Initiative for Global Leadership in Offshore Wind

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Research and Innovation

Political Context

2030 Climate-Energy Package

- 40% reduction of Greenhouse Gases
- 27% of renewable energy
- 27% improvement in energy efficiency

Energy Union

- *Energy security, solidarity and trust*
- *A fully integrated internal energy market*
- *Energy efficiency first*
- *Transition to a low-carbon society*
- *An Energy Union for Research, Innovation and Competiveness*

Strategic Energy Technology-Plan

- *Integrated Roadmap*
- *Communication on Integrated SET-Plan (COM[2015]6317)*

Political Context

Energy Union

Industrial Leadership

SET-Plan

10 Actions

1. Performant renewable technologies integrated in the system
2. Reduce costs of technologies
4. Resilience & security of energy system

European Commission

JRC SCIENTIFIC AND POLICY REPORTS

European Commission

2014 JRC wind status report

Technology, market and economic aspects of wind energy in Europe

Roberto LACAL ARÁNTEGUI

Javier SERRANO GONZÁLEZ

2015

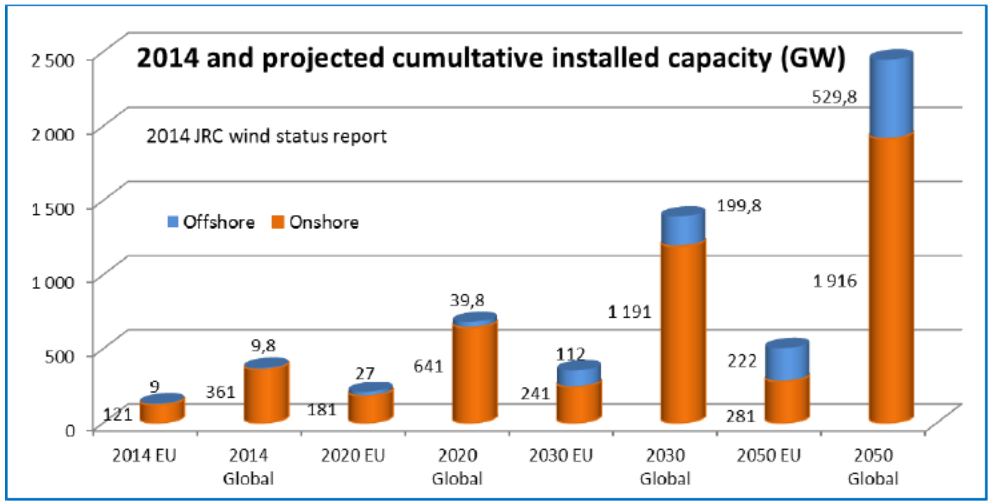

Figure 16: Projected cumulative installed capacity (GW). *Source:* GWEC (2015) for 2014 data and JRC estimates for the projections.

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"The main driver for developing wind technology further is to minimise the cost of energy (CoE) production, for which efforts focus on minimising capital and operation and maintenance costs and maximising reliability and energy production."

https://setis.ec.europa.eu/sites/default/files/reports/2014JRCwindstatusreport.pdf

Research and Innovation

Integrated SET-plan actions

- Strategic Targets in the context of an Initiative for Global Leadership in Offshore Wind

Two key issues need to be tackled:

1) Offshore wind costs must be reduced through, but not only, increased performance and reliability in order to meet its full potential contribution to the European energy mix.

2 - There is a need to develop (floating) substructures or integrated floating wind energy systems for deeper waters and wind energy systems for use in other marine climatic conditions, to increase the deployment possibilities and to improve the European position in the global market.

Agreed strategic targets for offshore wind energy

1) Reduce the levelised cost of energy (LCoE) *at final investment decision (FID) for fixed offshore wind* by improvement of the performances of the entire value chain to*

