Welcome…We will begin shortly

1. **You will be muted upon entering the webcast**

2. **Please use the chat feature to ask questions**
3. **This webinar is being recorded and will be available on MEIS**

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Webinar Series: Manufacturing Opportunities in Clean Energy Markets

Offshore Wind Manufacturing Opportunities

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Agenda

- Introduction
  - Jacques Koppel, CEMC Director
- U.S. Department of Energy Offshore Wind Strategy and Manufacturing Projects
  - Cash Fitzpatrick, US DOE Wind and Water Power Program
- Offshore Wind Manufacturing Opportunities
  - Patrick Fullenkamp, GLWN Director, Technical Services
- Questions and Answers
  - Submit using Chat

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- Goal is to help MEP Centers provide their clients supply chain **opportunities in the clean energy manufacturing** economy to support **growth** & **diversification strategies**
- Services have expanded beyond wind sector to include off-shore wind, solar, advanced transportation, natural gas and geothermal markets.
- We offer market expertise that helps both the MEP center/clients identify services/next steps needed to approach the clean energy market with a higher assurance of success. Our services include:
  - Workshops/Webinars
  - Technical assessments/assistance

For info contact lindan@thecemc.com or call 612 466.4506

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Webinar Schedule

January 23rd

Offshore Wind Manufacturing Opportunities

February 27th

Solar Industry Domestic Supply Chain Opportunities (PV)

March 27th

U.S. Department of Energy Clean Energy Manufacturing Initiatives

April 24th

Manufacturing Opportunities in Mass Transit

May 22nd

Exploring Growth Opportunities in the Natural Gas Industry

June 26th

Financing Growth in Clean Energy Manufacturing

July 24th

Batteries for Electrical Energy Storage in Transportation

August 28th

Geothermal Market and Manufacturing Opportunities

September 25th

Utility-Scale Wind Manufacturing – State of the Market

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Cash Fitzpatrick

US Department of Energy
Wind and Water Power Program

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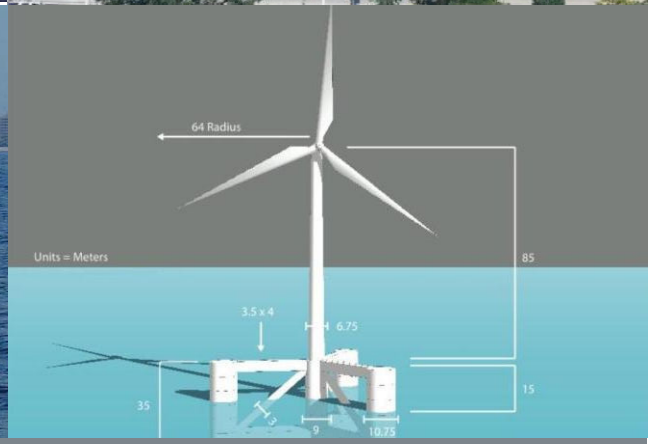
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy





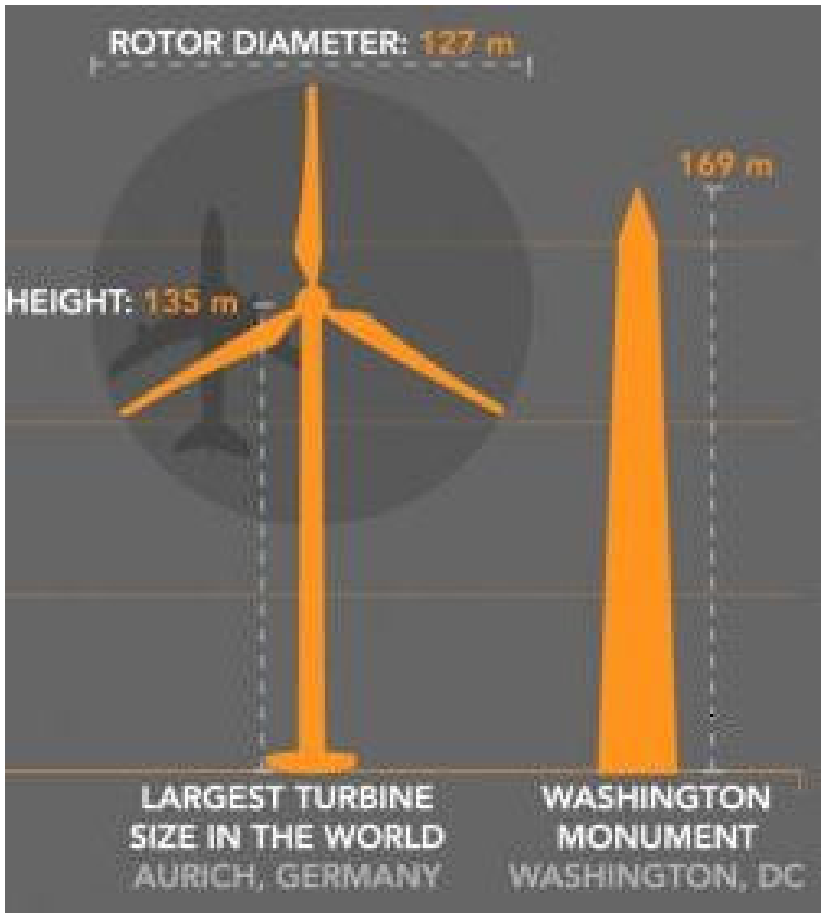
DOE's Offshore Wind Strategy & Manufacturing Projects

Cash Fitzpatrick
DOE Wind & Water Power Program
January 23, 2013

US Offshore Wind - Resource and Technology Potential

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

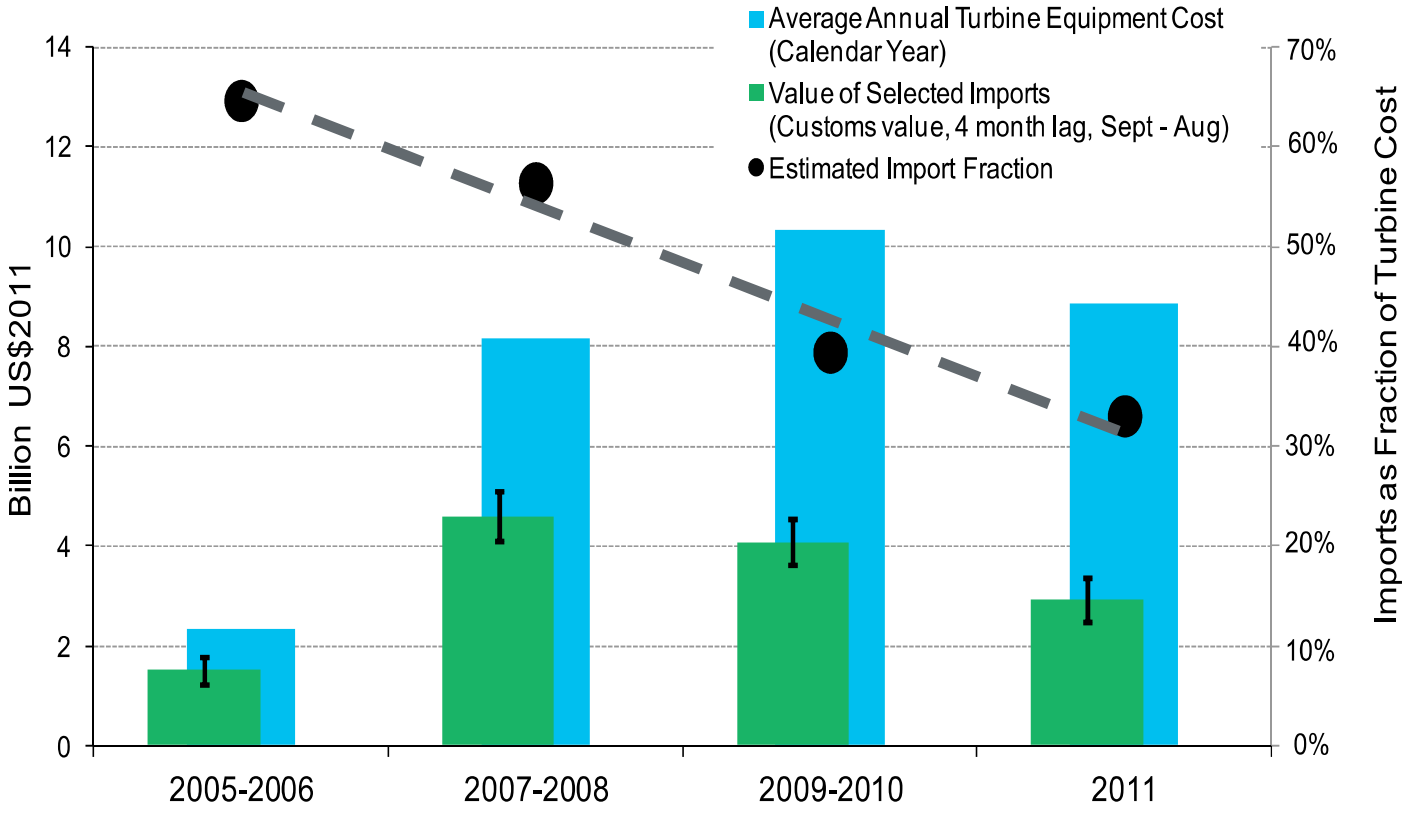
- 4,000 GW gross potential (4x entire U.S. generating capacity)
- It's in the right place: 28 coastal and Great Lakes states use 78% of the nation's electricity
- DOE's development goals for offshore wind could support as many as 200,000 manufacturing, construction, operation, and supply-chain jobs
- Would help revitalize U.S. ports and heavy industry



Lessons Learned From Our Land-Based Wind Experience

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Imports as Fraction of Value Installed in U.S.

