



# Offshore Wind GE Renewable Energy





# GE Offshore Wind



# Our Offshore Footprint


**Foxborough (MA)**   
• Sales and tendering


**Quonset (RI)**   
• O&M (Block Island)  
• Support functions

**Cherbourg**   
• Blades site

**Saint-Nazaire**   
• Manufacturing site

**Le Carnet**   
• Testing site

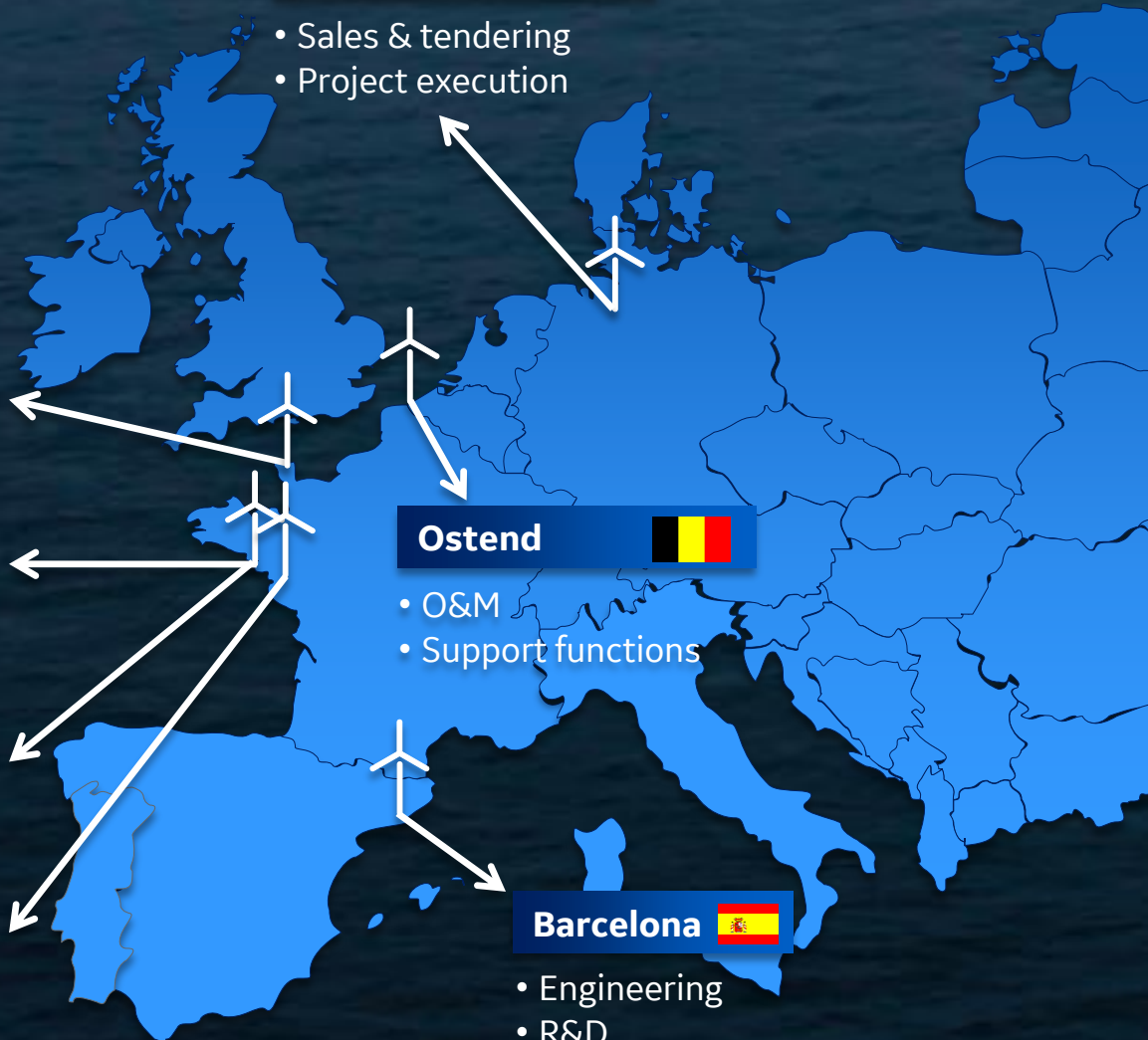
**Nantes**   
• Offshore HQ office

**Asian Hub**   
• Beijing offices

**Hamburg**   
• Sales & tendering  
• Project execution

**Ostend**   
• O&M  
• Support functions

**Barcelona**   
• Engineering  
• R&D



# Nantes (engineering center and headquarters)

- Opened 2013
- 250+ employees
- Engineering: Mechanical components, electrical components, loads, control, design...
- Project management: installation, commissioning, planning...