- **less than 10 ct€/kWh by 2020 and to**
- **less than 7ct€/kWh by 2030;**

** the costs for delivering the electricity to onshore substations are taken into account within the LCoE*

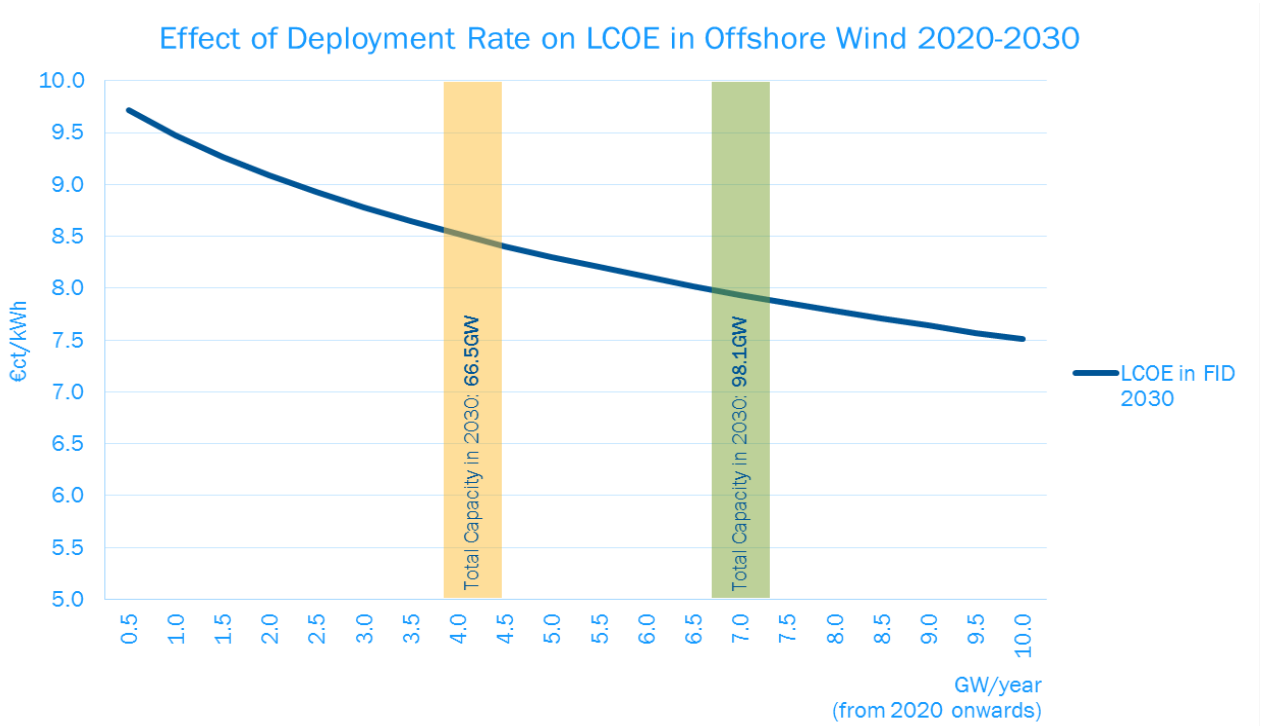
Agreed strategic targets for offshore wind energy

2) *Develop cost competitive* ***integrated wind energy systems*** *including substructures which can be used in* ***deeper waters (>50m) at a maximum distance of 50 km from shore with a LCoE* of***

- **less than 12 ct€/kWh by 2025 and to**
- **less than 9 ct€/kWh by 2030**

** the costs for delivering the electricity to onshore substations are taken into account within the LCoE*

How?


Effect of Deployment Rate on LCOE in Offshore Wind 2020-2030
€ct/kWh
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Total Capacity in 2030: 66.5GW
Total Capacity in 2030: 98.1GW
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
GW/year
(from 2020 onwards)
LCOE in FID 2030

How?

- ***Production value chain performance/cost competitiveness:***

Larger and lighter turbines (>10 MW while maintaining top-head mass below 50t/MW); more reliable turbines (materials and components of better quality; condition monitoring and control strategies); lower-cost, fast deployment installations, including foundations, and improved cable laying and protection methods; development of lower cost interconnection systems. Substructures or integrated wind energy systems for water depths beyond 50m and possibly in other climates conditions for instance for offshore wind farms in the Baltic Sea and Mediterranean.

- ***Production value chain***

Standardisation; better infrastructure for large scale deployment including appropriate and sufficient test and validation centers, effective methods for repowering and recycling, lighter, stronger and cheaper materials; new control and power electronics.

Better system integration

- *Grid development (enhancing system security, grid integration) and reliability of the grid at very high levels of wind power penetration, up to 70% of the electricity demand, and accuracy of wind power forecasting. .*

How?

- ***Wind conditions***

Efficiency and accuracy of wind design conditions, siting, resource assessment and forecasting. An uncertainty of less than 3% in the forecasting is expected by 2030.

- ***Non technological aspects***

A coordinated, continuous pipeline of offshore wind projects until 2030 enabling a continuous learning curve and cost reduction. New market designs and optimal business models for a power system with high shares of non-dispatchable renewables generation, improved financing conditions for wind energy projects especially reducing the cost of capital for offshore wind. Knowledge exchange (sharing best practice, seeking common solutions and standards, seeking common ground for economically viable investments)

- ***Environmental and societal issues***

Knowledge on potential impacts of wind energy on the environment and cost-effective solutions to minimise it, increase social acceptance and support for wind energy.

European Technology and Innovation Platform on Wind (ETIP Wind)

Industry and Research organisations working together

- Research, Innovation & Technology Industry Leaders group
- Working group Research and Innovation
- EERA JP Wind

- Developing Action plan to deliver on the targets
- Contributing to the implementation of this plan: private investments, research strategy, joint projects, ...