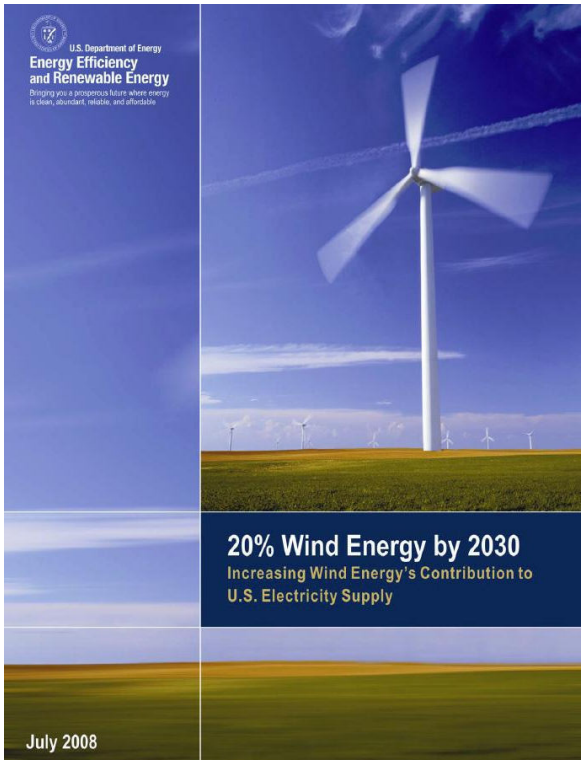


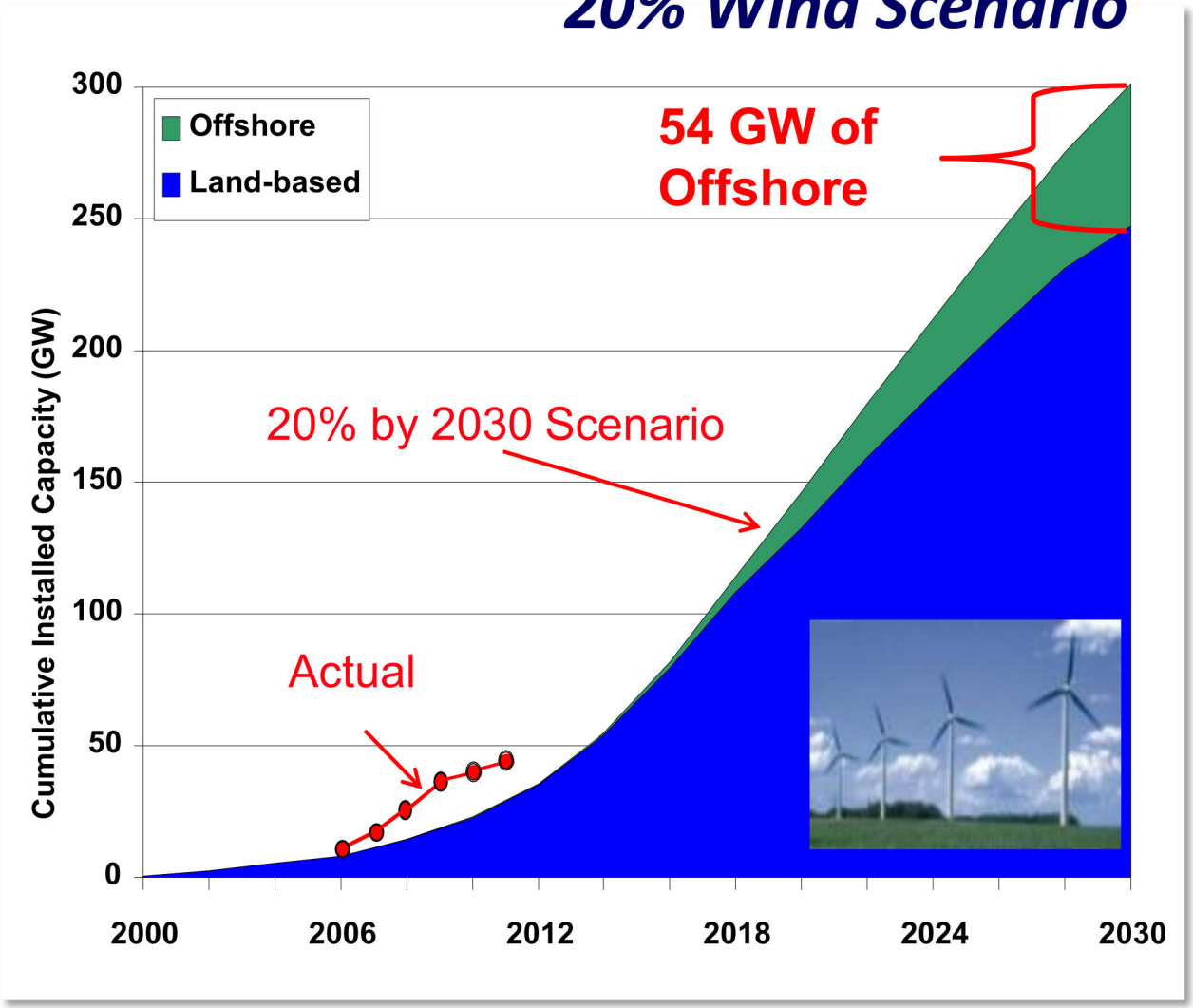
US land-based wind market has become increasingly domestic, up to 70% in 2011

Source: "2011 Wind Technologies Market Report", LBNL. Data is from the USITC.

DOE's Wind Program
Cost and Deployment Goals

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



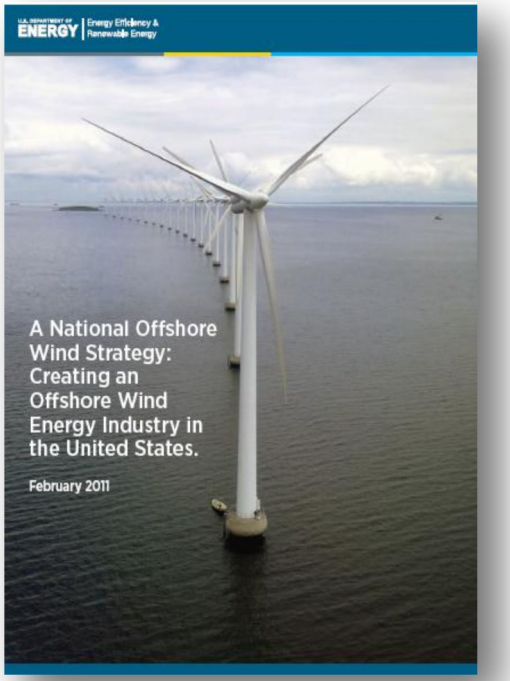


Our Guiding Framework: National Offshore Wind Strategy

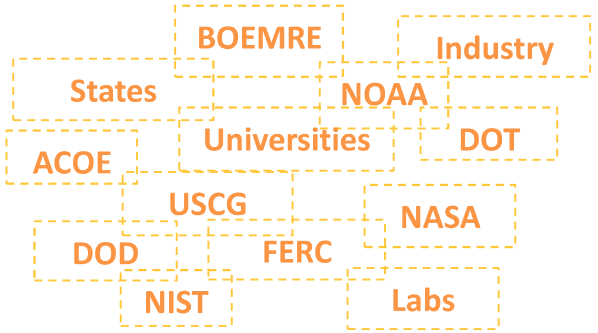
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

A commitment by the federal government to facilitate responsible deployment of offshore wind energy

- Provides long range strategy for
  - Technology Development
  - Addressing Stakeholder Issues and Market Barriers
  - Demonstration Projects
- Announced by Secretary Chu and Secretary Salazar in February 2011



Led by DOE & DOI, in partnership with:



Our Activities Align with the National Strategy

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

20% Wind by 2030
54 GW of Offshore Wind

Reduce Cost of Energy

World-Class Test Facilities

Clemson Dynamometer

Massachusetts Large Blade Test Facility

Removing Market Barriers

Manufacturing & Supply Chain

Siting and Permitting

Infrastructure

Resource Planning

Next Generation Drivetrain R&D

Aggressively Targets Key Cost Components

Developing Innovative Technology

Computational Tools

Turbine Design

Marine Systems Engineering

Promote Responsible Deployment

Demonstrate Next Generation Designs

7 Demonstration Project Partnerships with 50% Cost Share

A Partial List of DOE's Offshore Manufacturing Projects

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Project	Awardee(s)
Optimized Installation, Operations, and Maintenance Strategies	NREL Garrad Hassan
Offshore Wind Jobs and Economic Development (JEDI)	NREL
Manufacturing & Supply Chain Analysis	Navigant
Optimized Ports Assessment	Garrad Hassan
Optimized Vessels Assessment	Douglas-Westwood

- Publish ***free baseline information*** (ex: jobs created and annual market potential)
- Provide ***free tools*** to decision-makers (ex: GH's Ports model)
- ***Quantify the needs*** as well as a proposed path to effective growth
- Leverage lessons learned abroad while ***creating domestic knowledge clusters***

Commissioned by DOE, work performed by Navigant Consulting

**Final Report under DOE review, with publication expected soon*

Select Key Findings

1. $1.8-2.2B/yr annual market potential by 2020.

