

Nye forskningsaktiviteter og muligheter i Europa og Norge innen offshore vindkraft

FME, TPwind, EERA JP wind

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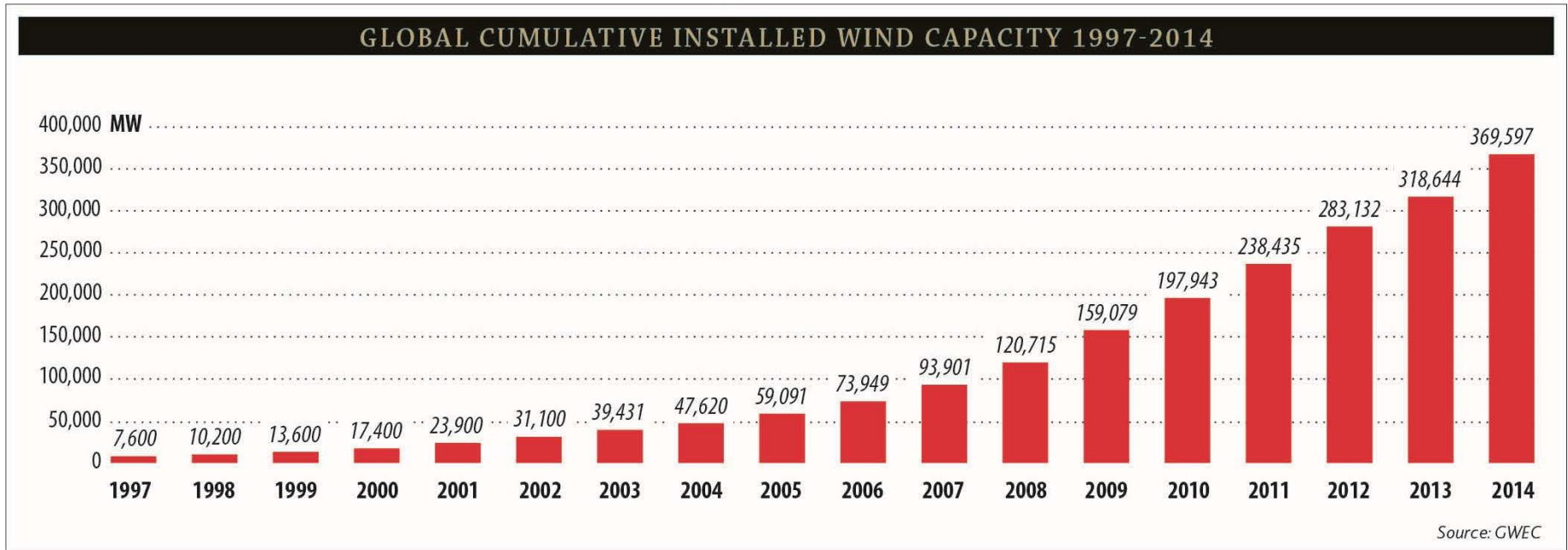
Director NOWITECH

Senior Scientist / Research Manager

SINTEF Energy Research

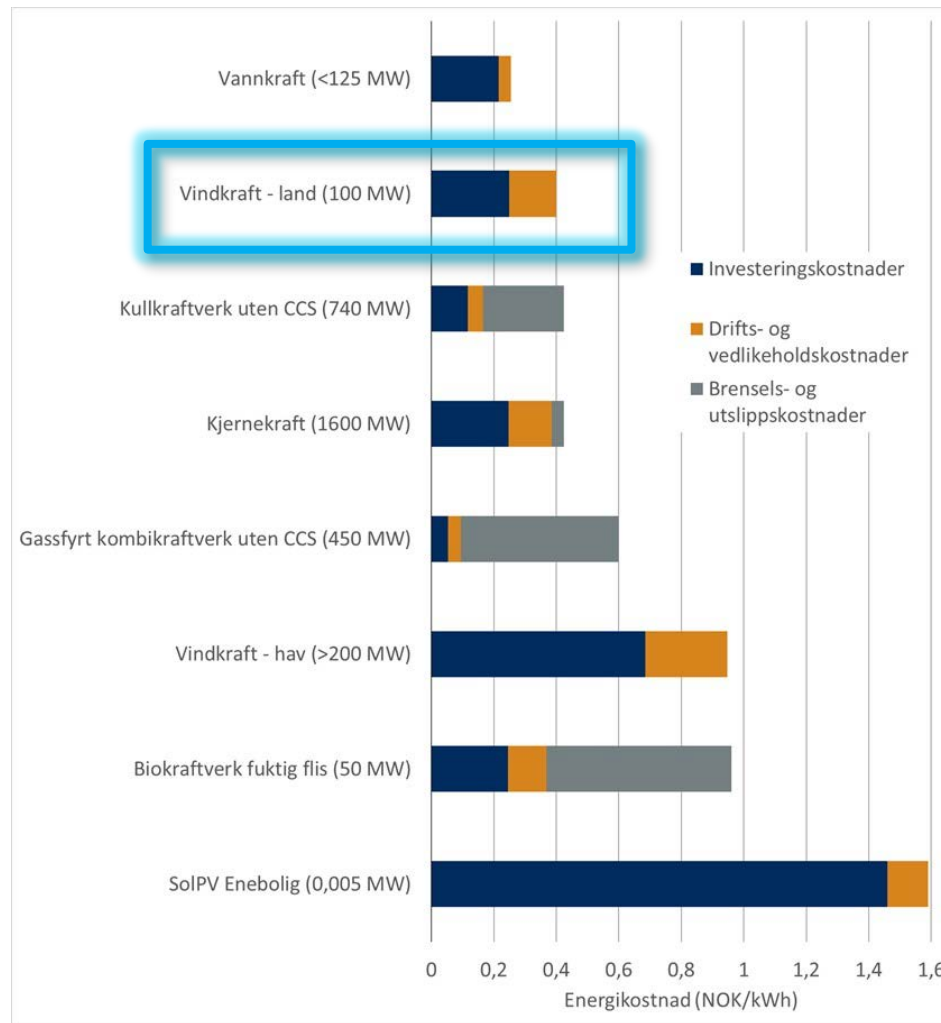
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Wind energy in strong development



- ✓ Land based: 8 GW in 1997; 361 GW in 2014
- ✓ Offshore: 8 GW in 2014; 361 GW in 2031 ??

Wind energy on land is cost competitive



NVE: Kostnader i energisektoren (2015)

A huge long-term market for green technologies

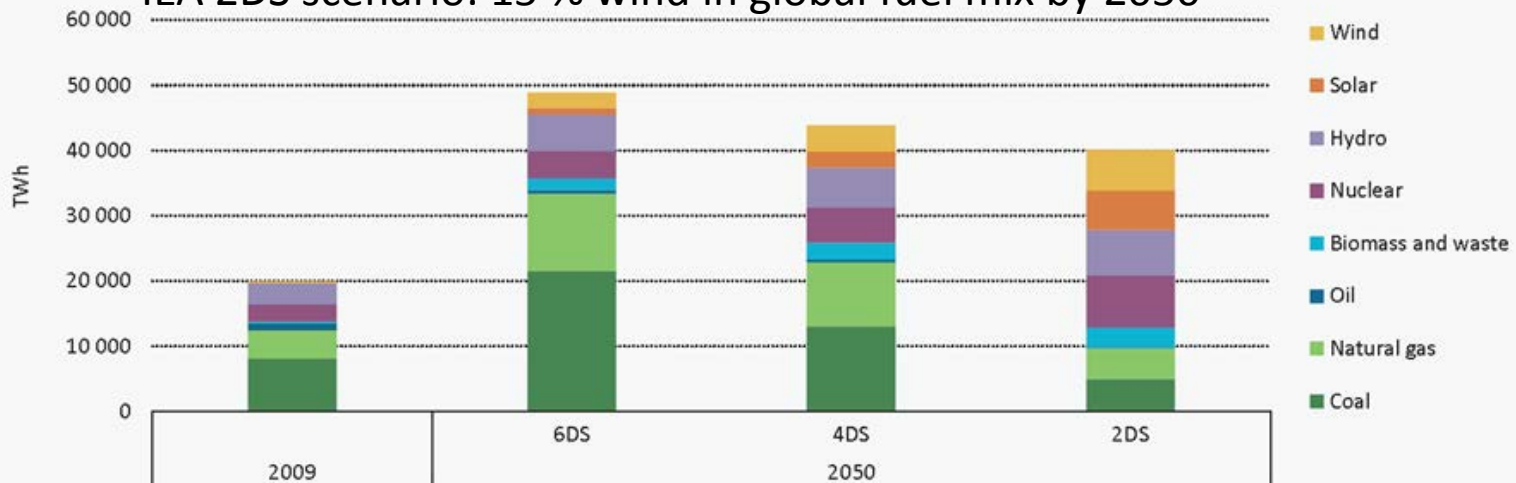
- Battle climate change
- Security of supply
- Industry value creation

Stern Review (2006):
..strong, early action on climate change far outweigh the costs of not acting.



