



IRPWIND – The role of an Integrated Research Programme in wind energy

Peter Hauge Madsen, DTU Wind Energy

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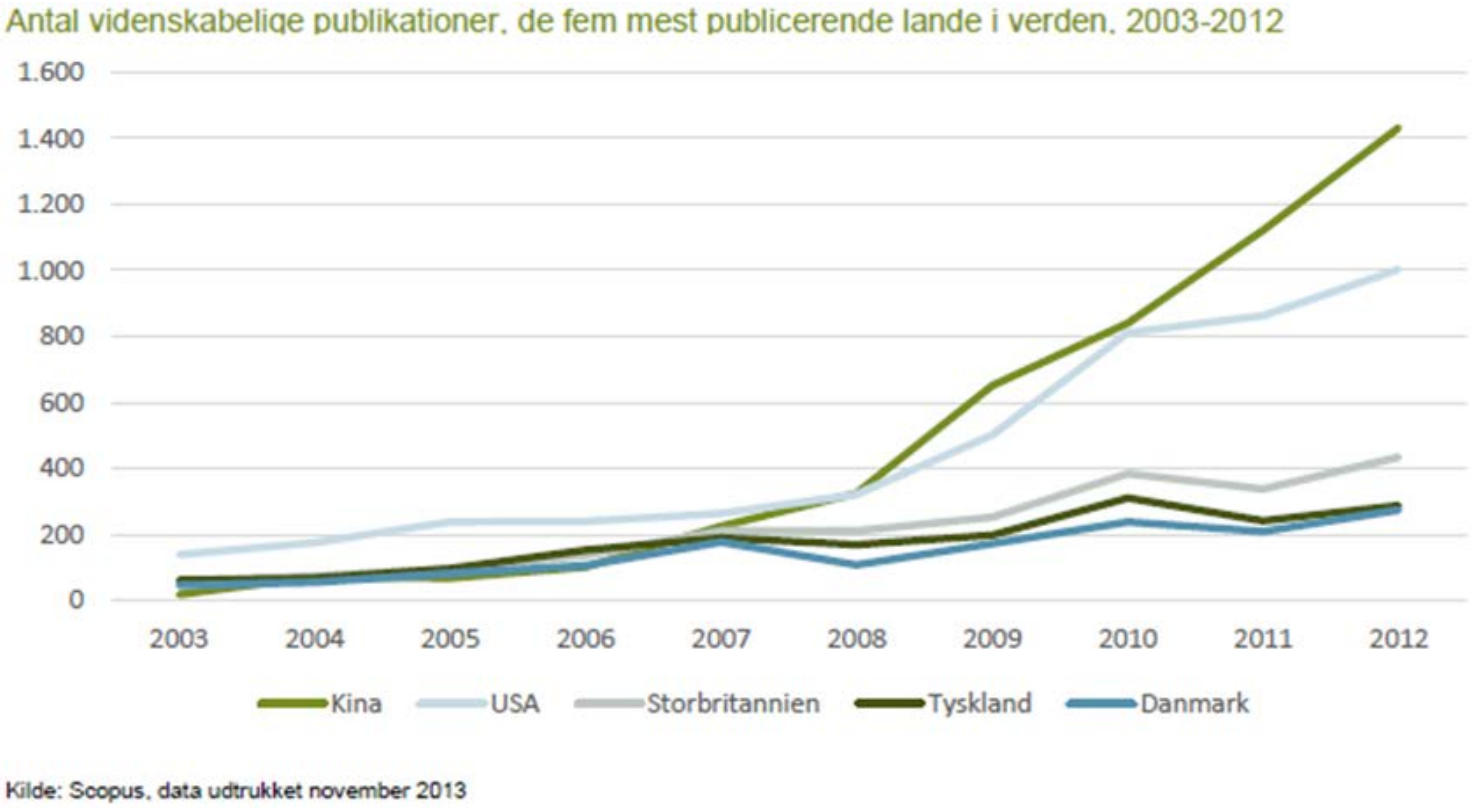
Publication volume– absolut numbers



Kilde: Scopus, data udtrukket november 2013

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Challenges

IRPWind

Europe needs to maintain its leadership in wind energy

Research is an important instrument, but

- New scientific powerhouses and increased number of researchers
- Focus on grand challenges
- Scrutiny of research integrity and accountability
- Global industrial competition
- Research shall deliver in terms of innovation, international competitiveness, jobs, sustainable energy

Which calls for

- European collaboration, coordination, alignment
- Multi-disciplinary research
- Open science
- Alignment and cooperation with industry and stakeholders

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EERA Wind Strategy

The EERA joint programme on wind energy accelerates the SET-plan goals, provides the strategic leadership for the scientific–technical medium to long term research to support the EII and the Technology Roadmap's activities on wind energy and provides added value through:

- 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, and
- Sharing of knowledge and research infrastructure.

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EERA Wind members

Full participants		Associated Participants	
DTU Wind Energy	DK	DHI, University of Aalborg, Dublin (IR)	DK
ECN	NL	TU Delft, WMC	NL
SINTEF	NO	NTNU, IFE, UoB, CMR MARINTEK, Sintef MC	NO
CRES	GR	NKUA	GR
CENER	ES	CIEMAT, IREC, CTC, CIRCE, Tecnalia, IK4 Alliance, IC3	ES
Fraunhofer IWES	GER	IEN (PO), DLR	GER
Forwind / University of Oldenburg	GER	Forwind/University of Bremen, Hannover, University of Stuttgart	GER
LNEG	POR	University of Porto	POR
VTT	FI		
TUBITAK	TU	METUWIND	
University of Strachclyde	UK	NAREC	UK
CNR	IT	ENEA, Politecnico di Milano	IT
Belgian Energy Research Alliance	BE		

13 full participants & 29 associated participants from 14 countries.
Applicants in process: Uni. of Aachen, TU München

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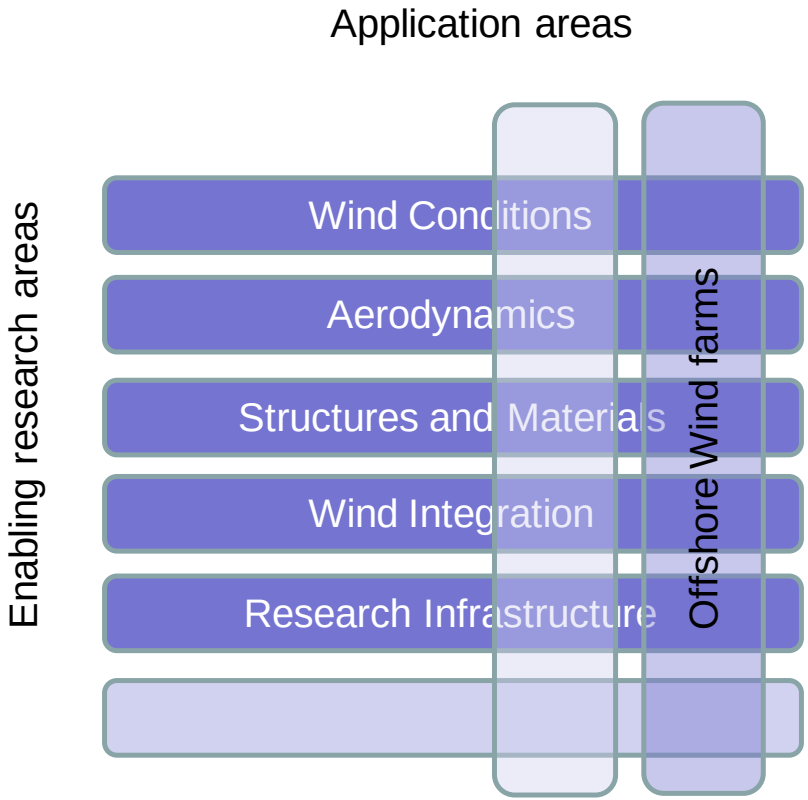
Structure

- **Wind Conditions**. Coordinated by DTU in Denmark.
- **Aerodynamics**. Coordinated by ECN in the Netherlands.
- **Offshore Wind Energy.** Coordinated by SINTEF in Norway.
- **Grid Integration.** Coordinated by FhG IWES in Germany.
- **Research Facilities**. Coordinated by CENER in Spain.
- **Structures and Materials.** Coordinated by CRES, Greece
- New SP:"Wind Integration – economic and social aspects



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Joint Programme on Wind Energy
Strategic Action Plan 2014-2017