2. Up to 14,000 FTE supplier jobs by 2030.

3. Greatest potential in foundations/substructures, towers, blade materials, power converters, and transformers.

Advanced Offshore Technology Demonstration Project

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Accelerate Next Generation Technologies

Optimized Wind Plant Designs for Geographic Regions

FOA

$170M

5-7 Years

2013: 7 Awards

$4M each for 50% Planning, Design & Permitting

2014: Select 3 Projects for Construction

Up to $47M each operational by 2017

Regions: Atlantic, Great Lakes, Gulf, Pacific

Federal Waters: 3

State Waters: 4

Fixed Foundations: 4

Floating Platforms: 3

Reduce risk and uncertainty for permitting, environmental review, & public acceptance

Establish a U.S. industry infrastructure & baseline LCOE

Facilitate innovative offshore systems development

Validate construction and operating costs

Demonstration Project Highlights

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

UNIVERSITY OF MAINE
2 x 6MW, Floating semi-sub,
Maine State waters

STATOIL NA
4 x 3MW, Floating spar,
Federal waters off Maine

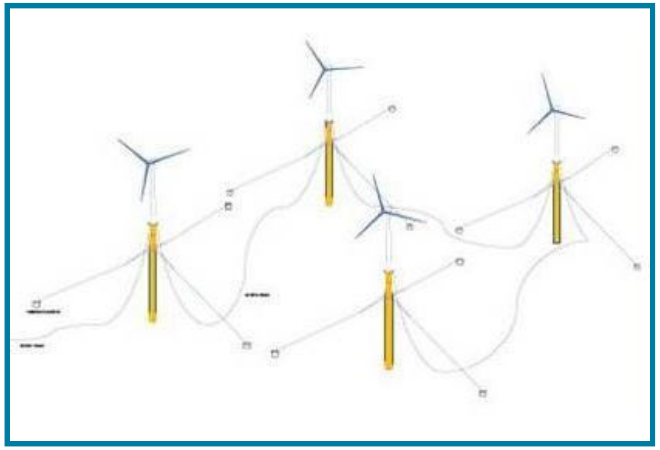
FISHERMEN'S ENERGY
5 x 5MW, Monopiles,
New Jersey State waters

DOMINION
2 x 6MW, IBGS foundations,
Federal waters off Virginia

BARYONYX
3 x 6MW, Jacket foundations,
Texas State waters

PRINCIPLE POWER
5 x 6MW, Floating semi-sub,
Federal waters off Oregon

LEEDCO
9 x 3MW, Icebreaking foundations,
Great Lakes (Erie) off Ohio



Looking Ahead to 2013

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Demonstration Projects – Aiming to have all their awards in place by end of next month, with projects installs by 2014
- Ports/Vessels/Installation/etc Projects – All should be delivering tools and published findings by this Summer
- GLWN Manufacturing Competitiveness Project – Ramping up now and continuing for the next year

DOE's Wind and Water Power Program continues to see this as a priority area with a portfolio of projects

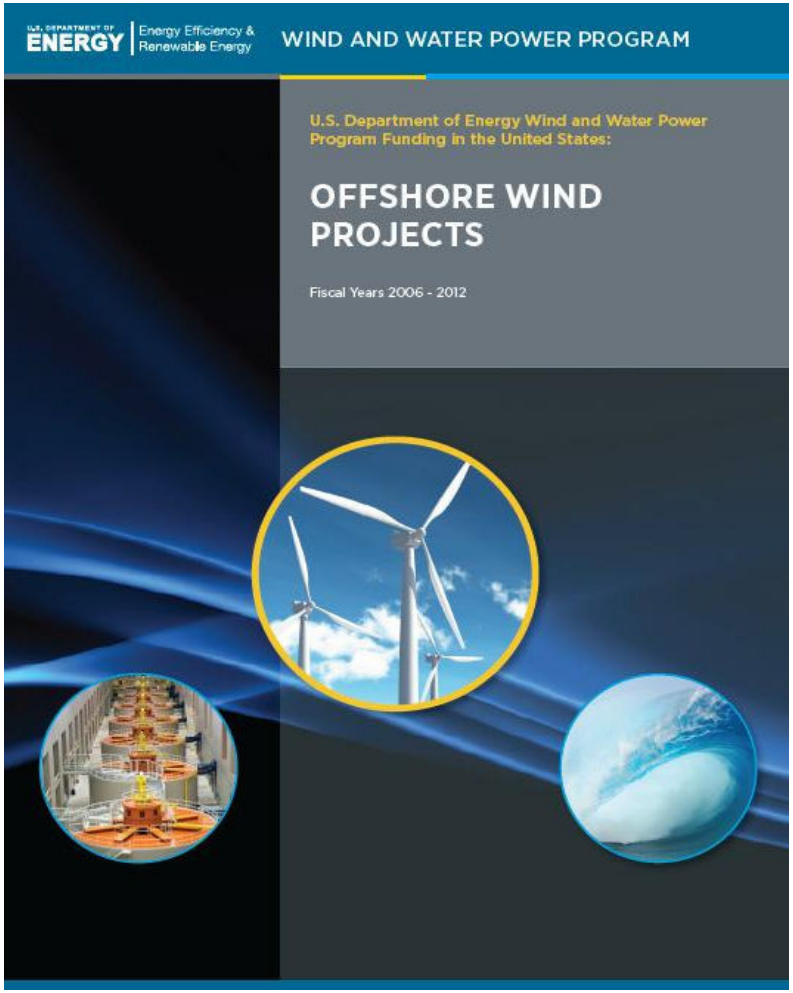
Thank You!

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Cash Fitzpatrick
Wind and Water Power Program
Office of Energy Efficiency and Renewable Energy
US Department of Energy
http://www.wind.energy.gov
Cash.Fitzpatrick@ee.doe.gov

DOE Offshore Portfolio Overview

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Describes 60+ projects worth $140M of DOE investment

Includes:

- Project recipient
- Award amount
- Work scope description

Activity Area	Total Funding
Technology Development Subtotal	**$119,643,294**
Test Facilities	$69,308,031
Advanced Turbine Technologies	$21,854,560
Floating Foundation Technologies	$13,501,941
Modeling, Simulation, and Design Tools	$10,408,412
Optimized Wind Plant Systems	$4,570,350
Market Acceleration and Deployment Subtotal	**$20,760,332**
Siting – Environmental and Permitting	$9,392,752
Resource Characterization	$4,936,064
Market Acceleration and Barrier Reduction	$3,916,606
Grid Systems Planning and Operations	$2,514,910
Total	**$140,403,626**

Available now at: wind.energy.gov/pdfs/offshore_energy_projects.pdf

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Patrick Fullenkamp

Global Wind Network

Director, Technical Services

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GLWN – BGA Offshore Wind Webinar - January 23, 2013

Patrick Fullenkamp – Director, Technical Services
pfullenkamp@glwn.org

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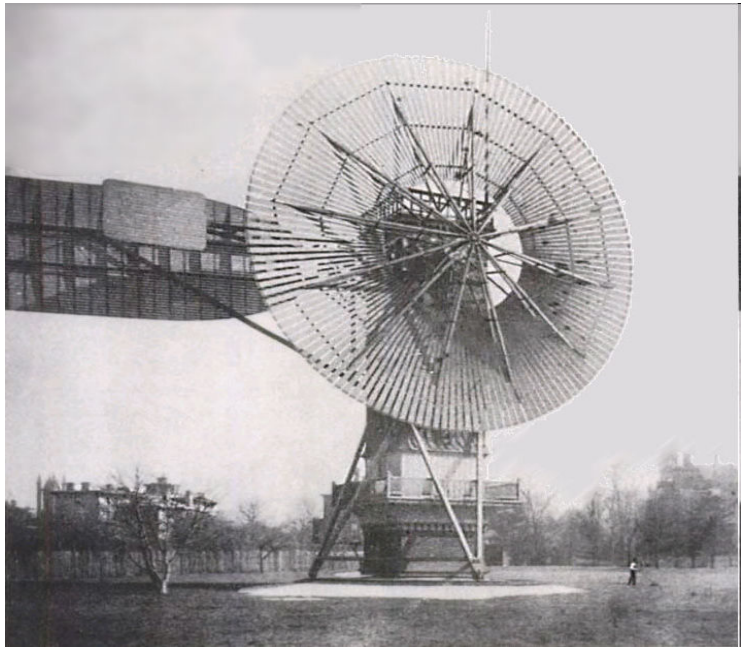
Wind Turbines:
An American Invention



Charles Brush Cleveland, OH
12 Kilowatts 1888

NASA Oahu, HI
3.2 Megawatts 1980

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GLWN……*Call us Global*

- **Membership-based, Non-Profit**
- **International Supply Chain Advisory Group**
- **1600 companies across 35 States + Canada**
- **Supplier Headhunters for the Wind Industry**
- ***Resource* for Suppliers and Service Providers**
- **Mission:**

  -Localize New Business Opportunities

  -Increase the Domestic Content of North America's Wind Turbines

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Topics to be Covered

- Offshore vs Onshore Wind Energy
- Manufacturing Opportunities based on German Model
- Manufacturing Sector Opportunities: Heavy Fabrication, Casting & Machining, Forging & Machining, Electrical, Composites, General Commodities
- DOE Project Focusing on Manufacturing Competitiveness

