

NOWITECH

We make it possible

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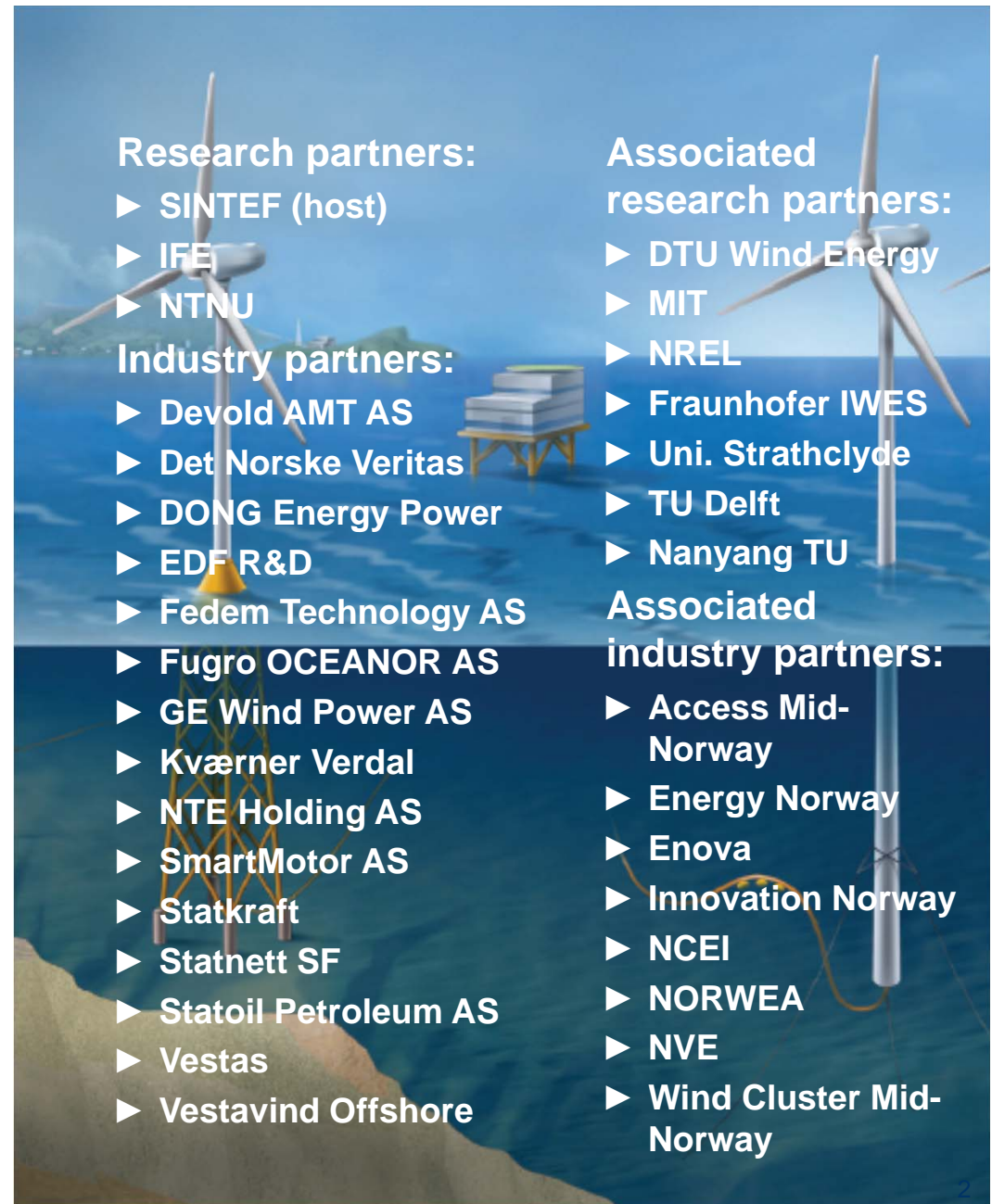
NOWITECH

Norwegian Research Centre for Offshore Wind Technology



NOWITECH in brief

- ▶ a joint pre-competitive research effort
- ▶ focus on deep offshore wind technology (+30 m)
- ▶ budget (2009-2017) EUR 40 millions
- ▶ co-financed by the Research Council of Norway, industry and research partners
- ▶ 25 PhD/post doc grants
- ▶ Vision:
 - large scale deployment
 - internationally leading



