industry; gives us scale, scope and capability to fulfill our mission



Block Island, USA

First US offshore wind farm

Developer: Deepwater Wind
Wind Farm:
US pilot wind farm with 5 **HALIADE 150-6MW*** (30MW)
Off the coast of Rhode Island: 5km
Water depth: 24m to 28m
Foundations : Jacket type
Generating 125,000 MW/h annually
1st offshore windfarm in the US





12 MW capacity

220-meter rotor

107-meter long blades

248 meters high

63% capacity factor

38,000 m² swept area

Wind Class IEC: IB

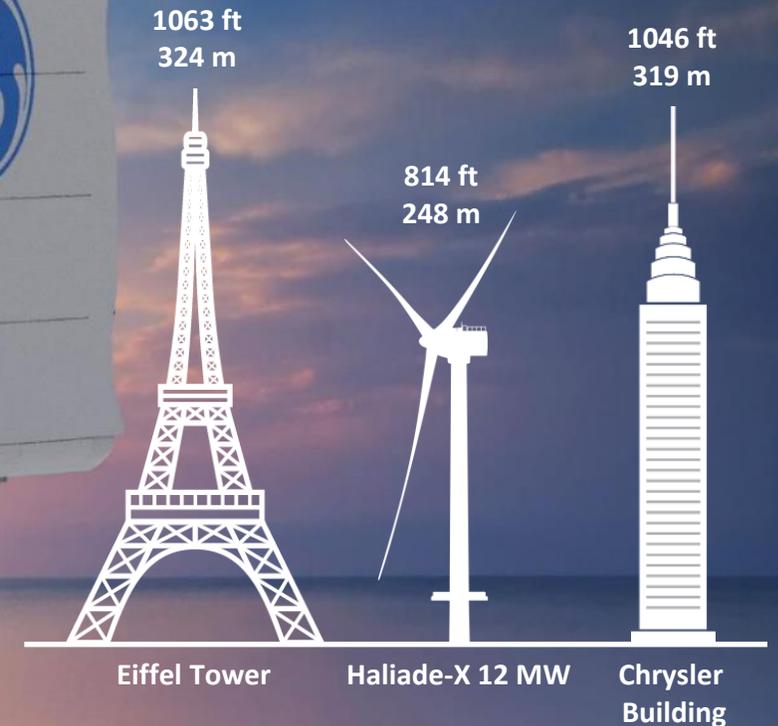
Generates **double the energy** as previous GE Haliade model

Generates almost **45% more energy** than most powerful wind turbine available on the market today

Will generate enough clean power for up to **16,000** European households per turbine, and up to **1 million** European households in a 750 MW configuration windfarm

