Innovations in Offshore Wind Technology through R&D

www.nowitech.no

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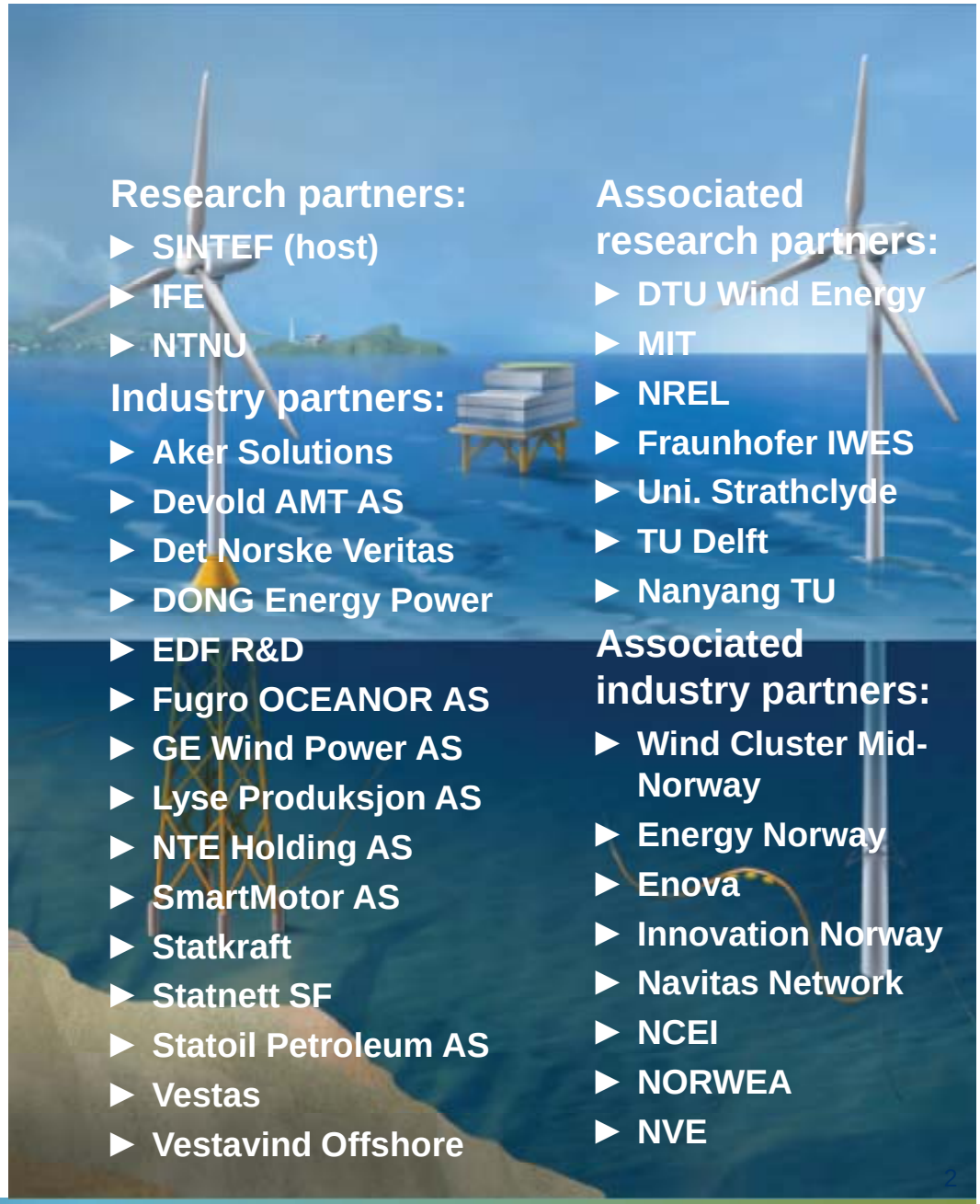
NOWITECH in brief

- 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:

- Aker Solutions
- Devold AMT AS
- Det Norske Veritas
- DONG Energy Power
- EDF R&D
- Fugro OCEANOR AS
- GE Wind Power AS
- Lyse Produksjon AS
- NTE Holding AS
- SmartMotor AS
- Statkraft
- Statnett SF
- Statoil Petroleum AS
- Vestas
- Vestavind Offshore

