BUSINESS NETWORK for OFFSHORE WIND

THE OFFSHORE WIND MARKET

presented by Liz Burdock of the
BUSINESS NETWORK FOR OFFSHORE WIND

> “The great use of life is to spend it for something that will outlast it.”

FRED OLSEN BRAVE TERN

Brave Tern is an offshore wind installation jack-up vessel specially designed for offshore wind installation

Brave Tern is capable of being used for decommissioning platforms in 300-ft water depths

Fred Olsen installed the offshore wind turbines on Block Island

Fred Olsen Windcarrier, Norway-based shipping company, owns Brave Tern vessel

Fleet consists of two self-elevating, self-propelled jack-up vessels and 7 crew transfer vessels

BLOCK ISLAND

America's first offshore wind farm, located in Rhode Island, constructed in 2015

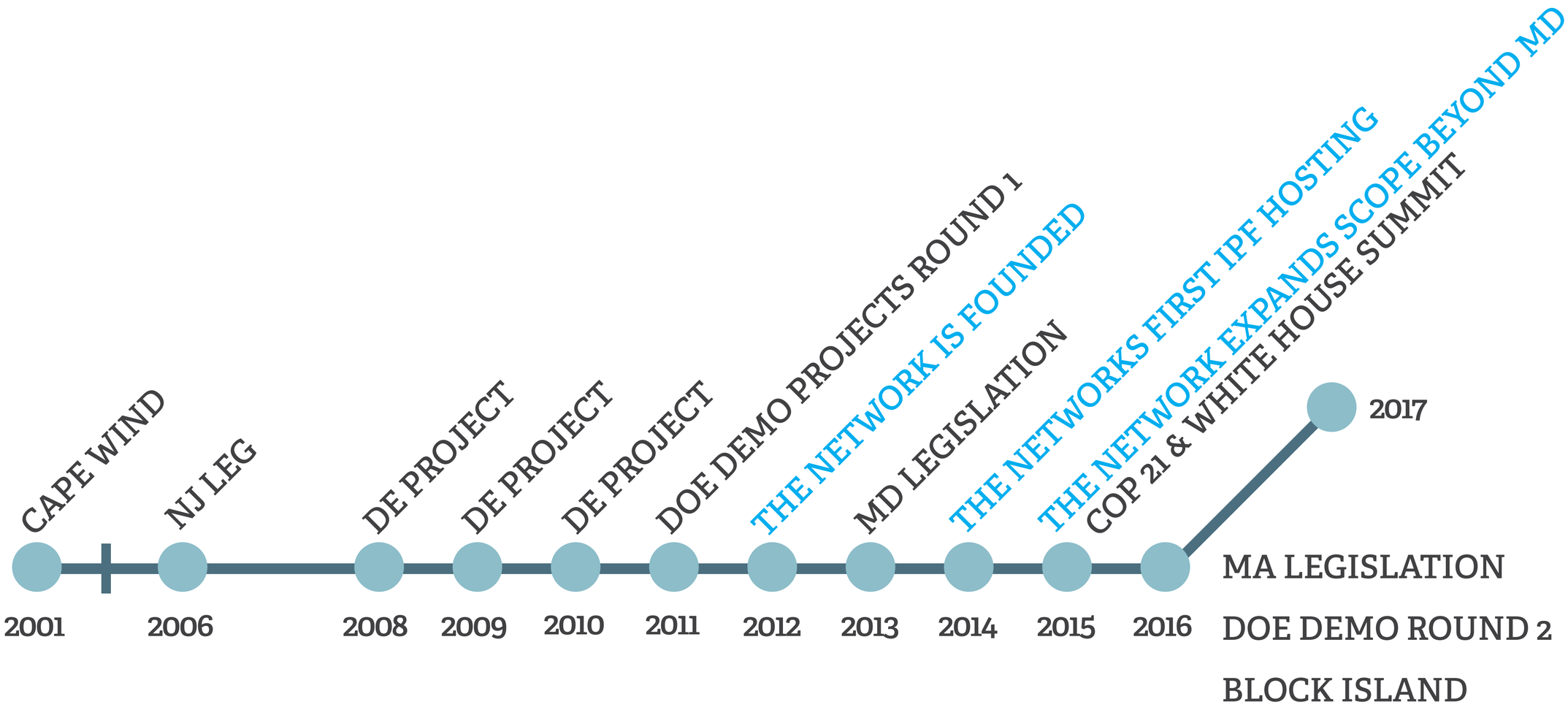
Developed by Deepwater Wind and powered by GE

5 turbines capable of powering 17,000 homes

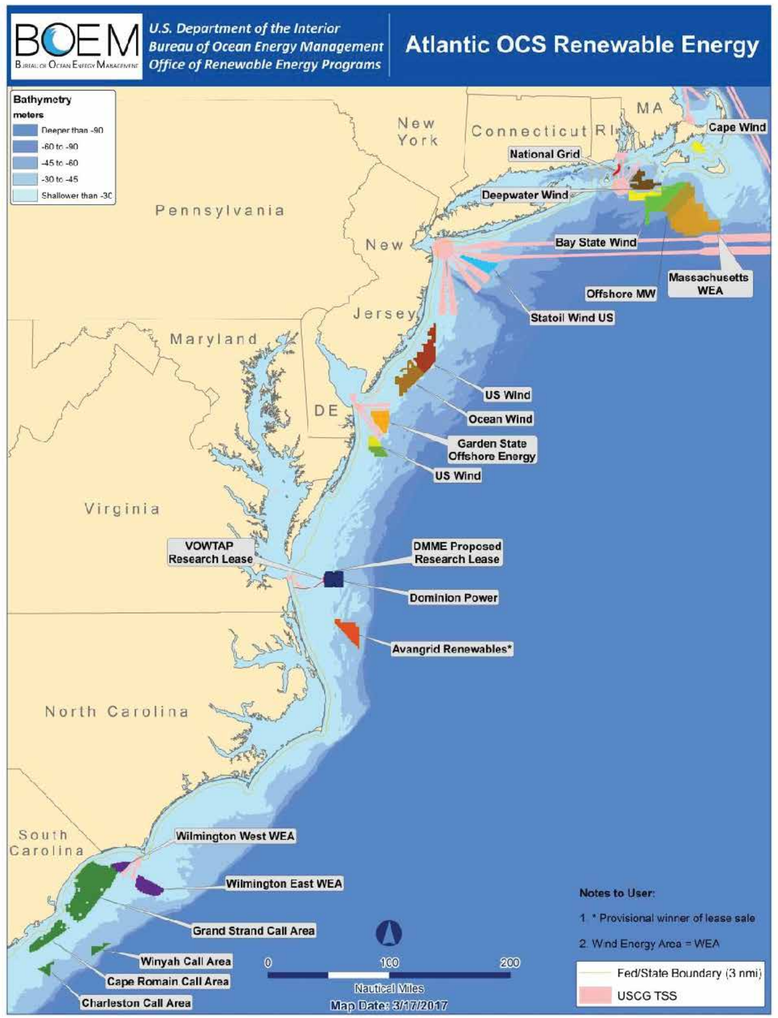
Reduces carbon dioxide emissions by about 40,000 tons per year