Research partners:

- ▶ SINTEF (host)
- ▶ IFE
- ▶ NTNU

Industry partners:

- ▶ Devold AMT AS
- ▶ Det Norske Veritas
- ▶ DONG Energy Power
- ▶ EDF R&D
- ▶ Fedem Technology AS
- ▶ Fugro OCEANOR AS
- ▶ GE Wind Power AS
- ▶ Kværner Verdal
- ▶ NTE Holding AS
- ▶ SmartMotor AS
- ▶ Statkraft
- ▶ Statnett SF
- ▶ Statoil Petroleum AS
- ▶ Vestas
- ▶ Vestavind Offshore

Associated research partners:

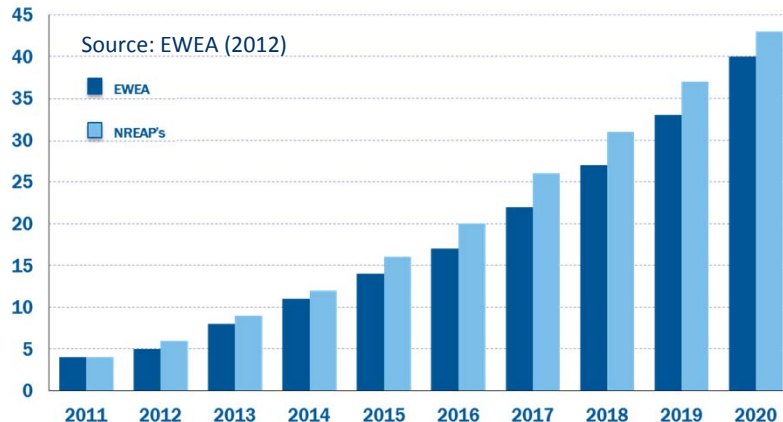
- ▶ DTU Wind Energy
- ▶ MIT
- ▶ NREL
- ▶ Fraunhofer IWES
- ▶ Uni. Strathclyde
- ▶ TU Delft
- ▶ Nanyang TU

Associated industry partners:

- ▶ Access Mid-Norway
- ▶ Energy Norway
- ▶ Enova
- ▶ Innovation Norway
- ▶ NCEI
- ▶ NORWEA
- ▶ NVE
- ▶ Wind Cluster Mid-Norway

A large growing global market for offshore wind technology

EU OFFSHORE WIND FORECAST INSTALLED CAPACITY (GW)



OFFSHORE WIND KEY INDICATORS

Key indicators	2010	2016
Capex (NOK)	26.6 bn NOK	92bn NOK
Capex (USD)	4.7 bn USD	16 bn USD
Added capacity	1 GW	3.6 GW
Turbines	370	975
Foundations	639	1,435
Cables	518 km	1,972 km
Installation vessels	21	45
PTVs	86	277

Source: Douglas-Westwood (2012)

► Main drivers:

- Battle climate change
- Security of supply
- Industry development

► Firm European commitment

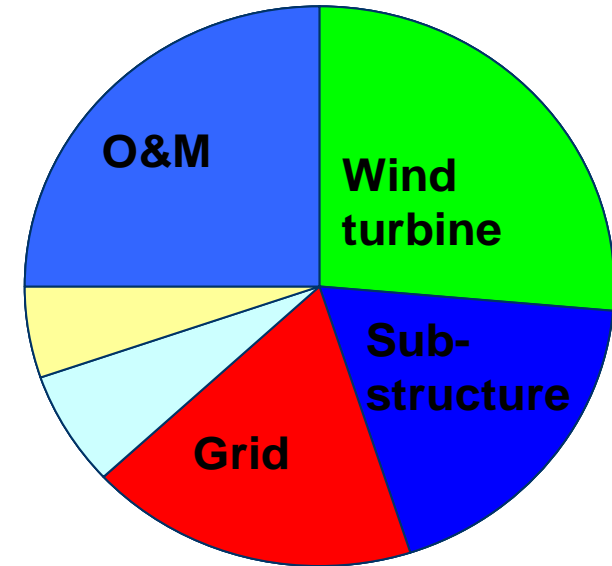
- 40 GW by 2020
- 150 GW by 2030

► Significant developments also in China, Japan, Korea and USA

► The near-term large market is mainly for bottom-fixed wind farms

► Significant interest in developing floating concepts expecting large volume after 2020