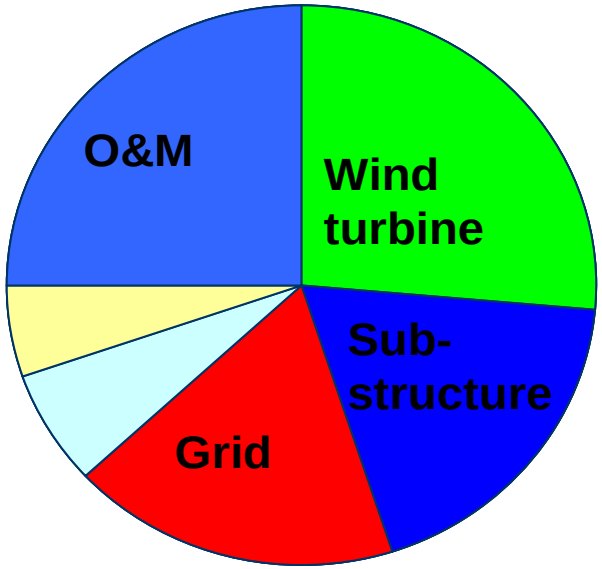
Associated research partners:

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

Associated industry partners:

- Wind Cluster Mid-Norway
- Energy Norway
- Enova
- Innovation Norway
- Navitas Network
- NCEI
- NORWEA
- NVE

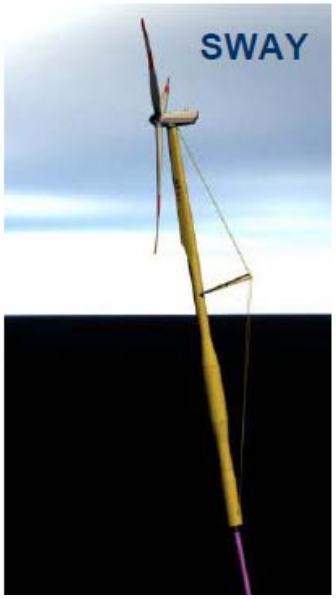
Multidisciplinary Research Challenges

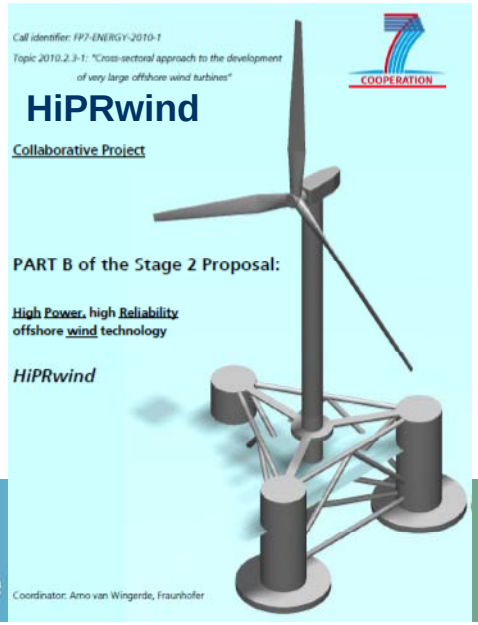


LPC distribution of offshore wind farm (example)

