Technology Frontier: Floating Offshore Wind

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NEBHE
April 23, 2010

New Technology Test

1. Does it bring the cost $/kWh down?
2. Does it enhance public acceptance?

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Mosaic of Energy Solutions Needed: Renewables + Conventional

$ 5 Billion/year
Leave Maine

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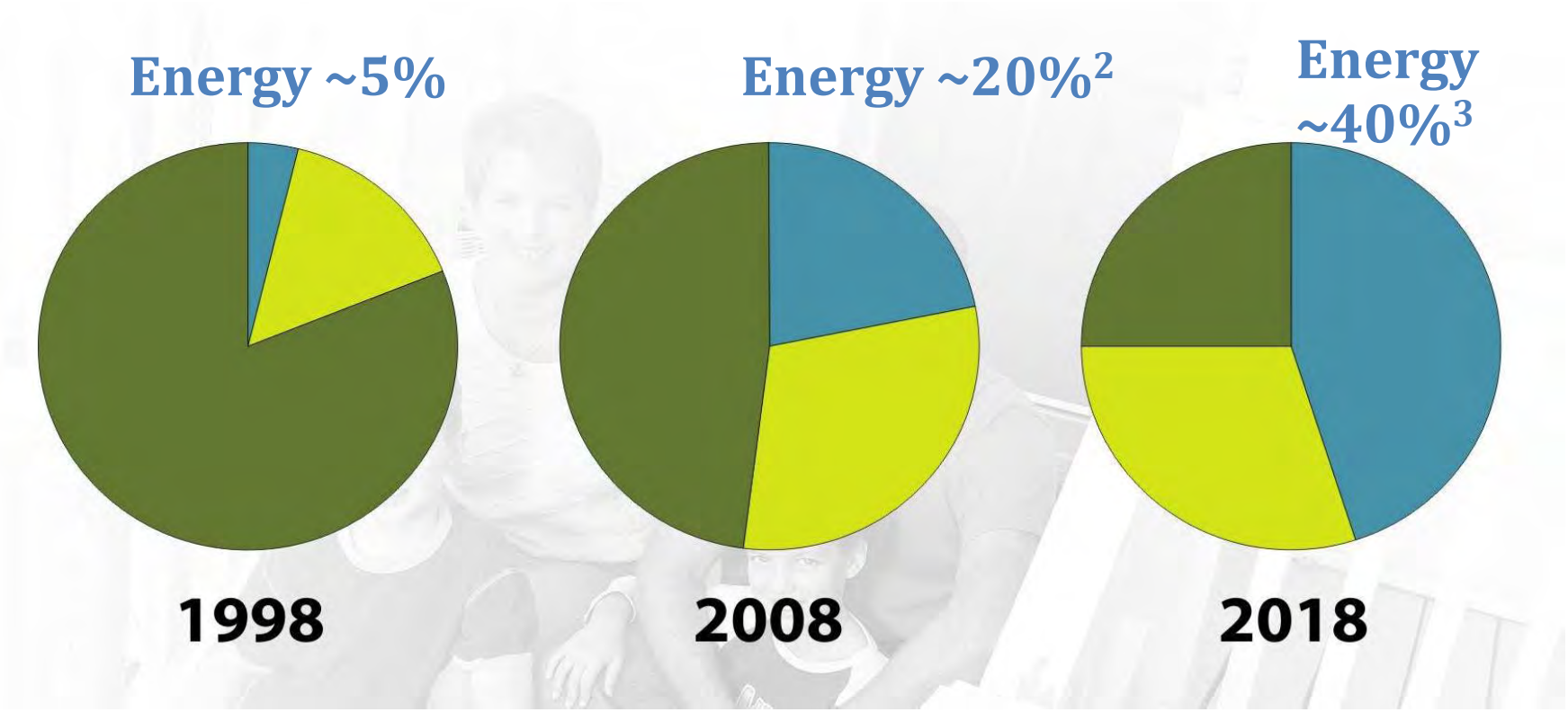
Maine Family Budget



"Family Energy"[1,2] = 50% Transportation
40% Heating
10% Electric Power

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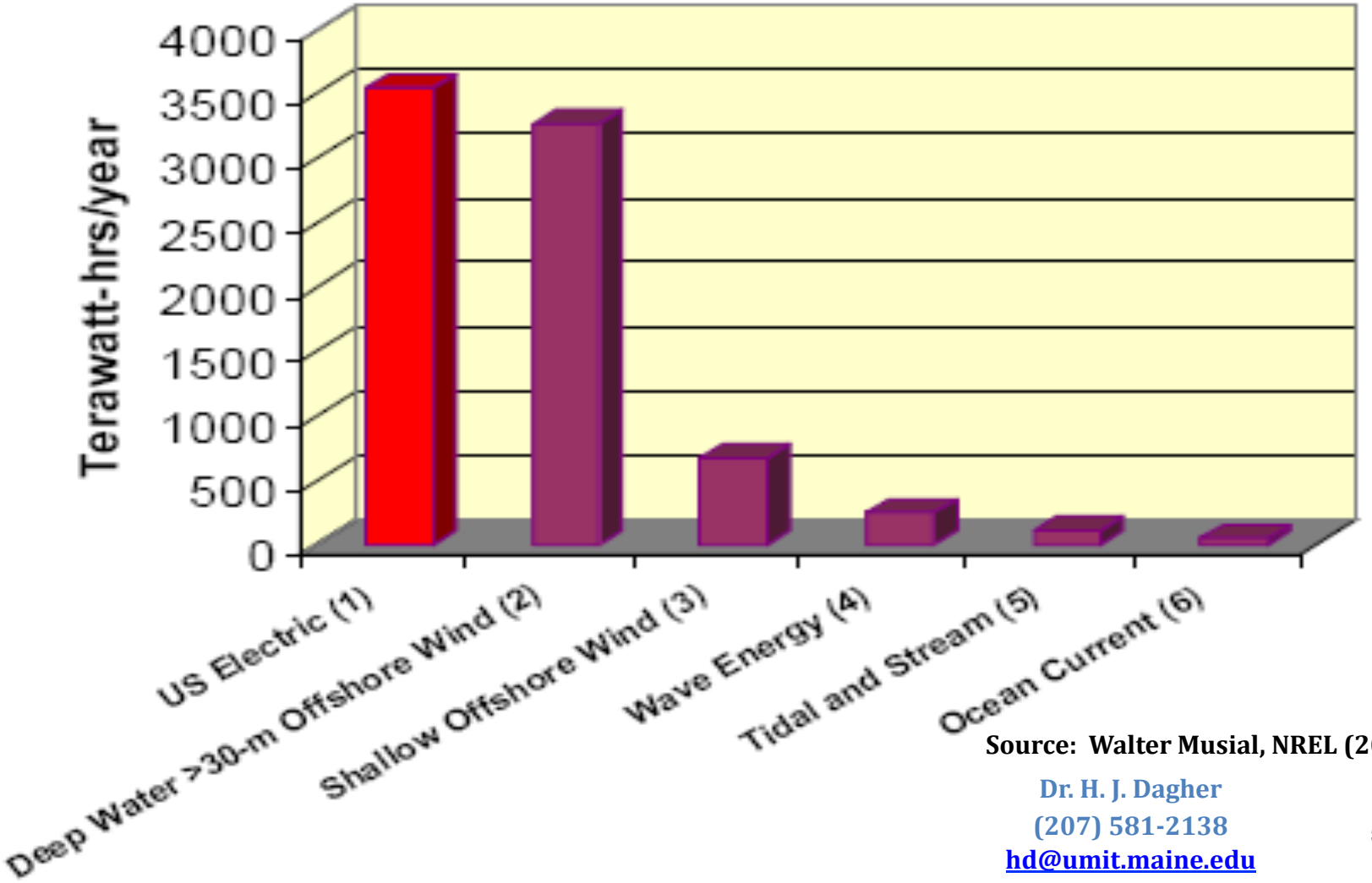
[1] Source:, Dr. George Hart, UMaine
[2] Based July '08 energy costs
[3] Assumes that health care costs do not grow past 30% of the average family budget in 2008-2018

Deepwater Wind:
Largest US Ocean Energy Resource



Source: Walter Musial, NREL (2008)