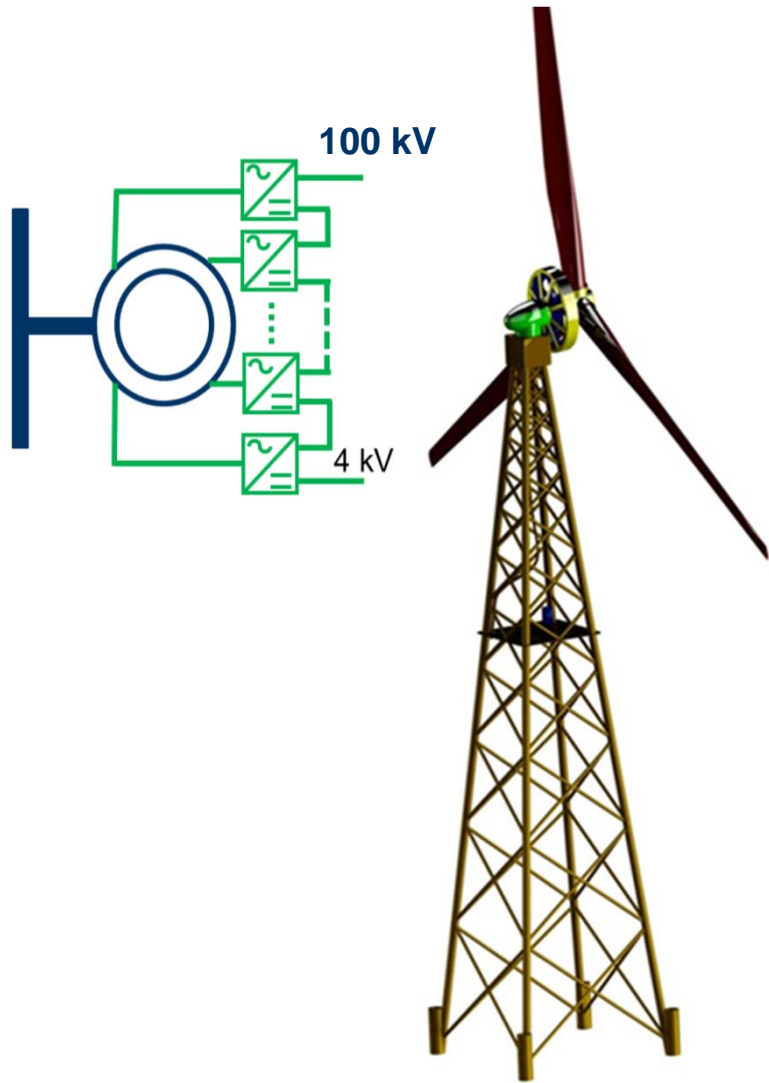
Multidisciplinary Research Challenges



LPC distribution of offshore wind farm (example)

Key issue: Innovations reducing cost of energy from offshore wind

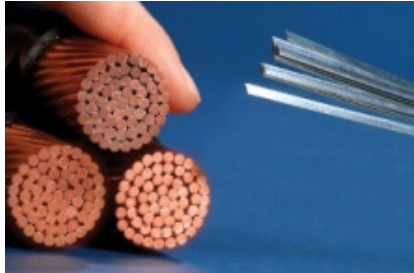
NOWITECH 10 MW reference turbine



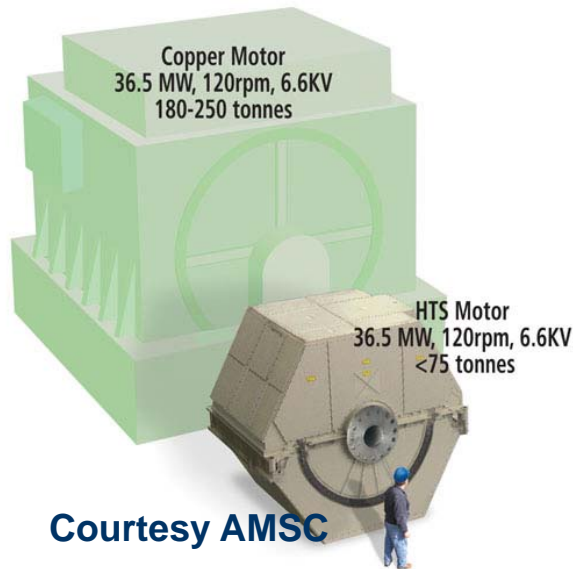
The NOWITECH 10 MW reference turbine introduces a new generator and support structure concept