- Operations & Maintenance: technical support, field service...
- Global Supply chain: Sourcing, manufacturing,...
- Support functions: HR, Finance, Marketing, Communication, Quality,...



# Saint-Nazaire (manufacturing facilities)



- Components: Generators and nacelles
- Capacity: 100 turbines/year
- Area: 32 Acres
- Constructed area: 5 Acres.
- Opened December 2014
- 200+ employees
- Dynamic production line
- Quality processes designed by manufacturing experts from the automotive and aircraft industries
- First European factory HEQ certified



# Blade production: LM Wind

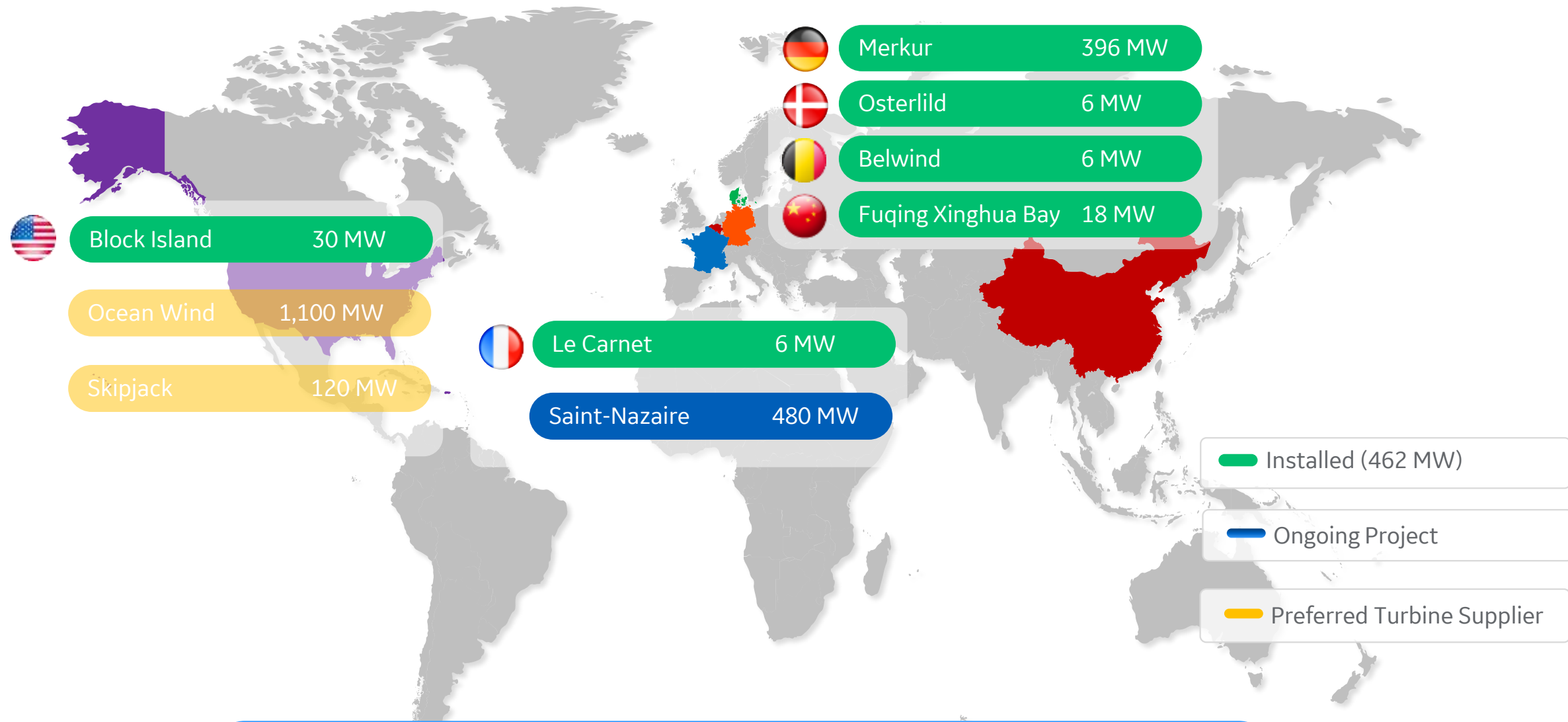
- In operation since 1978
- Produced > 185,000 blades
- Corresponding to ~ 77 GW capacity
- Saving > 147 MM tons of CO<sub>2</sub>/year
- 9,000+ employees
- 13 manufacturing facilities in 8 countries
- Supplier to 30 turbine OEMs