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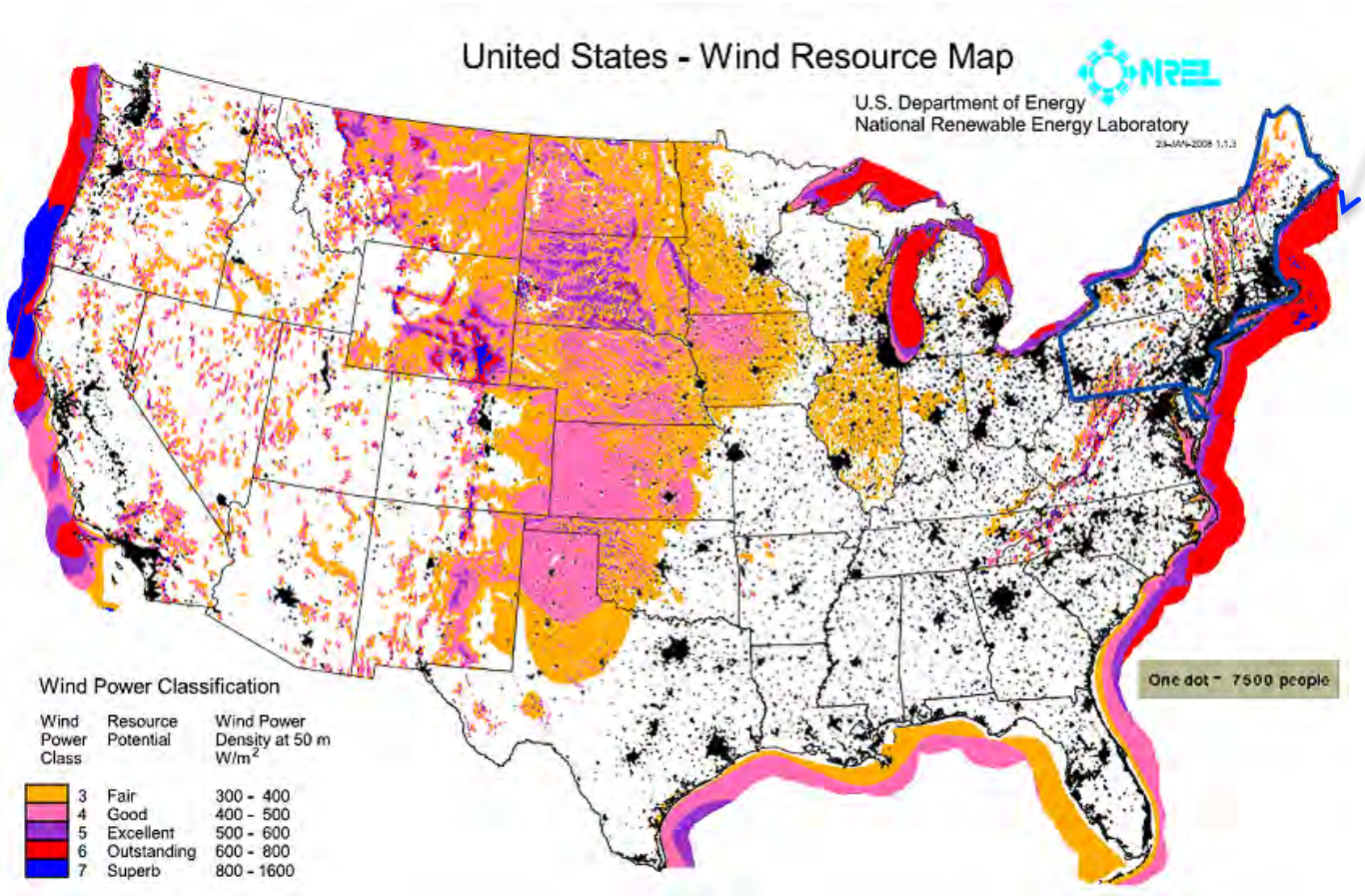
Maine: A Source of Green Energy for the Northeast U.S.



40 Nuclear Power Plants of Wind off Maine

55 million people

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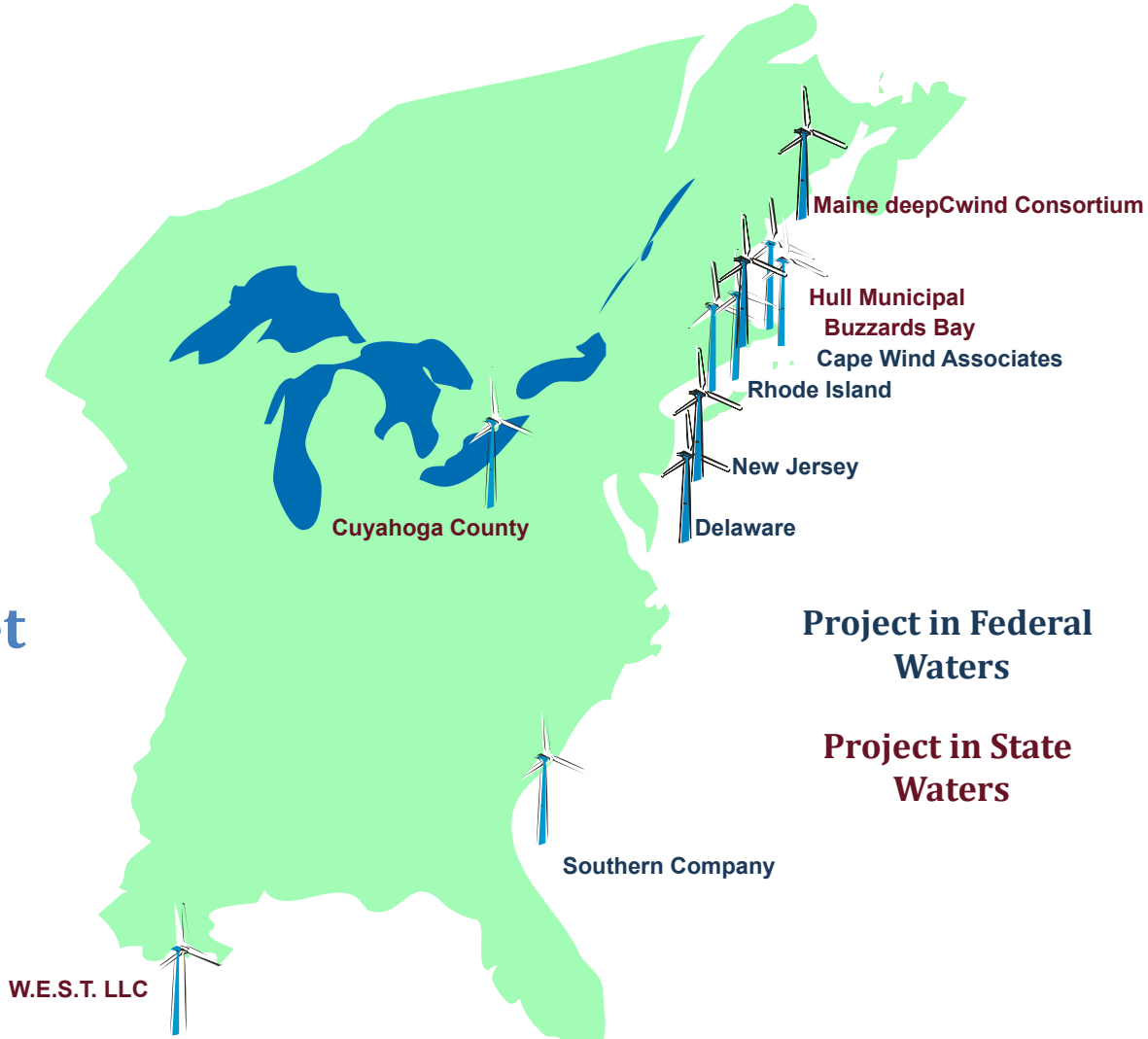
U.S. Offshore Wind Projects

US Offshore Wind Initiatives		
Project	**State**	**MW**
Capewind	MA	468
Hull Municipal	MA	15
Buzzards Bay	MA	300
Rhode Island (OER)	RI	400
Winergy	NY	12
New Jersey (BPU)	NJ	350
Delmarva	DE	350
Southern Company	GA	10
W.E.S.T.	TX	150
Cuyahoga County	OH	20
DeepCwind Consortium	ME	Demo
Total MW		2075

None Installed Yet



Project in Federal Waters

Project in State Waters

Source: Walter Musial (NREL), 4/09

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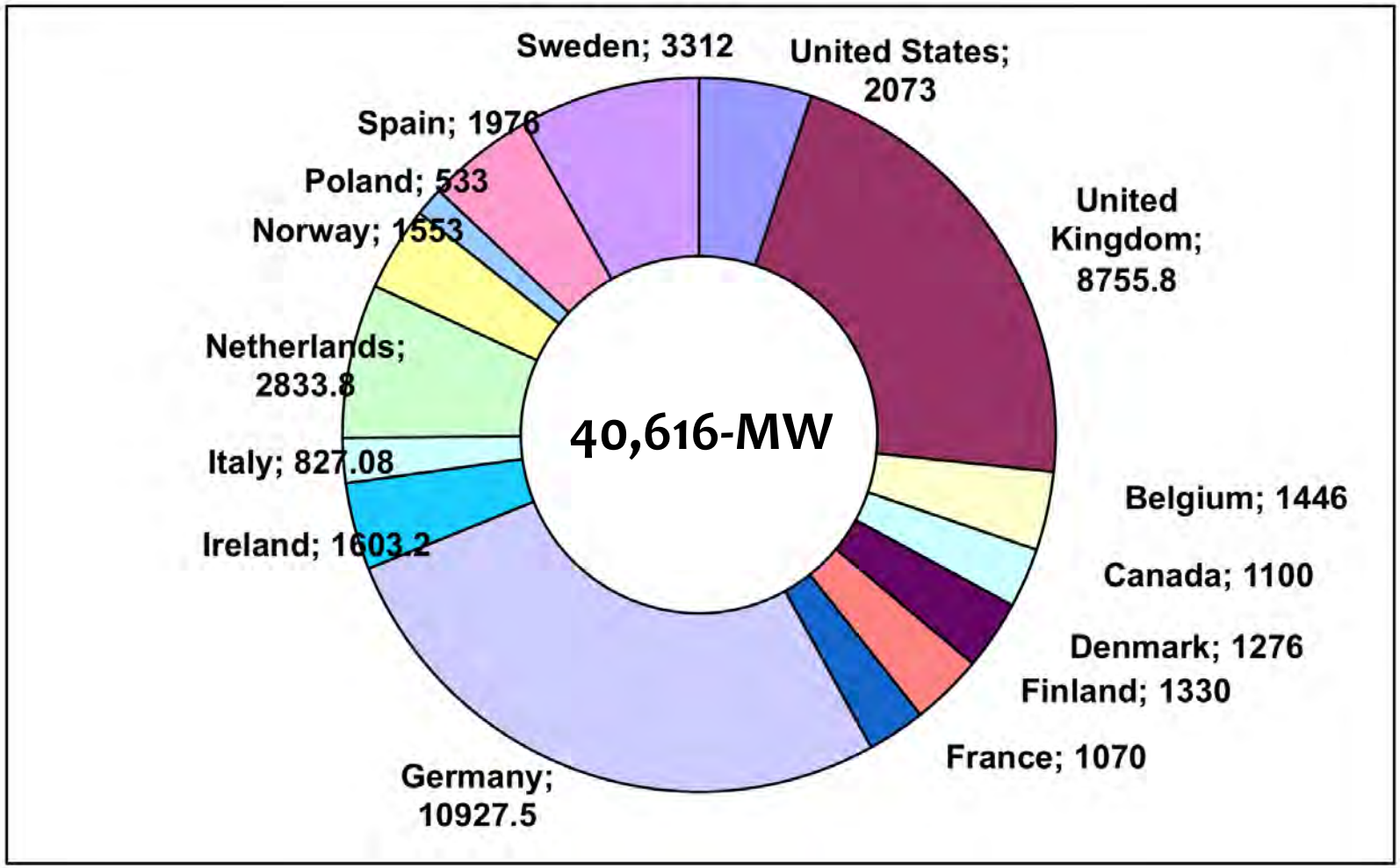
US is Behind:
Offshore Wind Projects Planned by 2015
Europe and North America