BUSINESS NETWORK for OFFSHORE WIND

OFFSHORE WIND IN THE US



LEASE AREAS



Alaska OCS Region

Gulf of Mexico OCS Region

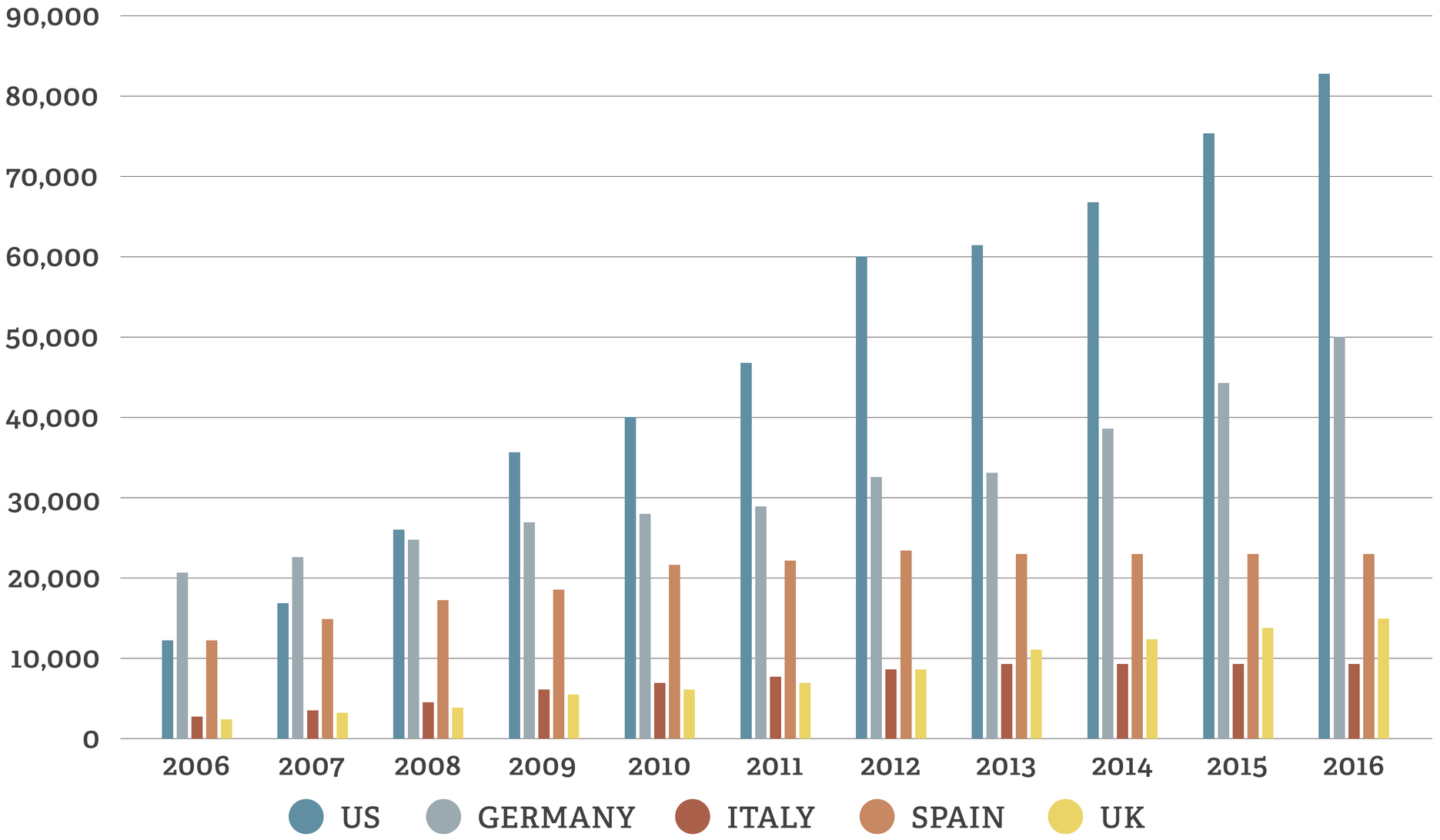
Pacific OCS Region

OSW WIND DRIVERS

BUSINESS NETWORK for OFFSHORE WIND

INSTALLED WIND CAPACITY (MW)