Source: GLWN

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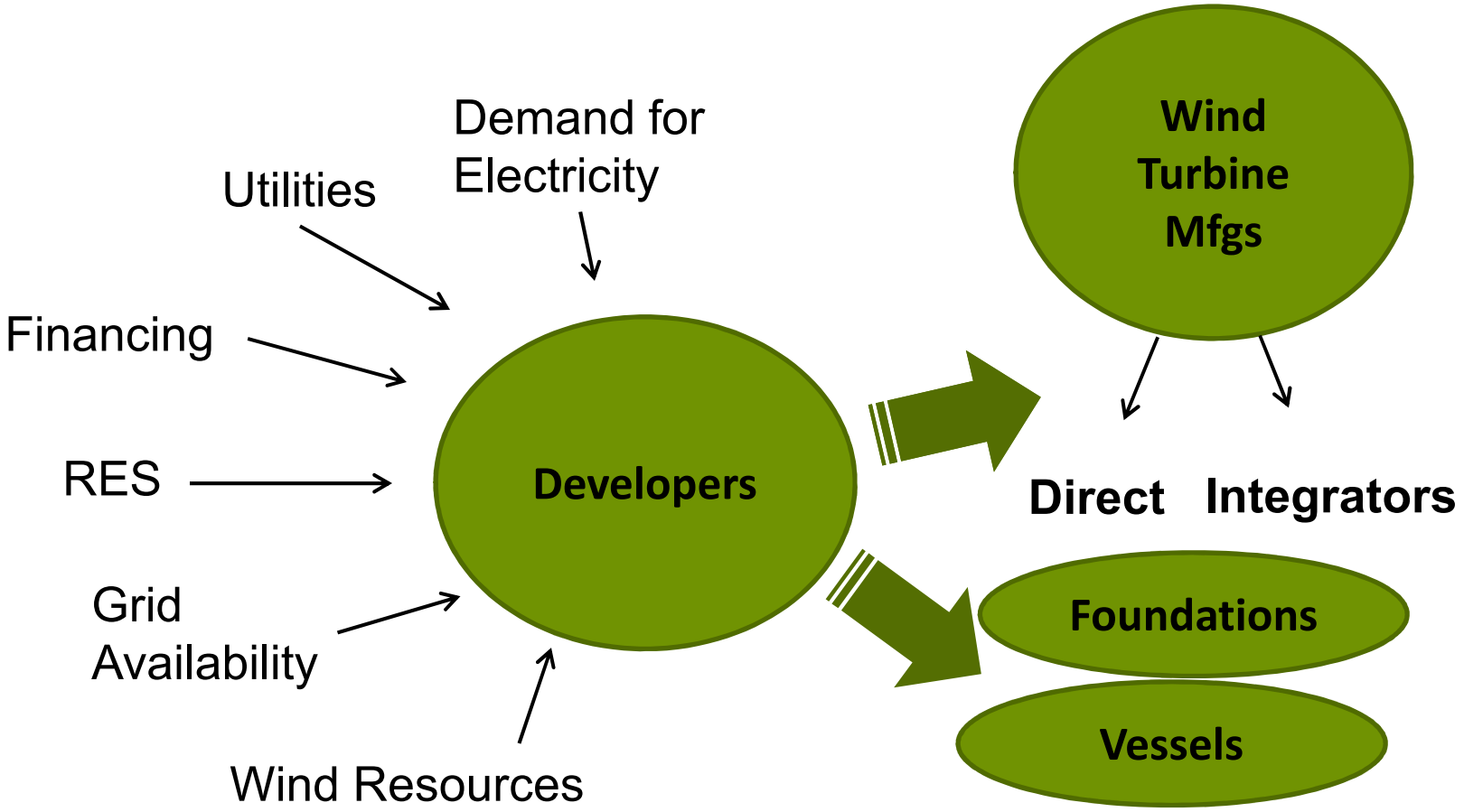
Driving Forces in Wind



Source: GLWN

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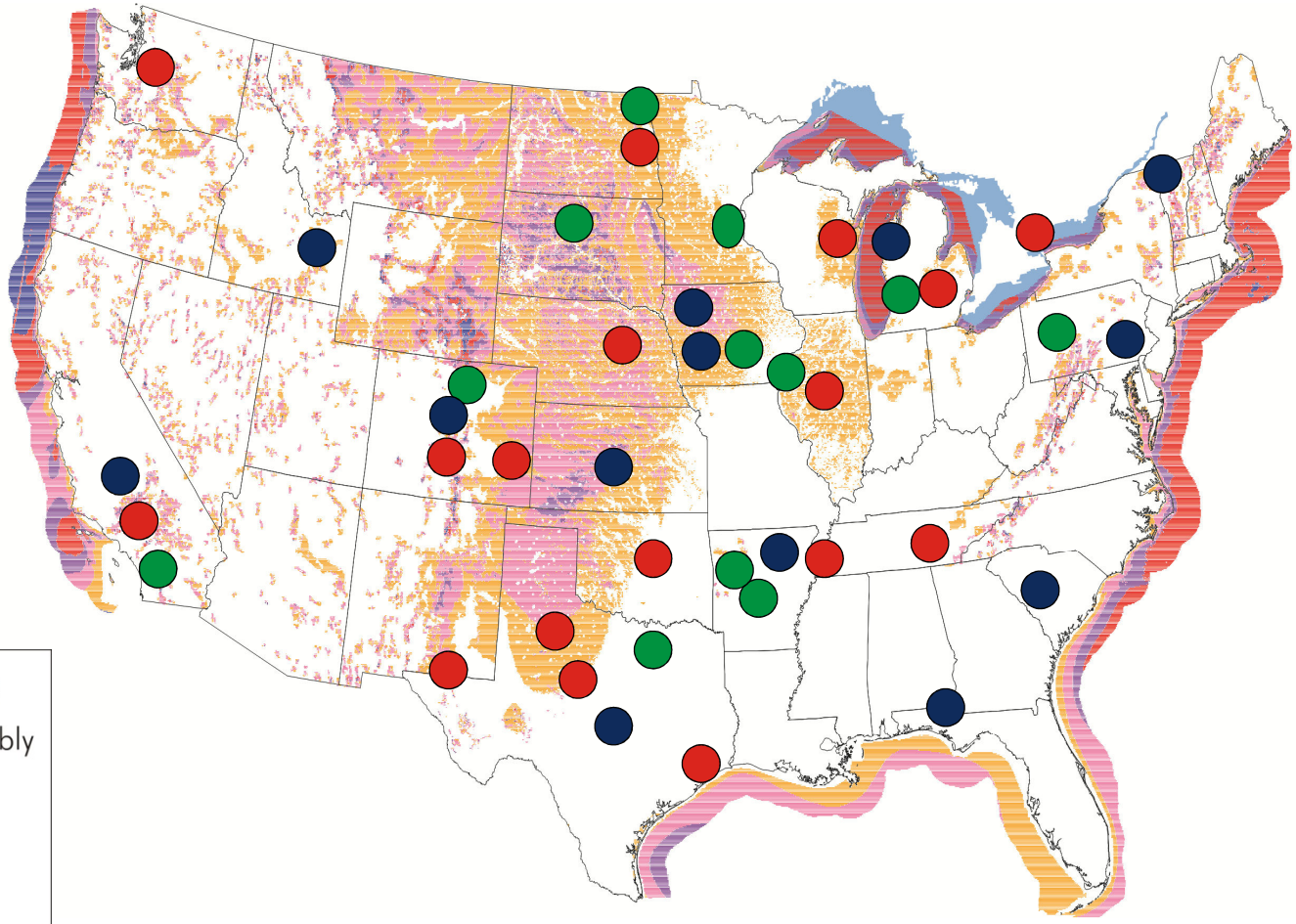
Onshore Turbines, Towers, & Blades

Offshore will be in Coastal Areas:
- **Atlantic**
- **Great Lakes**
- **Gulf**
- **Pacific**