How H2020 can contribute to value creation and cost reductions of offshore wind energy

More information:
www.ec.europa/research/horizon2020

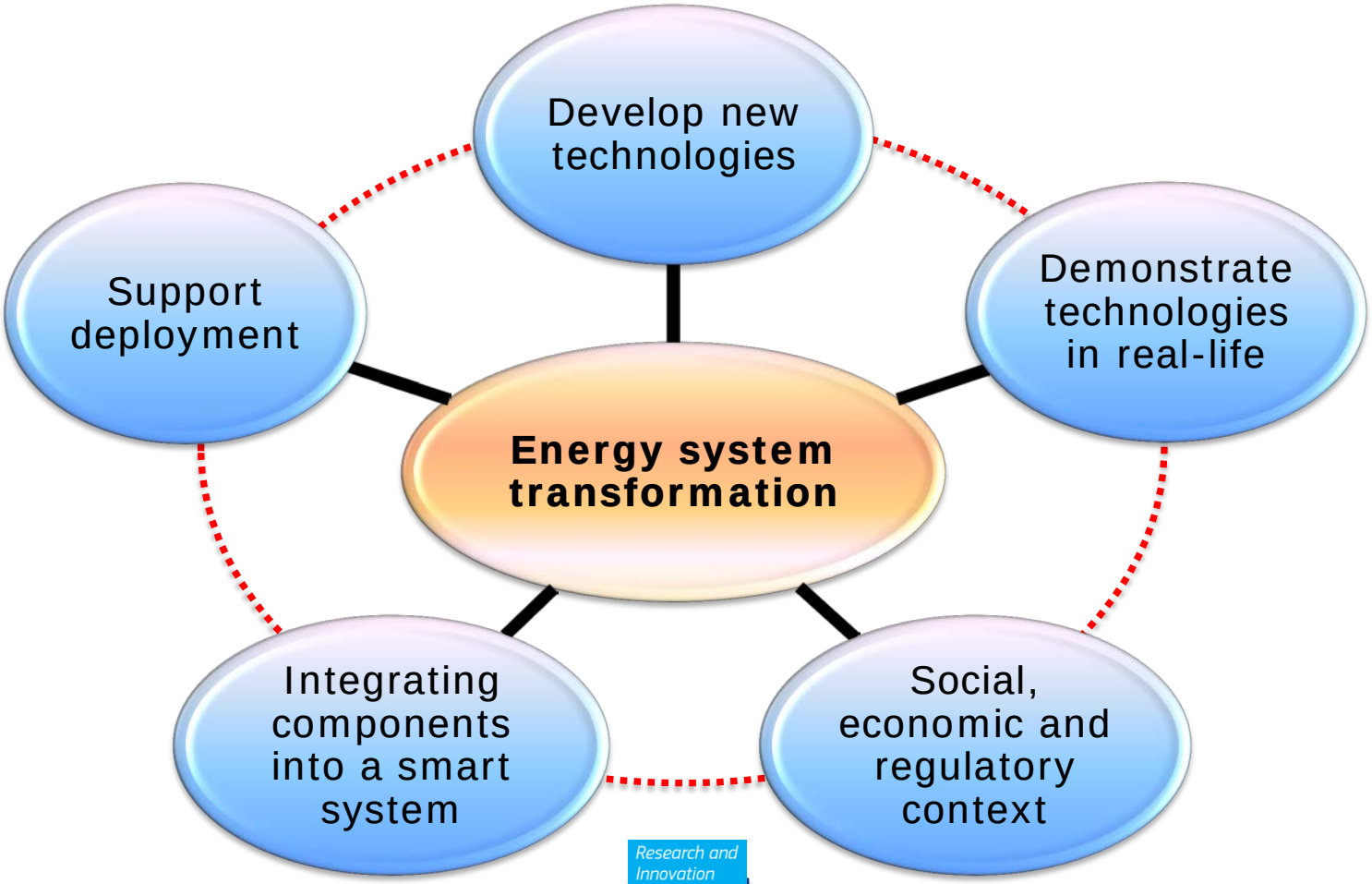
HORIZON 2020

Horizon 2020 – Overall Objectives

HORIZON 2020

- Responding to the economic crisis by investing in future jobs and growth
- Strengthening the EU's global position in research, innovation and technology
- Addressing people's concerns about their livelihoods, safety and environment
- Contributing to sustainable development (at least 35% of the overall budget)
- Supporting EU policies (e.g. Europe 2020 / Energy Union)

Systemic approach of the Energy Challenge ‘Secure, clean and efficient Energy’



The 2016-2017 calls of the Energy Challenge

Energy Efficiency (EE)
- Heating and Cooling
- Engaging consumers
- Buildings
- Industry, services and Products
- Innovative financing