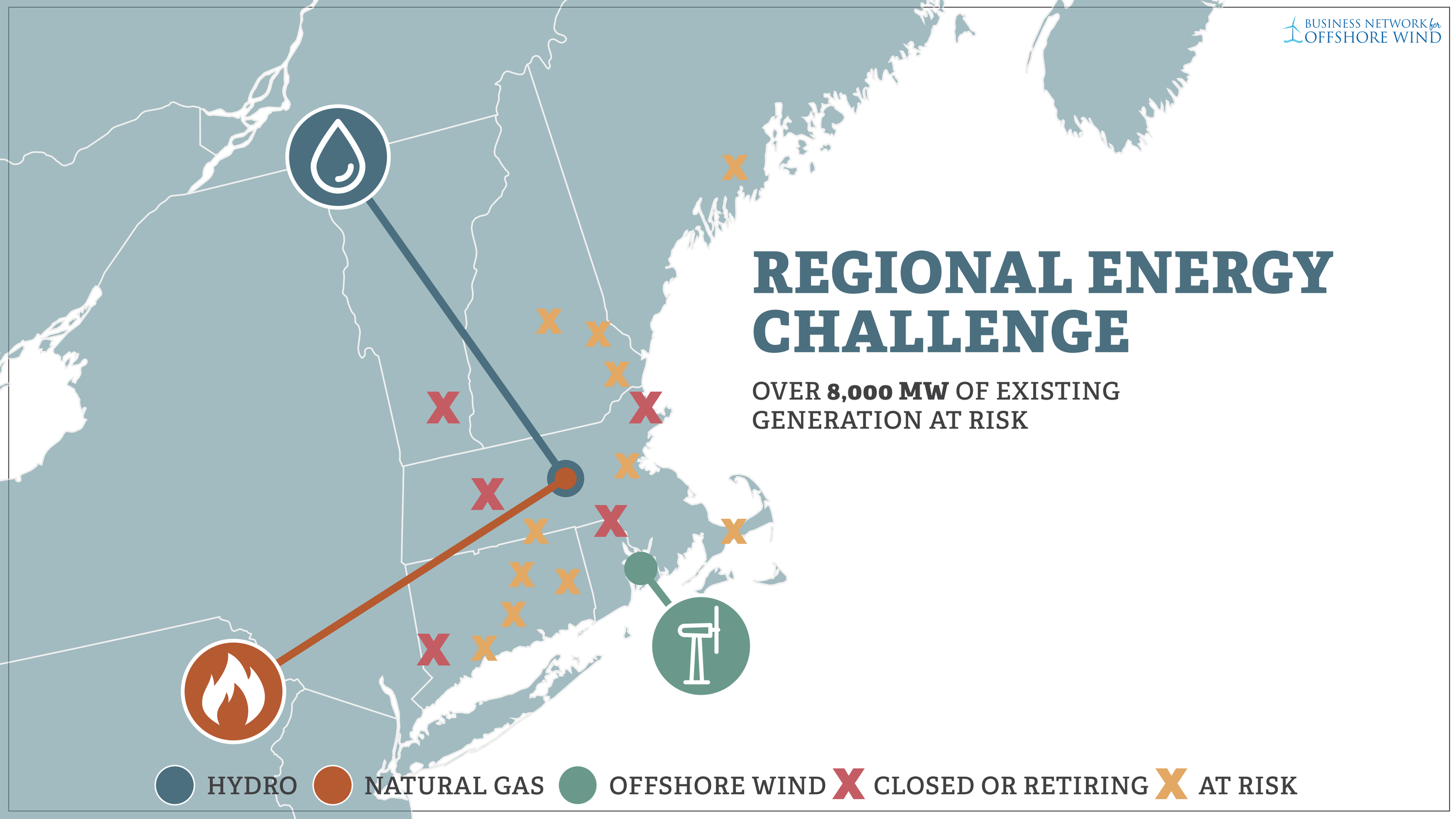
THE US HAS BECOME A LEADER IN RENEWABLES



BUSINESS NETWORK for OFFSHORE WIND

REGIONAL ENERGY CHALLENGE

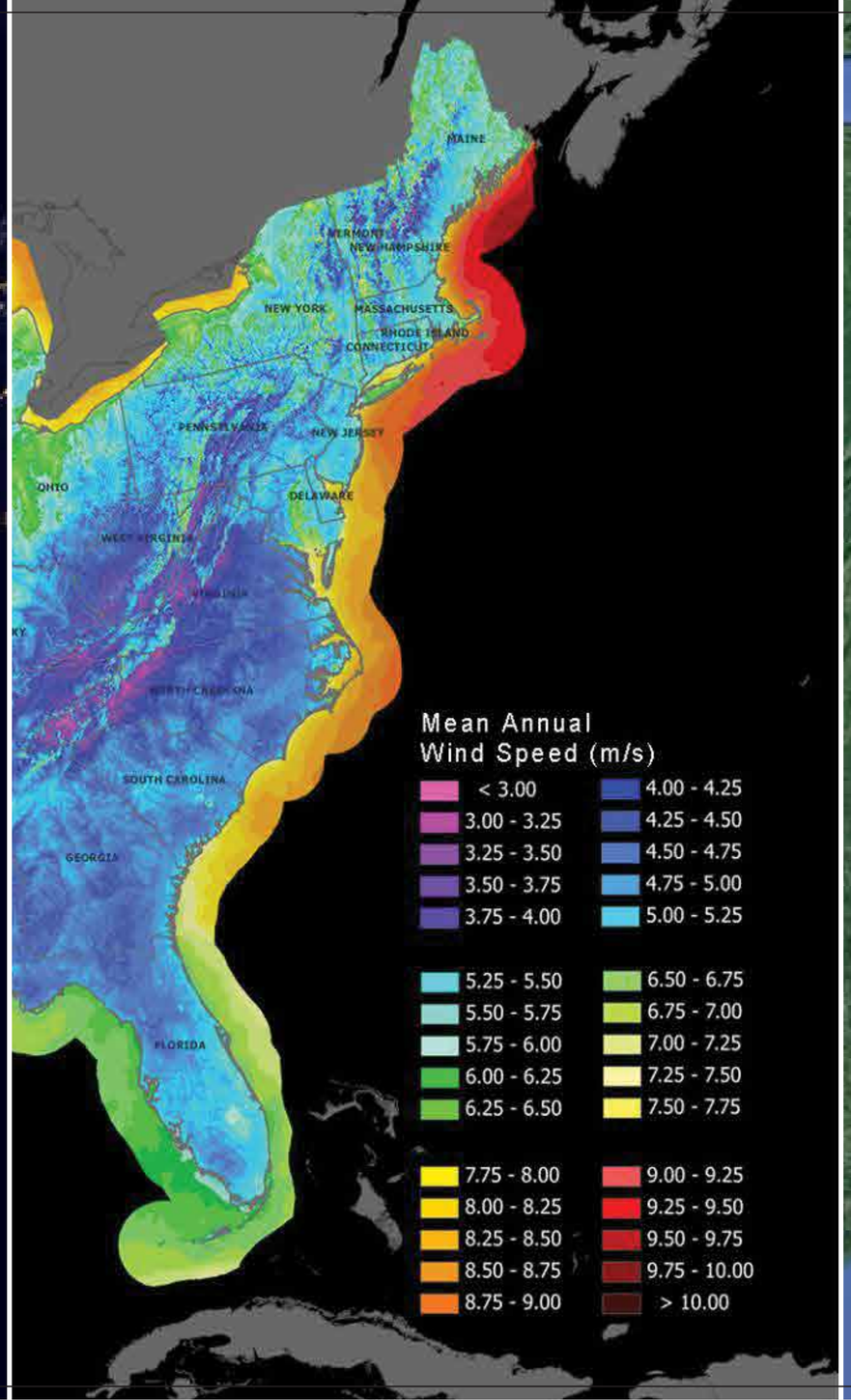
OVER **8,000 MW** OF EXISTING GENERATION AT RISK



