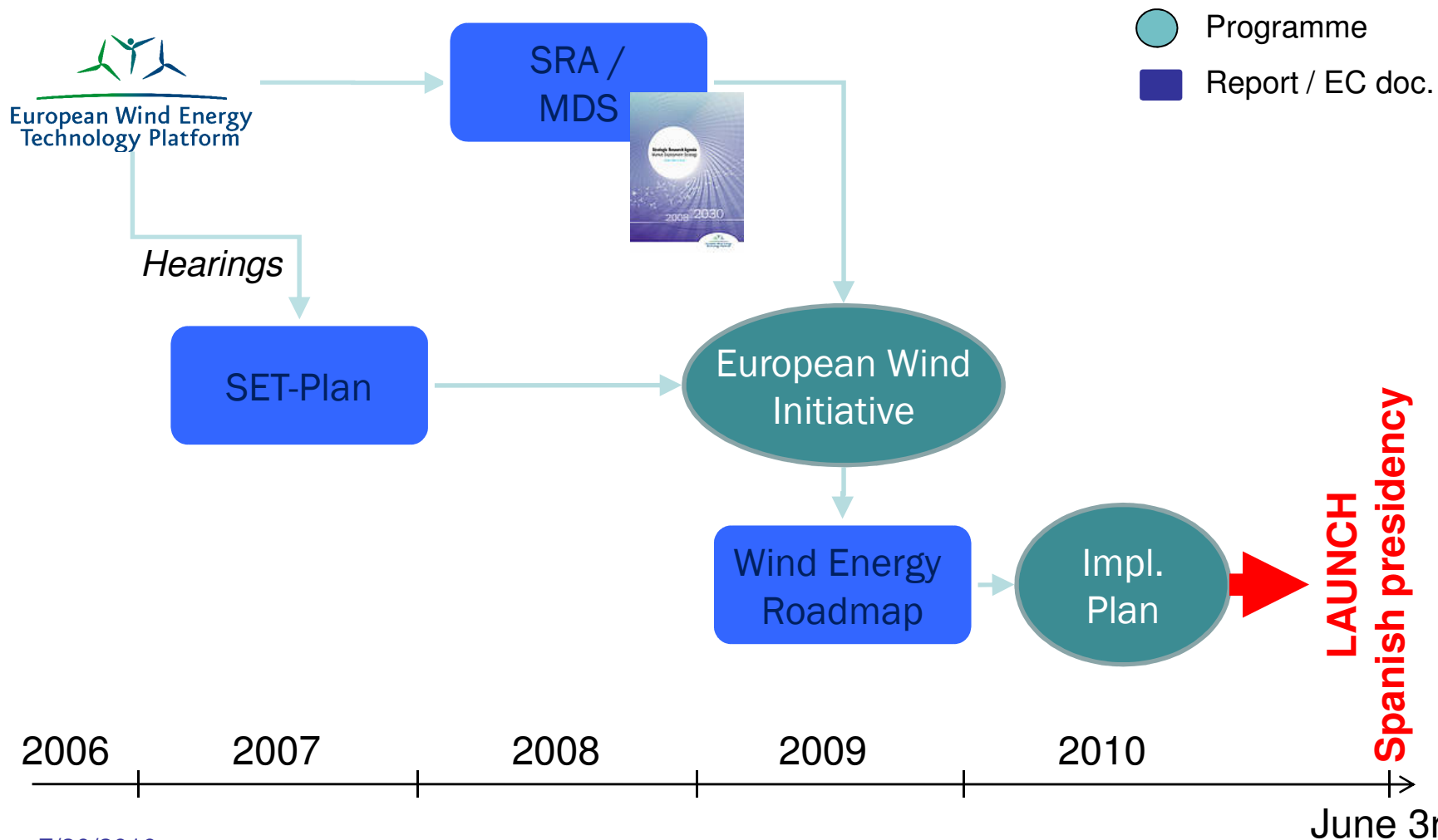


# Wind Energy Technology Roadmap

*Implementation plan 2010 - 2012*

Nicolas Fichaux, TPWind Secretariat