- New generator concept allows for direct HVDC connection to shore and avoiding costly offshore sub-station
- New support structure avoid costly transition piece between tubular tower and jacket

Superconducting generators reduce weight



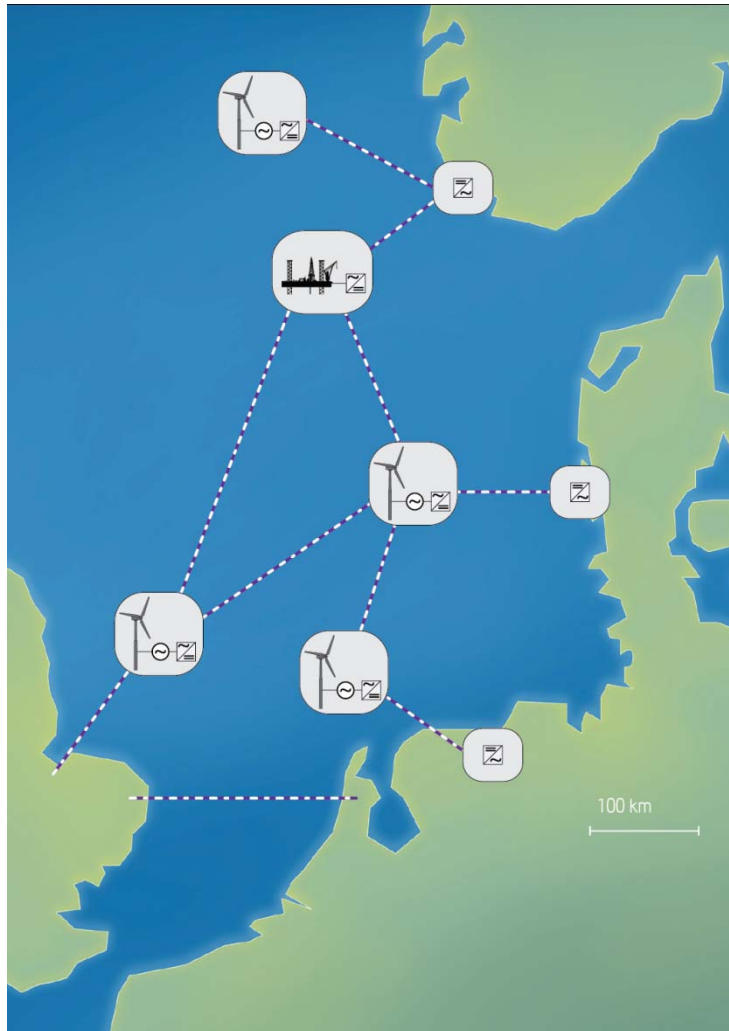
- 100 times the current density compared to copper
- More than doubles the achievable magnetic field
- Eliminates rotor losses
- Operating at 20-50 K