HYDRO NATURAL GAS OFFSHORE WIND X CLOSED OR RETIRING X AT RISK

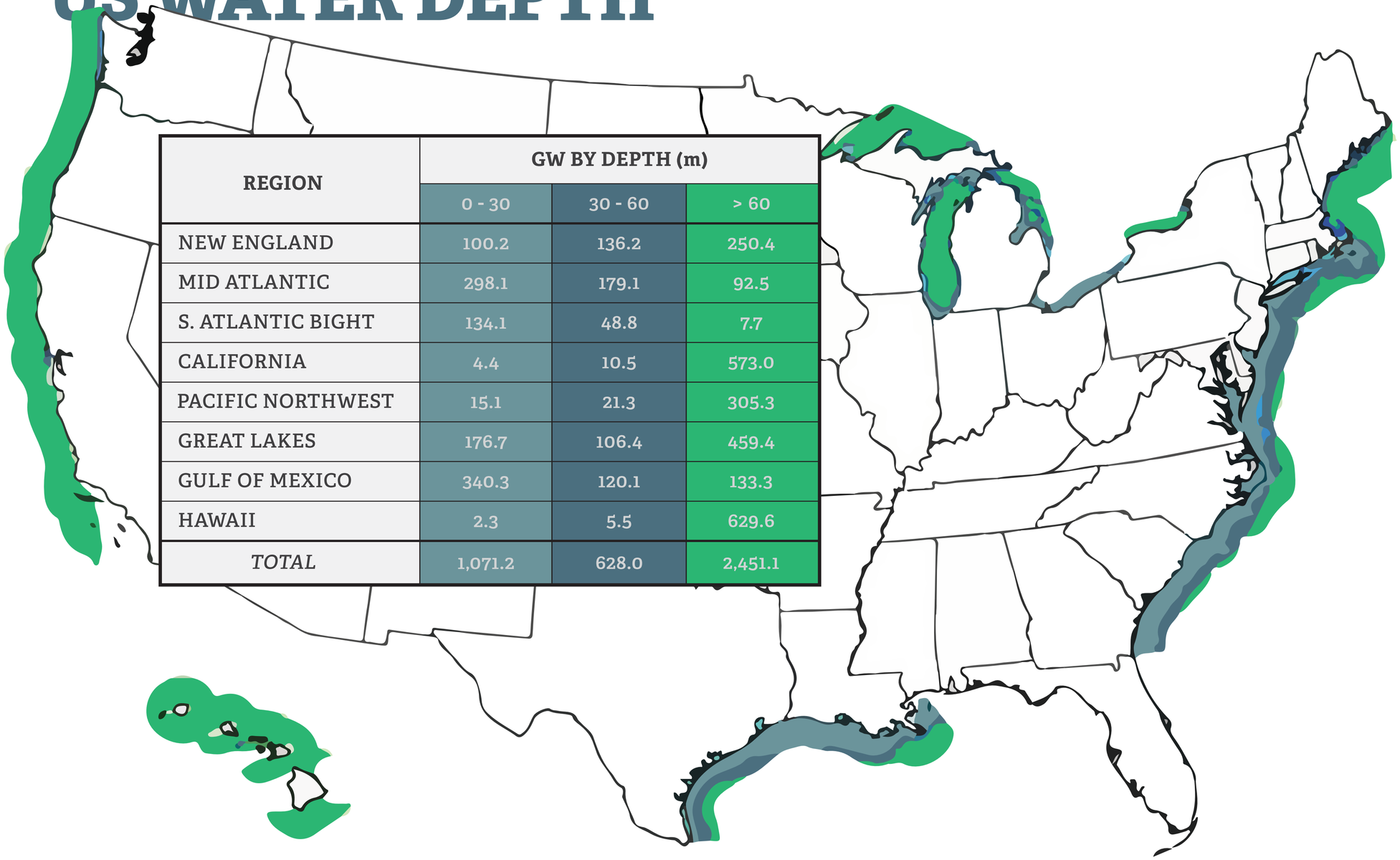
THE POTENTIAL

OFFSHORE WIND DELIVERS ENERGY WHEN AND WHERE IT'S NEEDED MOST.