Key issue: Innovations reducing cost of energy from offshore wind

Exciting floating concepts

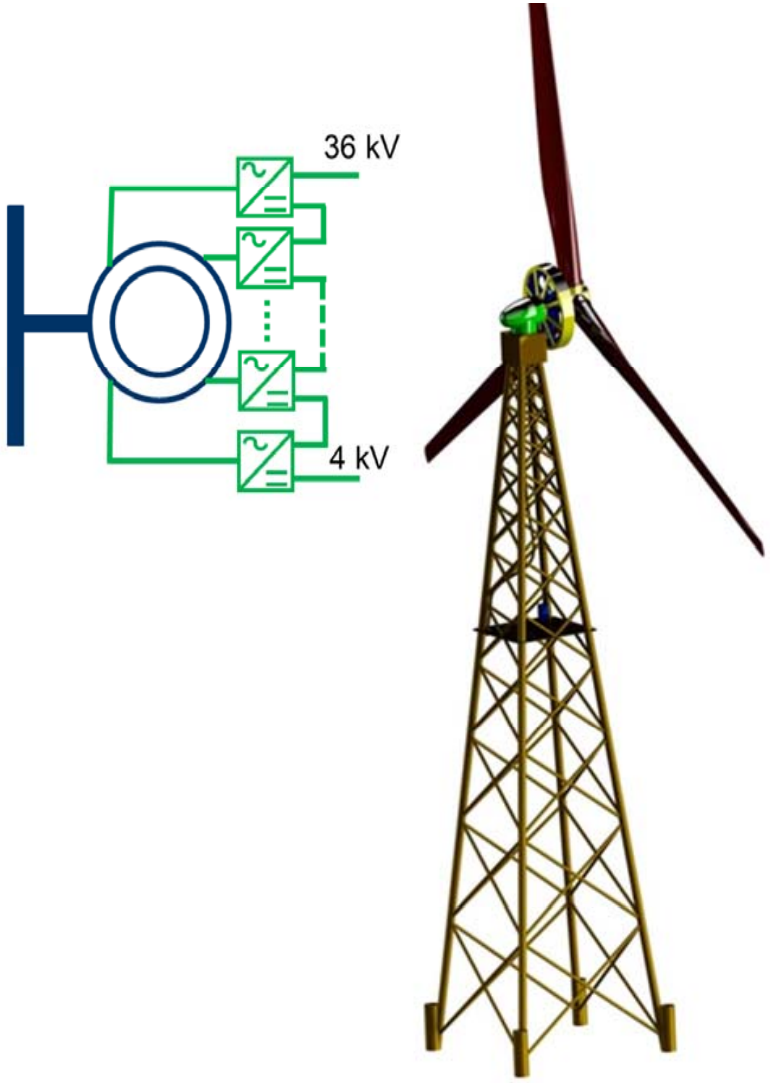




NOWITECH Norwegian Research Centre for Offshore

CENTRE FOR ENVIRONMENT-FRIENDLY ENERGY RESEARCH

NOWITECH 10 MW reference turbine

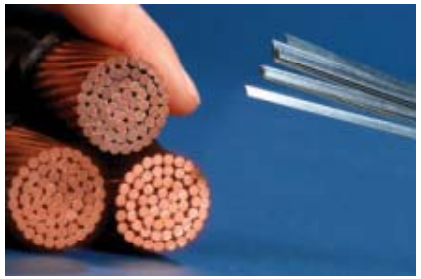


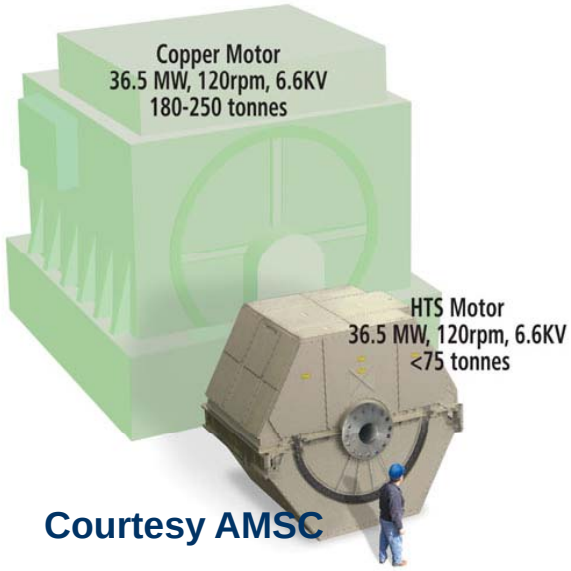
Initial design parameters

- Nominal power output 10.0 MW
- Design wind velocity 13.0 m/s
- Tip speed ratio 7.7
- Hub height 93.5 m
- Turbine diameter 141.0 m
- Design water depth 60.0 m
- Wind & waves ala Doggerbank
- **(work in progress!)**