Vertical integration to accelerate LCOE ↓



# Global installations



Only Offshore Wind Turbine OEM with installations in 3 continents





# Haliade-X 12 MW





**12 MW** capacity

**660-foot** rotor

**350-foot** long blades

**814 feet** high

**67 GWh** gross AEP

**63%** capacity factor

**38,000 m<sup>2</sup>** swept area

**Wind Class IEC: IB**

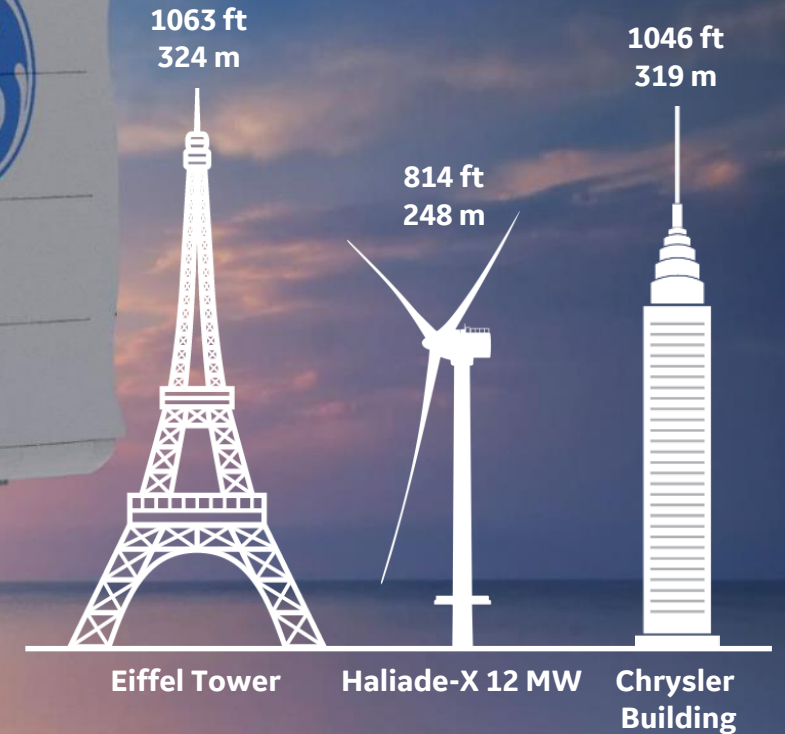
Generates **double the energy** as previous GE Haliade model