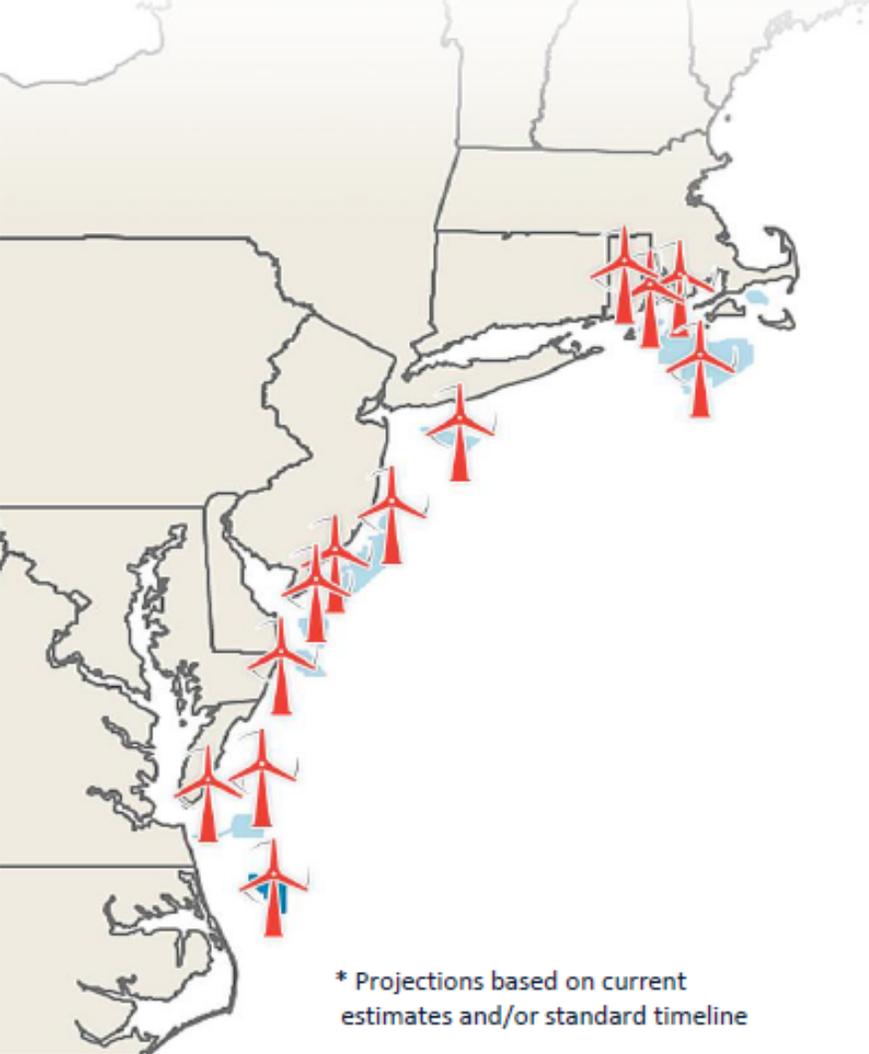
HALIADE-X 12 MW

GE Renewable Energy is developing **Haliade-X 12 MW**, the biggest offshore wind turbine in the world, with **220-meter rotor**, **107-meter blade**, leading capacity factor (**63%**), and **digital capabilities**, that will help our customers find success in an increasingly competitive environment.



Demand Scenario US Northeast Demand

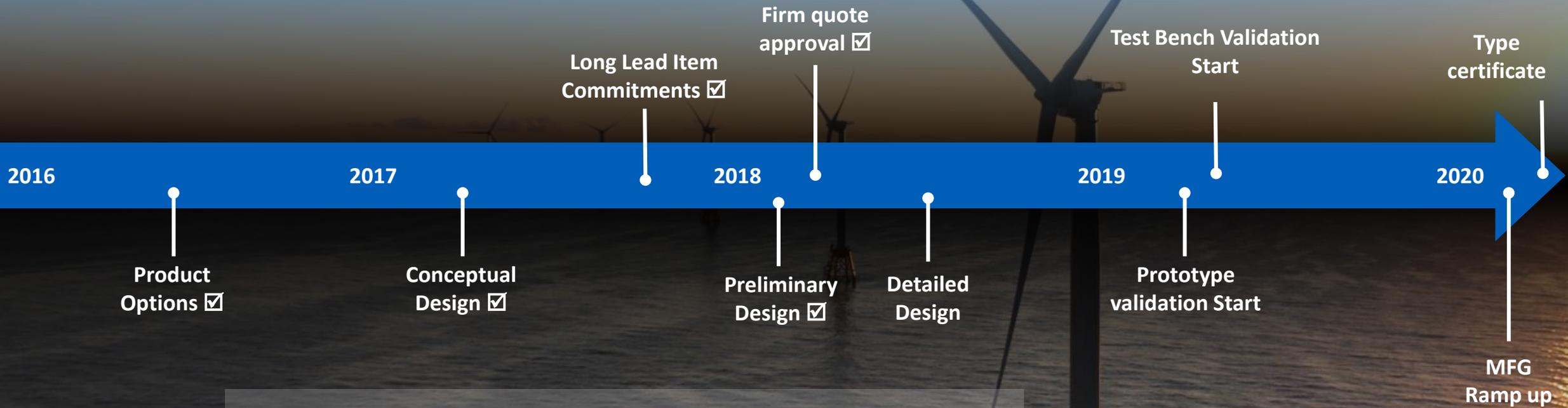
2 GW w/ revenue, +3 GW to be awarded, +8-10 GW targeted



Year	Project	Company
2020	Coastal Virginia Offshore Wind (12 MW)	DMME Orsted
2021	Vineyard Wind (800 MW)	VINEYARD WIND
2022	South Fork (130 MW)	Orsted
2023	Skipjack Windfarm (120 MW)	Orsted
2023	Revolution Wind (700 MW)	Orsted
2024	U.S. Wind (248 MW)	US Wind
2025	Empire Wind	equinor
2025	Bay State Wind	Orsted
2025	Atlantic Shores	Shell edf energies nouvelles
2025	Ocean Wind	Orsted
2026	Dominion Commercial Lease	Dominion Energy
2027	Kitty Hawk	AVANGRID



Haliade-X roadmap



2018 Year GE Renewable Energy in Review



Launch of Cypress, GE's largest onshore wind platform



Announced Haliade-X, world's most powerful offshore wind turbine



GE reclaimed #1 for manufacturers in '18 (40% US capacity installations)