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

Superconducting generators reduce weight



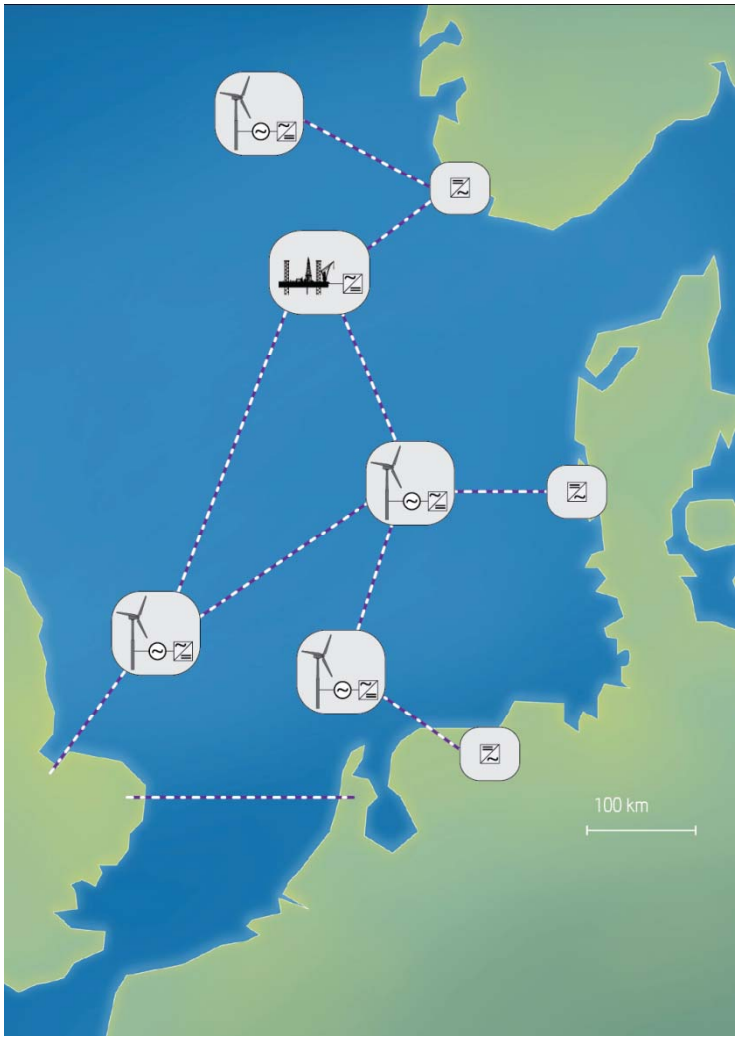


Courtesy AMSC

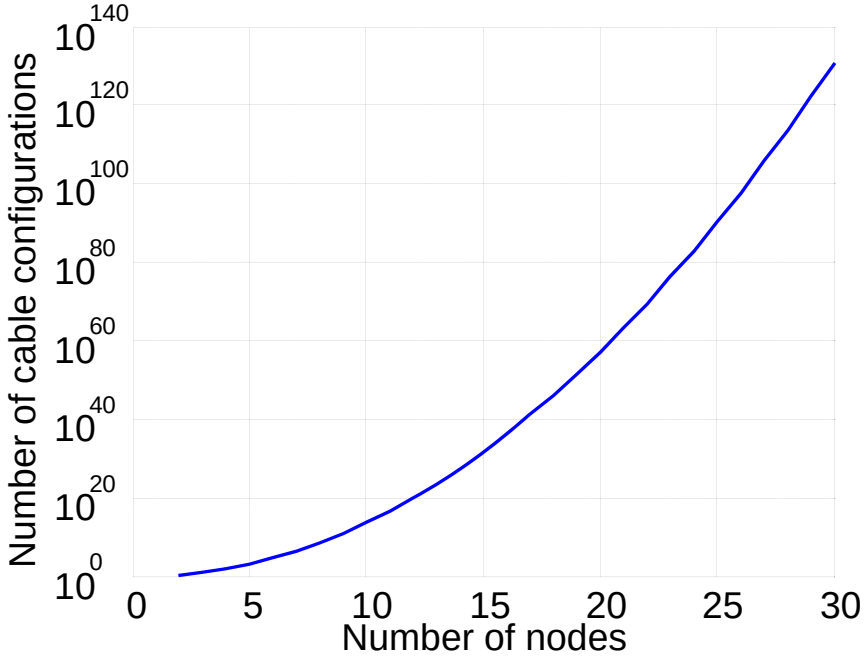
- 100 times the current density compared to copper
- More than doubles the achievable magnetic field
- Eliminates rotor losses
- Operating at 20-50 K