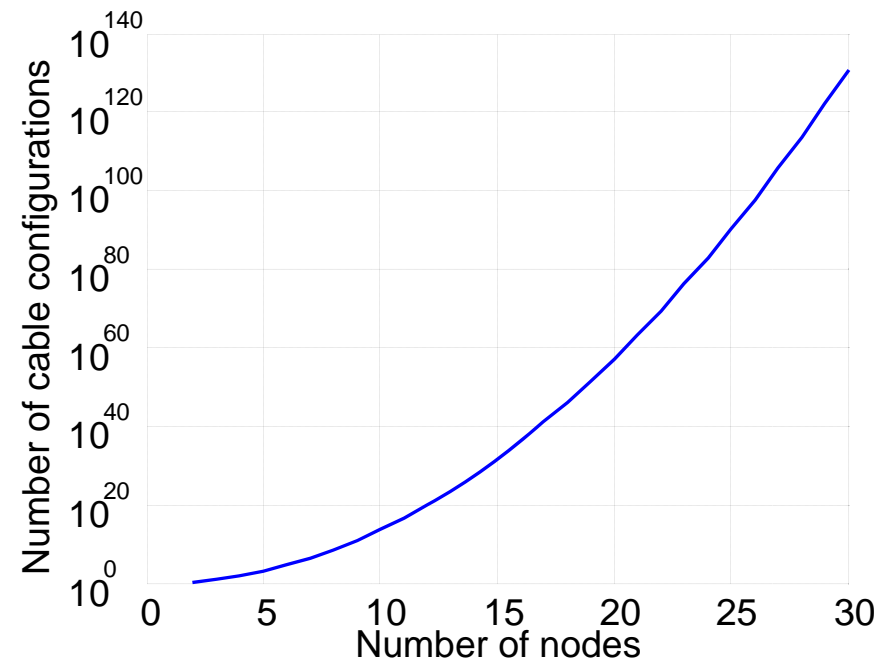
Courtesy AMSC

- New materials give new electromagnetic designs
- Possible step-changing technology
- Activity in new FP7 project application: InnWind

Optimization of the offshore grid



- ▶ Inside and between wind farms
- ▶ New market solutions are required
- ▶ New technology (HVDC VSC, multi-terminal, hybrid HVDC/HVAC, ..)
- ▶ Protection, Fault handling, Operation, Control, Cost, Security of Supply