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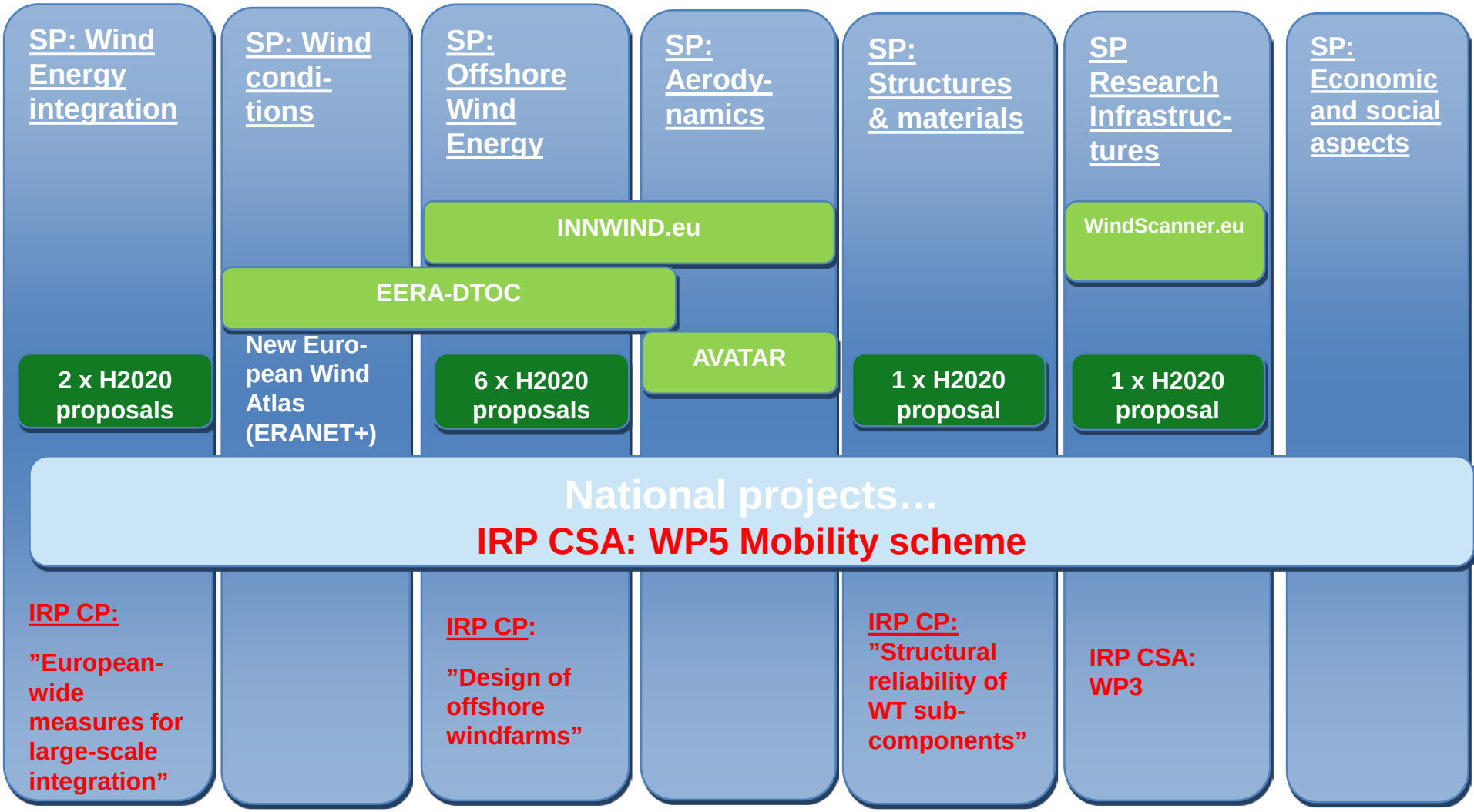
The EERA JP Wind portfolio



JP on *Wind Energy*

SWOT status

IRPWind

Strengths and opportunities

- EERA Wind comprises most relevant EU institutes and continues to grow
- Recognized as integral part of the Wind Sector in Europe and the SET Plan
- Successful with European projects and European Coordination
- Solid governance

Weaknesses and threats

- Not all members can be part of all consortia to stay effective
- Different degrees of commitment and activity between partners
- The PPYs indicated in DOW are not a real commitment to joint deliverables
- Difficult to point to national coordination effects

IRPWIND should imply that EERA JP WIND we take the next steps….

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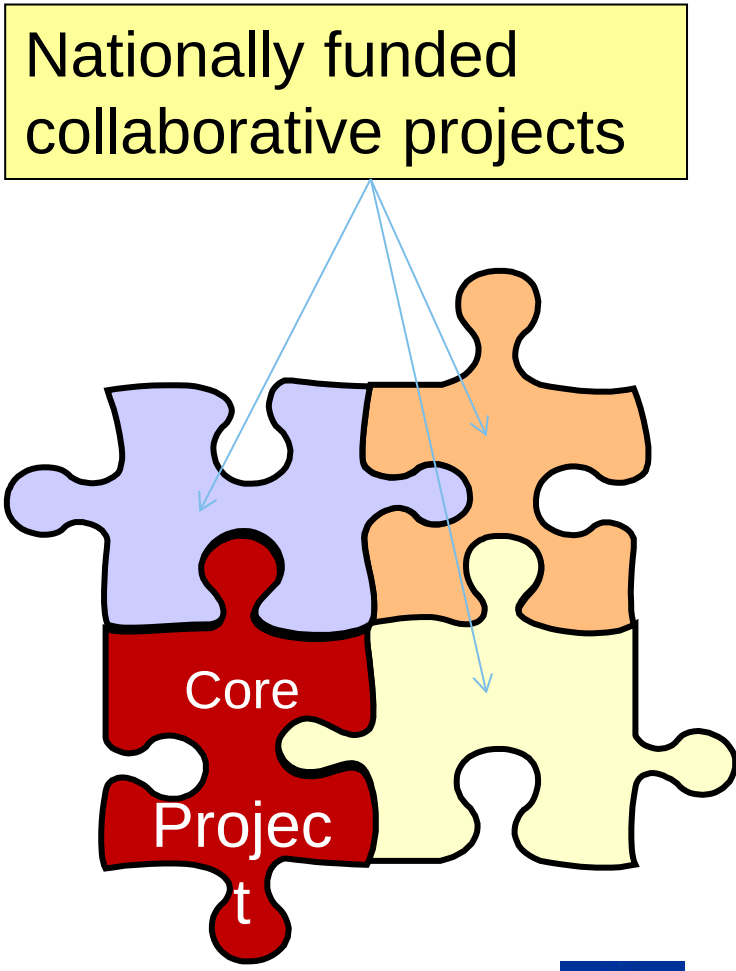
IRPWIND – Integrated Research Programme

Total budget: 9,8 M EUR

- 6 M EUR for CP
  - Offshore
  - Structural Reliability
  - Integration
- 4 M EUR for CSA
  - Mobility
  - Research Infrastructure
  - Secretariat, management

Not all EERA Wind members directly involved (but CSA-part benefits all)



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IRPWIND objectives

- The aim of EERA and the IRPWIND is to foster **better integration of European research activities in the field of wind energy research** with the aim to accelerate the transition towards a low-carbon economy and maintain and increase European competitiveness.

- The IRPWIND is expected to both benefit existing priority settings as well as to improve the quality and implementation of future priority settings through **the coordinating effect on the research communities.**

- An objective is to **integrate the various capacities and resources in the joint research activities** described in this IRP- with other ongoing European and National projects carried out by IRPWIND partners and/or other EERA JP Wind members.

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IRPWIND – what it's all about?