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

Optimization of the offshore grid

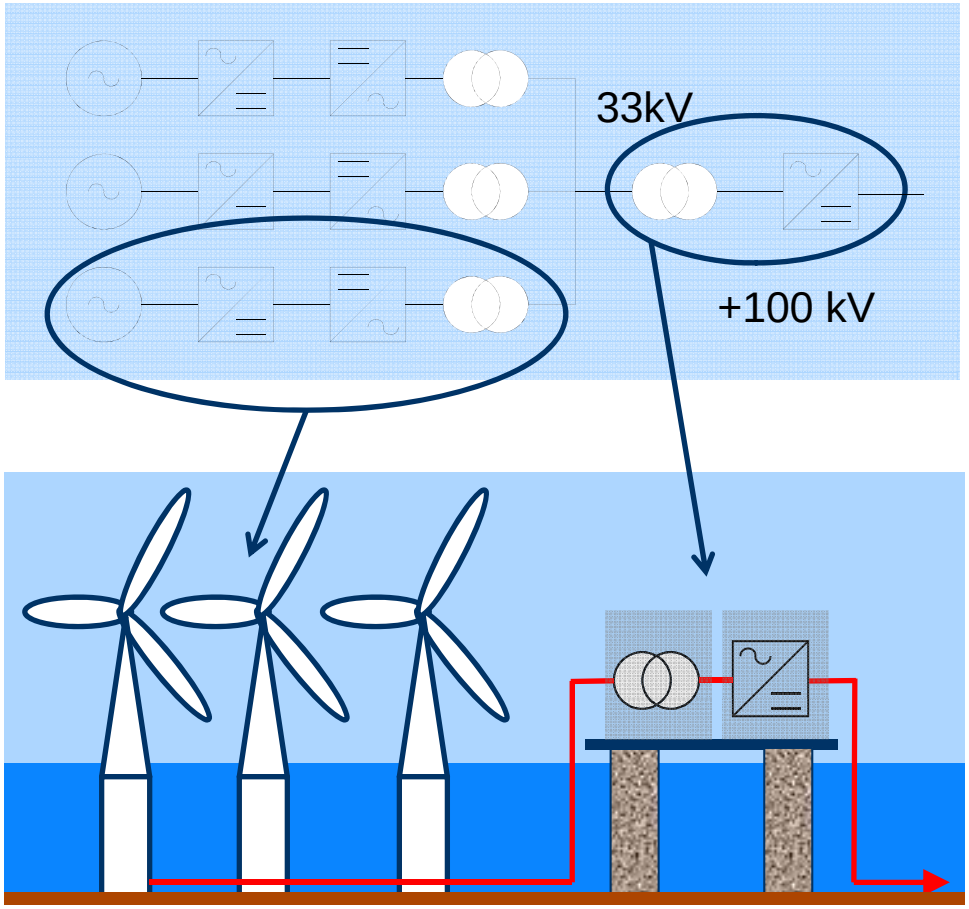


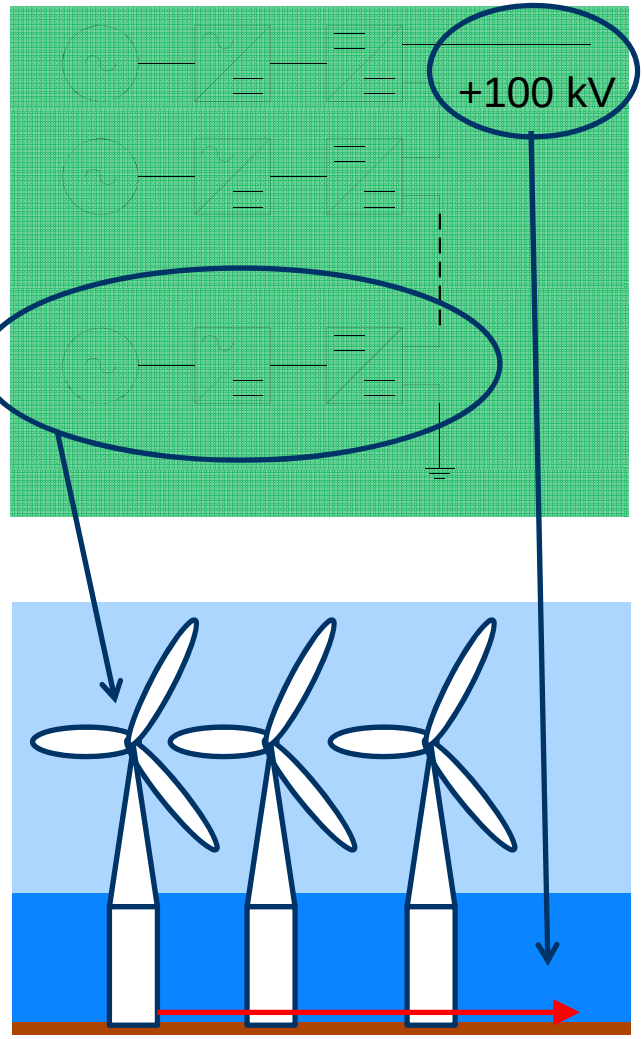
- Inside and between wind farms
- New market solutions are required
- New technology (HVDC VSC, multi-terminal, hybrid HVDC/HVAC, ..)
- Protection, Fault handling, Operation, Control, Cost, Security of Supply



Innovative DC grid solutions for offshore wind farms avoiding need for large sub-station