# TPWind involvement in SET-Plan process



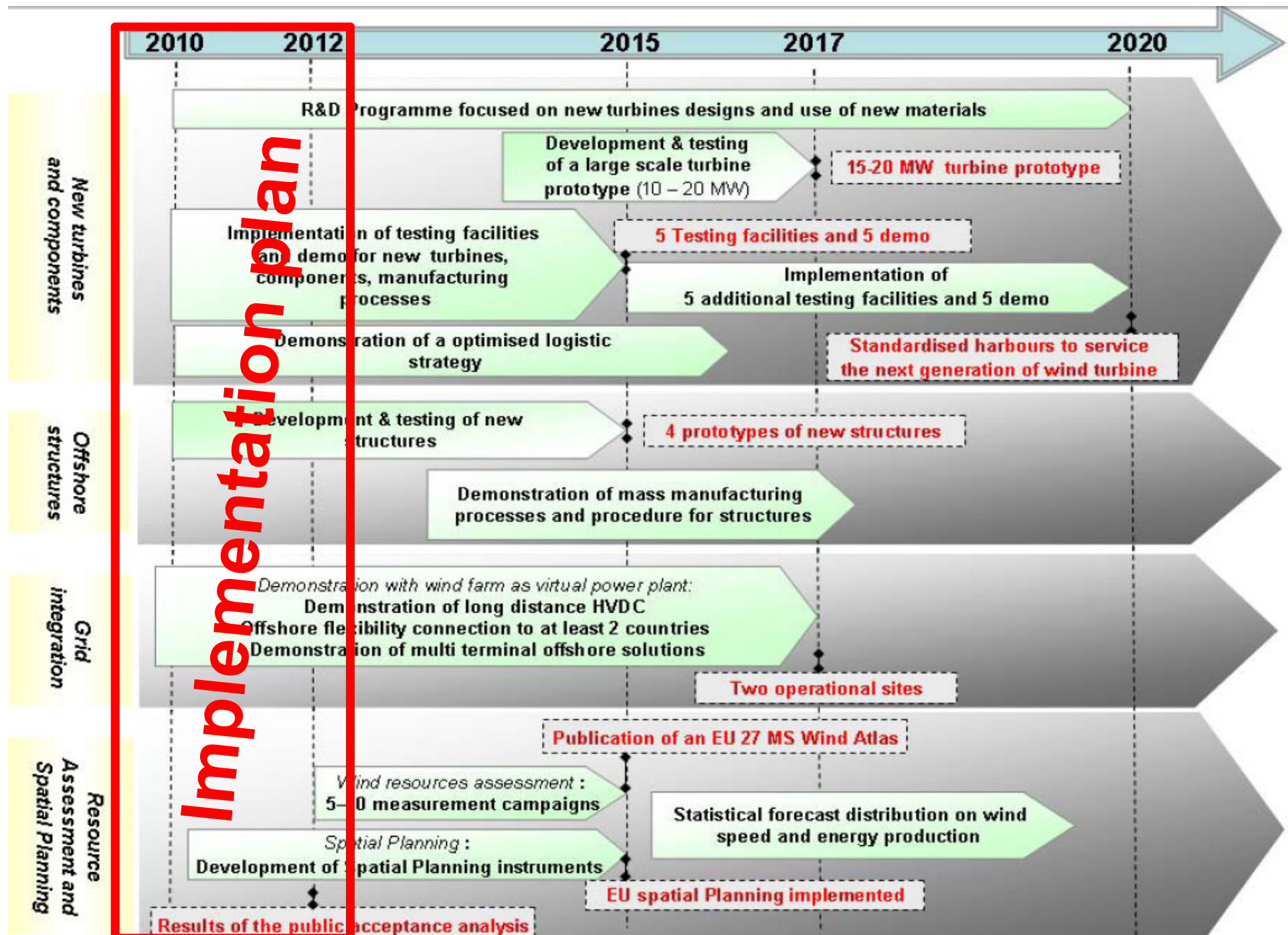
## Implementation plan – Guidelines – Dec. 09