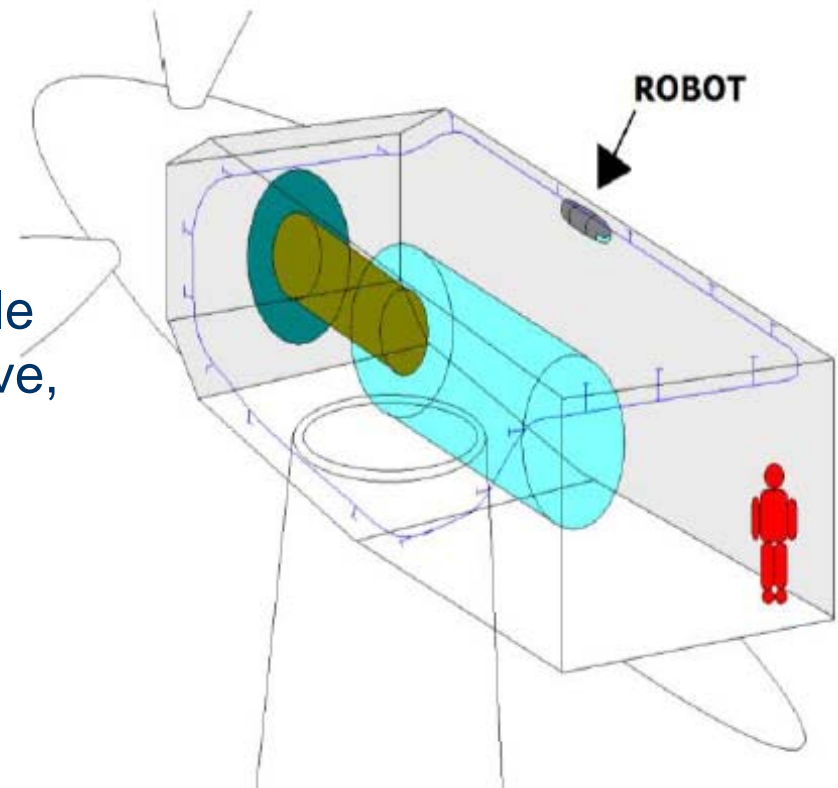


Remote presence reduce O&M costs

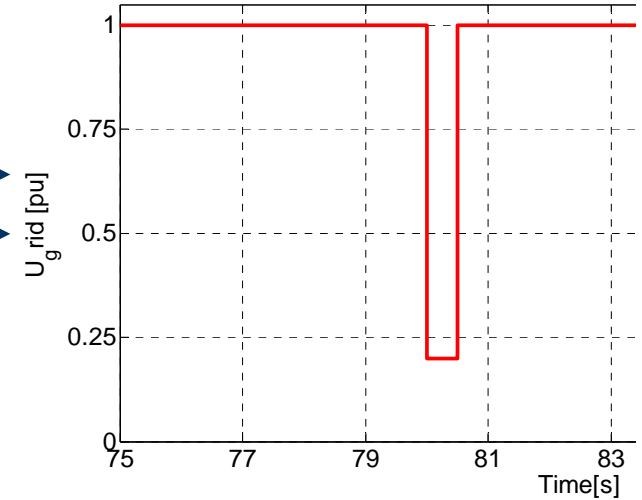
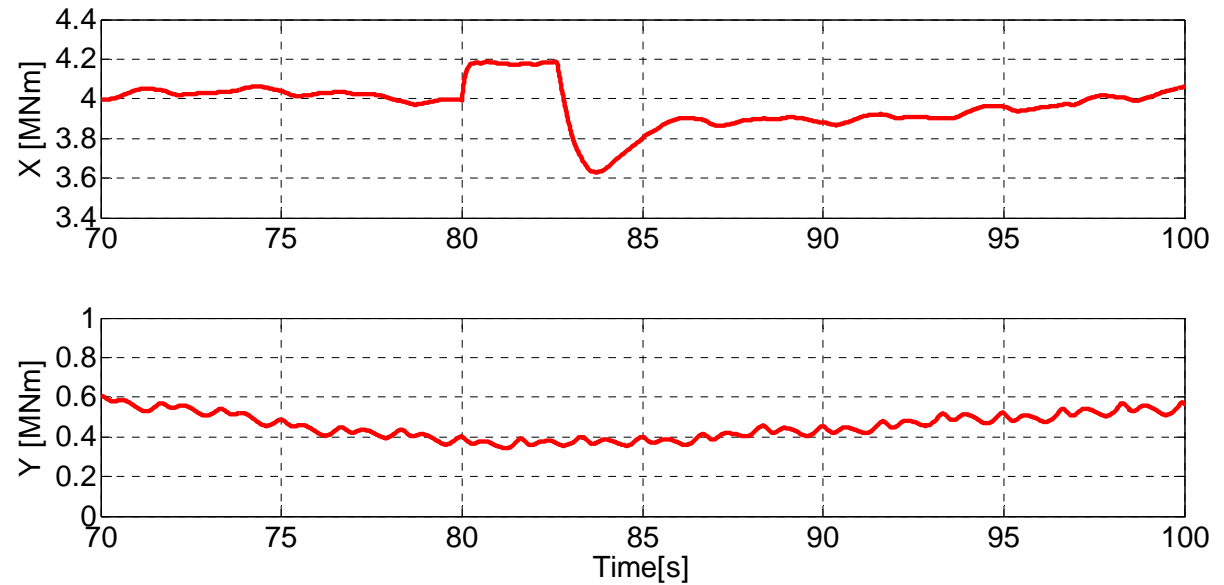
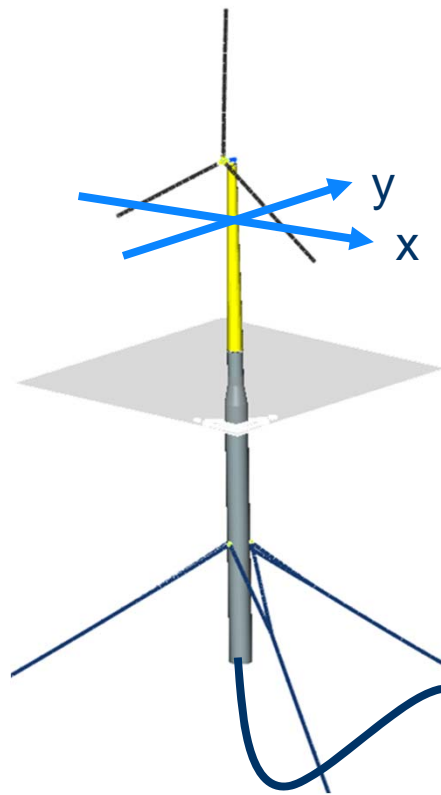
- ▶ It is costly and sometimes impossible to have maintenance staff visiting offshore turbines



- ▶ Remote presence:
 - Remote inspection through a small robot on a track in the nacelle equipped with camera / heat sensitive, various probes, microphone etc.
 - Remote maintenance through robotized maintenance actions