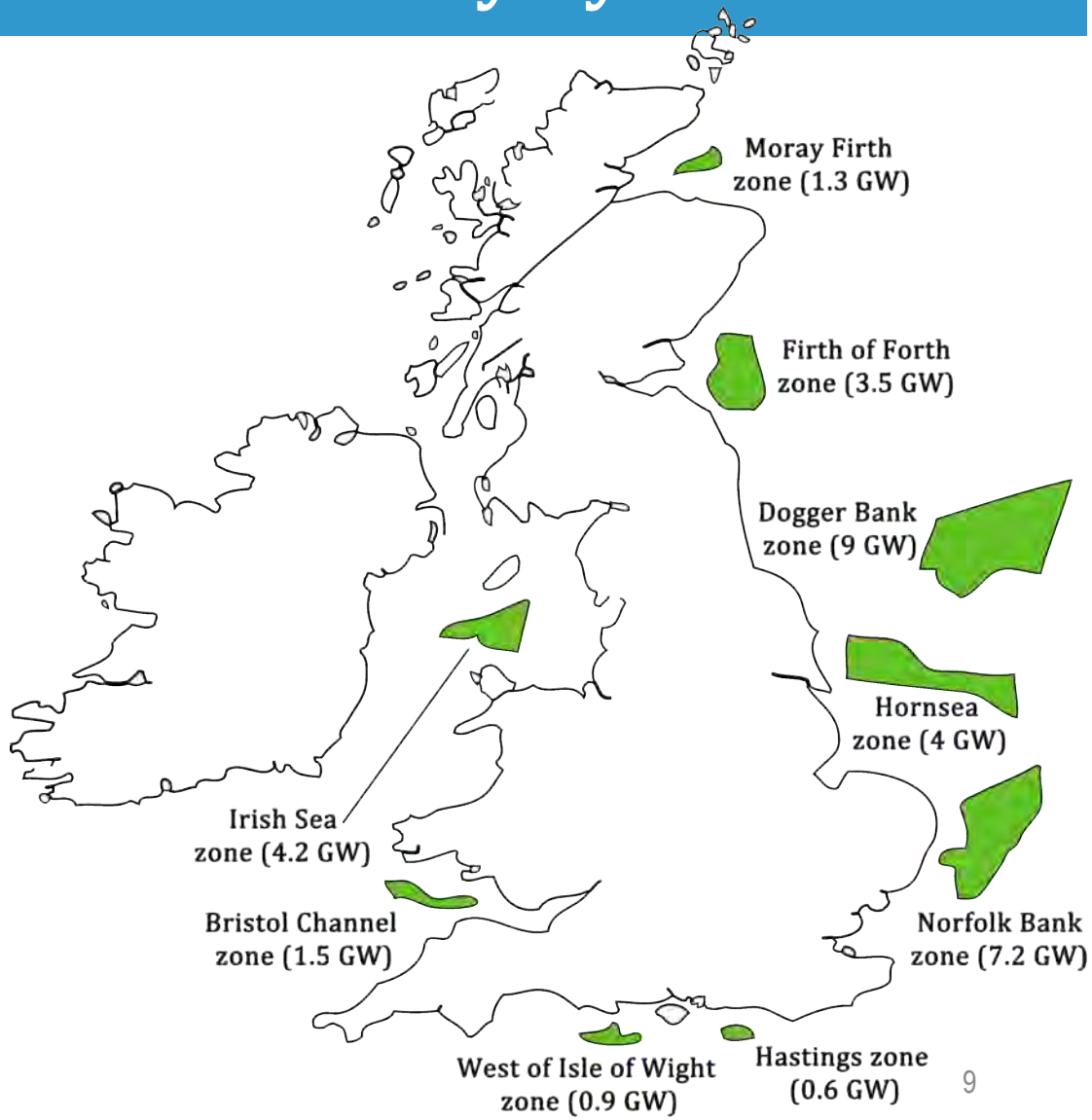
Source: Walter Musial, NREL

UK - Round 3 Successful Bidders Selected 1-8-10
25 GW, ¼ of UK's Electricity by 2020

Prime Minister
Gordon Brown

January 8, 2010

"The offshore wind industry is at the heart of the UK economy's shift to low carbon and could be worth $120 Billion and support up to 70,000 jobs by 2020."



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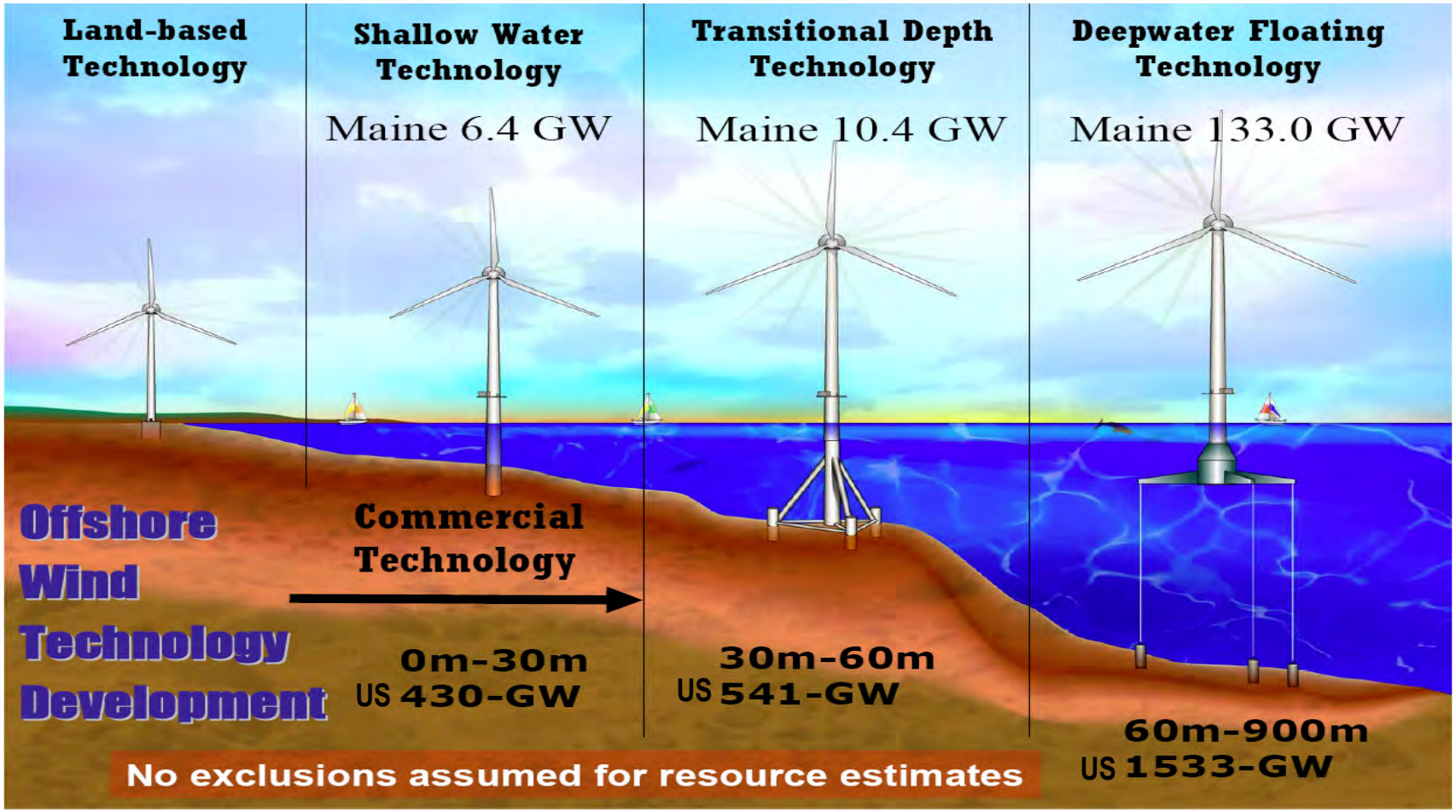
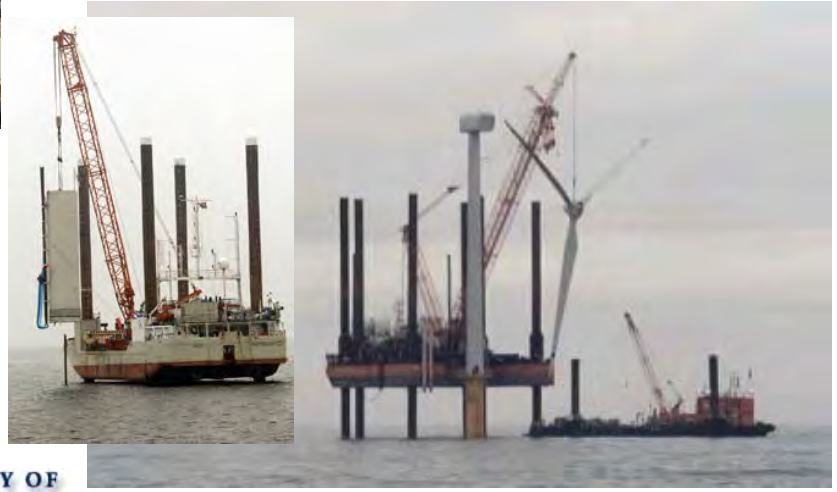
Offshore Wind Classification by Water Depth