Figure 1.10 Fuel mix in electricity generation, by scenario

IEA 2DS scenario: 15 % wind in global fuel mix by 2050



Key point

Diversification of fuels and increased use of low-carbon sources in the 2DS achieves a high degree of decarbonisation in electricity generation by 2050.

Copy from IEA Energy Technology Perspectives 2012

2013 installed wind:

Total 318 GW incl 7 GW offshore

2050 2DS wind:

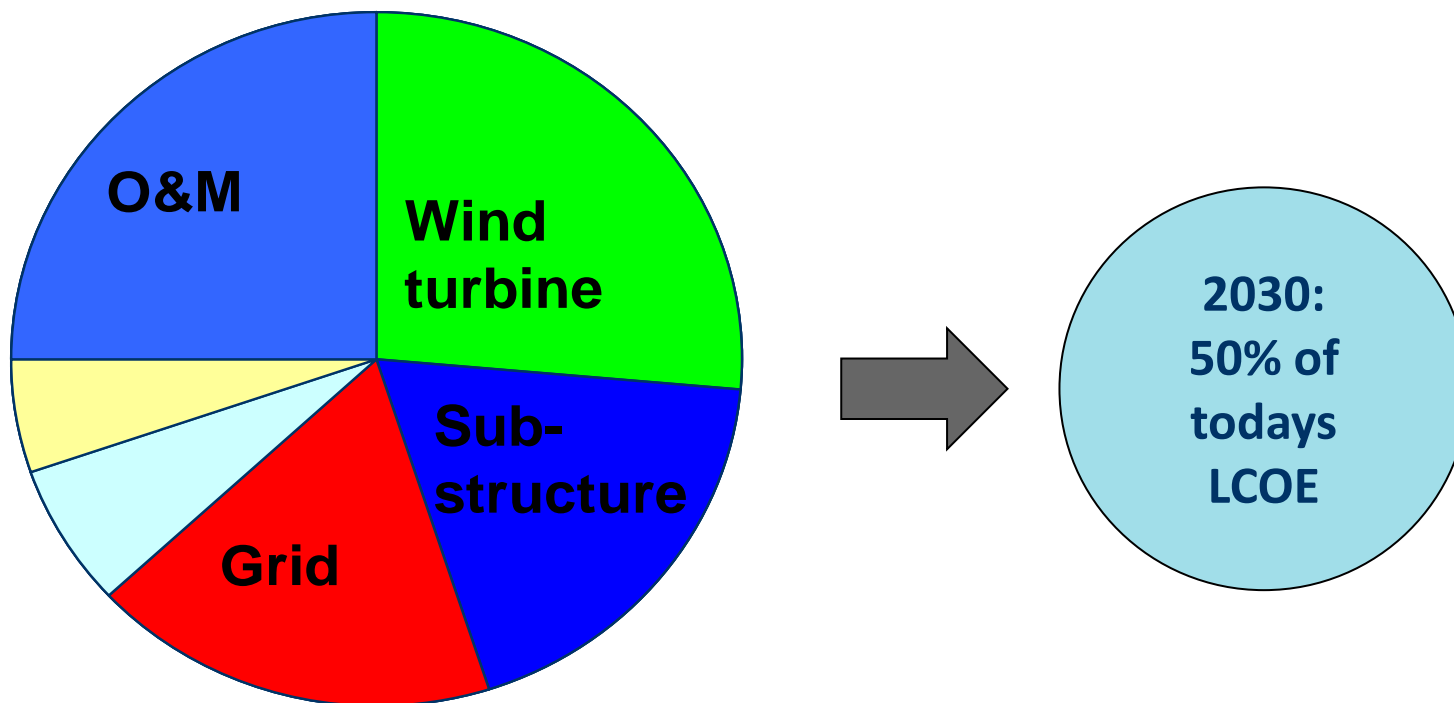
6000 TWh/3000 h = 2000 GW

Required annual installations to reach 2DS goal for wind:

2000 GW / 40 y = 50 GW/y

+ end of lifetime replacements

Offshore wind main challenge: Reduce Cost of Energy



EU TP wind KPI in new SRA:

Reduce LCOE by 50% from present levels for similar sites by 2030

Norwegian competence is attractive



- ▶ Aibel (HVDC platform, 23000 tons, 900 MW)
- ▶ Aker Solutions (Alpha Ventus, ++)
- ▶ DNV GL
- ▶ Fedem
- ▶ Fred Olsen
- ▶ Fugro Oceanor
- ▶ Kongsberg Maritime
- ▶ Nexans Norway
- ▶ Norsk Automatisering
- ▶ Reinertsen
- ▶ SINTEF/MARINTEK/NTNU
- ▶ Statkraft & Statoil (Sheringham Shoal, Dudgeon, Doggerbank)
- ▶ Olav Olsen
- ▶ Owec Tower (Beatrice)
- ▶ ++ INTPOW: 150 Norwegian companies



HyWind – Statoil taking the next step



Office de la Propriété
Intellectuelle
du Canada
Un organisme
d'Industrie Canada

Canadian
Intellectual Property
Office
An agency of
Industry Canada

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(54) Title: A METHOD FOR DAMPING TOWER VIBRATIONS IN A WIND TURBINE INSTALLATION



SINTEF/MARINTEK
Scaled lab test
2005



Norway
2.3 MW turbine
2009



Scotland
5x6 MW wind farm
2017

Norsk engasjement i landbasert vindkraft

- Utbygging stimulert av grønne sertifikat i Norge
- Utbygd: 0,9 GW
- Konsesjon gitt: 7,3 GW
- Potensial for økt verdiskapning gjennom
 - ✓ forskning og utvikling
 - ✓ støtte til teknologiutvikling
 - ✓ premiering av utbyggere som benytter ny (norsk) teknologi