IRPWind

Integration, coordination and alignment (as well as R&D)

- Strategic level (EII Team, EERA Wind Strategy, National strategies)
- Operational level
  - Integration of activities (EERA DoW, workshops, IRPWIND mobility scheme)
  - New joint activities (ERA NET+, Berlin model, ad hoc)
- Complete research programme
- Transparency – who does what, national programmes

Towards a European Wind Energy Programme and a virtual research institute based on national and European activities

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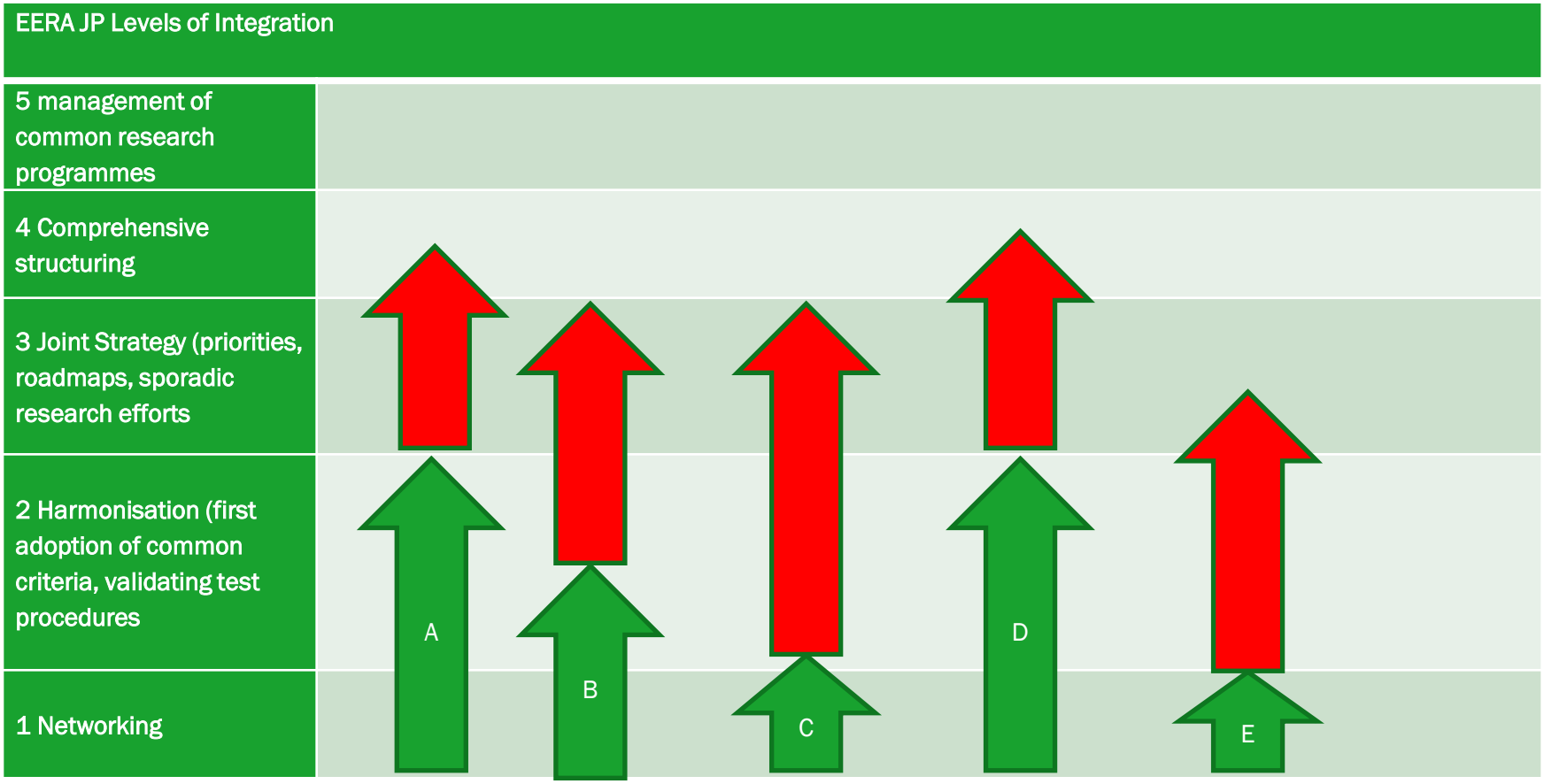
EERA JP Levels of integration



A: Exchange of knowledge
B: Exchange of researchers
C: Collaboration of industry
D: Coordination of national projects
E: International collaboration

www.eera-set.eu

Status on IRPWIND Work Packages

IRPWind

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WP2 Integrating Activities - Tasks

- IRPWIND secretariat (Done)
- Yearly reports and strategic documents (ongoing)
- National coordination as input to the IRPWIND yearly reporting and strategy process (ongoing)
- Interaction with EC and Member States in the framework of the SET Plan (M12)
- Interaction with the Wind Energy Sector (Ongoing) in the IRPWIND Advisory Board
- Development of **InCo strategy** for EERA IRP on Wind Energy
- Developing an Evaluation scheme and Business Plan for future steps (M30)
- **Strategy on Access granting to data** used in the IRPWIND and Wind Energy research projects in general (M12)

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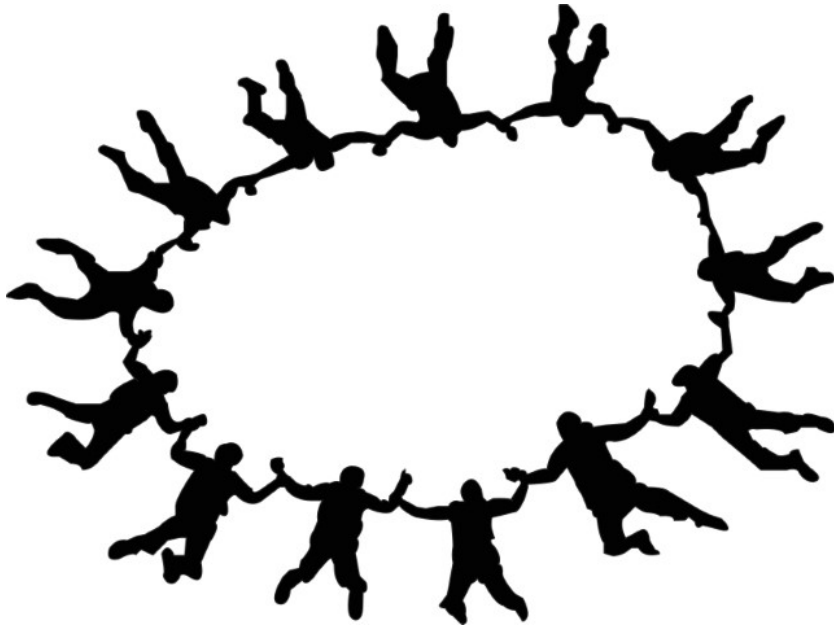
WP2 International Cooperation (InCo)

- An InCo strategy will be formulated with the aim of identifying **2 targeted countries** where a more strategic collaboration should be investigated by means of expert workshops

Aims:

- To identify areas of collaboration.
- The strategy should point to countries and also outline possible schemes for the collaboration.
- The strategy should be a living document and facilitate a continuous strategic discussion on how and with whom to collaborate.



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WP2 International Cooperation (InCo)

- At the point of Grant Agreement **USA and Japan** have been identified as the most relevant countries.
- **Reasons**

USA:

Excellence in research and development

Japan :

Mutual interest in floating off shore

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WP3 research Infrastructures – Tasks

- 3.1.- Networking of RI
  - Sharing of best practices, protocols or standards; Proposal of experiments; Proposals for new or reinforcement of facilities;
  - **Topics**: Testing for grid integration, wind tunnels and research wind turbines.
- 3.2.- Experiments selection and supported access to facilities
  - Mapping relevant existing facilities and creating awareness of its capabilities will increase level and effectiveness of use of EU facilities.
  - Supporting well focused experiments in which MS research merges with the IRPWind to back our DoW will provide focus and alignment of the research as well as a better development of the DoW.

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Work package status– WP 4 Transfer of knowledge

Main tasks:

- Organize annual events (ongoing)
- Organize dissemination events for industry (ongoing)
- Bi-annual newsletters (ongoing)
- Website (ongoing)
- Exploitation and dissemination strategy (M12)
- Plan for the Use and the Dissemination of the Foreground (M24)

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WP5 IRPWIND Mobility

- A very concrete way of facilitating more integration of national activities
  - Approx 18 man/years plus travel expenses
  - Mobility periods of 1 month, 3 months and 6 months.
  - 4 cycles of calls
  - Everything to be evaluated annually
- Basic idea: Travelling researcher bring own project which are “related to” similar project at the hosting institution

- Application: describe the national projects, the main goals/activities, how is it relevant to the DoW, what is the alignment and integrative goals
- Report: each report such provide input to the overall reporting of the IRP and possibly also be presented at the yearly event.