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

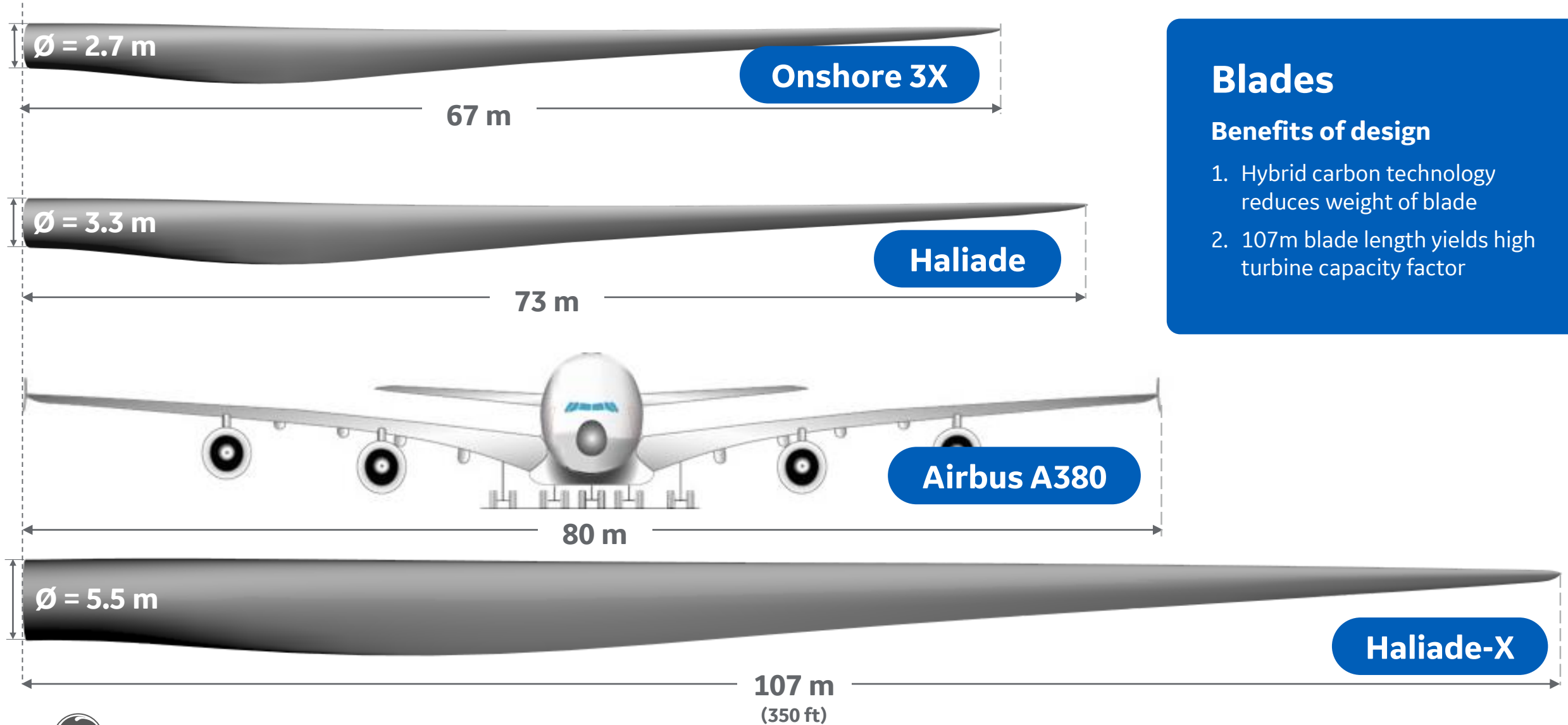
Will generate enough clean power for up to **16,000** European households per turbine, and up to **1 million** European households in a 750 MW configuration windfarm