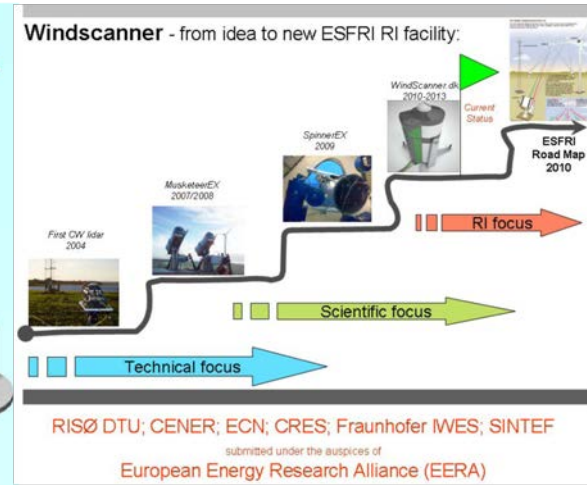
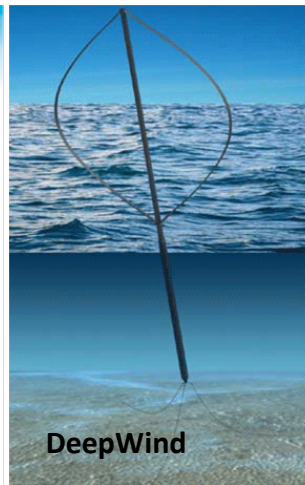
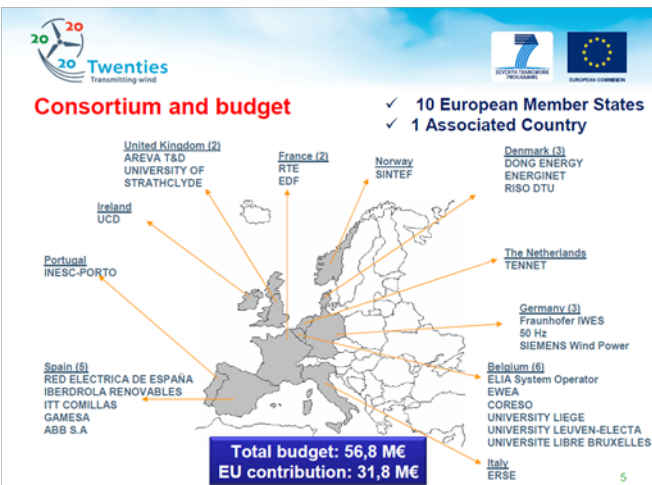
Norsk engasjement i offshore vindkraft

- Utbygging av offshore vindkraft utenfor Norge
- Leveranse av teknologi og tjenester til det globale markedet
- Potensial for økt verdiskapning gjennom:
 - forskning og utvikling
 - støtte til teknologiutvikling
 - utbygging i Norge for utvikling og kvalifikasjon av leverandørindustri



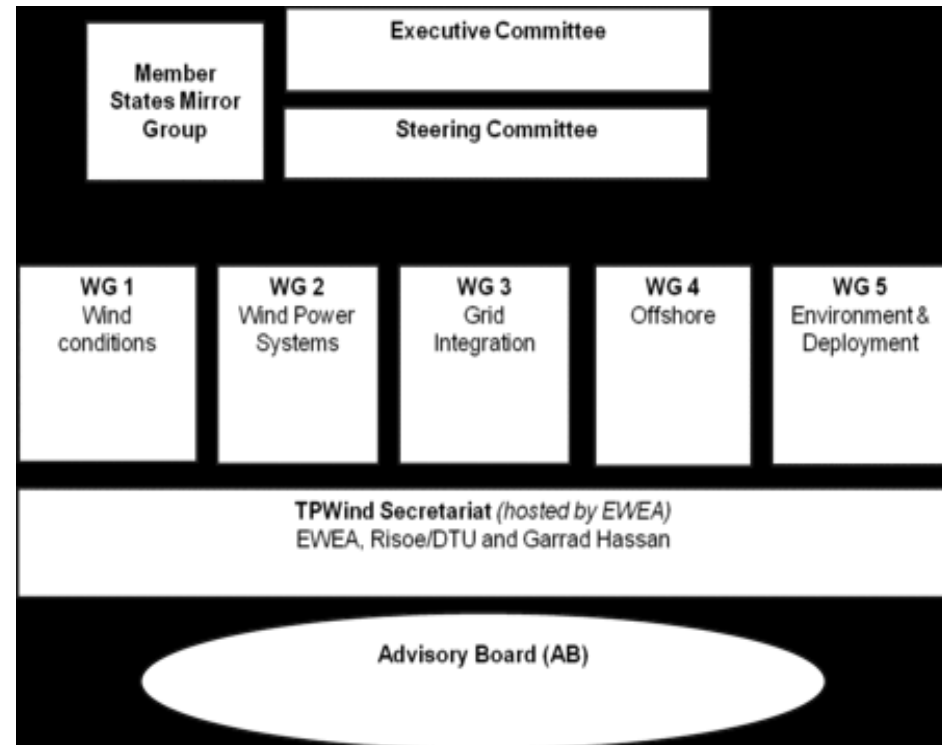
An attractive partner on the international scene

- Active in EERA, TPwind, EAWE, IEA, IEC
- Heading offshore works within EERA JPwind and TPwind
- Partner in EU projects, e.g.: Twenties (2009-), DeepWind (2010-), HiPRWind (2010-), EERA-DTOC (2012-), InnWind (2012-), WindScanner (2012-), LeanWind (2014-), EERA IRP wind (2014-), BestPaths (2014-), Lifes50+ (2015-)



"A dedicated voice for Technology and Policy R&D, speaking for the wind energy sector and its stakeholders"

- ▶ established in 2005/2006
- ▶ a permanent forum composed of more than 180 wind energy experts representing the EU wind power sector (industry and R&D community).



Strong impact on EU wind R&D agenda:

- ▶ The “Strategic Research Agenda / Market Deployment Strategy” (SRA/MDS), published by TPWind in 2008, which outlines the R&D challenges faced by the European wind energy sector. This publication quickly became a reference text in the sector
- ▶ The “European Wind Initiative” (EWI), published by the European Commission in 2009 in its Communication on “Investing in the Development of Low-Carbon Technologies” (COM(2009) 519) suggesting total public and private R&D investment of €6 bn for 2010-2020.



TPwind activities: New SRA in 2014

2011:

- ▶ Develop the EWI 2013 – 2015 Implementation Plan
- ▶ Prepare EWI 2012 Work Programme
- ▶ Renewal of the Steering Committee

2012:

- ▶ Update the SRA to be published spring 2014
- ▶ Prepare EWI 2013 Work Programme

2013

- ▶ Update the SRA to be published spring 2014
- ▶ Develop the EWI 2016 – 2018 Implementation Plan
- ▶ Prepare EWI 2014 Work Programme

2014

- ▶ Publish renewed [Strategic Research Agenda \(SRA\)](#)
- ▶ Renewal of the Steering Committee and WG members
- ▶ Minimum activity until new EU funding for secretariat is granted



About EERA

- ✓ **The European Energy Research Alliance (EERA) was established in 2008 to support the EU Strategic Energy Technology Plan (SET-Plan)**
- ✓ **Mission: to accelerate the development and deployment of cost-effective low carbon technologies**
- ✓ **Bringing together 250 research organisations**
- ✓ **Working together in 15 Joint Programmes**
- ✓ **Collaborating with European Industry**
- ✓ **With global outreach**
- ✓ **And aligning national research**



What is EERA JP Wind?

The EERA Joint Programme on Wind Energy (EERA JP Wind) started in 2010 on a voluntary basis.

The mission for EERA JP Wind is to provide strategic leadership for the medium to long-term research and to support the European Industrial Initiative and the Technology Roadmap activities on wind energy.