Conventional system

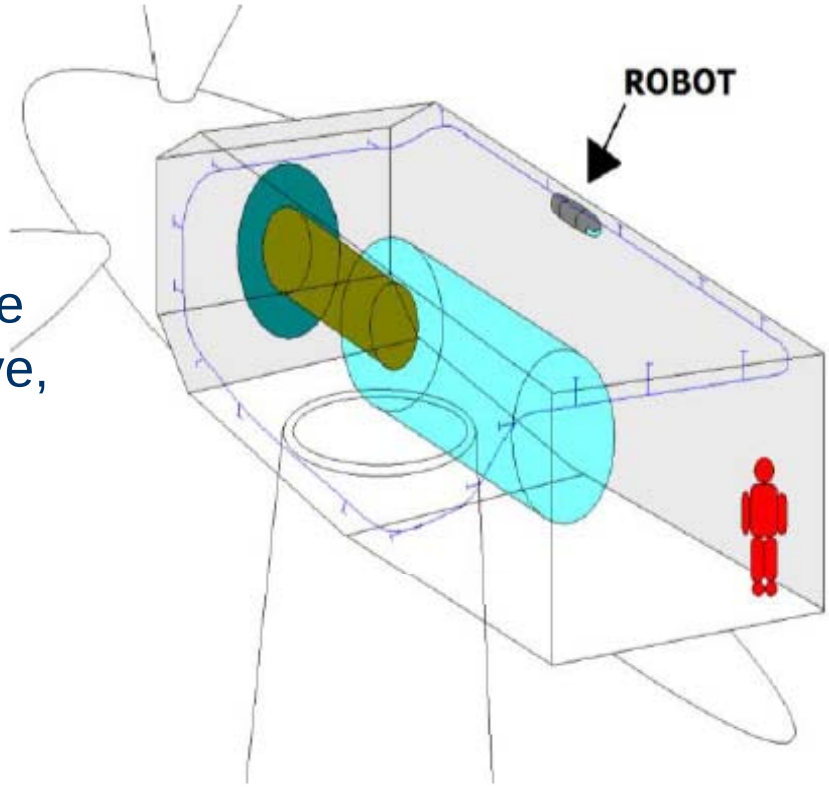




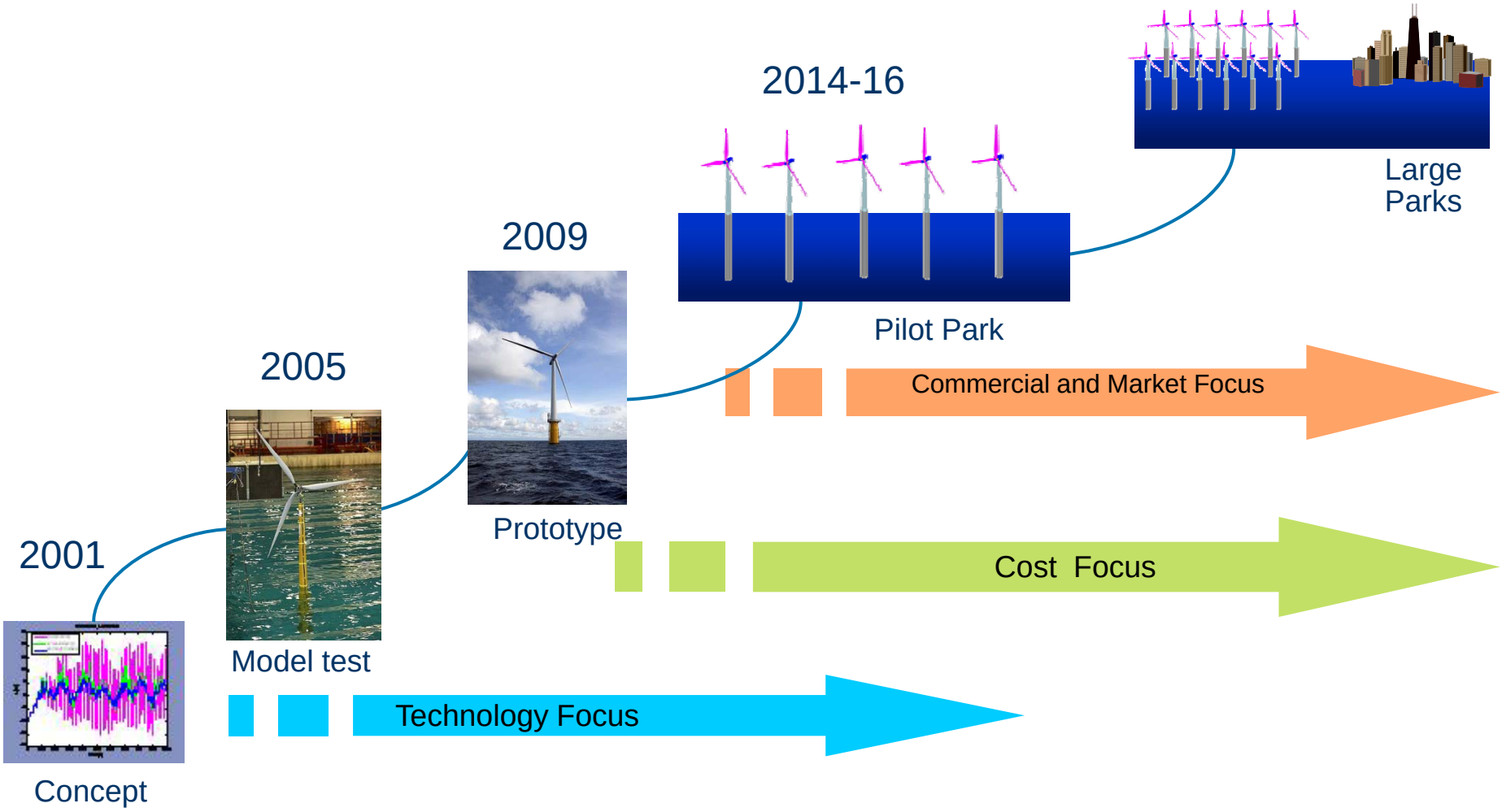
Remote presence reduce O&M costs

- 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



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