# 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.



# Product comparison



## Blades

### Benefits of design

1. Hybrid carbon technology reduces weight of blade
2. 107m blade length yields high turbine capacity factor



# Marshalling Harbor - Logistic Hub



# Layout of an Offshore Wind Logistic Hub

Section of Towers storage area

Nacelle storage area

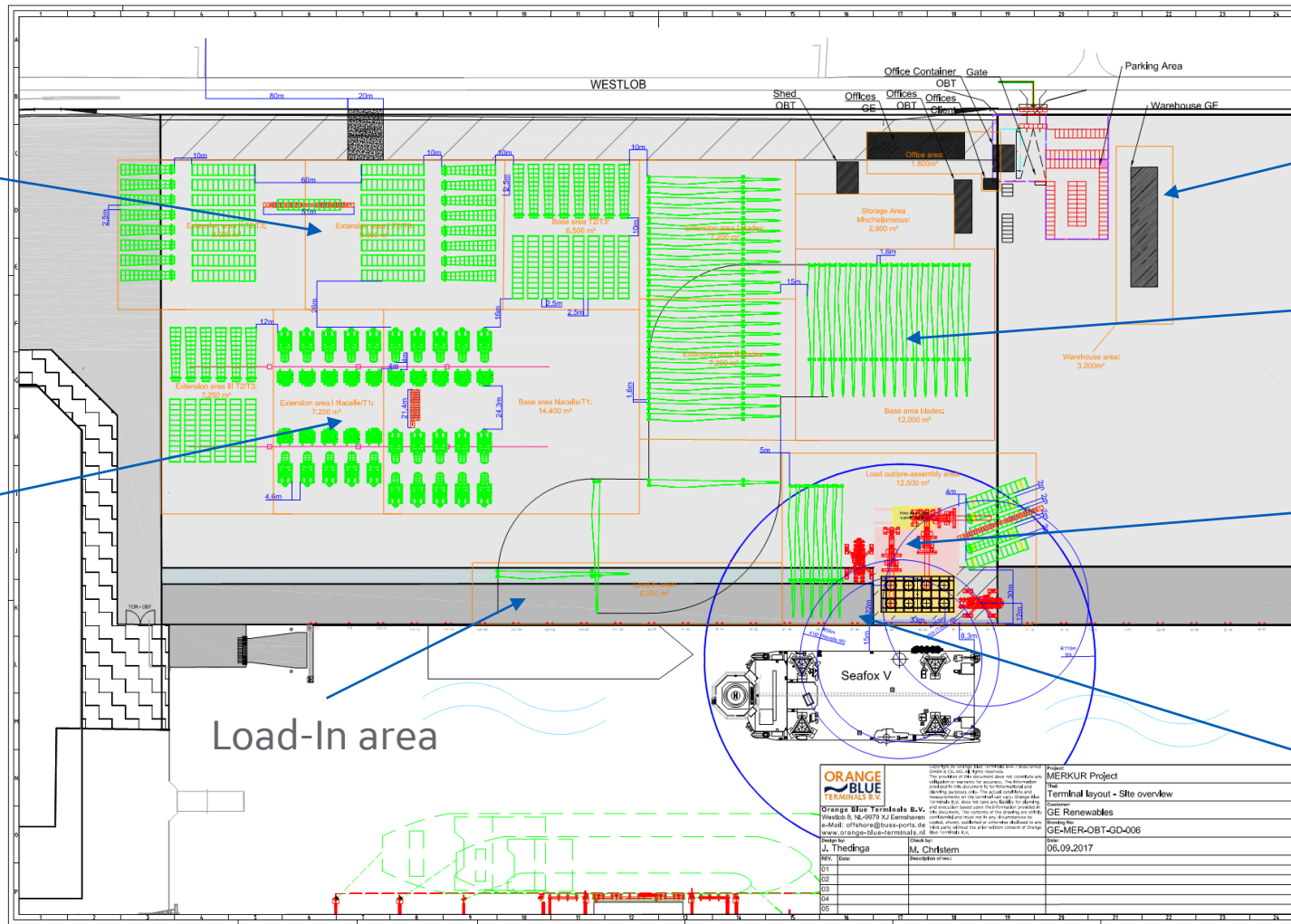
Load-In area

2.000m<sup>2</sup> used as a Storage Area (spares)