Source: GLWN & NREL

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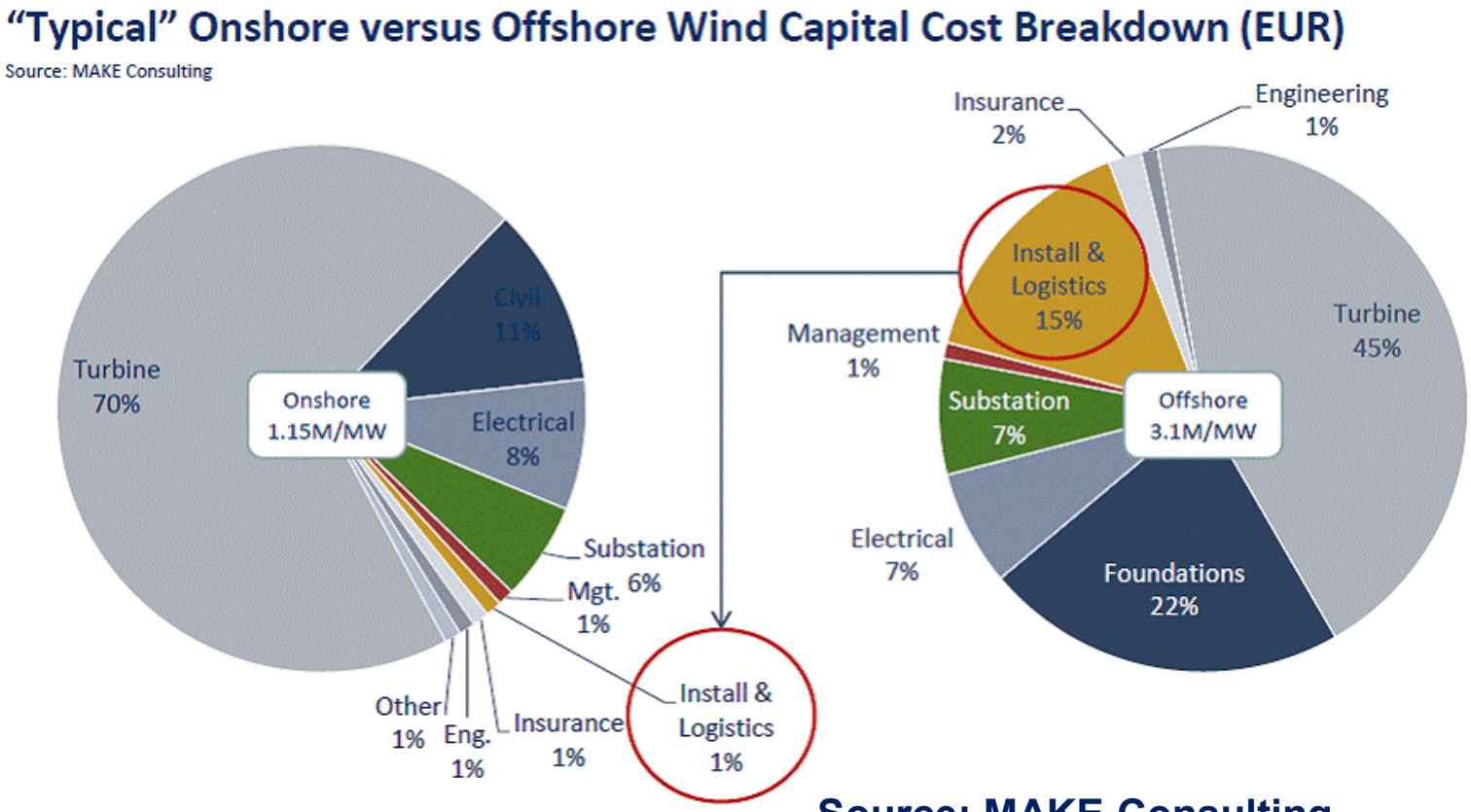
Onshore vs Offshore CAPEX



Source: MAKE Consulting

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Offshore Goals

- Europe 55 GW by 2020, 3.2 GW in 2011
- Europe 150 GW by 2030
- USA 10 GW by 2020, 0 GW in 2011
- USA 54 GW by 2030

For USA
500 – 5MW Units/Yr. 2017 to 2020
630 – 7MW Units/Yr. 2021 to 2030

Source: GLWN

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2012 Manufacturing – Buzzing in Germany. **This can be in the USA!**

Source: GLWN

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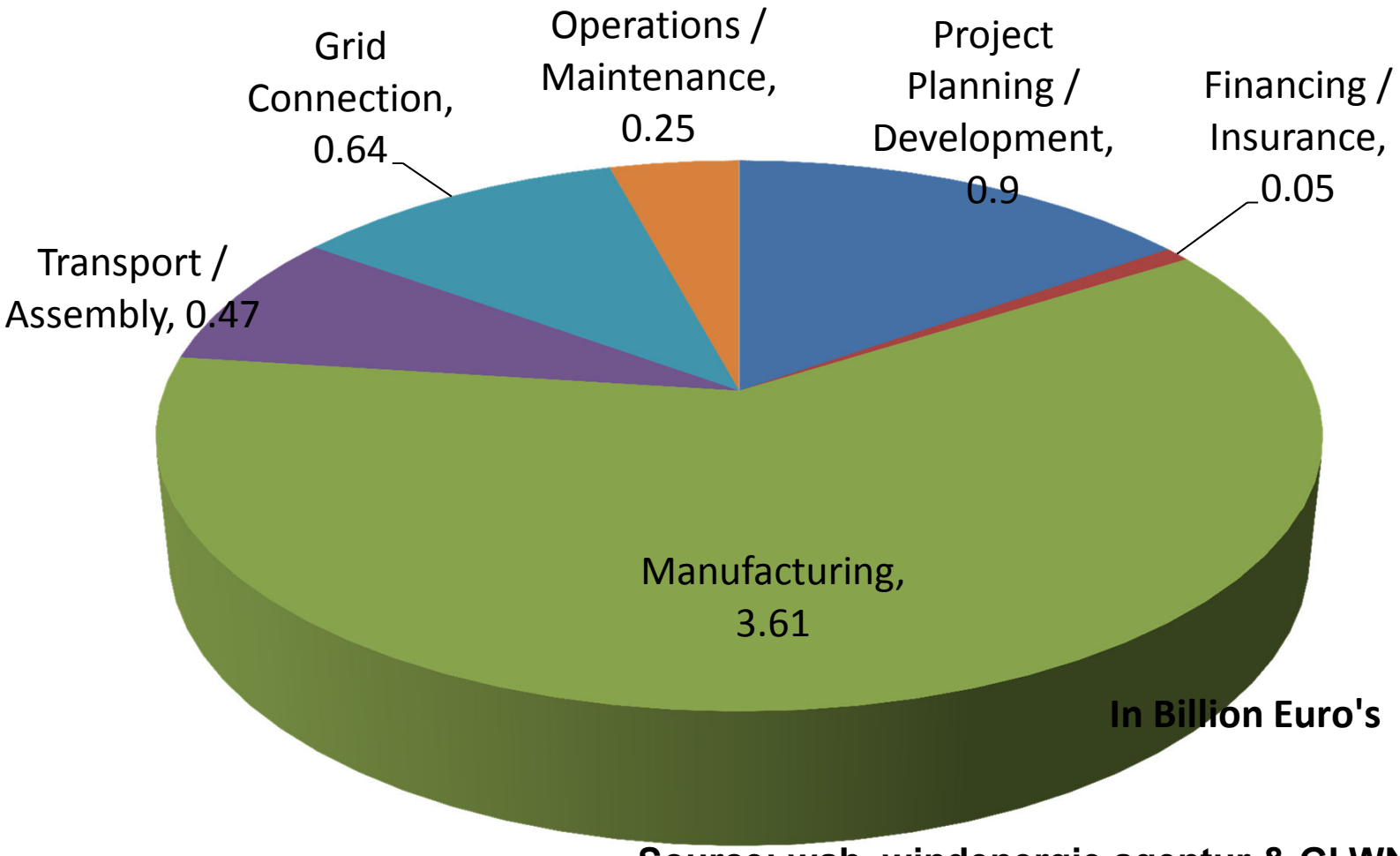
Germany 2011 Total Value Add 5.9B



Source: wab, windenergie agentur & GLWN

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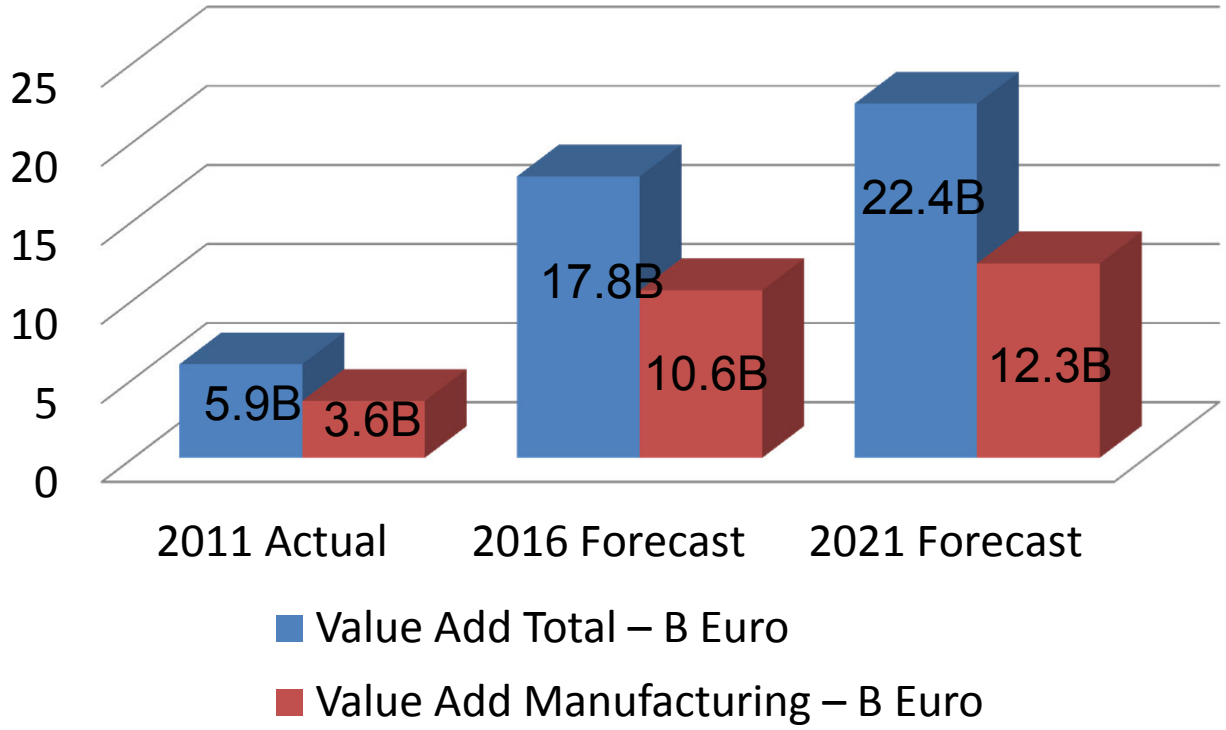
Germany Offshore Value Add