Statoil

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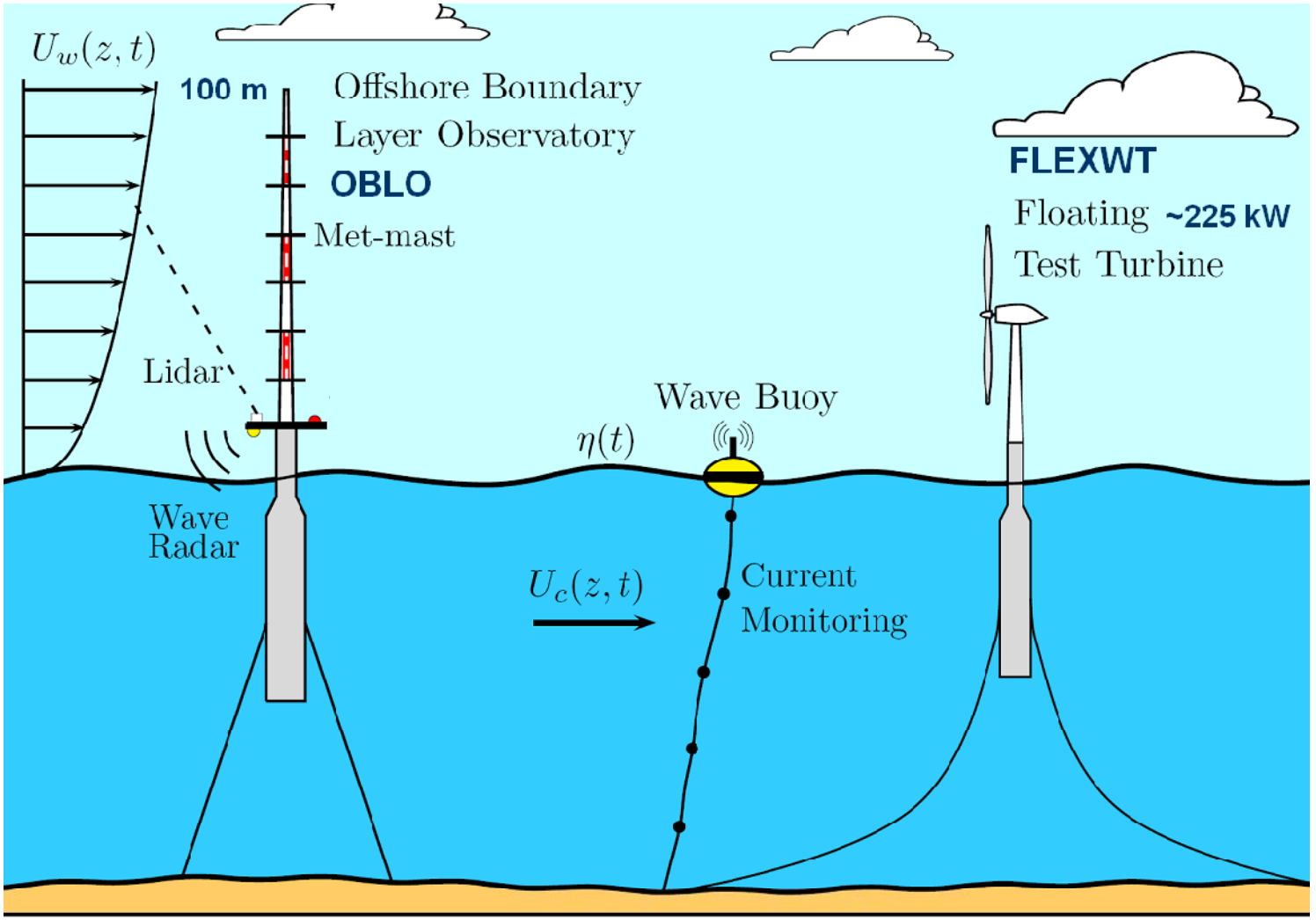
NOWERI – Norwegian Offshore Wind Energy Research Infrastructure (NORCOWE & NOWITECH – in preparation)