Blades storage area

Pre-assembly area

Load-Out area  
24h/7D



# Marshalling Harbor Requirements

## Pre-Assembly Site

### Quay Requirements:

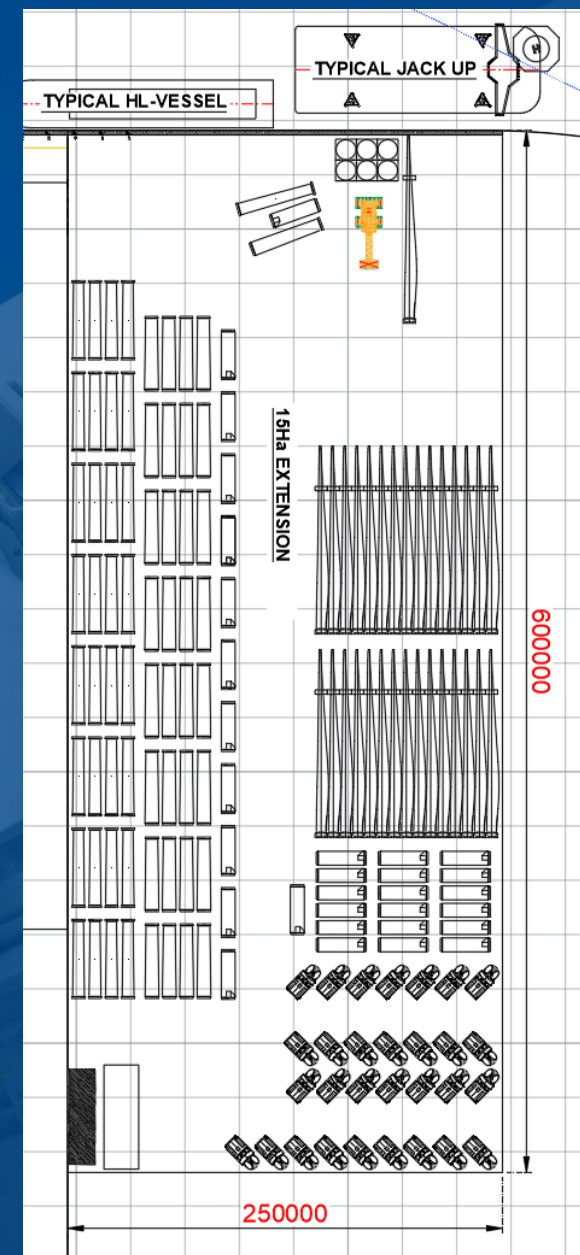
- Deep water access
- Length: 1050ft minimum
- Water Depth: 32.8ft LAT minimum
- Dedicated quay for Load In and Load Out operations
- Seabed adapted for Jack-up vessel following project basis
- Load Bearing capacity: 98 kPa min for Load-In and 294 kPa for Load-Out/pre-assembly

### Storage Area requirements:

- Storage Area: approx. 0.74 acres/WTG (245 kPa)
- Pre-Assembly Area: 4 acres
- Load bearing capacity: 294 kPa
- Site surface: 50 acres (storage of approx. 40WTG for 100WTG project)
- Horizontal and Vertical clearance: no restrictions

### Others:

- Security Level ISPS Level 1
- Power & Water Supply
- Local Supply chain



# Operations - Onshore

## *WTG main components Transportation*

- Road and Sea transport from factory to marshaling hub
- Handling and Lifting at quay of components
- Contracting full geared vessel for round trips



## *Marshalling Hub main functions*

- Storage of components and preservation
- Full tower or split tower pre-assembly at quayside before loadout.
- Pre-commissioning of main components

### **We need:**

- Port /Terminal: Storage area + quay
- Lifting equipment & Tools (Cranes, forklift,...)
- Transport vessels
- Manpower: Mech & Elec tech, Eng, CC, Quality, log..
- Service providers (Marine, Fuel, Water...)
- Training/ facilities/ IT/ consumables...



# Operations - Offshore

## *Load-out and Installation*

- 3 days average installation incl. Load-out, transit and installation
- Mechanical and Electrical completion works prior energization



### **We need:**

- Manpower: Inst & Com tech, quality, EHS...
- Equipment & Tools (Blade Rack, forklift, Cherry picker, ...)
- Rigging, certification, Torque, ...

## *Commissioning + O&M*

- Continuity tests, Energization and Hot Commissioning
- Dynamic tests incl. Spin Test and Production Test up to 1<sup>st</sup> kWh
- Remote Commissioning, Troubleshooting & Stabilization of WTG



- SOV, CTV, Heli, Marine Coordination, ...
- PPE, Tools and equipment, Aux-Gen, ...
- Training, facilities, Fuel, Consumables, IT, Water, ...





Thank You!