Germany's Ports – Bremerhaven, Cuxhaven, Emden, Wilhelmshaven, Rostock

Source: wab, windenergie agentur & GLWN

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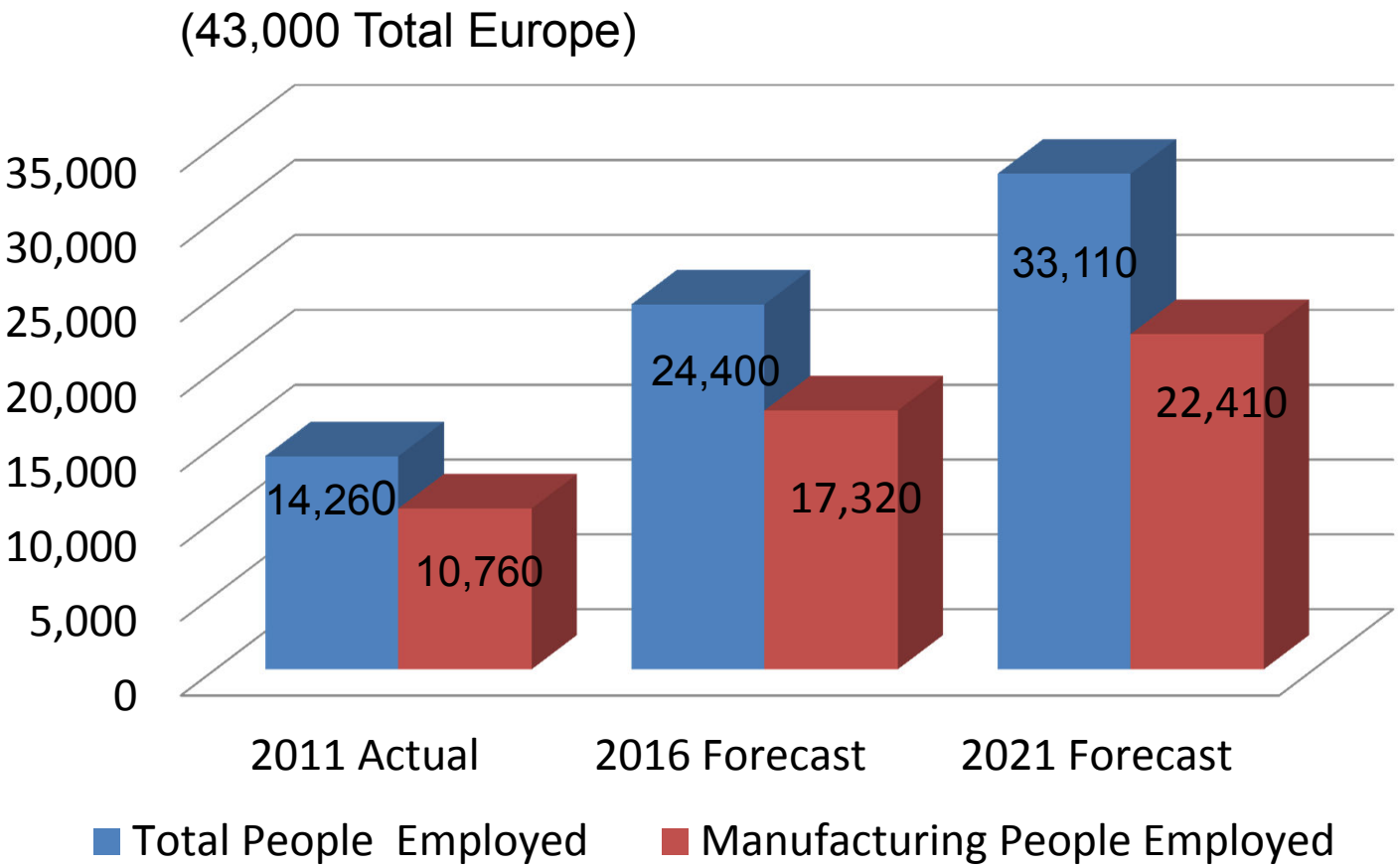
German Offshore Wind Employment



Source: wab, windenergie agentur & GLWN

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Offshore Heavy Fabrication

- Foundations (400T to 10,000T): Steel Plate Rolled, Forged Flanges, Fasteners, Angular and Tubular Steel, Brackets, Ladders, Weld wire
- Towers (250T to 600T): similar to foundations
- Platforms: Steel Plate, Tubular
- Main Frame, Generator Frame: Cut and welded flat plate all shapes and sizes, Weld wire
- Vessels – current ship building needs

Source: GLWN

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WeserWind Tripods – Production Halle II

- 900 – 1200 Ton
- 13 Major sub-asms

Source: GLWN

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WeserWind Tripod Components

Source: GLWN

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WeserWind Tripod – Foot Section for grouting to pile

Source: GLWN

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Fabrication Indirect Equipment

- Indirect Material: Welding Equipment, weld gas, dimensional measurement equipment, weld inspection

Source: GLWN

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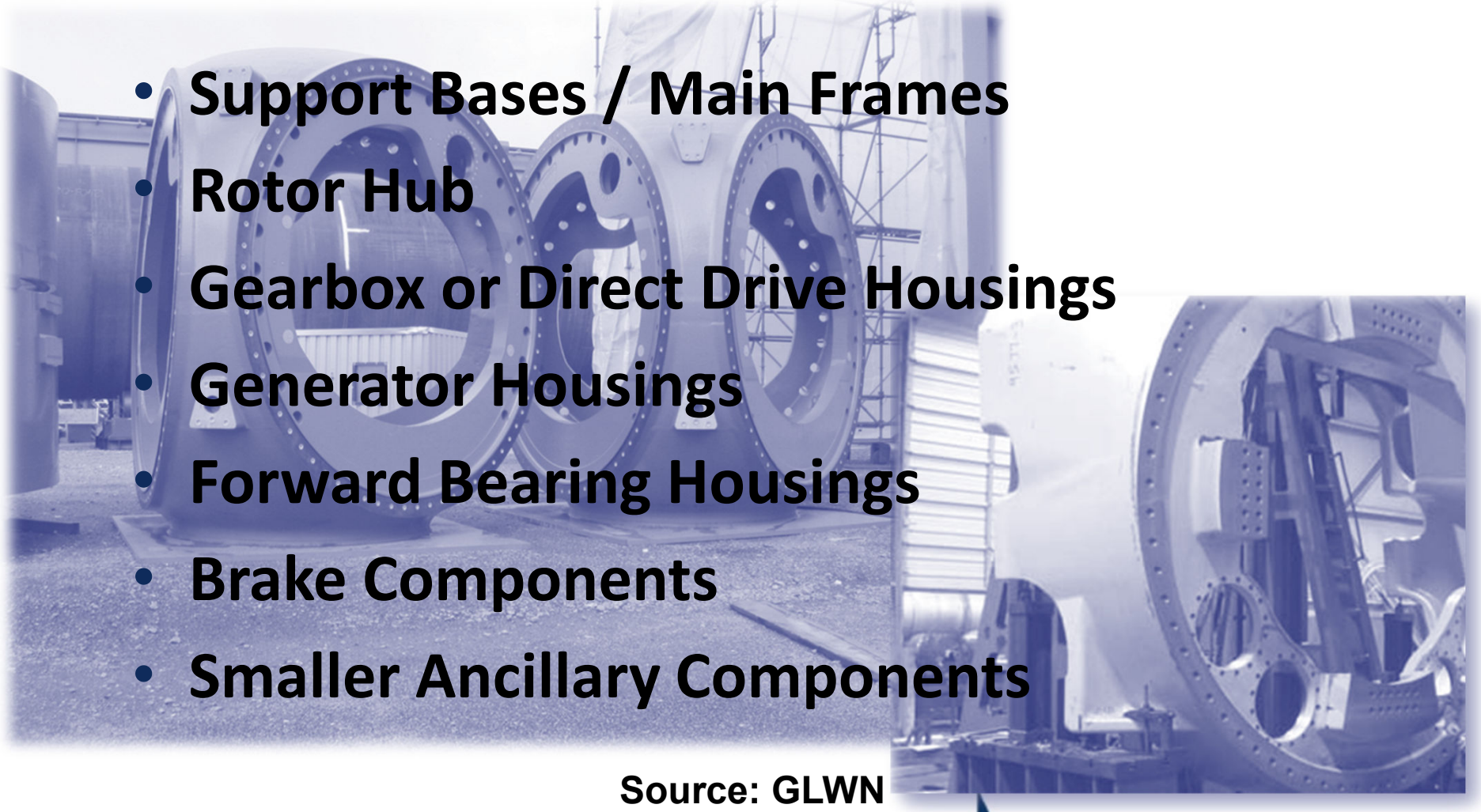
Casting and Machining



- Support Bases / Main Frames
- Rotor Hub
- Gearbox or Direct Drive Housings
- Generator Housings
- Forward Bearing Housings
- Brake Components
- Smaller Ancillary Components

Source: GLWN

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5MW Hubs

Source: GLWN

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Support Base

Source: GLWN

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Forging and Machining

- Main Shafts
- Flanges, Tower and Foundation
- Attachment Studs
- Gearbox / Drive Internals: shafts, Gears, Retainers
- Brake Components
- Shrink Discs
- Smaller Ancillary Components