Source: Walter Musial (NREL, 2008)

Shallow Monopile Foundations: 2-30 m, Drilled or Driven, Most Common



Monopile Driving

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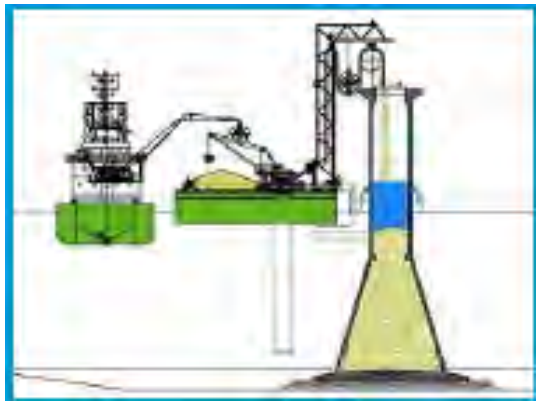
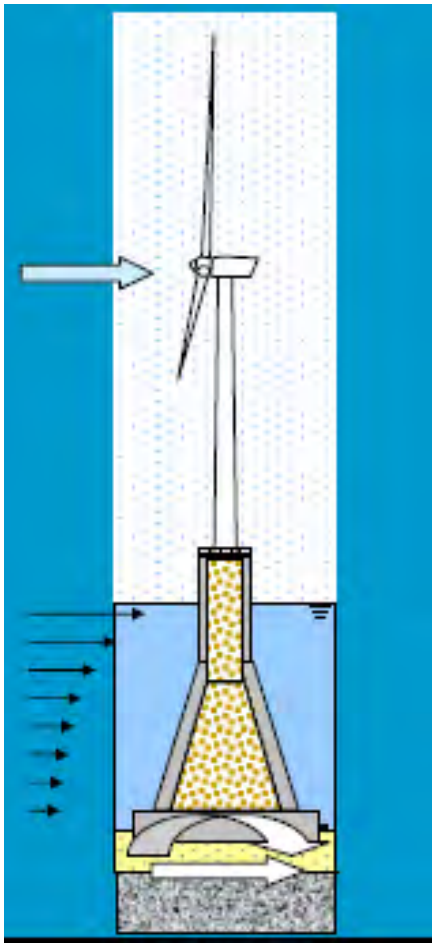
Shallow Gravity Foundations





[1]Source : TU Delft

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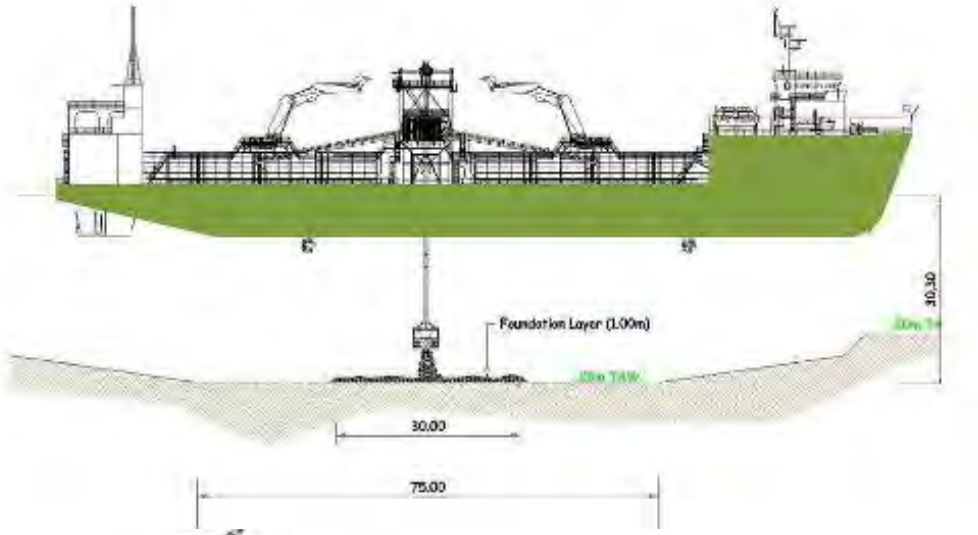
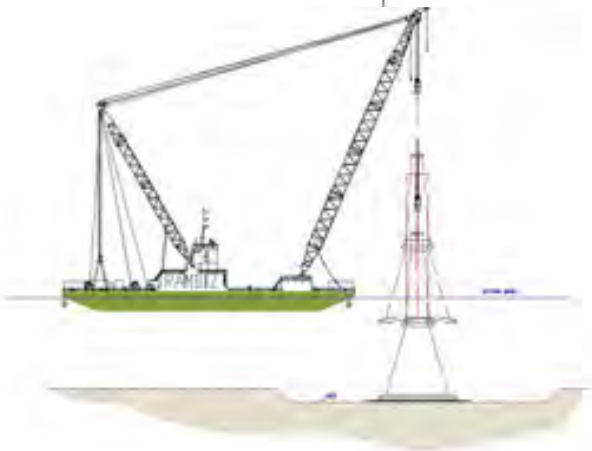
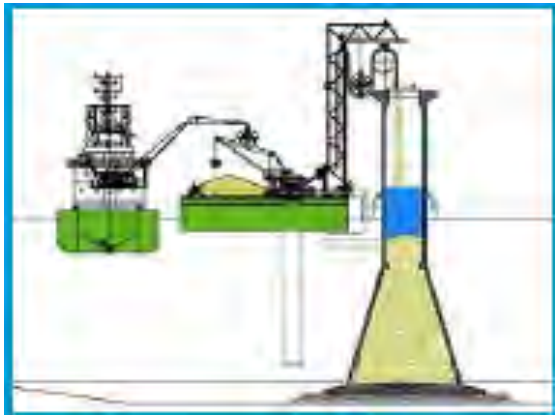
Shallow Gravity Foundations: Seabed Preparation and Installation







Source: TU Delft

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Shallow Gravity Foundations: Tower, Turbine and Blades Installation

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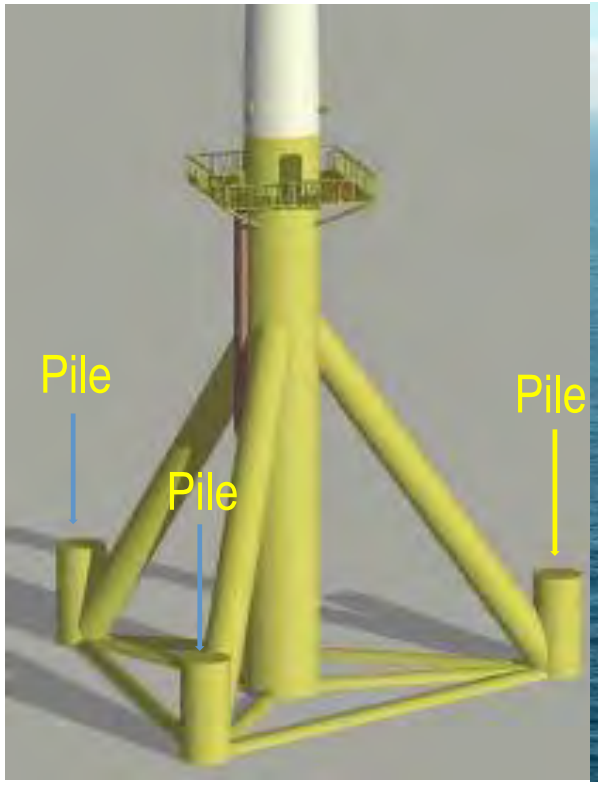
Transitional Waters Foundations (30-60m): Tripod