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WP 5. Mobility

IRPWind

1ST Call opened: 23th June 2014, Deadline: 31st August 2014

Received applications: 6, Concluded: 3, active: 2 , Postponed: 1

***First start:** 01 October, **End:** 01/04/2015*

2ND Call opened: 18th January 2015, Deadline: 28 February 2015

ENDED **POSTPONED**

Title of Research	Home Institution	Host Institution	IRP Core Project	Length of Grant
Working on the comprehension of the newest composites fatigue theories and their application in wind power industry	University of Strathclyde	SINTEF Energy AS	**Wind Integration**	1
Roadmap to Operation and Maintenance Strategy Selection, ROMSS	Fraunhofer IWES	SINTEF Energy AS	**Offshore**	3
Comparison of Wind Measurements from Wind Scanners and a 200 m Meteorological Mast in complex terrain	Fraunhofer IWES	DTU Wind Energy	**Wind Integration**	3
Wind power plant: control boundaries and modelling requirements	CENER	Fraunhofer IWES	**Materials**	1
Integrated blade design and 2 bladed downwind rotor design and study	CENER	DTU Wind Energy	**Offshore**	3
Research collaboration within Aerodynamics	DTU Wind Energy	CENER	**Offshore**	1

Grant Period	1 month	3 months	6 months
Year 1	12	6	5
Year 2	9	4	4
Year 3	9	4	4
Year 4	9	4	3
FUNDING SCHEME			
Daily Allowance	164 EU	105 EU	105 EU
Travel expenses	Lump sum 600 Euro		

Challenging issue:
Administrative rules different in each in country and Institution.

Next Step
Amendment for opening to EERA participants and Industry.

Opening to PhD at last year stage.

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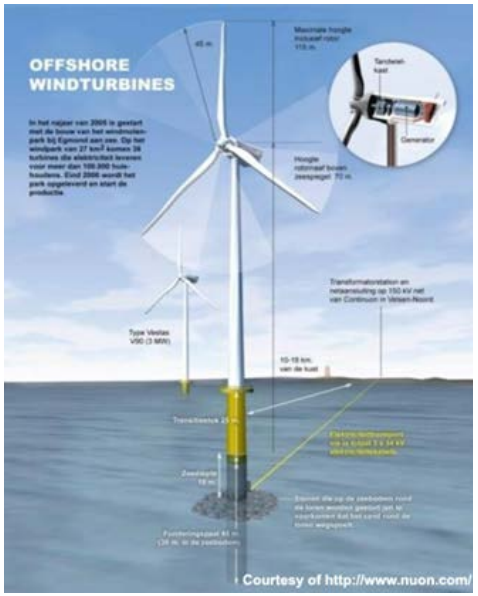
IRPWIND WP6:
Design of offshore wind farms

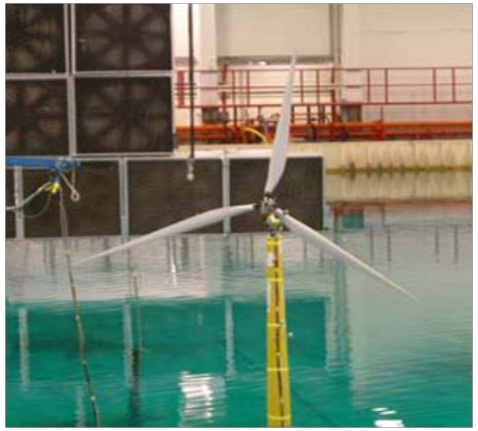
- Objective: to accelerate the design optimization of wind turbines and support structures for offshore wind farms, through validation of integrated design models, and subsequent development of methods and design criteria.
- Participants: DTU Wind Energy; CRES; ECN; SINTEF ER (WP lead); CENER (lead WP6.2); NTNU; University of Strathclyde (lead WP6.3); Tecnalia; ForWind – Oldenburg; ForWind – Hannover (lead WP6.1); MARINTEK

WP	Lead	PM	Start	End
WP6.1: Data assimilation	Hannover	46.0	12	36
WP6.2: Benchmark of models	CENER	105.5	1	36
WP6.3: Model development	Strathclyde	97.0	12	48

IRPwind WP6: Status

- ✓ **Progress according to plan**. Kick-off was held June 2014 at DTU, thereafter workshop at IRPwind conference, Sept. 2014 in Amsterdam.
- ✓ WP6.2 (benchmark of models) is started according to schedule and is preparing model evaluation protocol and identifying suitable test cases. WP6.2 meeting was held November 2014 at CENER.
- ✓ **First deliverable and milestone is on track** for end of February 2015: Model evaluation protocol for offshore design codes.
- ✓ **"Open access data" is addressed with WP2** preparing workshop during EERA DeepWind'2015 and with final reporting before end of February 2015
- ✓ WP6.1 (data assimilation) and WP6.3 (model development) will start March 2015
- ✓ **Next WP6 meeting is during EWEA Offshore** in Copenhagen 10-12 March 2015.





WP7: Improved & validated Structural Reliability Objectives

- Improve and validate structural design methodologies for:
  - Blades
  - Support structures
- Develop structural reliability methods
- Material models & life prediction methods
- Evaluate material state monitoring (SHM) & NDT solutions for blades

Preparation of foundation test pit (IWES)

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WP7: Improved & validated Structural Reliability Progress - Highlights

IRPWind

- Review of testing standard for validation of blade design (WP7.1)
  - Needed subcomponent test cases for validation of structural design methods identified
  - Next step: Design and performance of test
- Preparation stage for experiments to determine soil-structure interaction (WP7.2)
- Material models & experimental databases for materials used in blades & support structures under review (WP7.3)
  - Identification of missing data needed for probabilistic design
  - Next step: Plan & perform experiments

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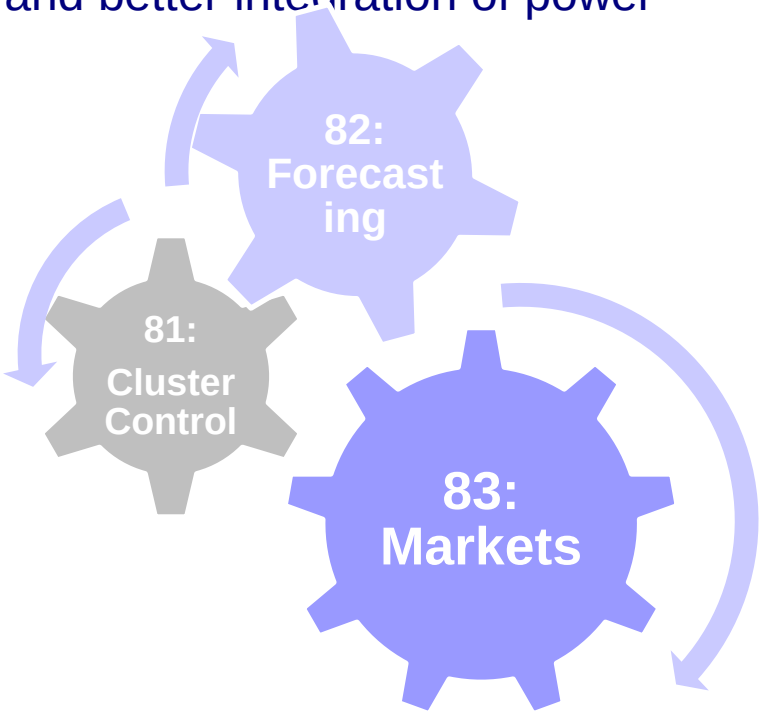
WP8: European-wide measures and structures for a large-scale wind energy integration

Overall: Solutions and a roadmap for coordinated steps to transformation of the energy supply system

- Economic and reliable operation of the future supply system supported by new system services from wind power plants due precise and high performance forecasts
- New approaches to power trading are needed, as well as market products better aligned with wind power characteristics, and better integration of power forecasting into market operations.



EERA Wind Horizon 2020 process

The EERA JP Wind has developed a transparent process for responding to EU calls for proposals Formalized procedure with clear roles for the Proposal Coordinators, Management Board and Steering Committee

<u>Aim</u>:

Prepare the best research proposals with the strongest research teams

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Immediate challenges

Horizon 2020

- Grand challenges (not technology specific)
- “Mature” technology
- Technology readiness level

Commercial interests limit openness and large collaborations

No funding for TPWind – Agenda and priority setting forum of stakeholders

Limited European research collaboration based on member state funding

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Technology Readiness Levels (TRL)

IRPWind

- **TRL 0: Idea**. Unproven concept, no testing has been performed.
- **TRL 1: Basic research.** Principles postulated and observed but no experimental proof available.
- **TRL 2: Technology formulation**. Concept and application have been formulated.
- **TRL 3: Applied research**. First laboratory tests completed; proof of concept.
- **TRL 4: Small scale prototype** built in a laboratory environment ("ugly" prototype).
- **TRL 5: Large scale prototype** tested in intended environment.
- **TRL 6: Prototype system** tested in intended environment close to expected performance.
- **TRL 7: Demonstration system** operating in operational environment at pre-commercial scale.
- **TRL 8: First of a kind commercial system**. Manufacturing issues solved.
- **TRL 9: Full commercial application**, technology available for consumers.