Competitive low-carbon energy Technologies (LCE)
- Energy system (grids, storage)
- Renewable energies
- Decarbonising fossil fuels
- Socio-economic research
- European Research Area in energy

Smart Cities and Communities (SCC)
- Light-house demonstration projects

SME instrument (SIE)

Call budgets (in Mio €)

Call	2016	2017
EE	93	101
LCE	352,66	367,62
SCC	60	71,50
SME	46	50

Strategy for research and demonstration projects in the area of wind energy

- Main focus on offshore wind energy where major cost reductions are needed
- Focus on increased performance of wind energy technologies and to increase deployment possibilities

Expected impacts

- Increased performance, reliability and lifetime of wind energy systems making it fully competitive, through a better design of wind turbines and having an impact on the turbine efficiency and therefore on the cost of energy produced

SC3 LCE – selection of topics

Towards an integrated EU energy system

LCE-1-2016-2017: Next generation innovative technologies enabling smart grids, storage and energy system integration with increasing share of renewables: distribution network

LCE-2-2016: Demonstration of smart grid, storage and system integration technologies with increasing share of renewables: distribution system

LCE-3-2016: Support to R&I strategy for smart grid and storage

LCE-4-2017: Demonstration of smart transmission grid, storage and system integration technologies with increasing share of renewables

LCE-5-2017: Tools and technologies for coordination and integration of the European energy system

SC3 LCE – selection of topics

Developing the next generation of renewable energy technologies

LCE-6-2017: New knowledge and technologies

LCE-7-2016-2017: Developing the next generation technologies of renewable electricity and heating/cooling

Demonstrating innovative renewable energy technologies

LCE-13-2016: Solutions for reduced maintenance, increased reliability and extended life-time of wind turbines/farms

LCE-14-2017: Demonstration of large >10MW wind turbine

LCE06 – New knowledge and technologies

- 2017 – Wind energy: *Improved understanding of the physics of wind as a primary resource and wind energy technology*

-Will improve the simulation capability for multi-scale wind flows, loads and materials failure
-Significant high-performance computing (HPC) resources needed
-Results can contribute to IEA tasks and international cooperation with leading groups outside Europe is encouraged.
-Further research after the project is expected and, therefore data should be with open access

LCE07 – Next generation of technologies

- 2016 – Wind energy: *Advanced control of large scale wind turbines and farms*
  - Current progress in wind energy like larger wind turbines and farms, floating offshore wind, but also specific geographical challenges, require the development of advanced control strategies. Overall challenge is to design an integrated approach to advanced operation of a wind turbine and/or farm.

- 2017 – Wind energy: *Reduction of environmental impact of wind energy*
  - Develop potential mitigating strategies or alternative solutions and to increase public acceptance of wind energy
  - Increased scientific understanding of the social and environmental impact of wind turbines and (clusters of) wind farms both on and off-shore (including floating)
  - Cooperation with NGOs and civil society groups is essential for further investigation of the roots of resistive behaviour as engaging and involving concerned communities can facilitate addressing this specific challenge.

2016 – LCE13 – Solutions for reduced maintenance, increased reliability and extended life-time of offshore wind turbines/farms

Specific Challenge: The challenge is to achieve a very substantial reduction in Operation and Maintenance (O&M) costs through new O&M and control concepts, including logistics planning, decision making and operation

Scope: The focus is to reduce the need for maintenance of wind turbines/farms and to develop measures for life-time extension, demonstrating innovative solutions and tools, and thereby the levelised cost of wind energy.
The actions should consider not only the wind turbines but also the substructure and the soil conditions.
Participation of wind turbine manufacturers and large wind farm operators is expected.
Demonstration project: TRL 7 should be achieved,
Expected EC contribution 7-10 M€

2017 – LCE14 – Demonstration of large >10MW wind turbine

Specific Challenge: To demonstrate and construct a full scale >10MW turbine and provide proof of a significant cost reduction potential.

Scope: The development of large scale (>10MW) turbines will have intrinsically logistical requirements regarding handling, installation, operation and maintenance. Improved handling (storage, loading, transport, etc.) on land, in the harbours and/or at sea, as well as improved logistics around operations and maintenance have to be taken into account in this innovation action.

Demonstration project: TRL 7 should be achieved,
Expected EC contribution 20-25 M€

LCE-21-2017: Market uptake of renewable energy technologies

- ***Wind energy****: One of the following specific sub-challenges need to be addressed:*
  - i) Develop spatial planning methodologies and tools for new onshore wind and repowering of old wind farms taking into account environmental and social impacts but also the adoption of the latest developments in wind energy technology;
  - ii) Identify the bottlenecks for further deployment in Europe and the regulations which limit the adoption of technological innovation and their deployment possibilities;
  - iii) Increase the social acceptance and support for wind energy in 'wind energy scarce regions' using, with solid involvement of social sciences and humanities and local communities and civil society to understand best practices and to increase knowledge about social and environmental impact of wind energy.