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Installed Foundation Types (2008)

Sources: TU Delft

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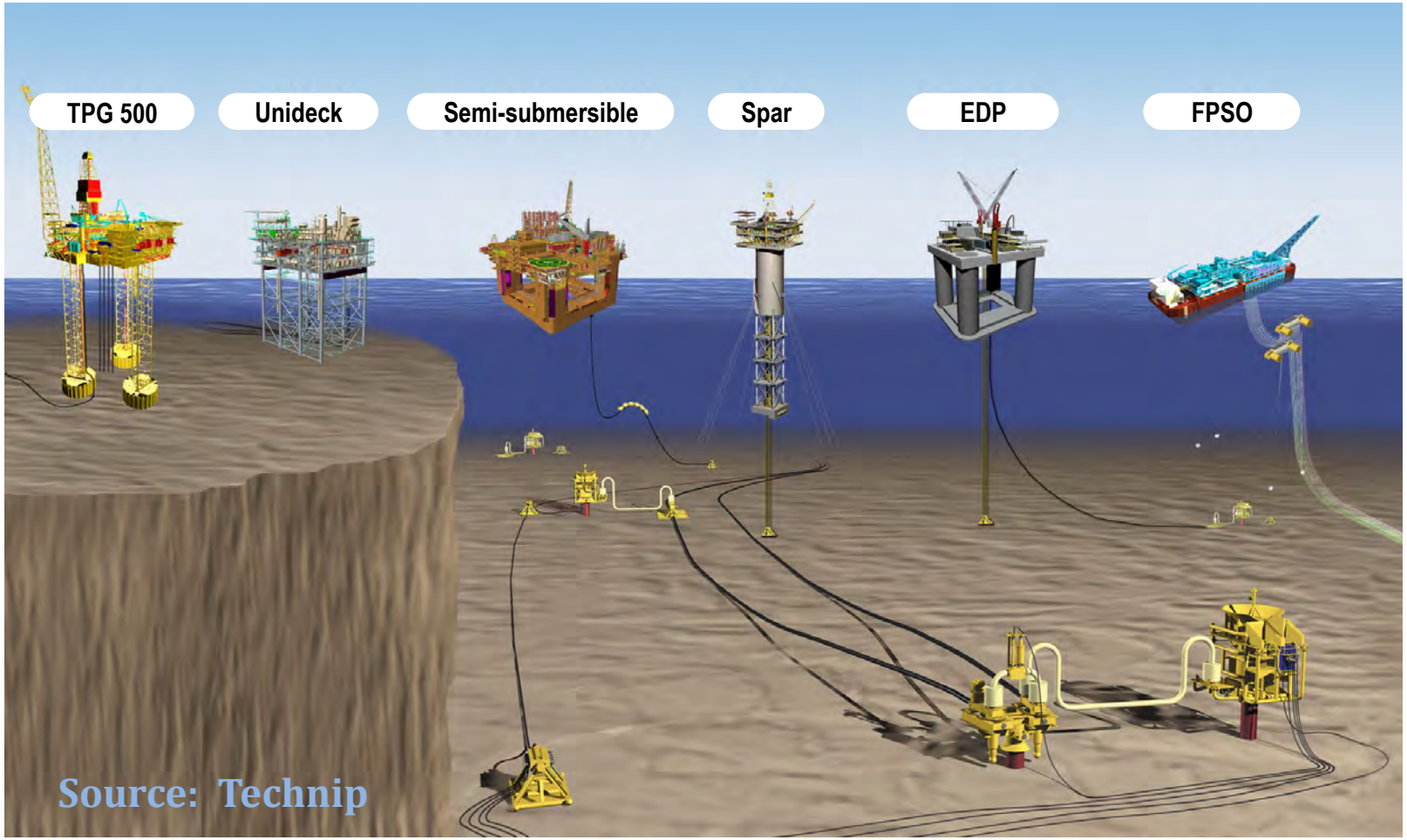
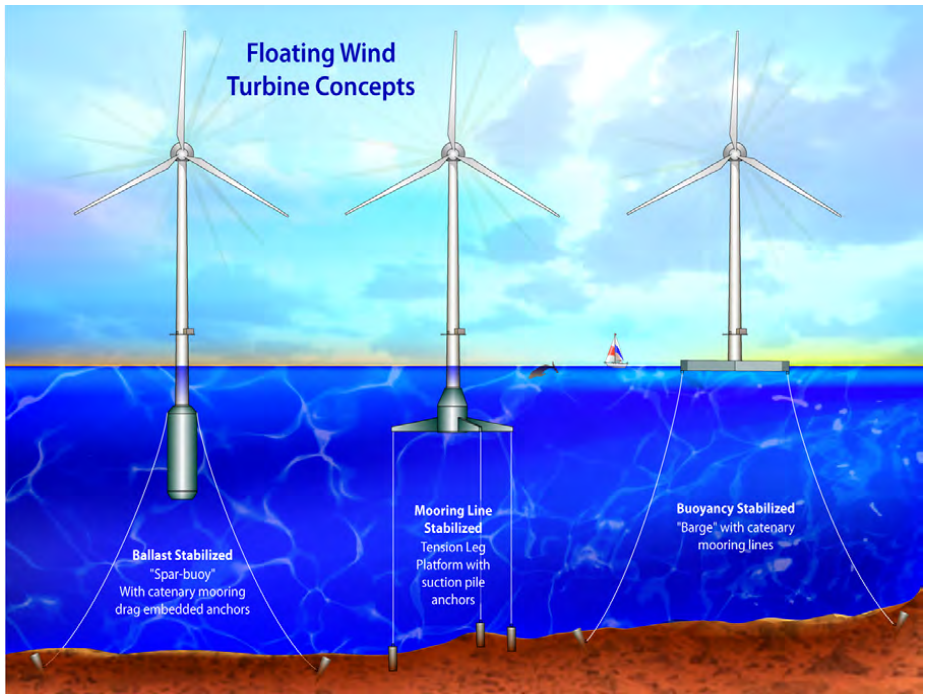
Floating Wind Turbines (> ~200ft): Building on the Offshore Oil and Gas Experience



Source: Technip

Deepwater Floating Turbines (> ~200ft): Design Space Based on Stability



Source: NREL

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Statoil Hywind
2.3 MW Spar – Sept 2009
Deployment Logistics

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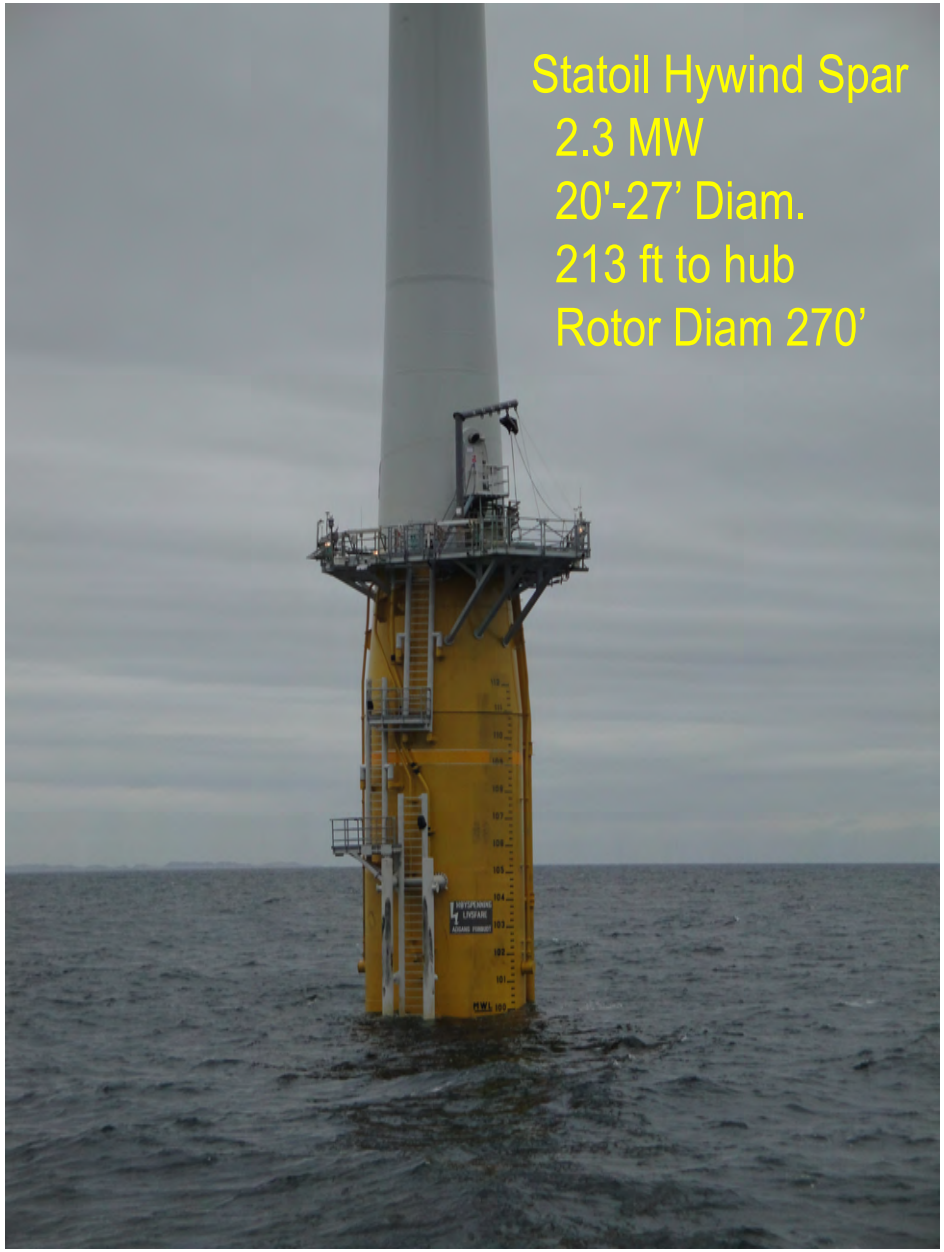