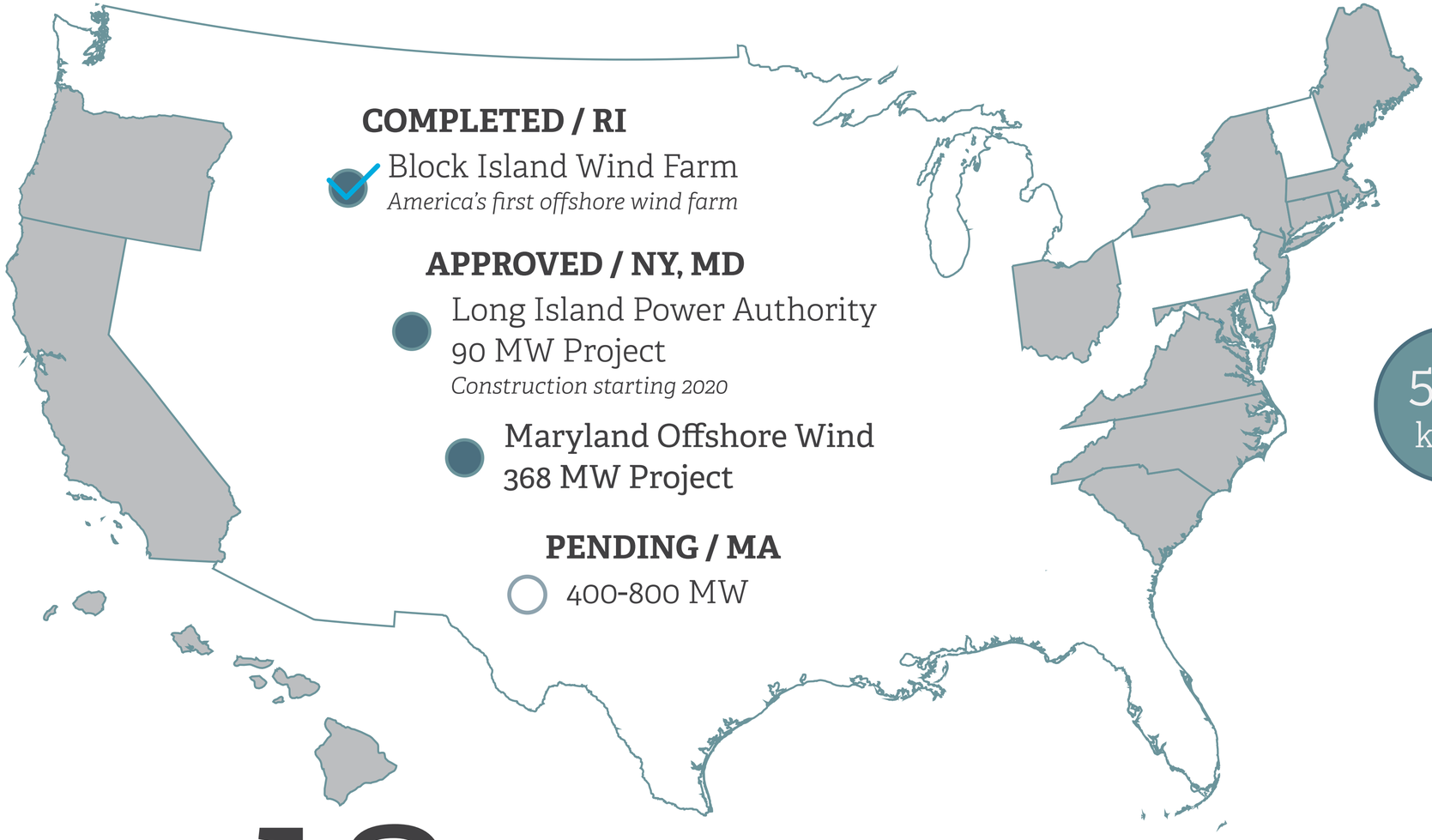


US WATER DEPTH

REGION	GW BY DEPTH (m)		
	0 - 30	30 - 60	> 60
NEW ENGLAND	100.2	136.2	250.4
MID ATLANTIC	298.1	179.1	92.5
S. ATLANTIC BIGHT	134.1	48.8	7.7
CALIFORNIA	4.4	10.5	573.0
PACIFIC NORTHWEST	15.1	21.3	305.3
GREAT LAKES	176.7	106.4	459.4
GULF OF MEXICO	340.3	120.1	133.3
HAWAII	2.3	5.5	629.6
TOTAL	1,071.2	628.0	2,451.1



BUSINESS NETWORK for OFFSHORE WIND



COMPLETED / RI

Block Island Wind Farm

America's first offshore wind farm

APPROVED / NY, MD

Long Island Power Authority
90 MW Project

Construction starting 2020

Maryland Offshore Wind
368 MW Project

PENDING / MA

400-800 MW

13 new

US wind energy areas equalling

15 GW

32%

reduction in energy costs for offshore wind since 2012

5.5¢ kWh

Offshore wind prices continue to decrease. In Europe, the purchase price is as low as 5.5¢ / kWh

13¢ kWh

Maryland offshore wind price

NY, MA, NJ and MD are committed to buy

5.46 GW

of offshore wind power

BOEM PROCESS

1 **PLANNING & ANALYSIS**

2 **LEASING**

3 **SITE ASSESSMENT**

4 **CONSTRUCTION & OPERATIONS**

1. PLANNING & ANALYSIS

BOEM publishes Call for Information and Nominations

BOEM identifies priority Wind Energy Areas (WEAs) offshore. WEAs are locations that appear most suitable for wind energy development, or

Processes unsolicited application for lease

BOEM may prepare an Environmental Assessment for Lease Issuance and Site Assessment Activities

2. LEASING

BOEM determines whether Competitive Interest exists

If Competitive Interest exists, BOEM notifies the public and developers of its intent to lease through Sale Notices before holding a lease sale

If Competitive Interest does not exist, BOEM negotiates a lease (note: issuance may be combined with plan approval)

3. SITE ASSESSMENT

Lessee conducts site characterization studies

Lessee submits Site Assessment Plan (SAP)

BOEM conducts environmental and technical reviews of SAP, eventually deciding to approve, approve with modification, or disapprove the SAP

If approved, Lessee assesses site (usually with meteorological tower(s) and / or buoy(s)

4. CONSTRUCTION & OPERATIONS

Lessee may conduct additional site characterization

Lessee submits Construction and Operations Plan (COP)

BOEM conducts environmental and technical reviews of COP, eventually deciding to approve, approve with modification, or disapprove the COP

If approved, Lessee builds wind facility

US OSW STRUCTURE

STATES
Policy / market drivers / regulations

US BOEM / US BSEE
Leasing and approval of plans / regulators

PRIVATE DEVELOPERS / LEASEES
Dong Energy, Statoil, Avangrid / Iberdola,
Copenhagen Offshore Partners, Deepwater Wind,
US Wind, Fishermen's Energy

SUPPLY CHAIN

BUSINESS NETWORK OSW

STRONGER TOGETHER

THE NETWORK

DEVELOPMENT

ADVANCEMENT

NETWORKING

DEVELOPERS

POLICY MAKERS

GLOBAL EXPERTS

OVER 130
MEMBER BUSINESSES

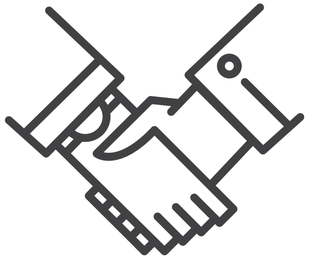
OUR MISSION

TO ADVOCATE & SUPPORT

The Network advocates for its Member business community by promoting and supporting policies that advance the industry.