Fast-track to Innovation Pilot

- Innovation from the demonstration stage through to market uptake (starting as of TRL 6)
- Completely bottom-up – covers all areas addressed by H2020
- Small consortia with strong participation from industry
- Business plans mandatory
- 3 submission deadlines in 2016 (15/3, 1/6, 25/10/2016)
- Budget 100 M€ (no earmarking for areas)

The SME Instrument

- Seamless business innovation support
- Completely bottom-up – all areas of the Energy Challenge covered
- Only open to SMEs – also single-beneficiaries possible

3 phases of support (no need to start with phase 1)

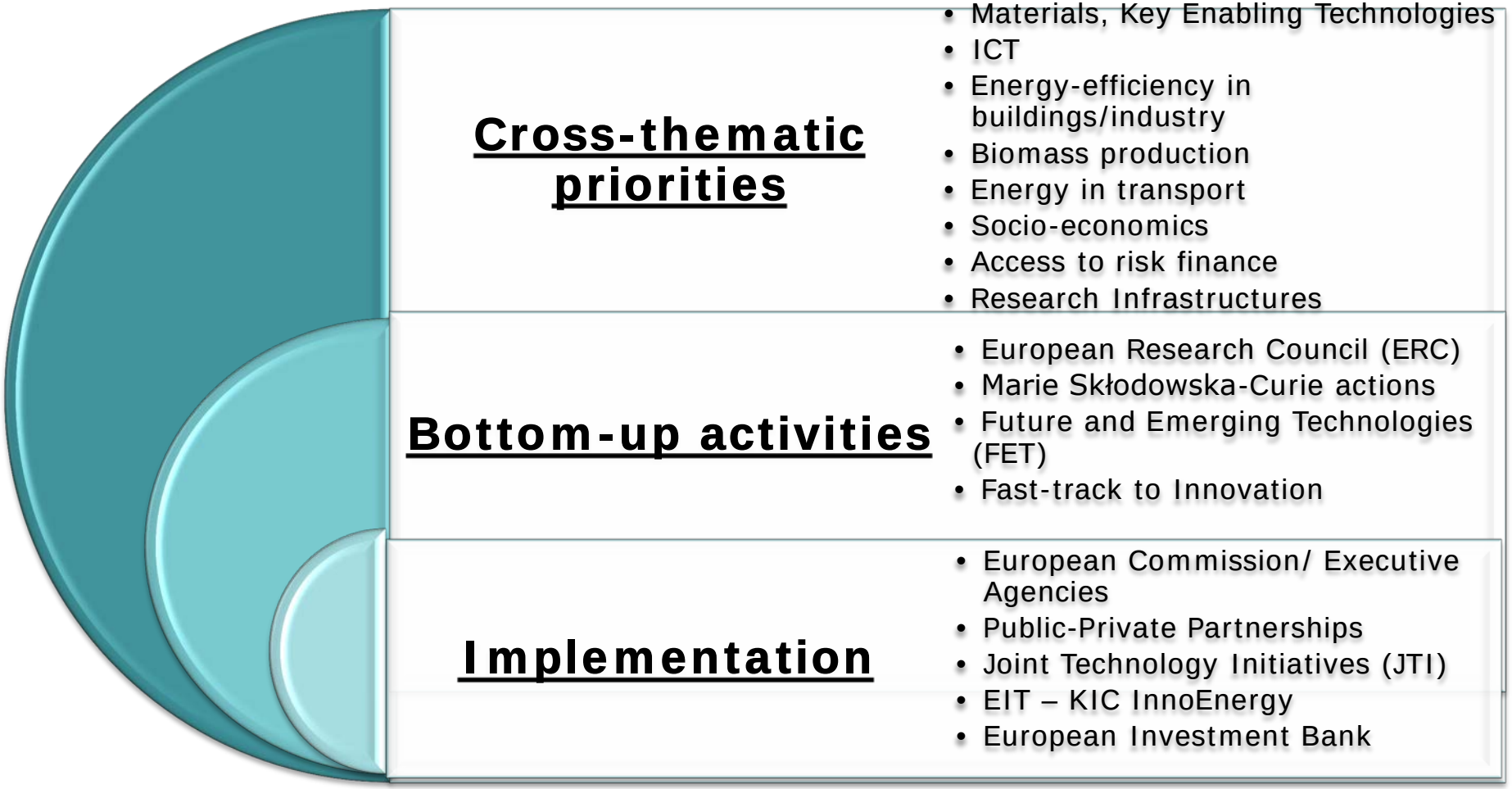
1. **Business innovation grants** (feasibility studies, lump sum of EUR 50,000 per project);
2. **Business innovation grants for innovation development & demonstration purposes** (between EUR 0.5 – 2.5 million / project)
3. **Free-of-charge business coaching,** access to a wide range of innovation support services and facilitated access to risk finance to facilitate the commercial exploitation of the innovation.