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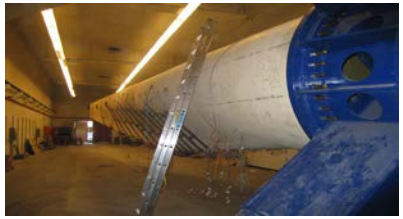
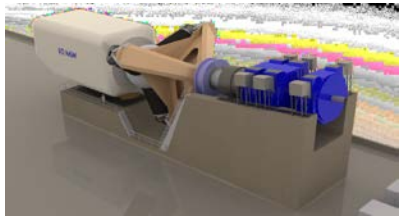
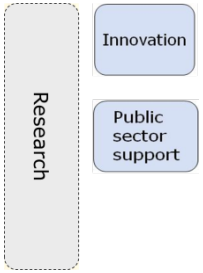
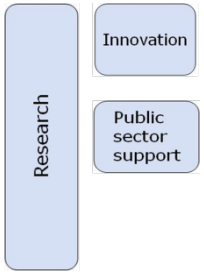
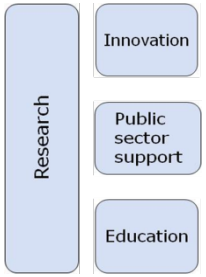
Technology development: Science (DTU) –industry

Concept development	Documentation	Development	Industrialization
			
•Demonstration •Proof of concept	• System test • Design basis • Basic design requirements • System approval		
		• Applied research, design tools, resource mapping • Int. standardization	• Basic strategic research • Integrated tools • Validation • Patents and education
			

Present mainstream WT technology trends

Competition pull for

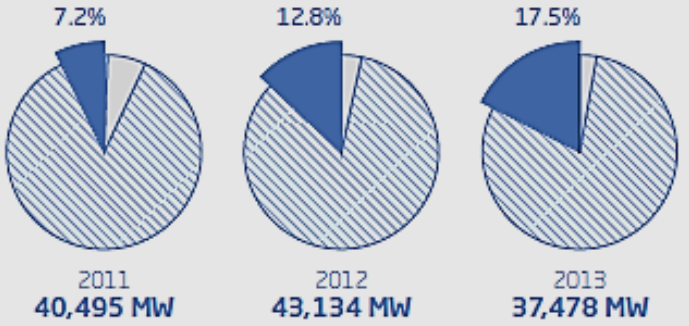
- Lower cost-of-energy
- Larger and more reliable turbines for offshore
- Development of sites with low or moderate wind climate

Leading to a mainstream development characterized by

- Upscaling to turbines with larger rated capacity for onshore and offshore
- Larger rotors for higher capacity factors
- New drivetrain solutions

World Market Update 2013, March 2014, Navigant Research [1].

Year	2011	2012	2013
Total MW supplied	40,495	43,134	37,478
Size range	% of total MW supplied		
<750 kW	0.6 %	0.1 %	0.1 %
750-1499 kW	6.6 %	3.5 %	2.8 %
1500-2500	85.7 %	83.5 %	79.6 %
>2500 kW	7.2 %	12.8 %	17.5 %



Science Readiness Level (SRL)

IRPWind

- A tool for assessing the feasibility (strengths and weaknesses) and timing of a technology step forward

- Based on identified scientific gaps

  - Scientific understanding
  - Modeling capabilities
  - Data requirements

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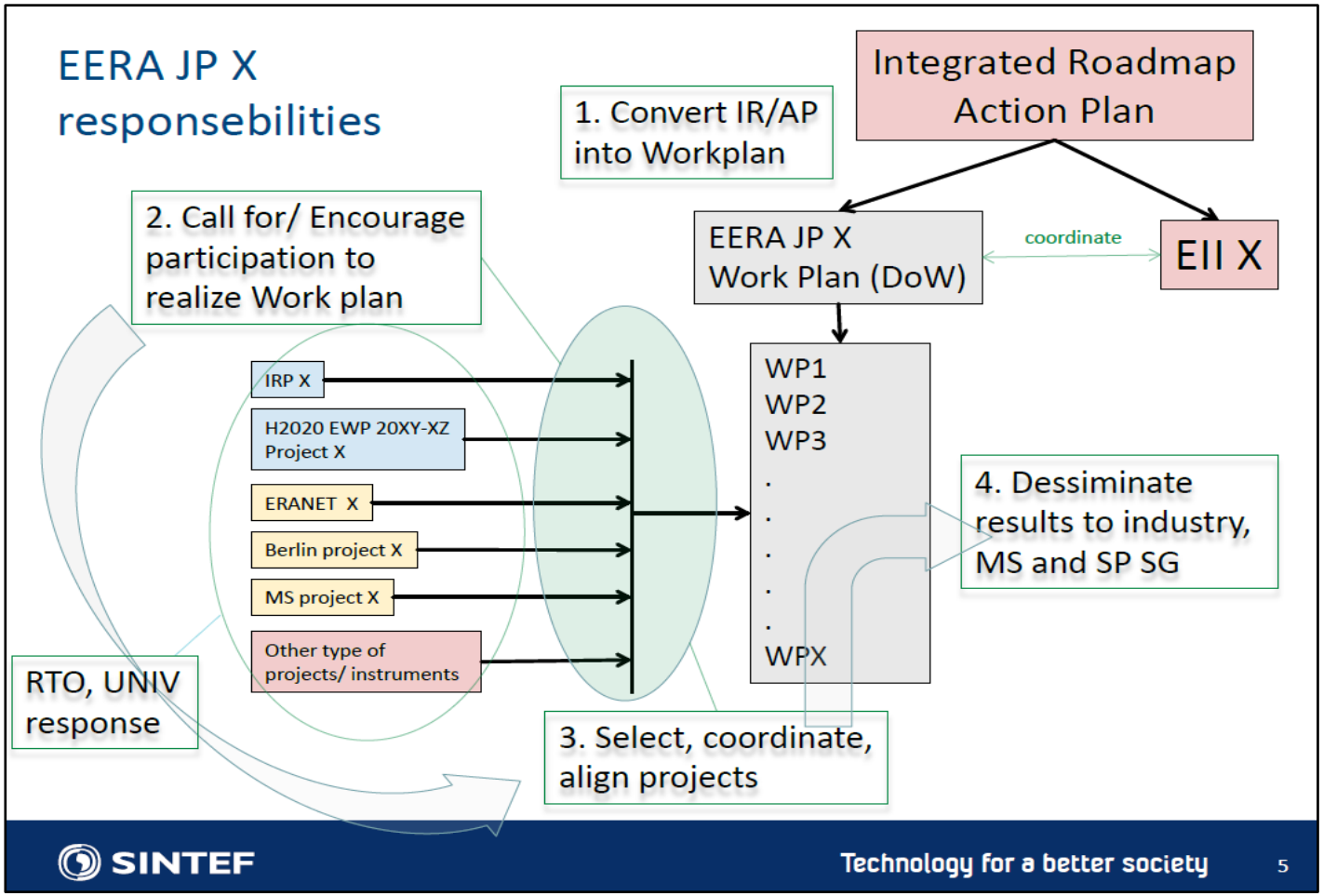
Integration of national activities – how?



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Concluding remarks

- EERA Joint Programme on Wind Energy has with IRPWind taken a large step towards coordination of European wind research
- Sharing, alignment, joint R&D activities, exchange etc foster open science for increased efficiency and involvement of many researchers
- Wind research closely tied to industrial innovation and development, mostly on national level
- EERA JPWE and IRPWind show the way for coop-tetion in the sector
- Research and research funding need to respect the character of the wind energy sector

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Thank you and enjoy the conference!