EERA JP Wind gives added value:

- ✓ Strategic leadership of the underpinning research
 - ✓ Joint prioritisation of research tasks and infrastructure
 - ✓ Alignment of European and national research efforts
 - ✓ Execution of coordinated and structured research in medium to long-term programmes
 - ✓ Coordination with industry
 - ✓ Sharing of knowledge and research infrastructure
-

EERA JP Wind members

Full participants

DTU Wind Energy

ECN

SINTEF Energi AS

CRES

CENER

Fraunhofer IWES

Forwind/University of
Oldenburg

LNEG

VTT

TUBITAK

University of Strathclyde

CNR

Belgian Energy Research
Alliance

Associated Participants

DK DHI, University of Aalborg, Dublin (IR) DK

NL TU Delft, WMC NL

NO NTNU, IFE, UoB, CMR, MARINTEK,
Sintef Stiftelsen NO

GR NKUA GR

ES CIEMAT, IREC, CTC, CIRCE, Tecnalia,
IK4 Alliance ES

GER IEN (PO), DLR GER

GER Forwind/University of Hannover,
University of Stuttgart, Uni. of Aachen,
TU München GER

POR University of Porto POR

FI

TU METUWIND

UK CATAPULT UK

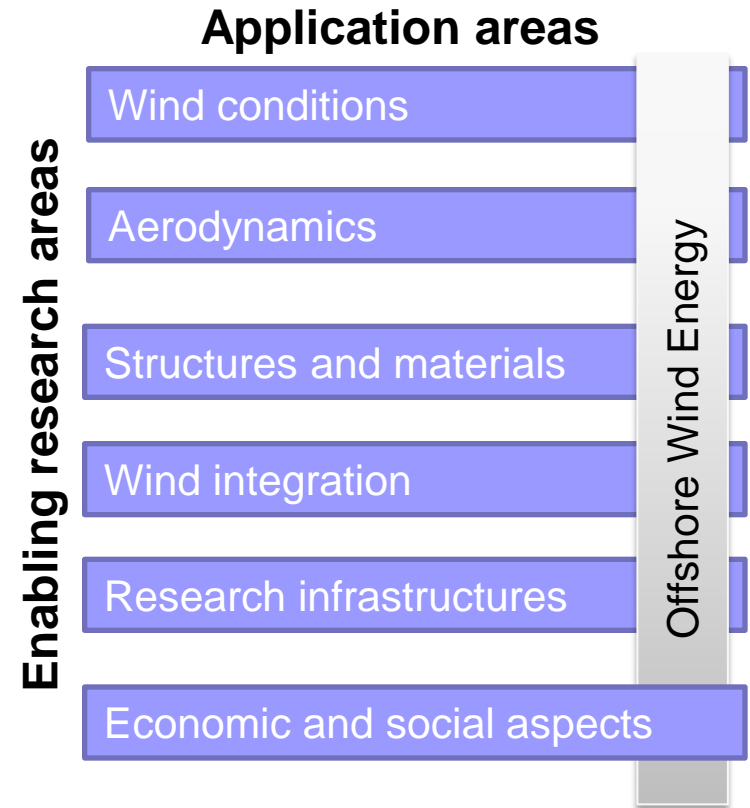
IT Politecnico di Milano IT

BE

13 full participants & 28 associated participants from 14 countries.

EERA JP Wind structure

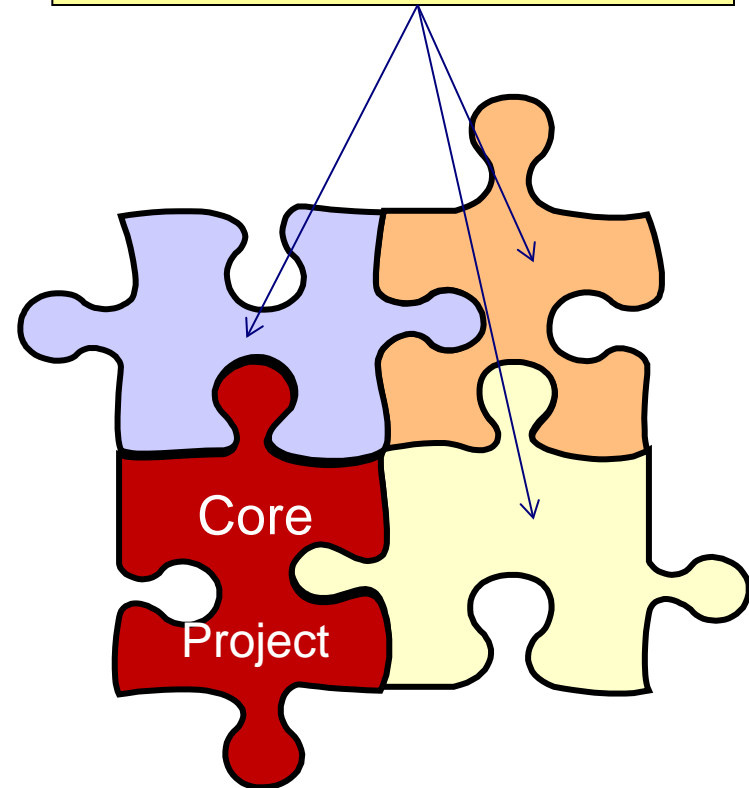
- ✓ **Wind Conditions.**
Coordinated by DTU, Denmark.
- ✓ **Aerodynamics.**
Coordinated by ECN, Netherlands.
- ✓ **Offshore Wind Energy.**
Coordinated by SINTEF, Norway.
- ✓ **Wind Energy Integration.**
Coordinated by Fraunhofer IWES, Germany.
- ✓ **Research Infrastructures.**
Coordinated by CENER, Spain.
- ✓ **Structures and Materials.**
Coordinated by CRES, Greece
- ✓ **Economic and social aspects.**
Coordinated by DTU, Denmark



EERA JP wind + IRPWIND = true

- ✓ IRPWIND is a 4 year Integrated Research Programme for Wind Energy started in March 2014 with a 9.8 MEUR EU FP7 grant
- ✓ IRPWIND and EERA JP wind are closely interlinked with IRPWIND providing funding for selected coordination and research activities:
 - ✓ Coordination and Support Actions: Mobility, Dissemination, RI
 - ✓ Core Projects: Offshore, Structural reliability, Integration
- ✓ IRPWIND gives support to EERA JP wind in developing from a voluntary network towards a “virtual research centre”.

Nationally funded collaborative projects



The EERA JP Wind project portfolio

SP: Wind
Energy
integration

SP: Wind
condi-
tions

SP:
Offshore
Wind
Energy

SP:
Aerody-
namics

SP:
Structures
& materials

SP
Research
Infrastruc-
tures

SP:
Economic
and social
aspects

INNWIND.eu

EERA-DTOC

New Euro-
pean Wind
Atlas
(ERANET+)

LIFES50+
(H2020)

AVATAR

WindScanner.eu

National projects...

IRPwind CSA

IRPwind CP:

"European-
wide
measures for
large-scale
integration"

IRPwind CP:

"Design of
offshore
windfarms"

IRPwind CP:

"Structural
reliability of
WT sub-
components"

IRPwind
CSA: WP3

EERA JP wind levels of integration

5) Management of common research programmes

European Virtual Institute for Wind Energy

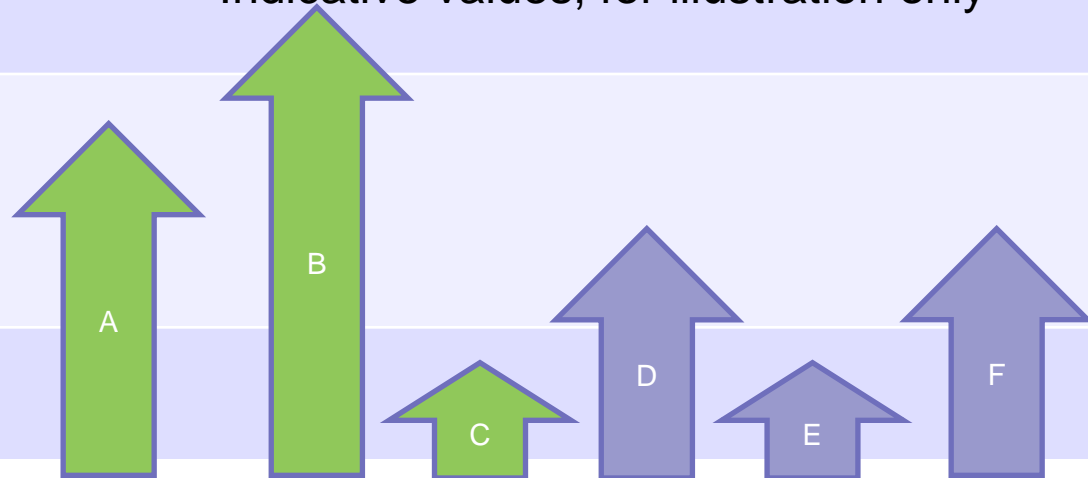
4) Comprehensive structuring

3) Coordinated research efforts across projects

2) Joint Strategy (roadmaps, research strategy)