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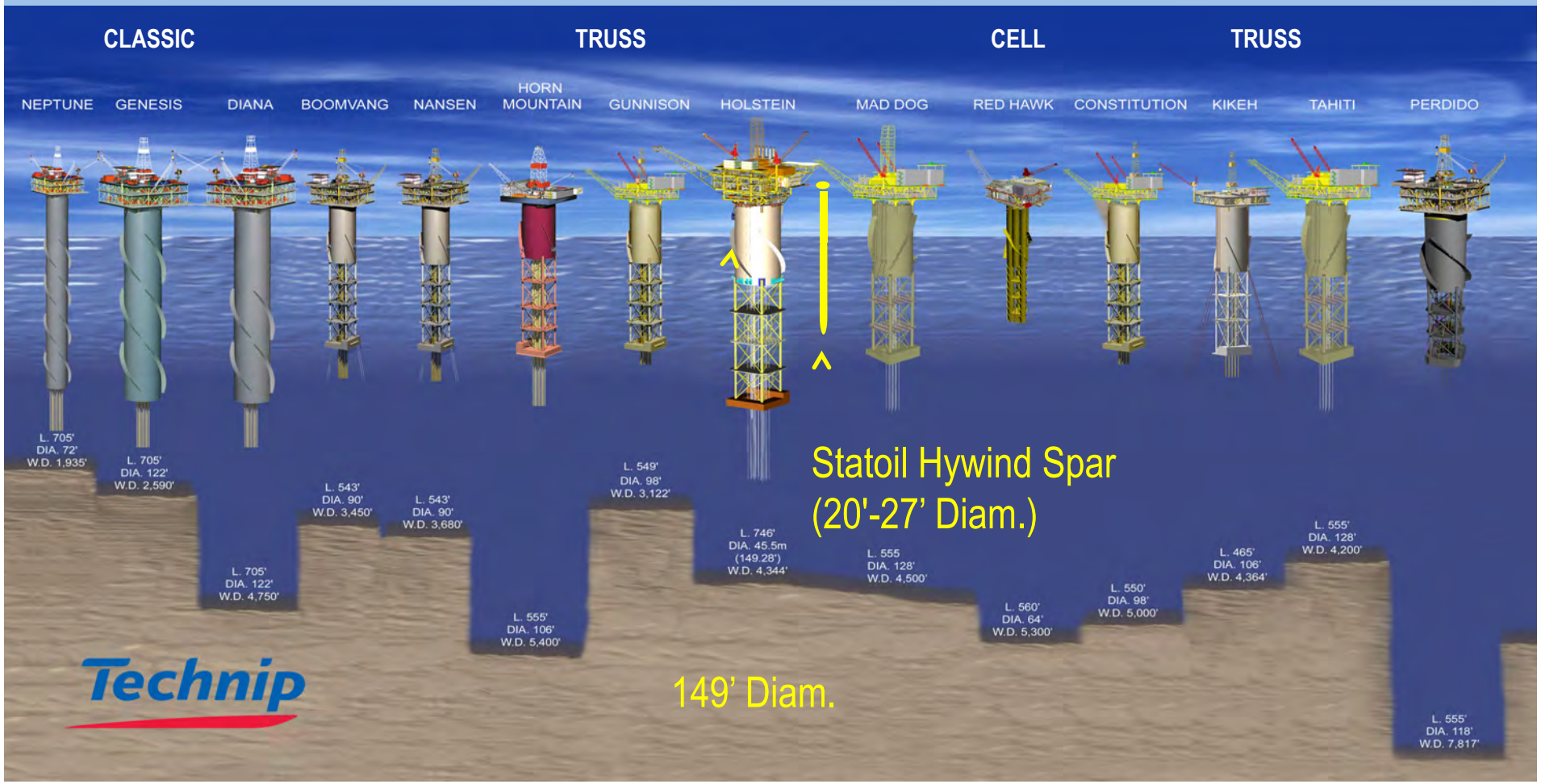
Offshore Wind Slender Tubes Compared to Oil & Gas Designs



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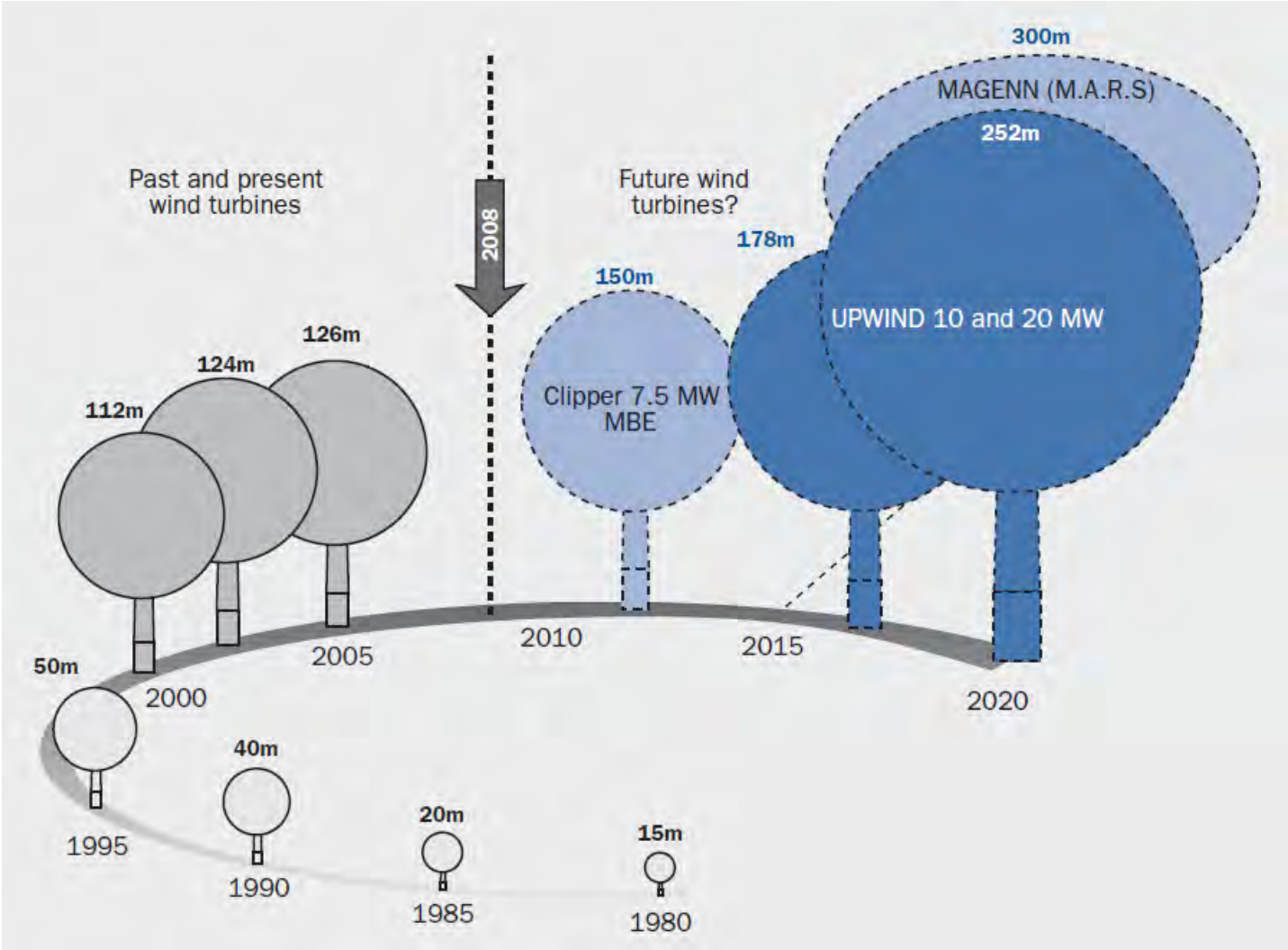
While Turbine Sizes Growing (Clipper 10 MW), Need Lighter Turbines for Floating Offshore



[1] Source: Garrad Hassan

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Advanced Structures & Composites Center