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‘SCIENCE 2.0’: SCIENCE IN TRANSITION

IRPWind

Drivers:

- Larger number of researchers need platforms for publishing, collaboration etc.
- New emerging powerhouses (e.g. asia)
- Availability of digital technology
- Focus on grand challenges
- Scrutiny of research integrity and accountability

Characteristics

- Open science and research processes
  - Open research collaboration
  - Open access
- Data intensive science
- Large increase of scientists and stakeholders

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IRPWind

European Wind Energy Technology Platform

- Industry driven
- Development, test & demonstration
- Forum, network for the sector

EERA
European Energy Research Alliance

- Research community driven
- Medium to long-term research
- Implementation, network

- MoU
- Both: tools of the SET-Plan (on behalf of European industry and the research community)
- Legitimate partners to be consulted when EC draft calls
- EERA in Wind EII Team since 2011

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Collaboration with industry within IRPWIND

- **Open access strategy**

This strategy will be developed together with European industry, (a workshop with TPWind and EWEA will be arranged). It will also be considered whether “model agreements” for granting access with the data owners could be developed.

- **Organisation of annual dissemination events for industry**

The feedback of industry to the IRPWIND research activities will be critically reviewed in order to assess the impact of the results and to assess the value of the R&D strategy to industry.

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EERA
European Energy Research Alliance

Ongoing EERA Wind EU projects

www.eera-set.eu

Support by:

INNWIND.EU
OVER VIEW OF PROJECT and RECENT RESULTS

Key Objectives of INNWIND.EU

1. Beat the cubic law of weight (and cost) of classical up scaling and render a 10-20 MW offshore design cost-effective in deep waters.
2. Develop innovative turbine concepts, performance indicators and design targets and assess the performance of components and integrated conceptual designs.
3. Development and assessment of modeling tools capable of analyzing 20MW innovative turbine systems.
4. Integrate the design, manufacturing, installation, operation and decommissioning of support structure and rotor-nacelle assembly in order to optimize the structure and life-cycle as a whole.
5. Establish effective communications channels in the co-ordination of all project activities between the partners and dissemination of the knowledge gained.

Main Results in Year 1

- Definition of *a 10MW reference wind turbine (RWT)* which forms the basis for assessing all innovations at the components and turbine level
- *Selection of proper Performance Indicators (PI) and their target values* for assessing the innovative designs.
- *New aerodynamic rotor concepts have been investigated.* Among them there are high-tip-speed, low solidity designs of two and three-bladed rotors along with high diameter low induction design variants.
- A *benchmark of the aerodynamic, aeroelastic and structural design tools* that will be used in the project by the different partners for the evaluation of the innovative designs has been concluded.
- A first *assessment of the Superconducting (SC) and the Magnetic Pseudo Direct Drive (PDD) generators* in terms of their critical performance indicators has been performed.
- An initial *roadmap* describing the path from innovative project results towards *implementation in the market* has been defined.

EERA Design Tool for Offshore wind farm Cluster (DTOC)

EERA DTOC

THE EUROPEAN ENERGY RESEARCH ALLIANCE
DESIGN TOOLS FOR OFFSHORE WIND FARM CLUSTER

Support by

SEVENTH FRAMEWORK PROGRAMME

EERA DTOC

- EERA DTOC is the first FP7 funded EERA project
- What is the project about
- Learnings from the project
- Evaluation

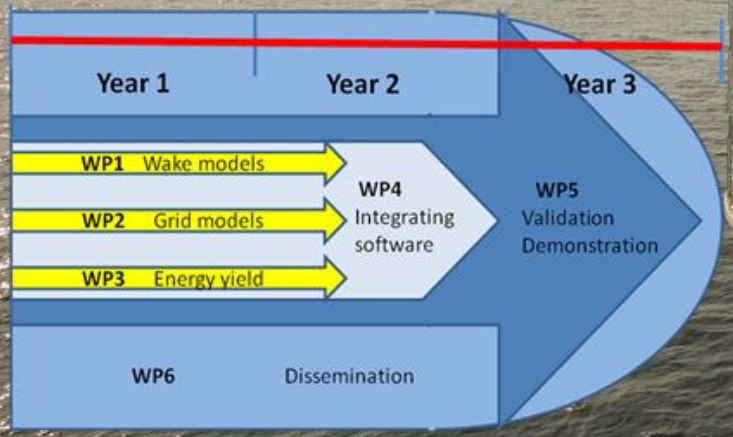
EERA DTOC in a nutshell

EERA-DTOC

European Energy Research Alliance – Design Tools for Offshore Clusters

Charlotte Hasager, Gregor Giebel, Pierre-Elouan Réthoré, EERA Wind members and industry
Contact: cbha@dtu.dk or grgi@dtu.dk, mob +45 4056 5085

Start 1 January 2012, runs for 3.5 years
Total funding is ~4 M€, EU share is 2.9 M€.



Product Vision:

A robust, efficient, easy to use and flexible **tool** created to facilitate the **optimised design of** individual and clusters of **offshore wind farms**.

A keystone of this optimisation is the **precise prediction of** the future long term wind farm **energy yield and** its associated **uncertainty**.

DTU Wind Energy
Department of Wind Energy

www.EERA-DTOC.eu

Risø Campus
Frederiksborgvej 399, P.O. Box 49, Build. 118
DK-4000 Roskilde, Denmark
www.vindenergi.dtu.dk

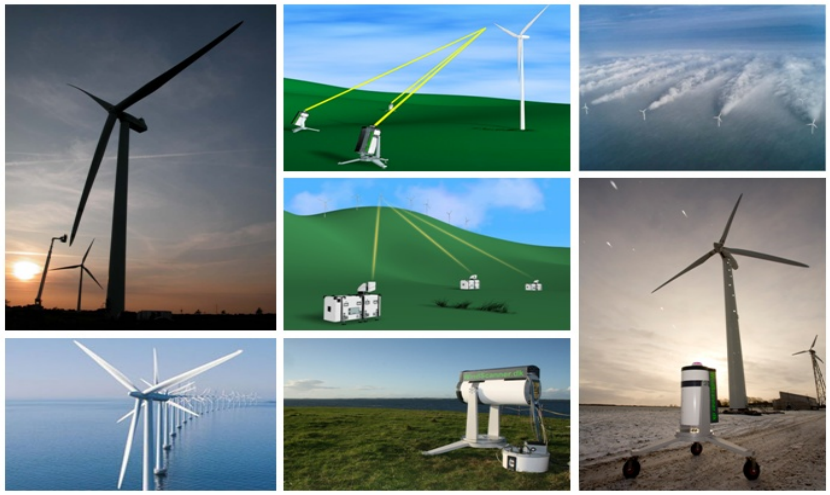
EERA DTOC vision

- A **robust, efficient, easy to use** and flexible tool created to facilitate the **optimised design** of individual and clusters of offshore wind farms.

- A keystone of this optimisation is the precise prediction of the future **long term wind farm energy yield** and its associated uncertainty.

WindScanner.eu - The European WindScanner Facility

- **Vision:** to develop, establish and operate a joint European distributed (and mobile) Research Infrastructure for experimental research in wind and turbulence fields for wind energy