✓ 4 submission deadlines per year for phase 1 and 2

✓ Budget for the Energy SME topic (SMEInst-09-2016-2017):

- ✓ **46 M€ in 2016**
- ✓ **50 M€ in 2017**

Energy outside the Energy Challenge



Risk finance for demonstration projects

InnovFin Energy Demo Projects Pilot Facility (EDP)
(Other Action#28)

- First-of-a kind commercial-scale industrial demonstration projects (TRL 7-8) for unproven pre-commercial technologies in the field of innovative **renewable energy**, **fuel cells and hydrogen** in support of the SET-Plan
- Loan amount: min EUR 7.5 M€, max EUR 75 M€
- Loan maturity: max 15 years

InnovFin
Energy Demo Projects

Application & inquiries: directly with the EIB - New Products & Special Transactions, EIB, Luxembourg
Tel: +352 4379 85002, E-mail: innovfinFDP@eib.org
http://www.eib.org/products/blending/innovfin/products/index.htm

Results first 2 years

FP7 projects

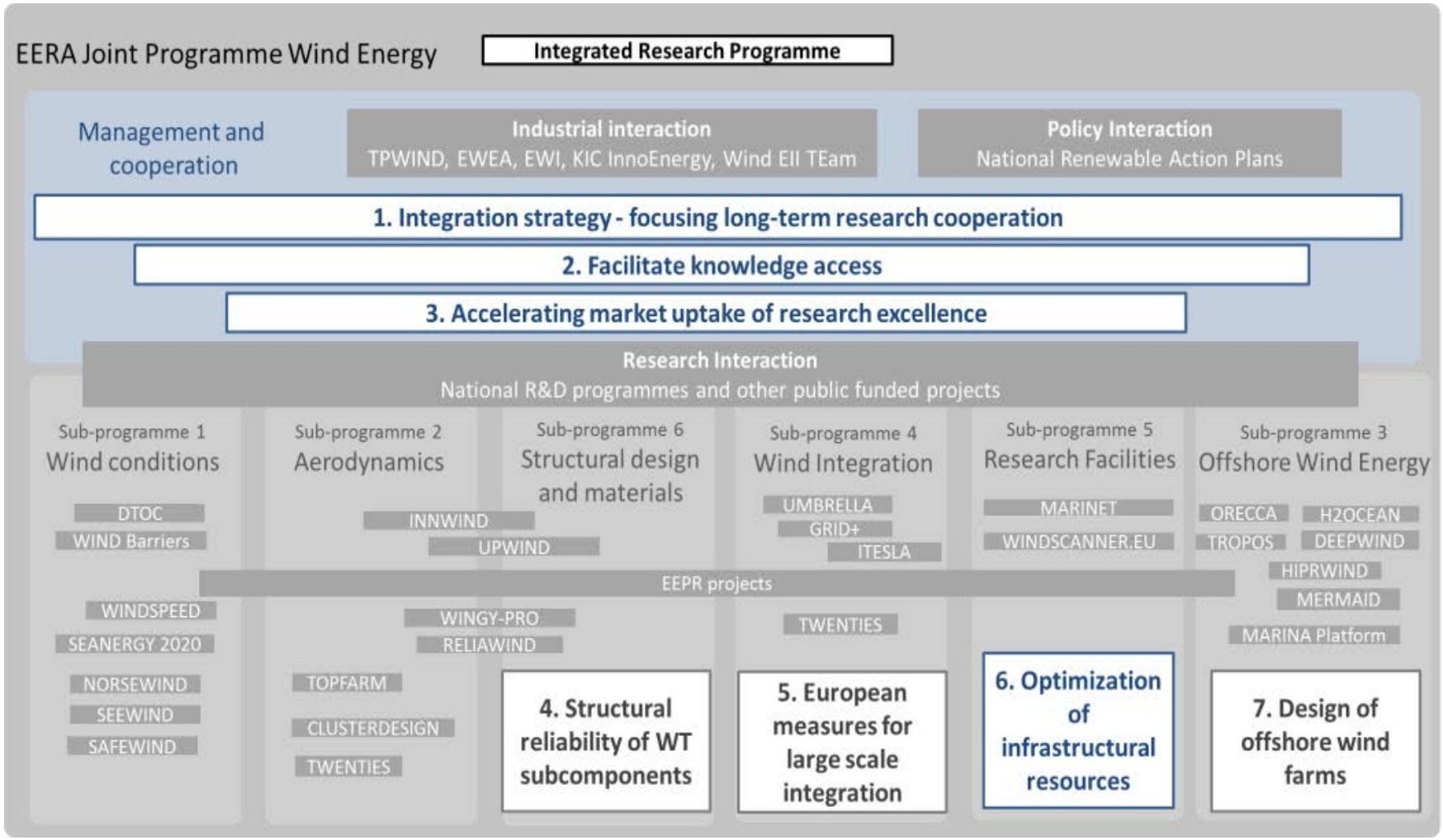


Figure 7- Rationale behind IRPWIND: Identification of gaps within the framework of EERA JP Wind