Source: GLWN

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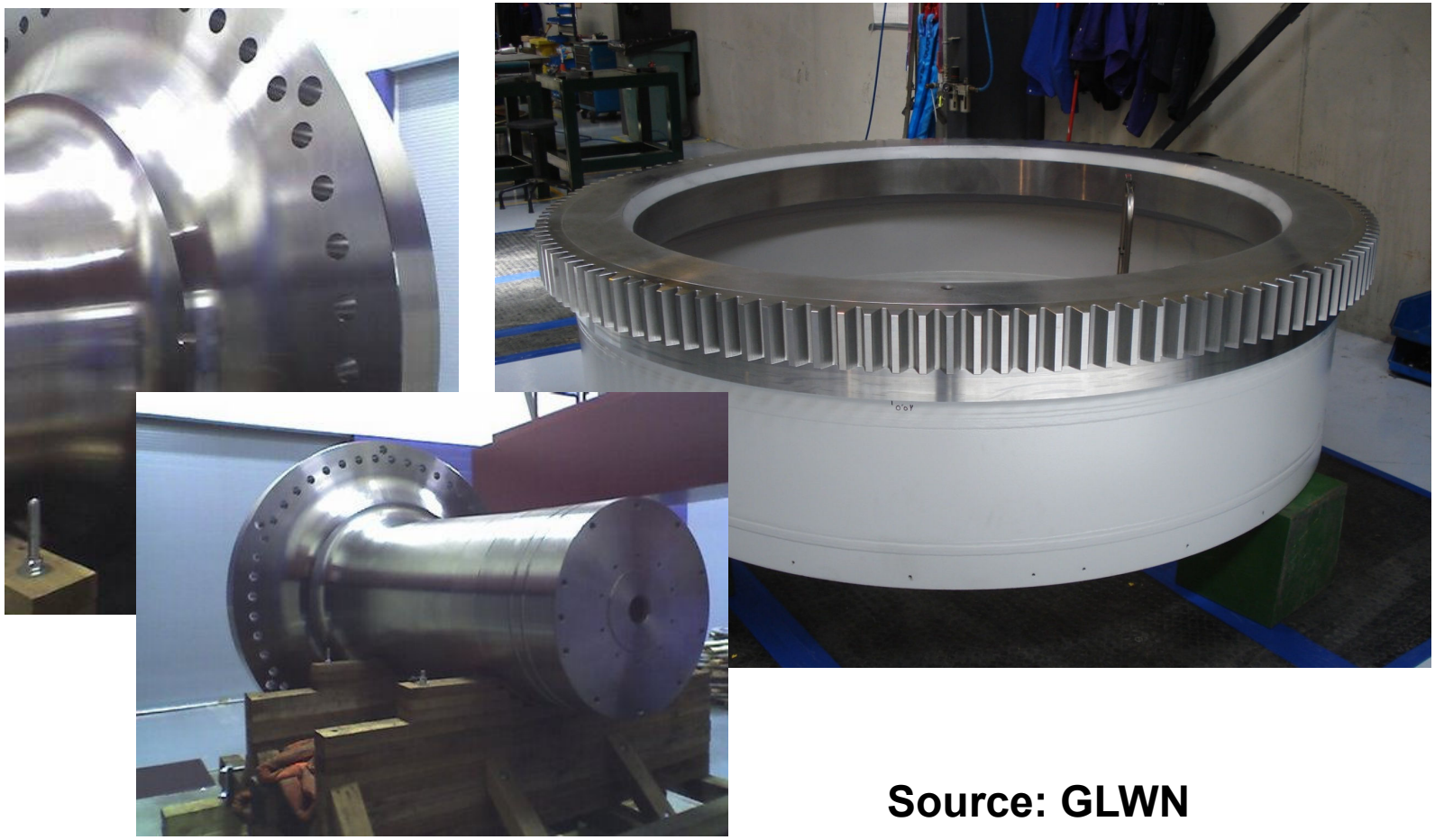
Forgings & Machining



Source: GLWN

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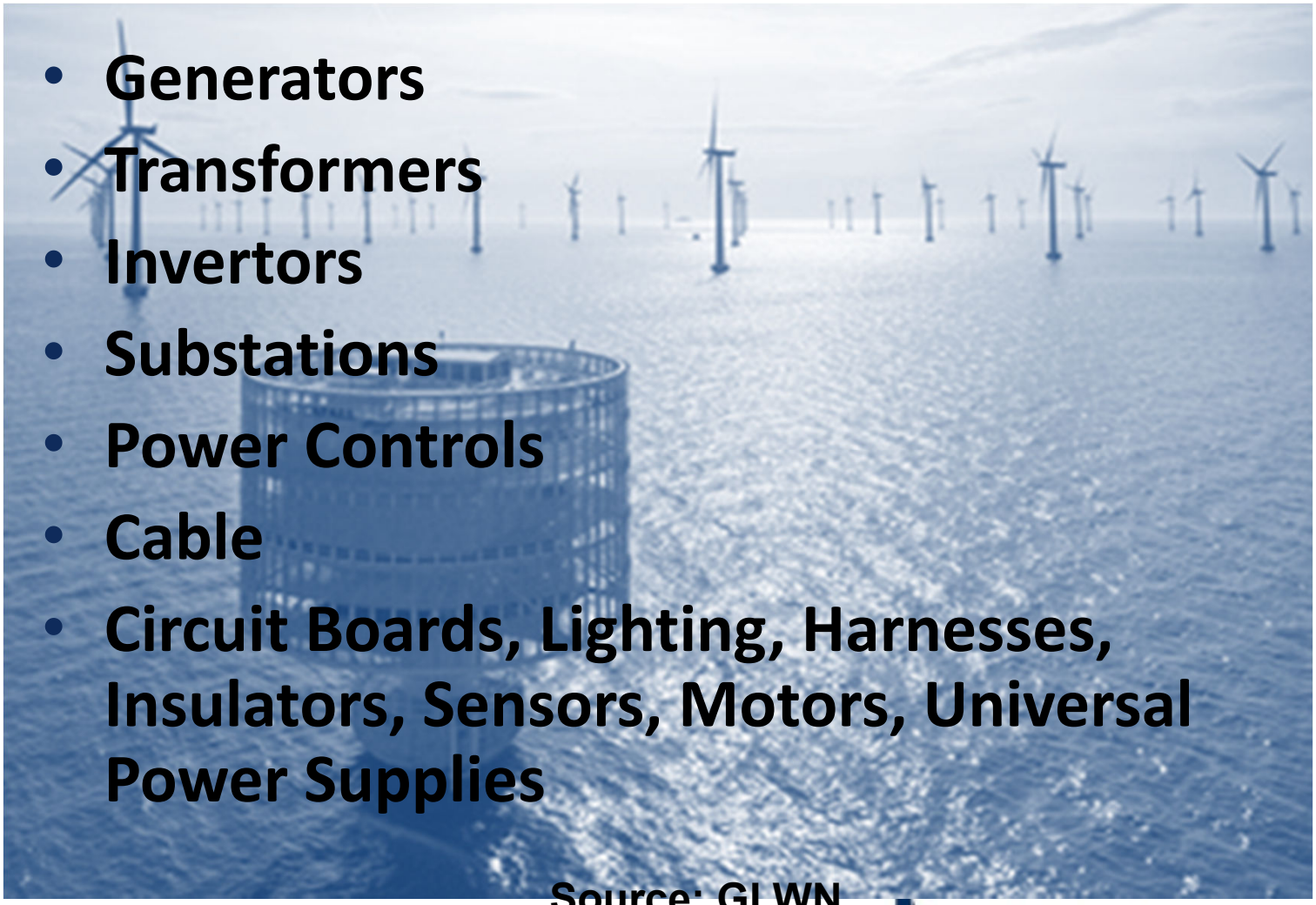
Electrical



- Generators
- Transformers
- Invertors
- Substations
- Power Controls
- Cable
- Circuit Boards, Lighting, Harnesses, Insulators, Sensors, Motors, Universal Power Supplies