TO BUILD & ESTABLISH

The Network is dedicated to building a supply chain that supports domestic wind farms and establishes the US as a global competitor in the offshore wind energy market.



TO EDUCATE & LEAD

Our Members are empowered with the education, tools and connections to take a leading role in the creation of the industry.

150 BUSINESS NETWORK MEMBERS

GE

DONG energy

SIEMENS

CIANBRO

Alpine
A GARDLINE COMPANY

EDF
ENVIRONMENTAL DEFENSE FUND™
Finding the ways that work

Maryland Energy Administration

YOUR OFFSHORE CONSTRUCTION WORKFORCE

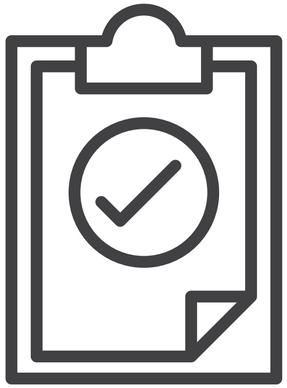
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

MEGGITT

M&T Bank

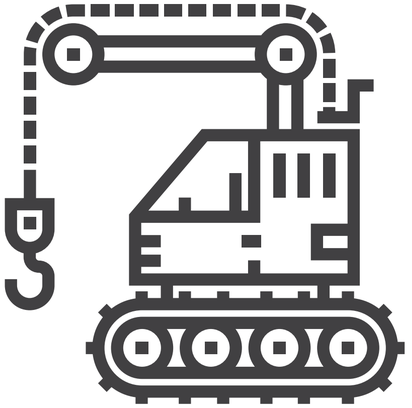
ATKINS

THE US SUPPLY CHAIN



RESOURCE CHARACTERIZATION/ ENVIRONMENTAL PLANNING/ PERMITTING

ENGINEERING



MANUFACTURING

Balance of Plant (foundations, towers, transition pieces, OTMs), ship building, marine construction / installation

NETWORK MEMBERS
IN THESE SUPPLY CHAIN AREAS

RES. CHAR./ ENVIRO. PLAN./ PERMITTING

Alpine
Amerigo Offshore LLC
TÜV SÜD
BTC
RAMBOLL
AWS Truepower
The Port of New Bedford Is ... READY FOR OFFSHORE WIND
PretiFlaherty
ATKINS
www.alpha-energy.com
DNV·GL
HR Wallingford Working with water
Johns Hopkins Environment, Energy, Sustainability & Health Institute

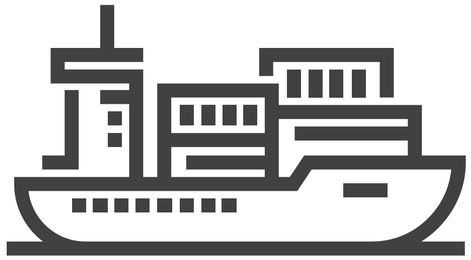
ENGINEERING

AWB ENGINEERS
DHI
GTA, Inc.
UMBC JCET NASA-GSFC
Keystone Engineering Inc.
Stantec
FOUNDOCEAN
FUGRO
SABIK OFFSHORE MARK IT · LIGHT IT · KEEP IT SAFE
VBMS We connect
MOTT MACDONALD

MANUFACTURING

SEAPROOF SOLUTIONS
VENTOWER INDUSTRIES
IP SUBSEA Green Marine Technology
Pharos Marine Automatic Power Global Quality, Global Solutions
Toroid® SUPERIOR TRANSFORMERS
CHET MORRISON CONTRACTORS
Versabar www.vbar.com
CIANBRO
Moss Marine USA — Workshop Services & Specialty Products — Ship & Industrial Equipment Repair
LM WIND POWER

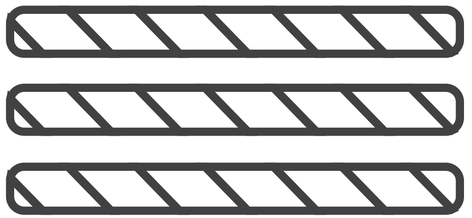
SUPPLY CHAIN GAPS



VESSELS

NACELLE & BLADE MANUFACTURING

Large wind components for Nacelles



CABLES

O&M WORKFORCE TRAINING

INTERNATIONAL OSW PARTNERING FORUM

NREL / DOE use the IPF to deliver scientific and technical information

It is the #1 US OSW Technical conference

International Wind Partnering Forum

2018 will be our 5th year

More than 600 people attend from more than 11 countries

135 speakers

Major sponsors: Dong Energy, GE, LM Wind Power, Siemens

FROM THE IPF

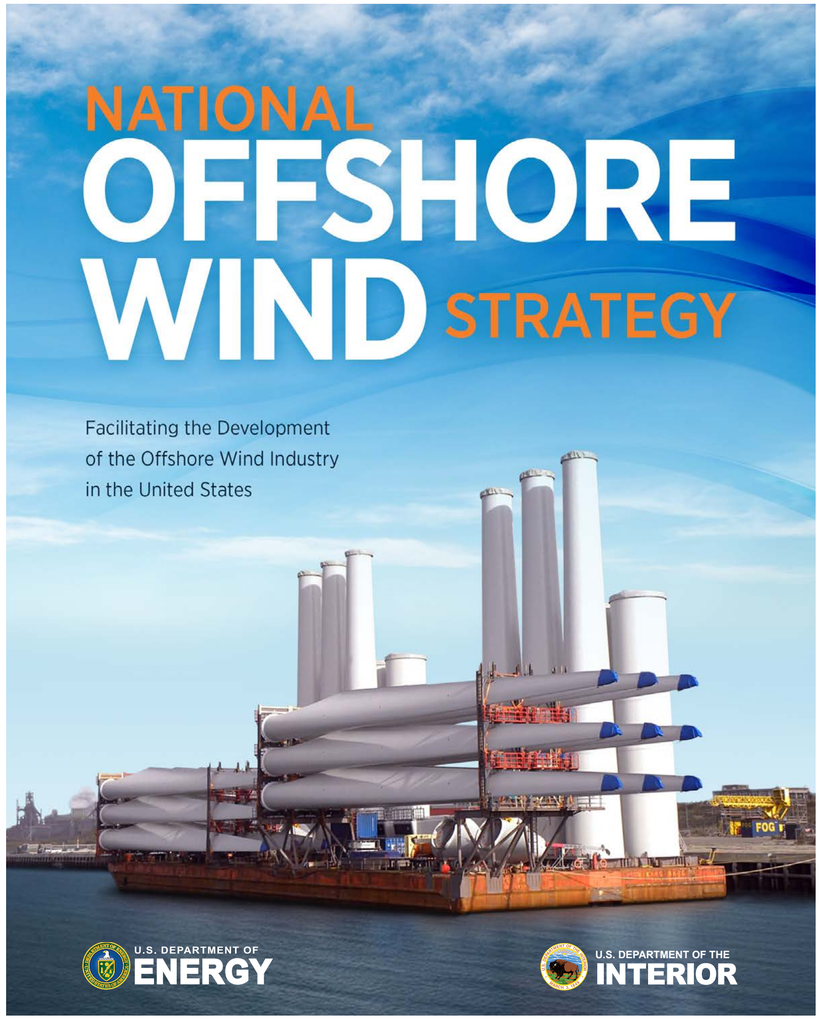
FSHORE
KEEP IT SAFE
KING
ore
Farms
WIND
OCEAN WIND
DONG energy
EADER IN OFFSHORE
CATHIE ASSOCIATES
Offshore Geoscience & Geotechnical Engineering Consultancy
For the Renewable Energy Industry