H2020 – projects

- *Wind turbine*
  - **Ecoswing – Energy Cost Optimization using Superconducting Wind Generators - World's First Demonstration of a 3.6 MW Low-Cost Lightweight DD Superconducting Generator on a Wind Turbine (<TRL7, IA, 10.591.734 €, 1/3/2015 – 28/2/2019, Envision Energy (DK))**

H2020 – projects

- *Substructures*
  - **TELWIND – Integrated telescopic tower and evolved spar floating substructure for low-cost deep offshore wind and next generation of 10MW+ turbines (<TRL5, RIA, 3.498.530 €, 30 months, 1/12/2015 – 31/5/2018, ESTEYCO SAP)**
  - **LIFES50+ - Qualification of innovative floating substructures for 10 MW wind turbines and water depths greater than 50 m (<TRL5, RIA, 7.274.838 €, 40 months, 1/6/2015 – 30/9/2018, Marintek (NO))**
  - **ELISA/ELICAN – Self-bouyant precast concrete foundation for the craneless installation of complete offshore wind turbines: full scale offshore protype (SME -2, IA , 13.679.850 €, 24 months, 1/6/2015 – 31/5/2017, ESTEYCO SAP)**
  - **DEMOGRAVI3, innovative gravity based foundation for offshore wind turbines (TRL7, IA, 19.243.042 €, 48 months, 1/1/2016 – 31/12/2019, EDP (PT))**

H2020 – projects

- *Cost reduction in offshore wind*

  - **DEMOWIND (Eranet Cofund, IA, 10.000.000 €, 60 months, 1/1/2015 – 31/12/2019, DECC (UK)) combined with national funding of UK, DK, NL, ES, PT and BE total: 31.000.000 €**
  - **DEMOWIND 2 (Eranet Cofund, IA, 8.300.000 €, 60 months, 1/1/2016 – 31/12/2020, DECC (UK)) combined with national funding of UK, DK, NL, ES, BE and NO total: 25.000.000 €**

H2020 – projects

- *Small wind*
  - **Briareo – Implementation of a vertical axis micro-wind turbine capable of working at high efficiency even at a low wind speed (SME-1, 50.000 € funding, 6 months, 2015, Arken SPA)**
  - **IRWES Integrated Roof Wind Energy System (SME-2, 1.696.381 € funding, 24 months, 2015 – 2017, IBIS Power BV)**
  - **Omniflow – Next-generation hybrid wind and solar power technology (SME-1, 50.000 €, 6 months, 2015, Omniflow SA (PT))**

H2020 – projects

- *Airborne Wind*
  - **AMPYXAP3 – Commercial introduction of the first Airborne Wind Energy system: renewable eneryg at costs below fully depreciated coal fired power plants (SME-2, 2.500.000€ funding, 23 months, 2015, Ampyx Power BV)**
  - **REACH – Resource Efficient Automatic Conversion of High Altitude Wind (FTIPilot -1, 2.675.132€ funding, 36 months, 2015, ENEVATE BV) Kite Power**

H2020 – projects

- *Education and training*
  - **ICONN – European Industrial DoCtorate on Offshore WiNd and Wave ENergy (MSCA-ITN-EID, 845.838 €, 48 months, 2015 – 2019, Trinity College Dublin)**
  - **AWESOME – Advanced Wind Energy Systems Operation and Maintenance Expertise (MSCA-ITN-ETN, 2.862.074 €, 48 months, 2015 – 2019, CIRCE (ES))**
  - **AWESCO – Airborne Wind Energy System Modelling, Control and optimisation (MSCA-ITN-ETN, 2.999.015 €, 48 months, 01/01/2015 – 31/12/2018, TU Delft (NL))**
  - **SPARCARB – Lightning protection of wind turbine blades with carbon fibre composite materials (MSCA-ITN-ETN, 1.093.151 €, 48 months, 01/01/2015 – 31/12/2018, GLPS (DK) and Univ Southampton (UK))**
  - **AEOLUS4FUTURE – Efficient harvesting of the wind energy (MSCA-ITN-ETN, 3.811.805 €, 48 months, 01/01/2015 – 31/12/2018, LULEA Tekniske Univ (S))**