THE HAVSUL CONCEPT BY VESTAVIND OFFSHORE

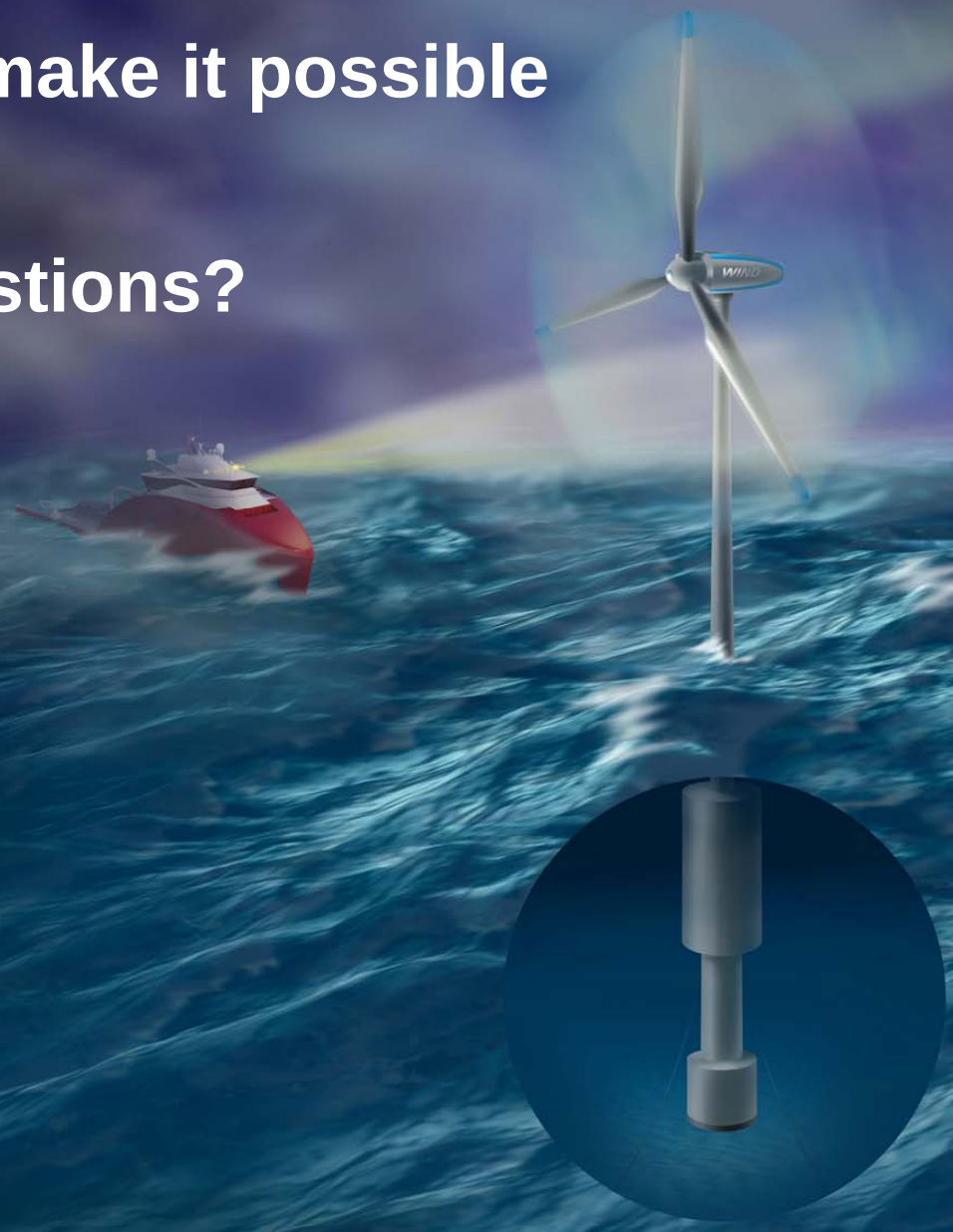
- Norway's only granted license for a full scale offshore wind farm
- 350 MW installed capacity – estimated annual energy output 1-1,3 TWh
  - Floatable foundation solutions for bottom fixed offshore wind turbines
  - Inshore assembly of complete wind turbine including foundation
  - Offshore installation in one operation without need for special purpose vessels

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
- Offshore wind is a multidisciplinary challenge – international collaboration is the answer!

We make it possible

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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