PARTNERING FORUM

WE MAKE PARTNERSHIPS HAPPEN

(left to right)
Daniel Woodman (Offshore Design Engineering),
Liz Burdock (Business Network for Offshore Wind)
Jay Borkland (Apex Companies, LLC)

NATIONAL STRATEGY



DOE aims to reduce the levelized cost of energy through technological advancement to compete with local electricity costs, and create the conditions necessary to support DOE's Wind Vision2 study scenario levels [2] of deployment by supporting the coexistence of offshore wind with the environment, coastal communities, and other users of ocean space.

DOI aims to enhance its regulatory program to ensure that oversight processes are well-informed and adaptable, avoid unnecessary burdens, and provide transparency and certainty for the regulated community and stakeholders

WORKING GROUPS

GRID &
TRANSMISSION

INFRASTRUCTURE

INNOVATION &
COMMERCIALIZATION

WORKFORCE &
ECONOMIC
DEVELOPMENT

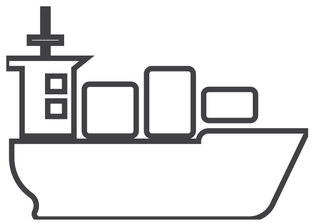
HEALTH &
SAFETY

US INNOVATION

LOGISTICS

CYBER SECURITY

GRID TRANSMISSIONS



VESSELS

FLOATING WIND

UNMANNED SYSTEMS

FUTURE OF US INNOVATION

WATER TEST SITES

RESEARCH & DEVELOPMENT

FUTURE:

Floating offshore wind

US offshore wind potential 2,000 GW

US OSW standard development

BUSINESS NETWORK PARTNERS

CARBON TRUST

FRIENDS OF THE SUPERGRID

City of Aberdeen

greenporthull

renewableUK
The voice of wind & marine energy

BSEE
Bureau of Safety and Environmental Enforcement

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

EDF
ENVIRONMENTAL DEFENSE FUND™
Finding the ways that work

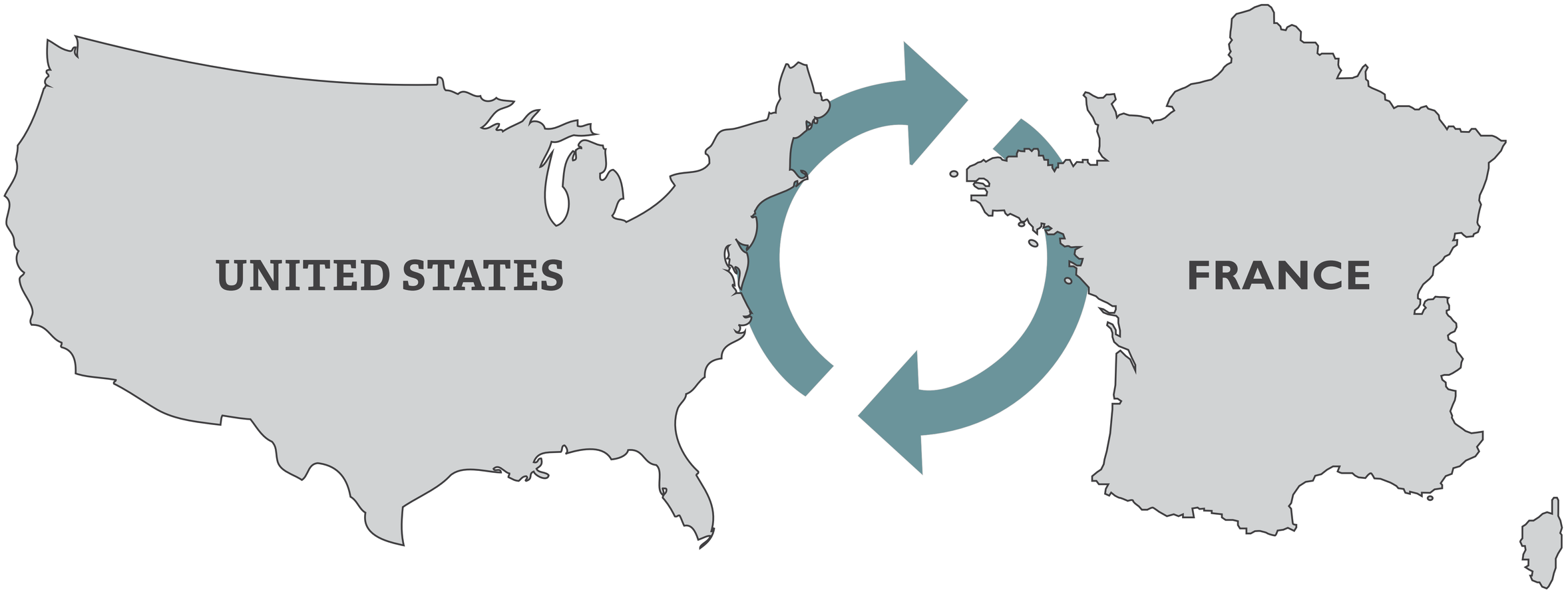
DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