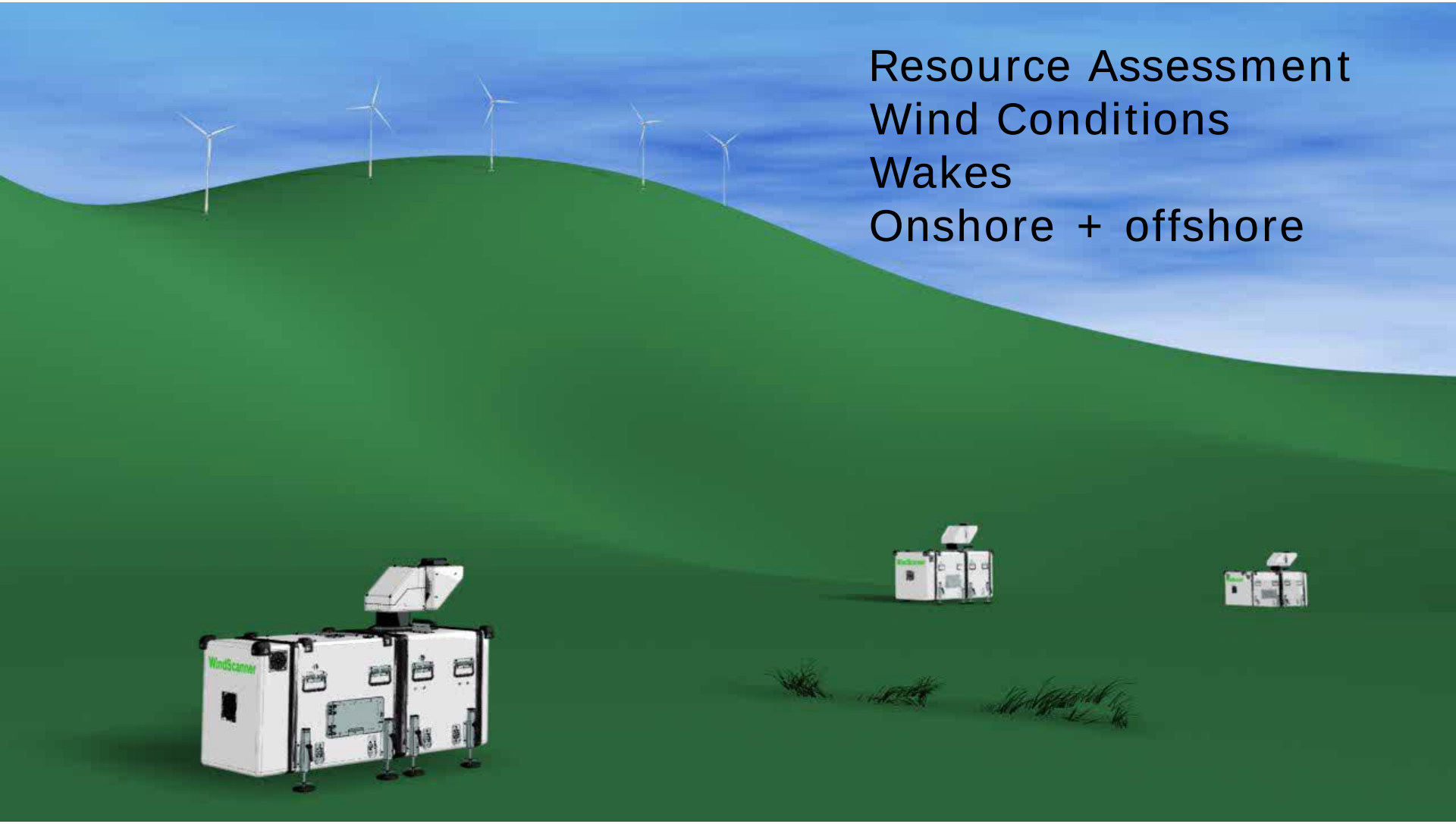


ESFRI Preparatory Phase Project (started in October 2012)

Providing:

- unique services for the community
- access programme
- Joint R&D development of the facility
- Joint training and educational programme for operating the WindScanners and for the user community

Long-range WindScanners



Developments within WindScanner.eu
Short-range Research Infrastructure Instrumentation: New 6” Telescope 2015 –Range 300 meters.

Multible Scanning Lidars

WindScanner.eu – the concept

- **A mobile, distributed facility with a set of national nodes**
  - ✓ LRWS + SRWS deployed at existing or planned test facilities (different climate conditions and terrains)
- **Central Facility**
  - ✓ Data management, hosting servers, hosting of website, administrative office, training of technicians and researchers operating the WindScanners, training of users, etc.
- **A coordinated programme of measurement campaigns using the WindScanners**
  - ✓ Database of wind data from potential wind energy sites, enabling detailed and site-specific information on wind condition, (3D wind and turbulence measurements) from on- and offshore
- **Pan-European users programme - One point of entry**
- **Research Infrastructure to underpin and enable the EERA Joint Programming on Wind Energy**
  - ✓ Important research activities on remote sensing based mapping of the regional wind resources and conditions etc.

WindScanner.eu

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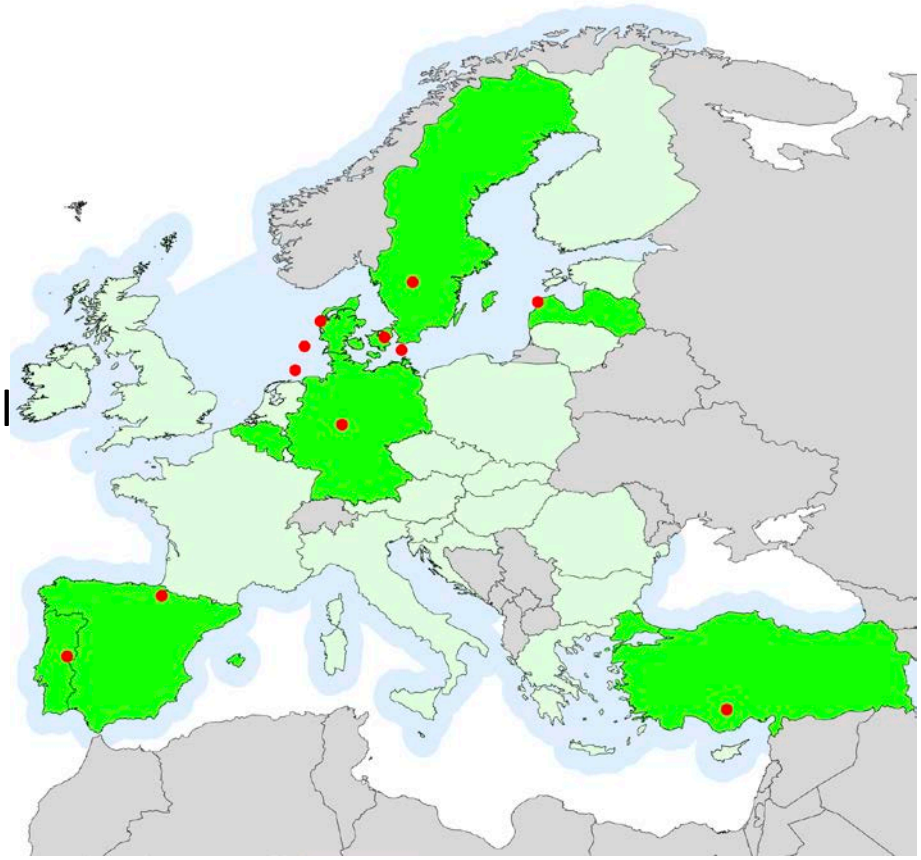
- **Research Infrastructure to underpin and enable the EERA Joint Programming on Wind Energy**
  - ✓ Important research activities on remote sensing based mapping of the regional wind resources and conditions etc.

The New European Wind Atlas

1. Accurate mapping of wind conditions for the estimations of resources and loads
2. Development and testing of the model chain
3. A series of atmospheric field experiment to validate the model and atlas.



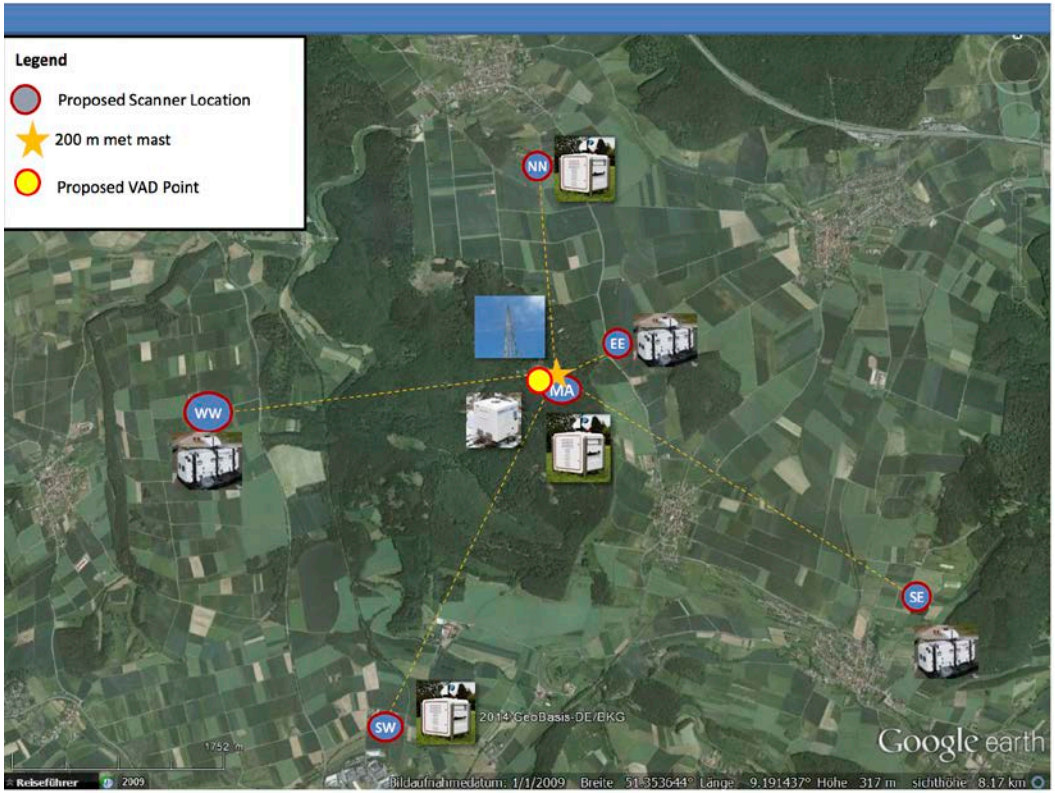
Participating countries
Other countries covered by NEWA
Offshore area covered by NEWA
NEWA experimental sites

NEWA experiments

All experiments will use meteorological masts and scanning wind lidars.