1) Networking

Indicative values, for illustration only



A: Exchange of knowledge

C: RIs and open access

E: International collaboration

B: Exchange of researchers

D: Coordination of national projects

F: Collaboration with industry

SP Offshore Wind Energy

Overall objective

Pre-competitive research
laying a scientific
foundation for the
industrial development of
more cost effective
offshore wind farms and
enabling large scale
deployment at any seas



SP Offshore Wind Energy

Research objectives (and project examples)

- ✓ **Design optimization through validation studies offshore (IRPwind WP6)**
 - ✓ **Characterization and interaction of wind, wave and current (NEWA, ...)**
 - ✓ **Innovative wind farm electric grid connection for offshore applications (BestPaths, ...)**
 - ✓ **Control, operation and maintenance of offshore wind farms (new H2020 project?, ...)**
 - ✓ **Development of novel concepts for deep sea, including multi-use of wind farm areas giving step-changes in technology for reducing cost of energy from offshore wind farms (new H2020 project?, ...)**
-

SP Offshore Wind Energy

Key results

- ✓ Sharing knowledge for joint benefits and efficient use of resources
 - ✓ Expert workshops
 - Integrated design tools (2010)
 - Offshore grid development (2010)
 - Predictive tools for O&M (2011)
 - Offshore wind farm grids (2012)
 - Offshore learnings / O&M (2013)
 - Innovative wind turbines (2013)
 - ✓ Annual Deep Sea Offshore Wind R&D Conference: EERA DeepWind
 - ✓ Peer-reviewed papers are published online in [Energy Procedia](#)
 - ✓ Preparation of strategy aligning with national and EU priorities
 - ✓ Joint national projects
 - ABYSS (DK-NO), kick-off 2014
 - NSON (NO-UK-DE), kick-off 2014; DK/DTU and NL/ECN to join
 - Application on new FME (NO) on offshore wind energy in preparation
 - ✓ New EU projects
 - EERA DTOC, kick-off 2012
 - EERA InnWind, kick-off 2013
 - EERA IRPWind, kick-off 2014
 - EERA Lifes50+, kick-off 2015
-

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
- ▶ **Key target: innovations reducing cost of energy from offshore wind**
- ▶ Vision:
 - large scale deployment
 - internationally leading

Research partners:

- ▶ SINTEF ER (host)
- ▶ IFE
- ▶ NTNU
- ▶ MARINTEK
- ▶ SINTEF ICT
- ▶ SINTEF MC

Industry partners:

- ▶ CD-adapco
- ▶ DNV GL
- ▶ DONG Energy
- ▶ EDF
- ▶ Fedem Technology
- ▶ Fugro OCEANOR
- ▶ Kongsberg Maritime
- ▶ Norsk Automatisering
- ▶ Rolls Royce SmartMotor
- ▶ Statkraft
- ▶ Statnett
- ▶ Statoil

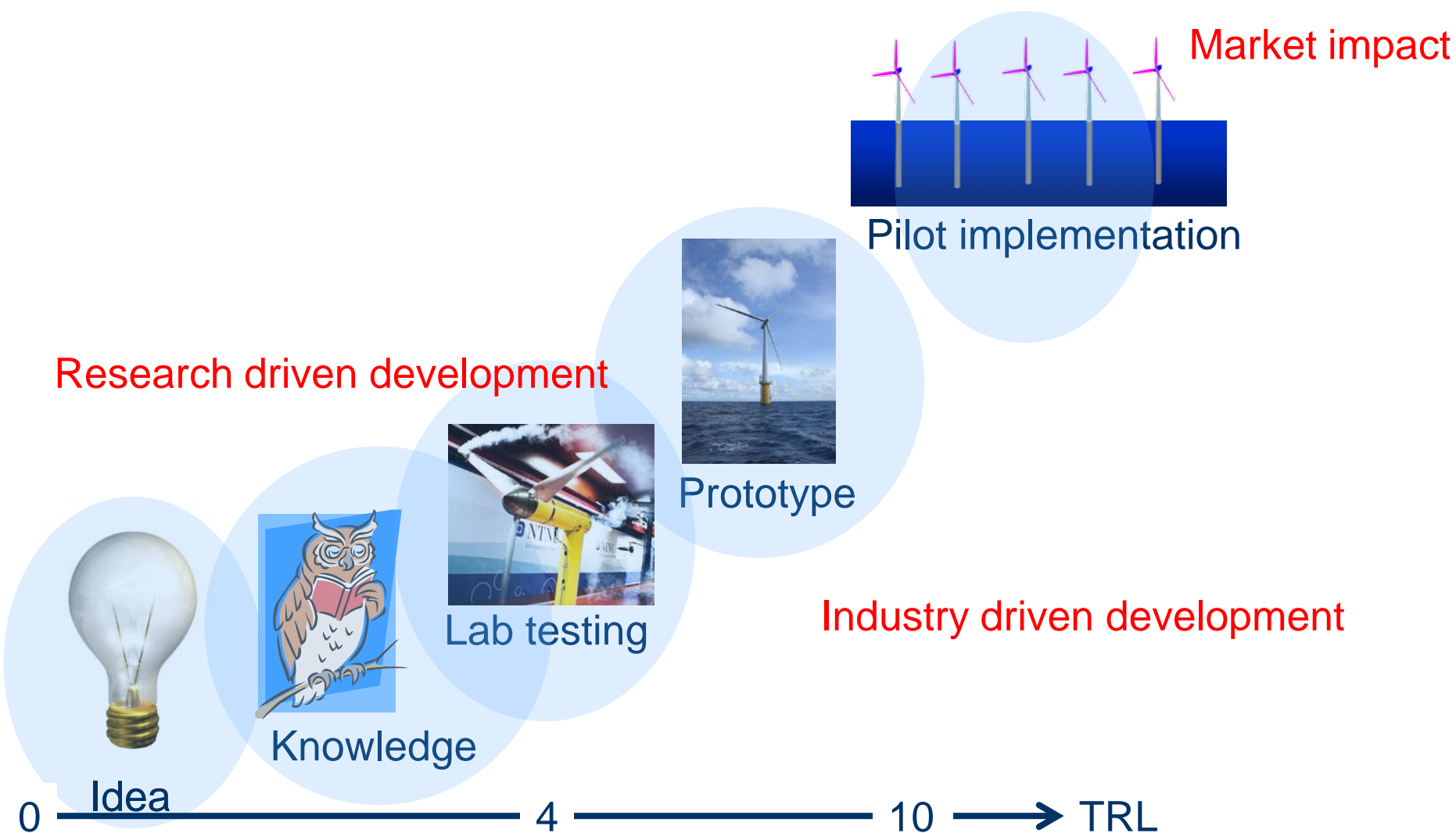
Associated research partners:

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

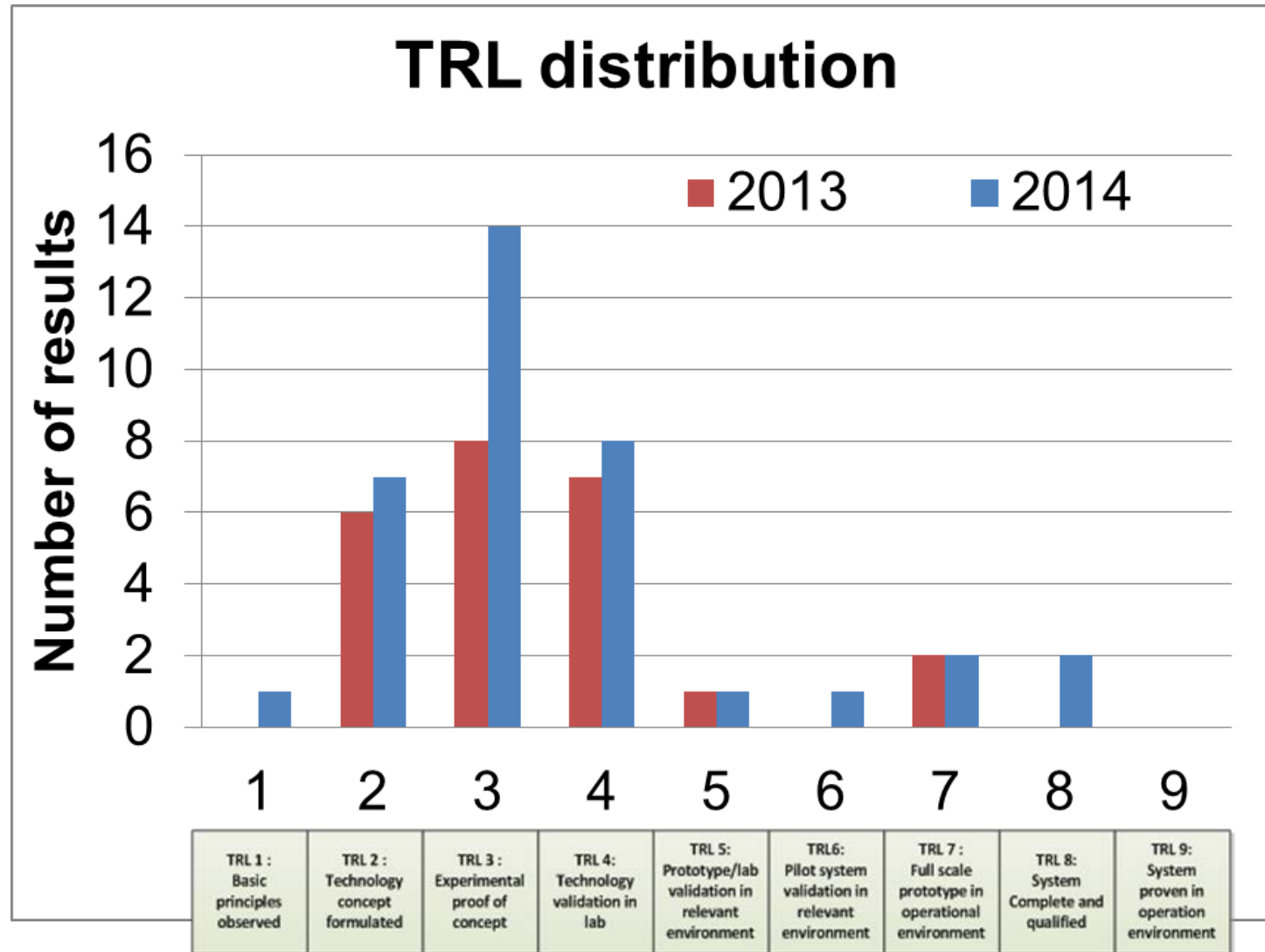
Associated industry partners:

- ▶ Devold AMT AS
- ▶ Energy Norway
- ▶ Enova
- ▶ Innovation Norway
- ▶ NCEI
- ▶ NORWEA
- ▶ NVE
- ▶ Wind Cluster Norway

From R&D to innovations to cost reductions

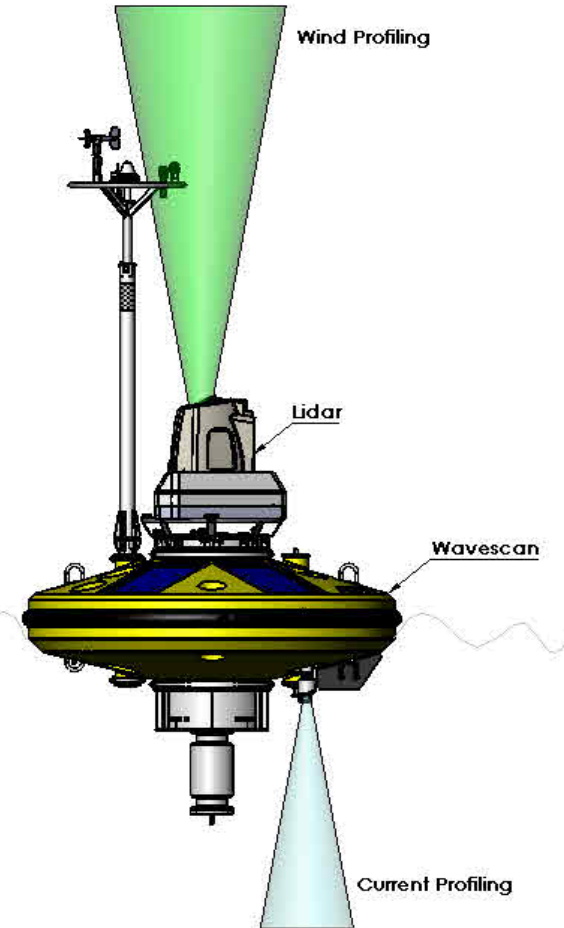
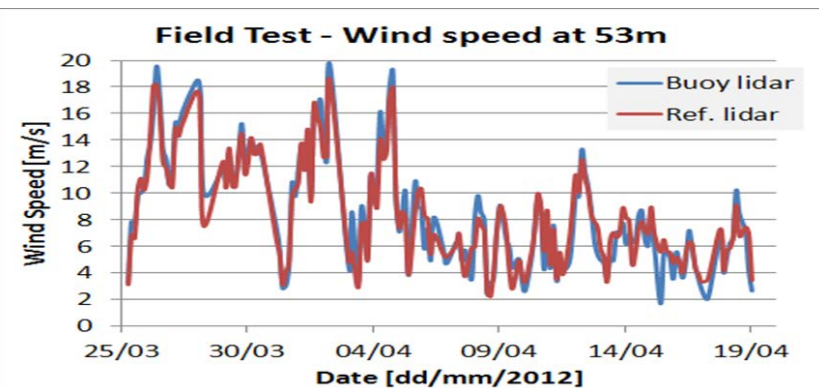


Successful innovations are achieved



SEAWATCH Wind Lidar Buoy

- ▶ Cost efficient and flexible compared to offshore met mast
- ▶ Measure wind profiles (300 m), wave height and direction, ocean current profiles, met-ocean parameters
- ▶ Result of NOWITECH "spin-off" joint industry project by Fugro OCEANOR with Norwegian universities, research institutes and Statoil.