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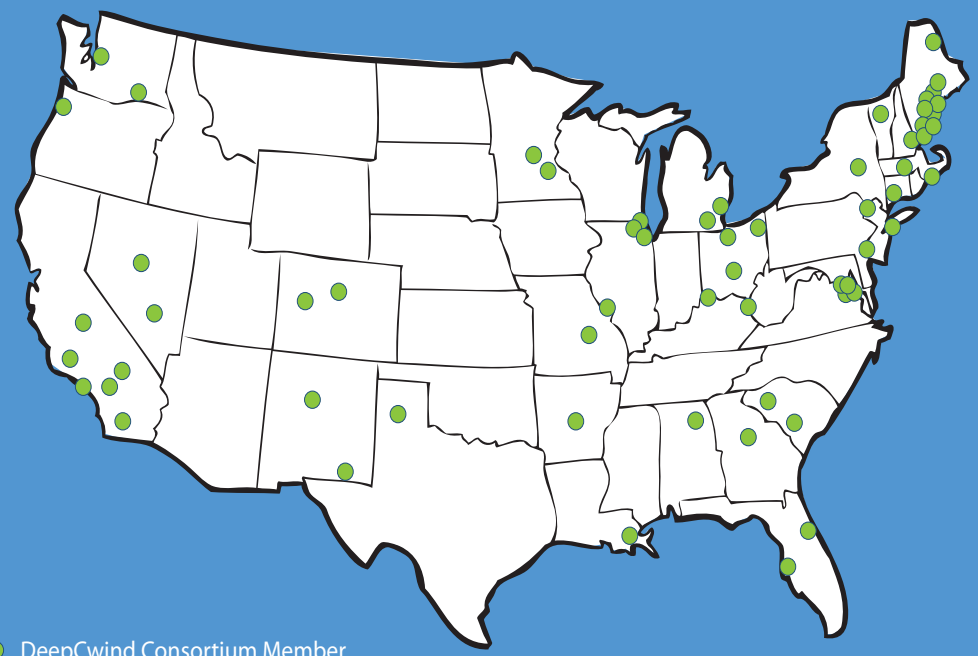
DeepCwind Consortium Membership Map

Over 30 Consortium Members Nationwide



DeepCwind Consortium Member

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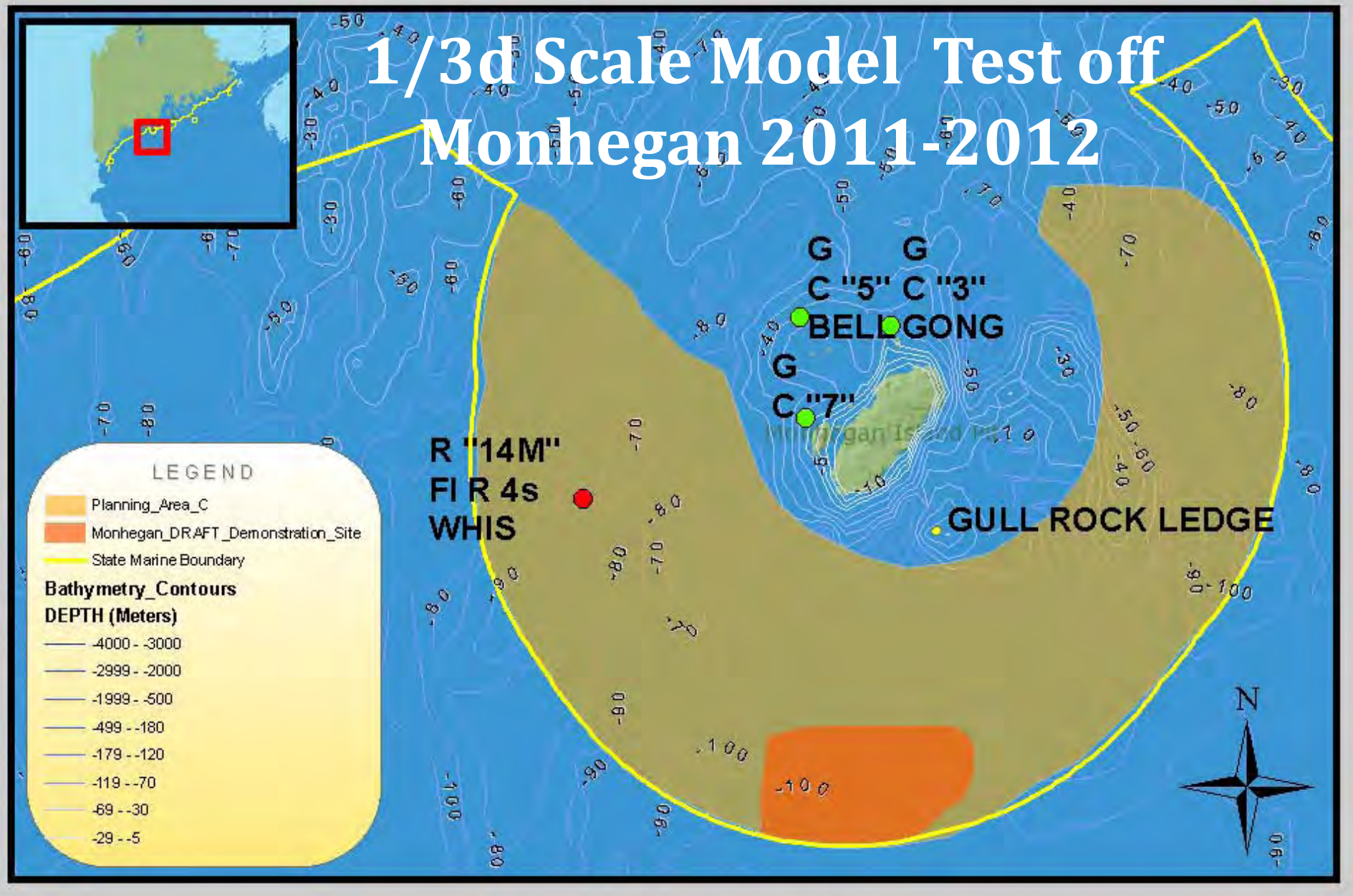
NREL
Pacific Northwest NATIONAL LABORATORY
GENERAL DYNAMICS
The Maine Composites Alliance
American Superconductor
OEI Ocean Energy Institute
ACMA
Technip
ISLAND INSTITUTE
ZOLTEK
ASHLAND
CIANBRO
MAG
BERNSTEIN SHUR COUNSELLORS AT LAW
Kleinschmidt Energy & Water Resource Consult
Central Maine Power Your Electricity Delivery Company
MAINE WIND INDUSTRY INITIATIVE
Bangor Hydro
SEWALL
OWENS CORNING
KENWAY CORPORATION
Northern POWER SYSTEMS
PRINCIPLE renewable energy delivered
polystrand
SIMMONS & COMPANY INTERNATIONAL
PPG
Clean Energy Design

U.S. DEPARTMENT OF ENERGY
NSF

Setting the Course for Energy Independence

1/3d Scale Model Test off Monhegan 2011-2012

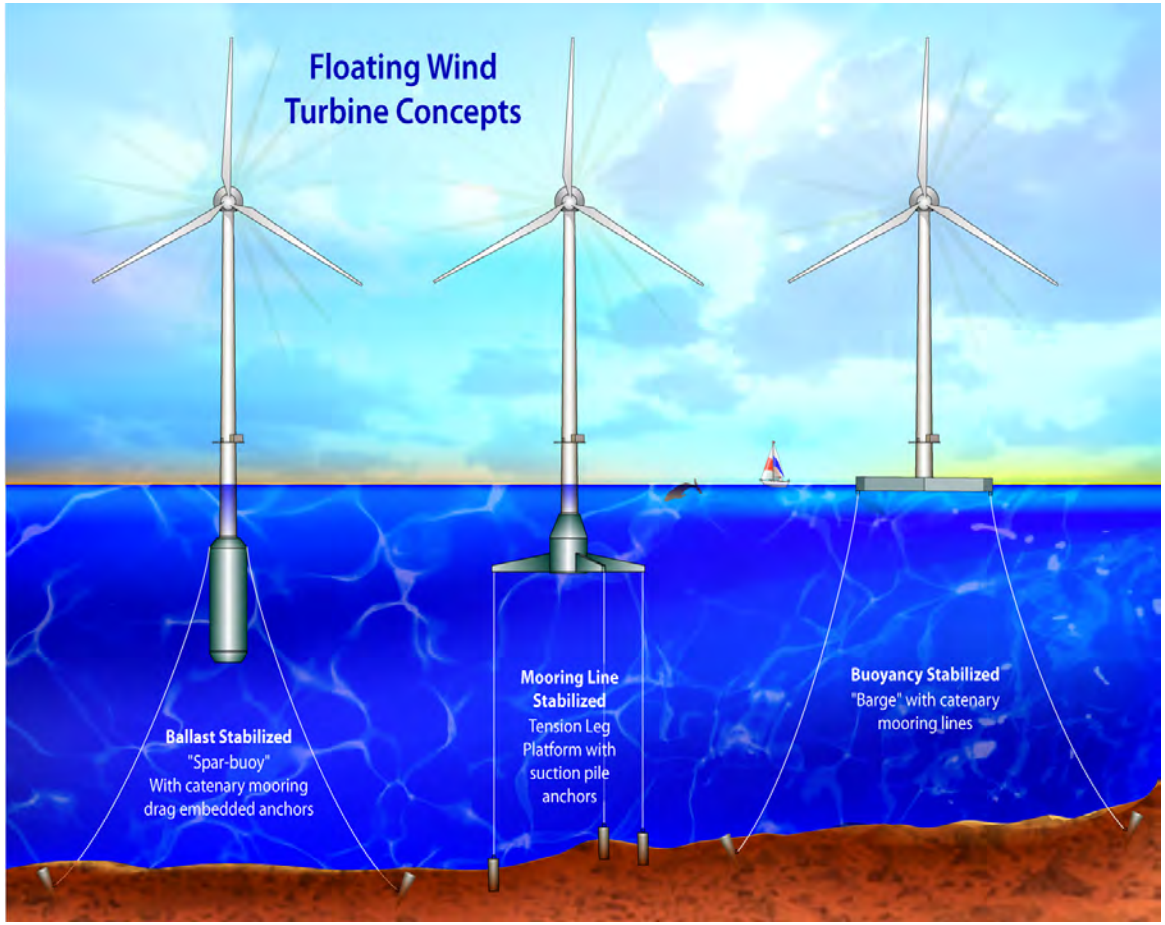


MONHEGAN ISLAND
DRAFT OCEAN ENERGY DEMONSTRATION AREA

Phase 2:
Single Full-Scale Test in 2011-2013

Technical Goals:

- Predictive models
- Cost optimization ($3.5/W):
  - Manufacturability
  - Deployment logistics
  - Composites
  - Durability: corrosion/fatigue.
  - Maintenance
  - Survivability (extreme events)
  - Platforms, Structures & Foundations
  - Class 6 and 7 winds



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Phase 3: 2014-2016

25 MW Stepping Stone Floating Wind Farm
Expand to larger Commercial Farm

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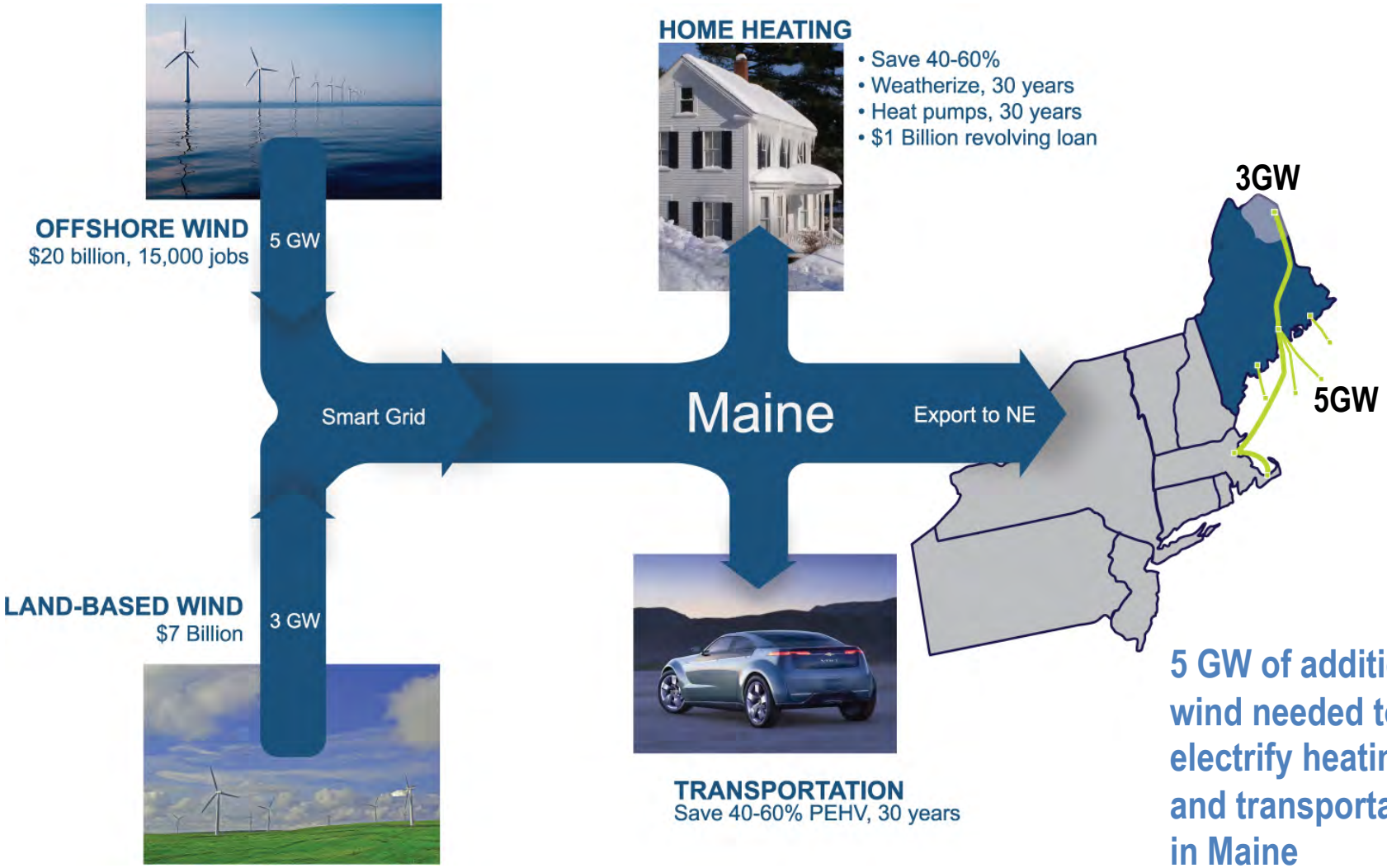
The Maine Plan: Over-the-Horizon Farms:

A National Electrification Model



5 GW of additional wind needed to electrify heating and transportation in Maine

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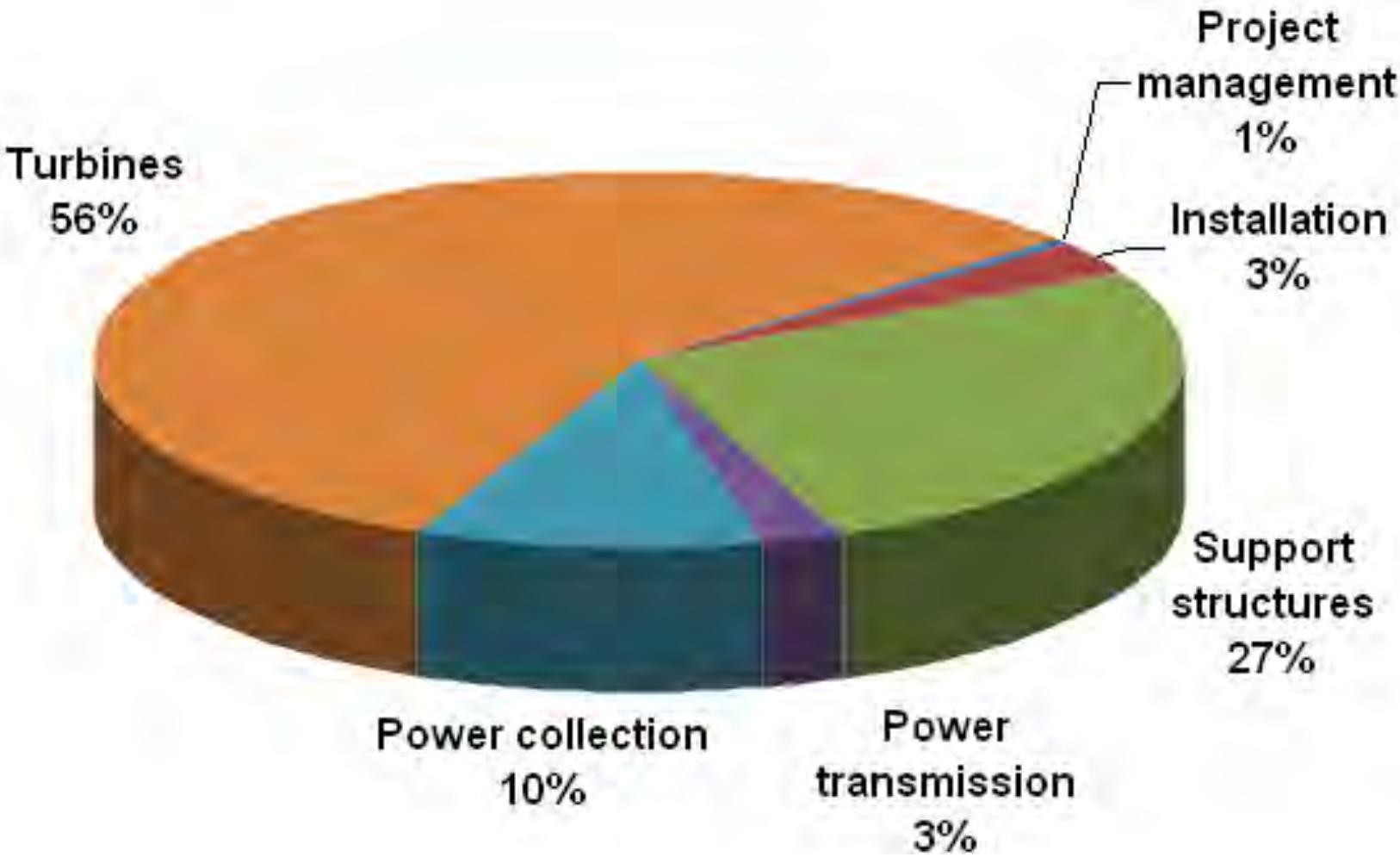
Economic Opportunities for Maine
15,000 jobs if we maximize supply chain



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