External partners are welcome to contribute to experiments

Many difficult to model terrains will be addressed: complex terrain, hills with patchy forest, near coastal waters, etc.



WindScanner.eu Pilot experiment performed over a forested hill near Kassel, Germany. Six synchronized lidars were placed kilometers apart.

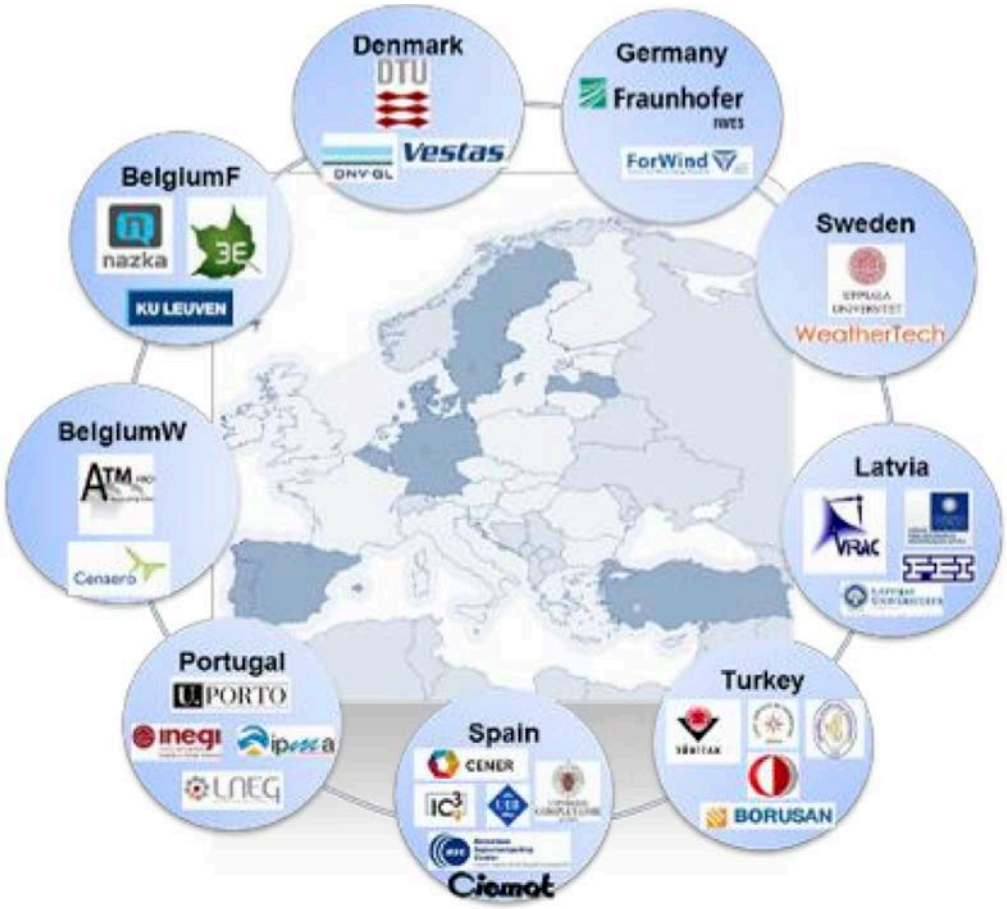
NEWA databases and modeling

Databases contain both data from experiments and models output

Databases will be publicly available also after the end of the five year project

At least one complete model chain will be open-source

The atlas will not only contain wind resources, but also extreme winds, factors important for wind turbine loads, seasonal and diurnal variations, etc.



NEWA partners

AdVanced Aerodynamic Tools for lArge Rotors

www.eera-avatar.eu

AVATAR project

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grand agreement No FP7-ENERGY-2013-1/n° 608396 .

AdVanced Aerodynamic Tools for lArge Rotors

Motivation

- We simply don't know if present aerodynamic models are good enough to design 10MW+ turbines
  - *"No mature industry will ever design a MEuro machine with unvalidated tools"* *M. Stettner, GE Global Research*
- 10MW+ rotors violate assumptions in current aerodynamic tools, e.g.:
  - Reynolds number effects,
  - Compressibility effects
  - Flow transition and separation,
  - (More) flexible blades
- **Hence 10MW+ designs fall outside the validated range of current state of the art tools.**

AdVanced Aerodynamic Tools for lArge Rotors

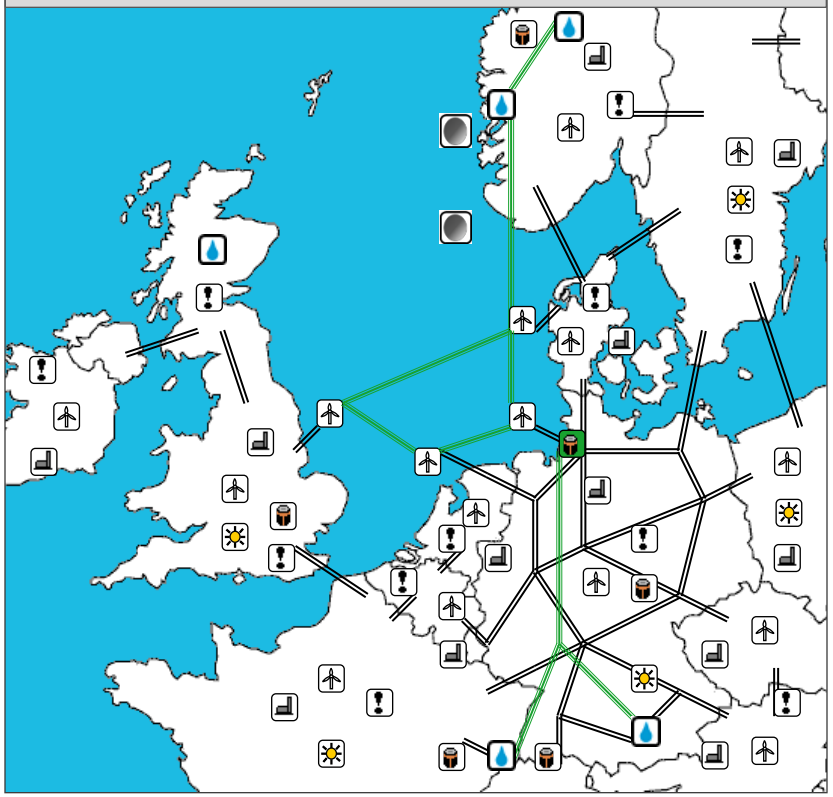
Avatar: Main objective

To bring the aerodynamic and fluid-structure models to a next level and calibrate them for all relevant aspects of large (10MW+) wind turbines

NSON - North Sea Offshore Network national proposal submission

European Commission identified
offshore grid in the North Sea as a **priority corridor**[1)],
connecting northern and central Europe

North Sea Offshore and Storage Network (NSON)



NSON initiative is **determined**
to tackle challenges of an offshore grid in the North Sea
as a **combined effort** of
Univ. of Strathclyde, SINTEF and **Fraunhofer IWES**
in a **pre-project** and **feasibility phase**

<u>Objectives of the NSON initiative‘s pre-project and feasibility phase:</u>

- **Analyzing** and **evaluating different market and grid design concepts** of a NSON and their **socio-economic cost-benefit allocation**
- Evaluating **potential of offshore storage systems** in a NSON
- **Examining effects** of a NSON **on European supply system**
- **Assessing repercussions** on **onshore grid infrastructure**
- **Developing reusable** mathematic optimization **methods for** transmission **grid planning** and **operation**

[1)] European Union (2011): Energy infrastructure priorities for 2020 and beyond. A Blueprint for an integrated European energy network.