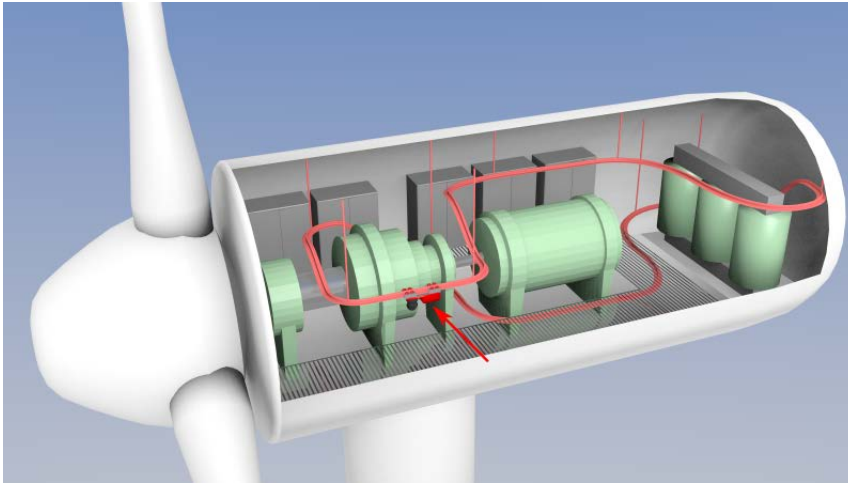


Thermally sprayed silicon carbide coating



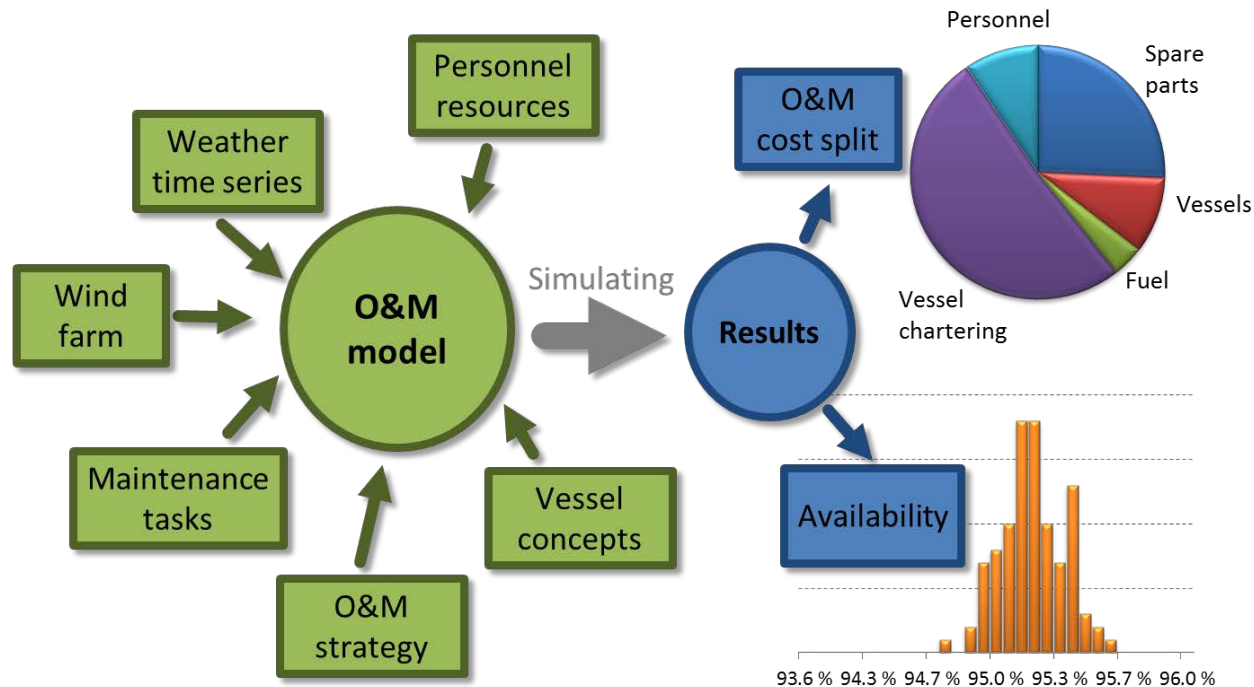
- ✓ Patented process result of NOWITECH PhD work.
- ✓ Being developed as a commercial product through the new spinout company Seram Coatings AS.
- ✓ The process provides for an extremely hard, wear-resistant, low friction ceramic coating that can be applied to rotating machinery like main bearings in large direct drive wind turbines; ultimately increasing lifetime and reducing cost for maintenance.

Remote presence



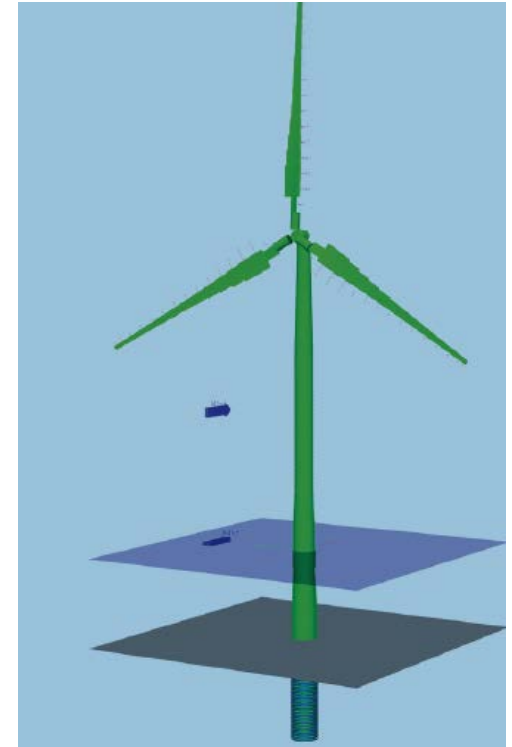
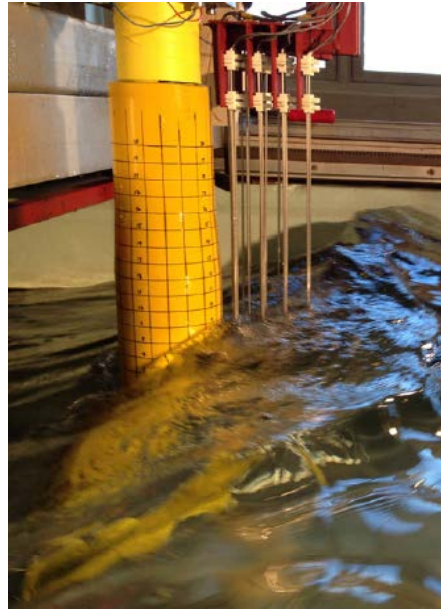
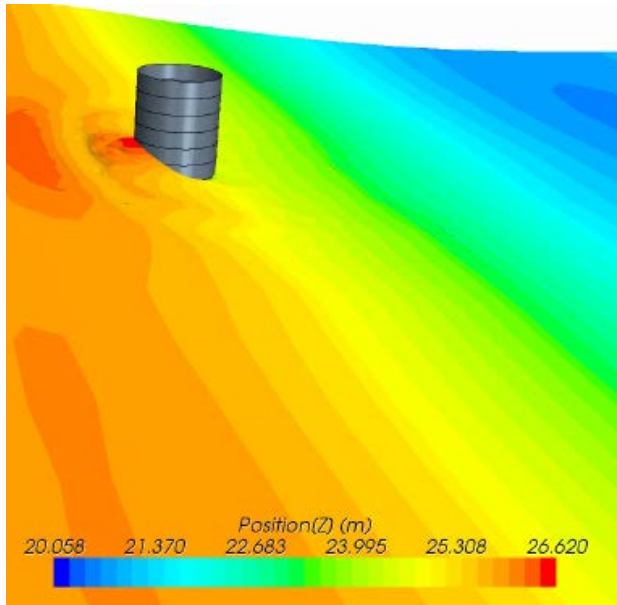
- ✓ Technology developed in part through NOWITECH PhD work
- ✓ Remote presence through a small robot on a track in the nacelle equipped with camera / heat sensitive, various probes, microphone etc. reducing offshore work by service personnel, downtime and costs
- ✓ Technology is commercialized by Norsk Automatisering AS