H2020 – projects

- *Varia*
  - **HPC4E – HPC for Energy (LEIT, RIA, 1.998.176 €, 24 months, 1/1/2016 – 31/12/2017, Barcelona supercomputing centre)**
  - **Opti-LPS – Optimal Lightning Protection System (SME-1, 50.000 €, 6 months, 2015, GLPS AS (Dk))**
  - **MEWi-B – More efficient Wind Blades (SME-1, 50.000 €, 6 months, 2015, ETA Srl (IT))**
  - **FLOATMAST – An Innovative Wind Resource Assessment Tension Leg Platform for combined Anemometer and Lidar reliable and bankable wind measurements for offshore wind parks (SME-1, 50.000 €, 6 months, 2015, ETME Streamlined (EL))**
  - **SEAMETEC – Smart Efficient Affordable Marine Energy Technology Exploitation using Composites (SME-1, 50.000 €, 6 months, 2015, Eirecompoisites Teoranta (IE))**

H2020 – projects

- *Varia*
  - **I-WSN – Intelligent Wireless Sensor Networks for Asset Integrity Monitoring (SME-1, 50.000 €, 6 months, 2015, Inertia Technology BV (NL))**
  - **EeC WITUR – Efficient energy cleaning robotic platform for wind turbines (SME-1, 50.000 €, 6 months, 2014, Tratamiento Superficial Robotizado SL (ES))**
  - **CLOUD DIAGNOSIS – Providing Predictive Maintenance for Wind Turbines Over Cloud (SME-1, 50.000 €, 6 months, 2014, ITESTIT (ES))**
  - **AIRCRANE – New Building methodology for improved full-concrete wind towers for wind turbines (SME-1, 50.000 €, 6 months, 2014, Structural Research S.L. (ES))**
  - **Aeropaft – Delay of flow separation and stall on Aerofoils using a passive flow control technology which will improve aerodynamic performance and stabilty of wind turbines increasing their range of operation (SME-1, 50.000 €, 6 months, 2014, Jarilo Limited (UK))**

European Commission

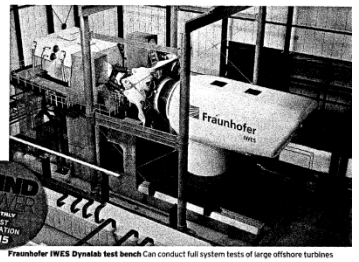
MEDAL WINNER

GOLD Fraunhofer IWES Dynalab

The full-scale dynamic nacelle testing laboratory — Dynalab for short — is a test bench suitable for either direct-drive or geared drivetrain components, and complete nacelles right up to 8MW.

But what makes Dynalab stand out from other advanced test rigs is that it incorporates the world's biggest and most advanced grid simulator. The main focus of the rig is to be able to give full system tests, which aim to get as close as possible to real world operating conditions for the machinery.

This means that the time spent in prototype field-testing can be substantially reduced, while at the same time minimising the product development risk, and achieving high efficiency and reliability of the product right from launch. The total package could also help turbine suppliers with early-stage



Fraunhofer IWES Dynalab test bench Can conduct full system tests of large offshore turbines

TOP INNOVATIONS *Northern Europe remains the hotbed for wind power's pioneering technology*

Make/Model	Description	Noteworthy	Status
Fraunhofer IWES Dynalab (Germany)	Industry's most advanced drivetrain and nacelle test rig	Incorporates the world's biggest and most advanced grid simulator; focused on full system tests rather than highly accelerated life testing (HALT)	Operational since autumn 2014
Vestas LDST (large diameter steel tower) (Denmark)	Patented lighweight wide-based tubular steel tower for high hub heights	Bottom sections are manufactured in tapering circles, then sliced into 120-degree segments. The sections can be transported by flatbed trucks and the parts, which fit together precisely, re-assembled on site	More than 80 turbines mounted on LDST are now in operation
Max Bögl wind turbine tower and energy storage solution (Germany)	High tower with incorporated power storage	Pumped storage device comprises a water basin with a hollow 40-metre structure with varying water column level; provides the basis for tower mounting; hub height of 178 metres	Prototype under construction
Seatower Cranefree Gravity Foundation (Norway)	Offshore gravity base foundation	Self-installing hollow-concrete foundation base; floating structure that is towed to its location; installation implemented by filling concrete part with water and, in final step, replacing with sand	One unit now installed at French Fécamp offshore development
Lagerwey L136 turbine (Netherlands)	3.6/4.0MW turbine for IEC Class IIA	Compact direct-drive turbine design with 225-tonne head mass; features innovative simplified inner-rotor generator with traditional stator housing and 100% passive air cooling	Design under construction; first commercial deliveries expected in second half of 2017

Thank you for your attention!

More information:
www.ec.europa/research/horizon2020

HORIZON 2020