The implementation plan should cover the first 3-year period and will be revised every year, thus becoming rolling out programmes. The following elements should be included:

- Taking into account the present technology, and projects financed by the EU and Member States, identifying the priority actions to move towards the objective / milestone
- Estimate the budgets, the European added-value of the actions and the risk involved by the different actions
- Identify the existing available public and private financial sources
- Identify the needed actors and potential countries to finance the actions
- Define Key Performance Indicators
- Estimate the contribution of the identified priority actions towards the 2020 objectives/milestones
- Identify possible links with joined programmes of the EERA
- Deadline: End Jan. 2010

## Process

- |         |   |  |
|---------|---|--|
| Dec. 09 | + | <input type="checkbox"/> Draft from 5th GA content   |
|         |   | <input type="checkbox"/> Draft circulated to SC, telcos with Chairs and Vice-chairs  |
| Feb. 10 | + | <input type="checkbox"/> Presented by EC to MS experts (Sherpas, feb. 11th)  |
|         |   | <input type="checkbox"/> Comments included by Secretariat  |
|         |   | <input type="checkbox"/> Presented by EC to High level steering group (March 5th)  |
| Mar. 10 | + | <input type="checkbox"/> Council decision on Ells launch “before 2011” (March 12th)  |
|         |   | <input type="checkbox"/> On period Jan. – March, Secretariat visited 10 countries to present and discuss implementation plan (Sherpas and Steering Group members) – It, UK, Fr, Ge, Sp, Pt, Se, Fi, De, Au, + NI, Gr, Be |
|         |   | <input type="checkbox"/> Side meetings: international cooperation, JRC meeting on KPIs, DG RTD on training, EC/ TPWind meeting on grid initiative  |
| June 10 | + | <input type="checkbox"/> Need development on KPIs  |
|         | ↓ | <input type="checkbox"/> Launch under Spanish Presidency – “letter of intent”  |