NOWIcob – A operation and maintenance analysis tool for offshore wind farms



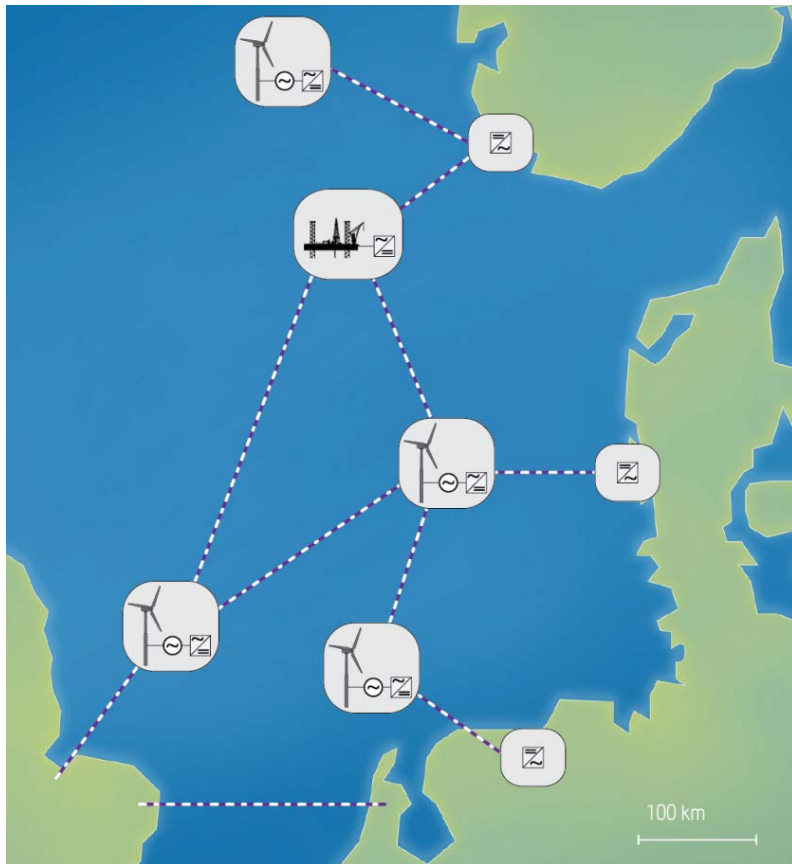
- ✓ Strategic discrete-event simulation tool for analysis of different offshore wind farm maintenance and logistics strategies

Savings costs with knowledge, models and labs



De-risking monopole for Dudgeon 402 MW Offshore Wind Farm

Developing solutions for the future offshore grid

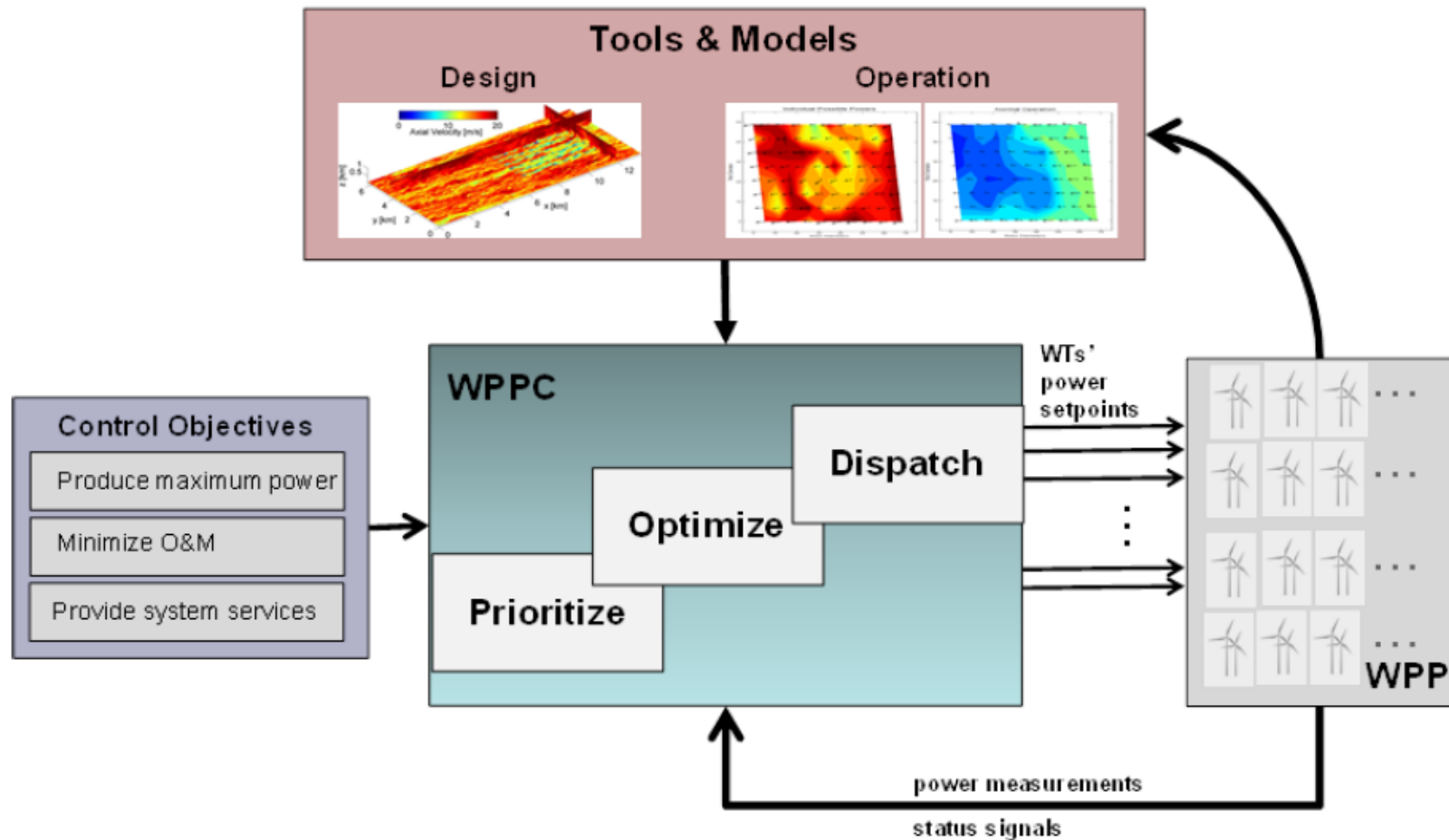


- ▶ Operation and control
- ▶ Converter interoperability
- ▶ System stability
- ▶ Fault handling
- ▶ System services
- ▶ Security of supply
- ▶ New market solutions



Enabling far offshore wind farms with HVDC and VSM technology
Validating new HVDC technology in BestPaths (EU FP7)

New wind farm control concepts in development



SmartWind (EU H2020 application)

NOWITECH achievements



Successful innovations



Excellence in research



Strong educational program

A new FME on offshore wind is in preparation

FME title	Centre for Offshore Wind Energy Research (COWIND)
Host institute	SINTEF Energi AS
Contact person	John Olav Tande, +47 9136 8188, john.tande@sintef.no
Partners	Research: CMR, MARINTEK, met.no, NTNU, SINTEF, UiA, UiB Industry / user partners (TBC): Statoil, Statkraft, Kongsberg, DNV GL, Dong, Fedem, Acona, Vestas, Gamesa, Vattenfall, StormGeo

- Annual budget: 60 MNOK with 50 % from RCN, 25 % from user partners and 25 % from research partners
- Application deadline 25 November 2015.
- Start-up in 2016/2017, pending on funding. Duration 8 years.
- **Industry parties are invited to join a Industry Reference Group for the further dialogue on the development of the new FME.**

Make sure to be there!

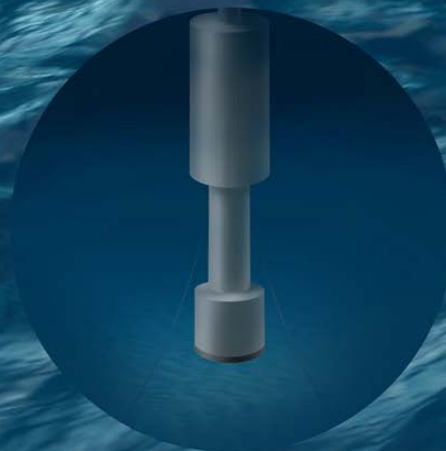
EERA DeepWind'2016

13th Deep Sea Offshore Wind
R&D Conference

Trondheim 20-22 January,
Norway

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

- Numerical tools and sub-structures
- O&M and materials
- Grid and wind farms



www.NOWITECH.no

NOWITECH

Norwegian Research Centre for Offshore Wind Technology