Source: GLWN

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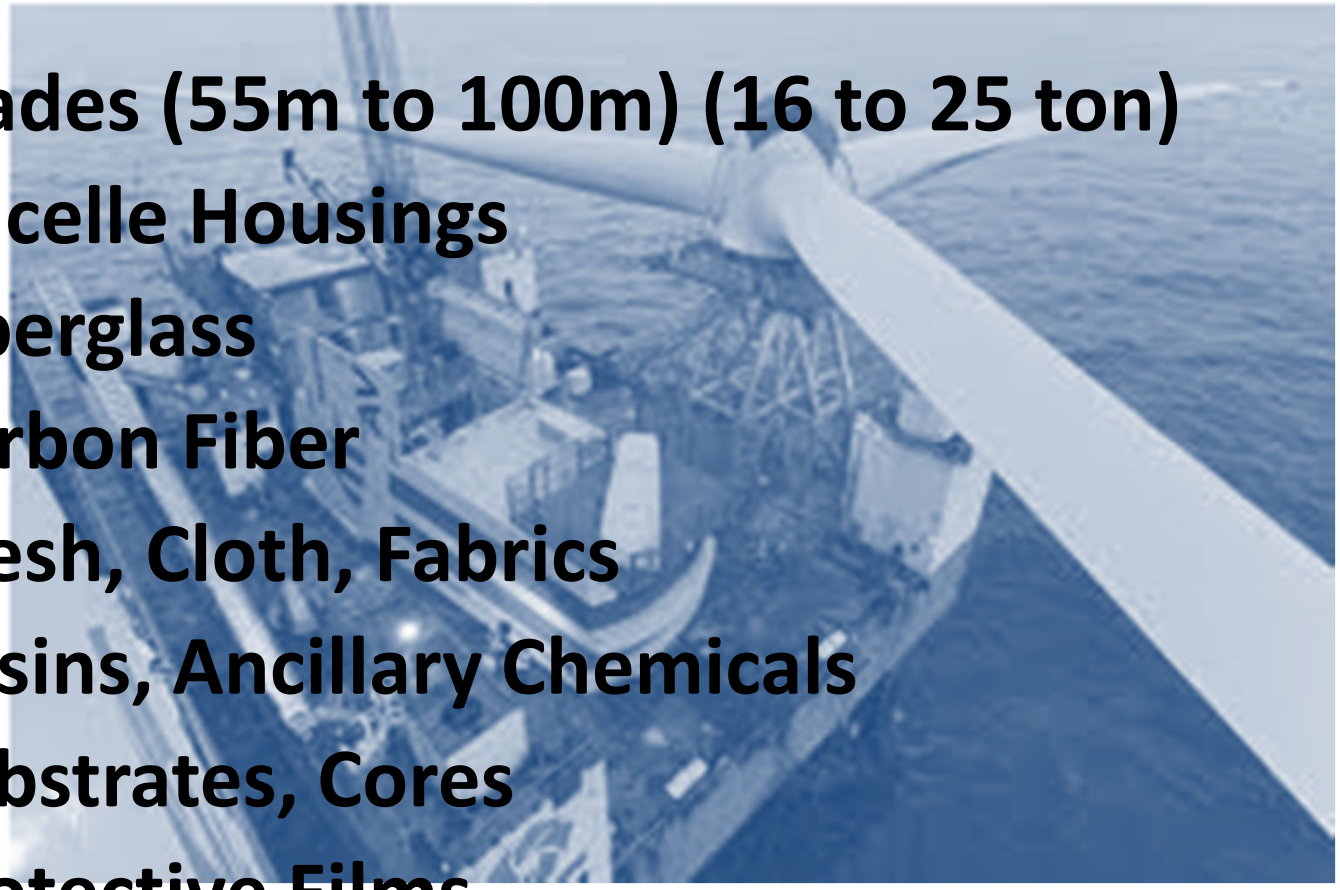
Composites



- **Blades (55m to 100m) (16 to 25 ton)**
- **Nacelle Housings**
- **Fiberglass**
- **Carbon Fiber**
- **Mesh, Cloth, Fabrics**
- **Resins, Ancillary Chemicals**
- **Substrates, Cores**
- **Protective Films**

Source: GLWN

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5 MW Blade Production Germany

5 MW Turbine Blade

56.5 m length
16 ton

Source: GLWN

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Commodity Opportunity Summary

- Bearings
- Instrumentation
- Cranes
- Lube Systems
- Cooling Systems
- SCADA Systems
- Meteorological Systems
- +Many More

Source: GLWN

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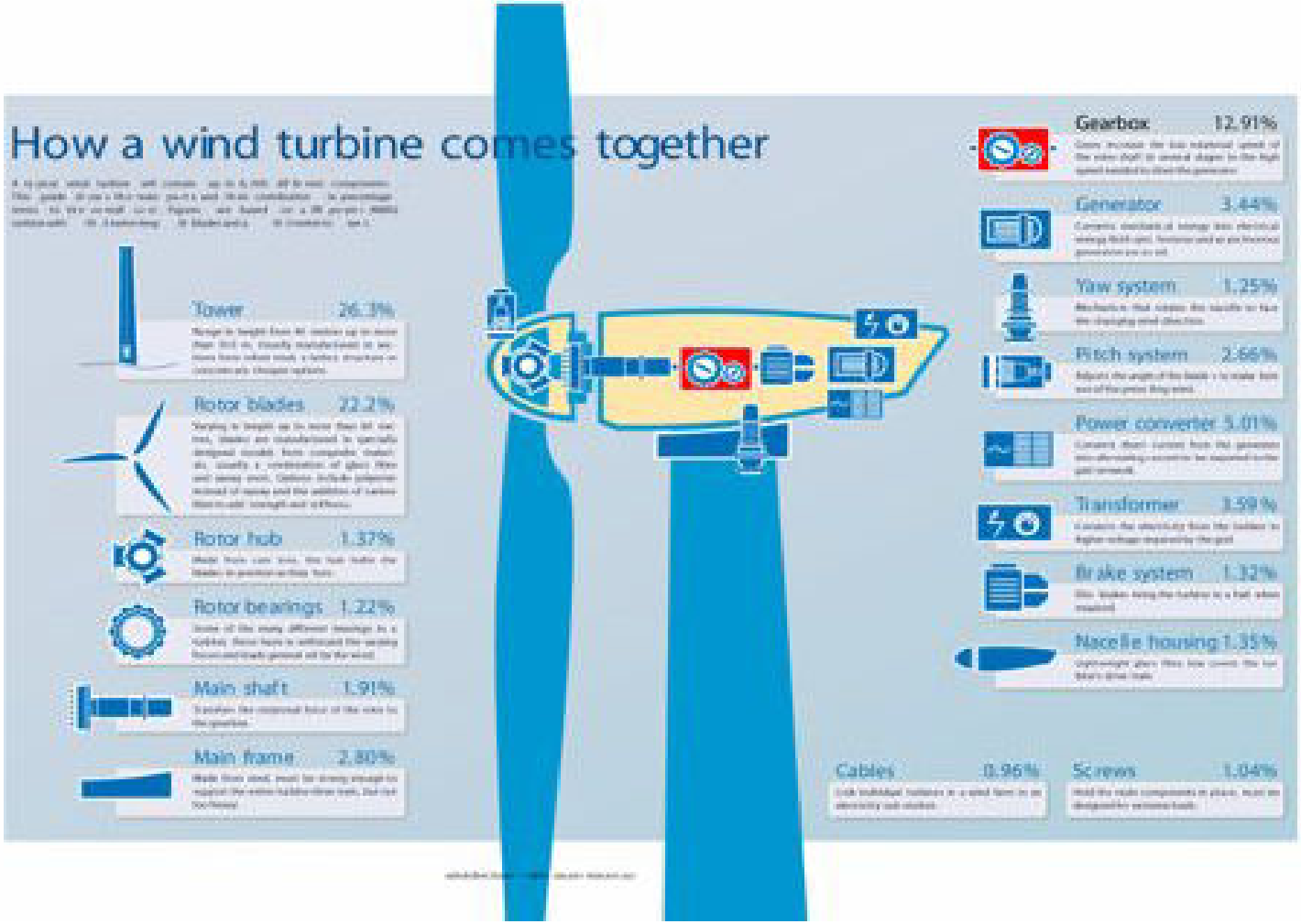
Major Wind Turbine Systems



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Jacket Transport Barge Mounting Piece

Source: GLWN

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Vessels

- Transport Vessels
- Installation Vessels – Lifting Platform (Jack-up), Self propelled jack-up that can transport and install, Heavy duty ships with wave compensation
- Crew Transport Vessels
- Helicopters 3,000 to 18,000 lb payload

Source: GLWN

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Installation Vessel

Ocean Jack-up Vessel

BARD – Wind Lift 1 in Europe

Length hull	93.0 m
Breadth hull	36.0 m
Depth hull	7.4 m
Displacement	>20,000 t
Max water Depth	45.0 m

4 Diesel Generators
1 emergency diesel
Accommodations 50 Crew

SBM OFFSHORE GustoMSC

< 23 m Hull Breadth if in Great Lakes

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Transport & Installation Vessels

SBM OFFSHORE GustoMSC

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Crew Transport Vessels

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Offshore Wind Supply Chain Opportunities

DOE Goal 54 GW by 2030 = 10,800 Units if all are 5 MW

- Logistic & Port Infrastructure Impact
- Foundations - fabrication-machining-coatings
- Towers – fabrication-forging-machining-coatings
- Blades – composites-processing-machining
- Support Bases and Hubs – casting/fabrication-machining-coatings
- Vessels – fabrication-casting-forging-machining-electrical-hydraulics-coatings
- Cable & Substation – all major manufacturing sectors

Source: GLWN

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DOE Project Award to GLWN

- **US Wind Energy Manufacturing and Supply Chain: A Competitiveness Analysis** Deliverables:
  - Value Stream Mapping (Foundations, Towers, Blades, Direct Drive Generators) – 3 Regions US, Europe, China
  - Cost Breakdown Analysis (same as above)
  - Identify Capable Manufacturers & Service Providers with MEP collaboration
  - Update GLWN's Supply Chain Database and Map
- GLWN working with Coastal State MEPs to get regional mfgs listed on a new Offshore Supply Chain Map at www.glwn.org. Contact Dee Holody dholody@glwn.org

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THANK YOU!

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Questions and Answers

Submit using Webinar Chat feature

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August 28th

Geothermal Market and Manufacturing Opportunities

September 25th

Utility-Scale Wind Manufacturing – State of the Market

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For Further Information

- Contact Linda Nielsen, Program Manager, Clean Energy Manufacturing Center, lindan@thecemc.com , 612.466.4506

- Or visit our website at www.thecemc.com

Be with us next month as we explore the **Manufacturing Opportunities in the Solar Industry** – 4th Wednesday at 1:00 Eastern

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