BOEM
Bureau of Ocean Energy Management

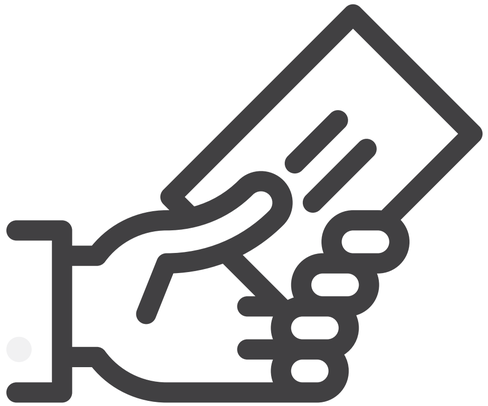
Maryland
Energy
Administration

MARYLAND
FOUNDED 1634

BRIDGING THE TRANSATLANTIC



WORKING TOGETHER



LEND EXPERTISE

STRENGTHEN THE US SUPPLY CHAIN

OPPORTUNITIES TO PARTNER

MARKET OUTLINES

ROBUST PROJECT FINANCE MARKET

- o New York is an active Project Financing center
- o Financing parties have experience with renewable financing structures from on-shore wind space

SUPPORTIVE, YET UNCOORDINATED, GOVERNMENT REGULATIONS & INCENTIVES

- o Federal lease area provides one-stop permitting and site control (BOEM)
- o Federal Renewable Clean Energy Mandates and other programs (DOE)
- o Federal Tax incentives that help secure partial off take (ITC/PTC)
- o ITC/PTC result in about 1/3 off project capital cost or cash flows being converted/contracted
- o State level REC and other clean energy mandates

EXCELLENT LOCATIONAL ADVANTAGE PARTICULARLY ALONG THE EASTERN SEA-BOARD

- o Good wind regime and water depth
- o Close to load centers (eg New York, Boston, Greater Baltimore/DC

TECHNOLOGY IMPROVEMENTS AND ESTABLISHED OPERATING HISTORY OF EUROPEAN PROJECTS WILL PROVIDE BENEFITS IN THE US MARKET

HIGH COMPETITION INTEREST OVER THE LATEST AUCTIONS

BOEM'S OFFSHORE SITE APPROVAL PROCESS

PLANNING & ANALYSIS / 2 years

- o Intergovernmental Task Force
- o Request for Information (RFI) / Call for Information & Nominations (Call)
- o Area Identification
- o Environmental Reviews

LEASING / 1-2 years

- o Publish Leasing Notices
- o Conduct Auction
- o Issue Lease(s)

SITE ASSESSMENT / 5 years

- o Site Characterization
- o Site Assessment Plan (SAP)

CONSTRUCTION & OPERATIONS / 2 years (+25)

- o Construction & Operations Plan (COP)
- o Facility Design Report (FDR) and Fabrication & Installation Report (FIR)
- o Decommissioning

LEAD TIME: 7-10 years

AN EMERGING SECTOR FACING SEVERAL CHALLENGES

REGULATION

- o Lack of Federal, State, Local, and Tribal Coordination
- o Regulatory process is not mature, which led to extended delays in approval of SAP, COP, and other permits
- o Political risks associated with renewable incentives (Federal and State incentives tied to political process, and can be out of step even when reliant on one another)

PROJECT ECONOMICS

- o Offshore wind LCOE vs other alternative and conventional energy, with low cost natural gas
- o Financing and securing of tax credits
- o Lack of stable, long term policy incentives (RPS, PTC, ITC, OREC, etc)
- o Limited market mechanisms to monetize benefits of offshore wind

SUPPLY CHAIN

- o No domestic supply chain for major offshore wind components resulting in expensive foreign suppliers and manufacturers
- o Limited amount of vessels that can support US windfarm installation in compliance with Jones Act and its potential changes under cbp review
- o Lack of experienced work force
- o Stop and go of the US market has resulted in vendor fatigue

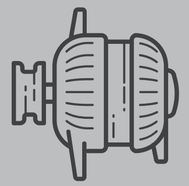
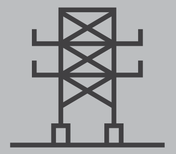
INFRASTRUCTURES

- o Interconnection / transmission
- o Availability and performance of new manufacturing facilities and harbors

PROJECT DEVELOPMENT

- o Challenging sites: soil conditions, extreme conditions due to hurricanes, earthquake, DoD compliance, etc
- o Social acceptance, risk of legal recourse against authorizations
- o Potentially retrictive Standard Operating Conditions

WIND ENERGY SUPPLY CHAIN IN THE US

COMPONENT		LAND-BASED		OFFSHORE	
		INVESTMENT REQUIRED	MAJOR HURDLES	INVESTMENT REQUIRED	MAJOR HURDLES
TOWERS	3MW	LOW	Capability exists	LOW-MODERATE	Logistics: Rail/road challenges to ports. Mfgs located in Midwest.
	5MW	MODERATE-HIGH	Logistics: Rail/road challenges Fac/Equip: Upgrades likely	HIGH	Logistics: Rail/road challenges to ports. No tower mfg port side.
BLADES	3MW	LOW	Capability Exists	MODERATE-HIGH	Logistics: Rail/road challenges to ports. Mfgs located in Midwest.
	5MW	MODERATE-HIGH	Logistics: Raid/road challenges. Facility and equipment upgrades likely	HIGH	Logistics: Rail/road challenges to ports. No blade mfg port side.
 GENERATORS	3MW	LOW	Capability Exists	LOW	Capability Exists
	5MW	LOW-MODERATE	Fac/Equip: Possible upgrades for crane capacity & finish tanks	LOW-MODERATE	Fac/Equip: Possible upgrades for crane capacity & finish tanks
 JACKET FOUNDATIONS	3MW	n/a		MODERATE-HIGH	Capability exists in Gulf & Pacific region. Investments likely for serial production. Port side facilities needed for Atlantic and Great Lakes.
	5MW	n/a		MODERATE-HIGH	