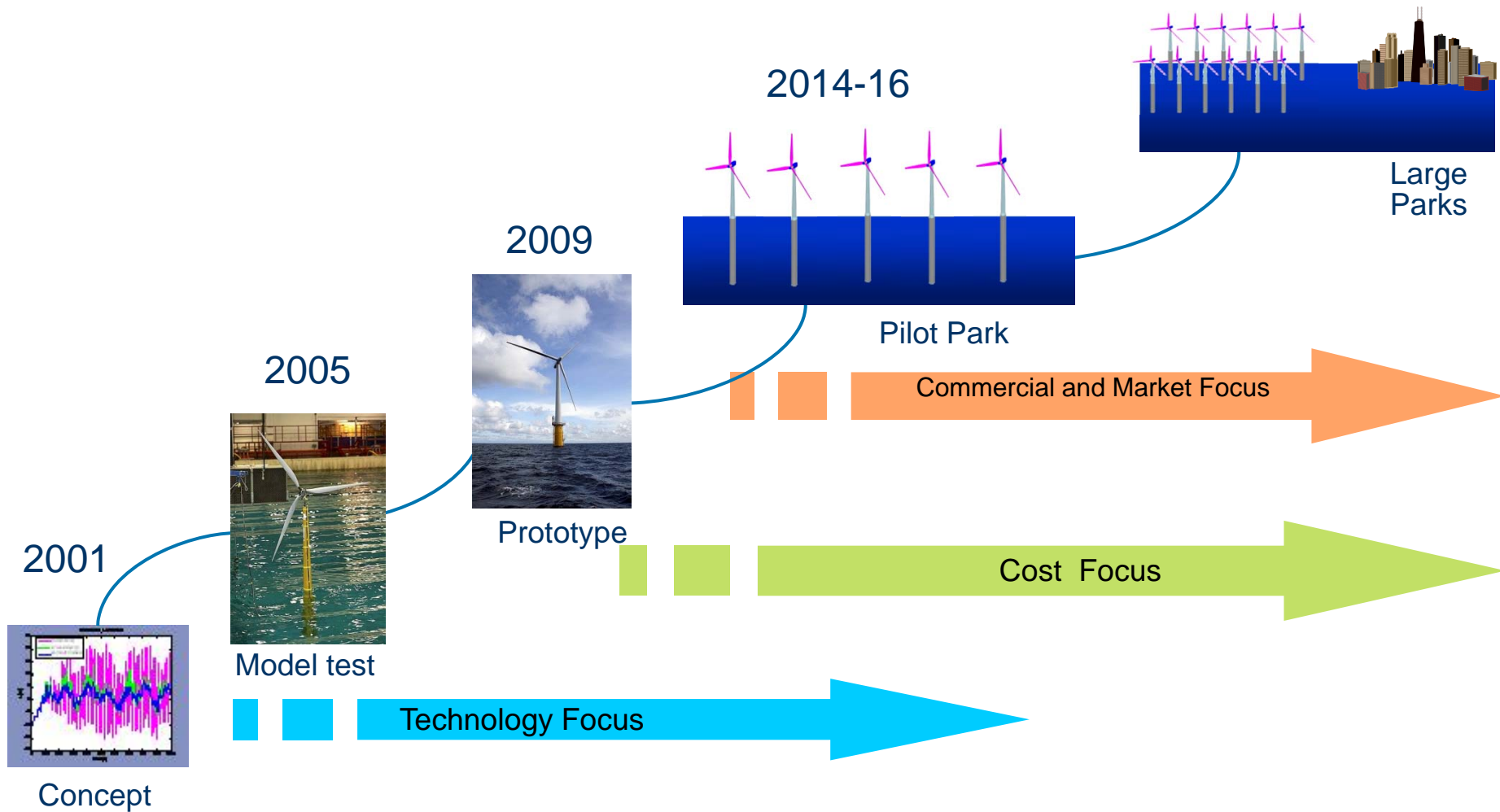


Integrating structural dynamics, control and electric model



Best poster at EOW 2011

From Idea to Commercial Deployment



Graphic is copy from Statoil presentation on HyWind at Wind Power R&D seminar; 20-21 January 2011, Trondheim, Norway



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Rounding up

- ▶ Remarkable results are already achieved by industry and R&D institutes on deep offshore wind technology
- ▶ Technology still in an early phase – Big potential provided technical development and bringing cost down
- ▶ Research plays a significant role in providing new knowledge as basis for industrial development and cost-effective offshore wind farms at deep sea
- ▶ Cooperation between research and industry is essential for ensuring relevance, quality and value creation
- ▶ Test and demonstration, also in large scale, is vital to bring research results into the market place

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Questions?

NOWITECH is a joint 40M€ research effort on offshore wind technology.

- Integrated numerical design tools
- New materials for blades and generators.
- Novel substructures (bottom-fixed and floaters)
- Grid connection and system integration
- Operation and maintenance
- Assessment of novel concepts

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