# Financing instruments

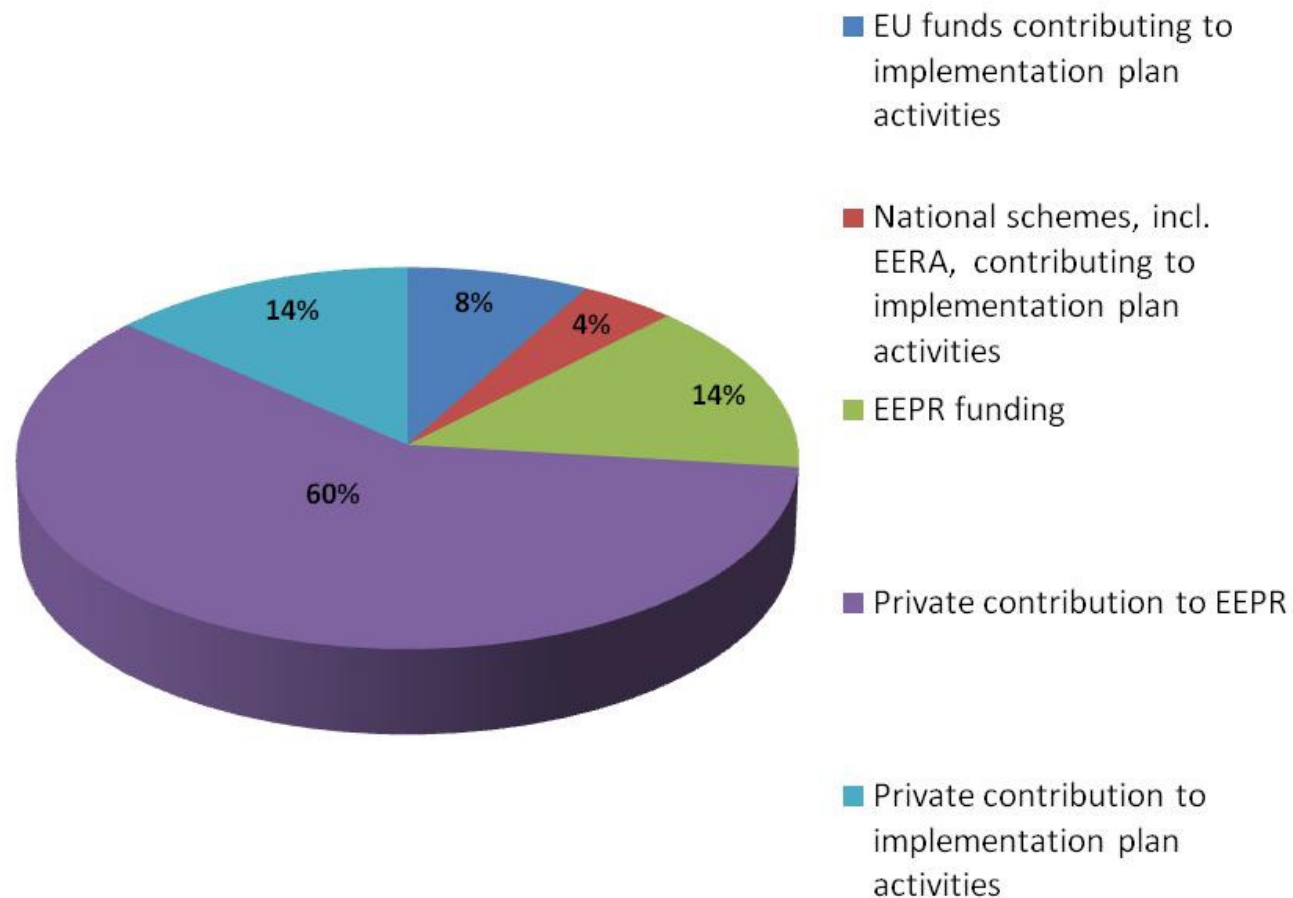
Preliminary research / Policy actions	Pre-competitive research	Demonstration / Test facilities	Market uptake / Innovation / Private infrastructures
<ul style="list-style-type: none"> <li>1.1.1 (Large turbines)</li> <li>4.1.1 (Measurement campaigns)</li> <li>4.2.1 (Offshore spatial planning)</li> <li>4.3.1 (Economic value of wind)</li> </ul>	<ul style="list-style-type: none"> <li>1.1.2 (Reliability)</li> <li>1.1.3 (Complex terrains)</li> <li>1.1.4 (Cold climates)</li> <li>1.2.1 (Testing standards)</li> <li>3.2.1 (Wind Power Plants)</li> <li>3.3.1 (Balancing technologies)</li> <li>3.3.2 (Market integration)</li> </ul>	<ul style="list-style-type: none"> <li>1.2.2 (Large testing facilities)</li> <li>1.2.3 (Large field testing facilities)</li> <li>1.3.1 (Large-scale manufacturing)</li> <li>2.1.1 (Offshore sites)</li> <li>2.3.1 (Standards)</li> <li>3.1.1 (Kriegers Flak)</li> <li>3.1.2 (HVDC multi terminal solutions)</li> </ul>	<ul style="list-style-type: none"> <li>2.2.1 (Mass manufacturing of substructures)</li> </ul>
<p>EU Grants, Member States for relevant actions</p> <p>Total public funding level 50%</p>	<p>EU Grants, Member States for relevant actions</p> <p>Total public funding level 50%</p>	<p>EU Grants, Member States, equity (EIB)</p> <p>Total public funding level 50%</p>	<p>Member States, Loans or equity (EIB)</p> <p>Total public funding level 25%</p>

## Budget intensity

Technology objectives	Total budget (M€)	Budget (M€) on period 2010-2012	Budget intensity
1. New turbines and components	2 500	760	30%
2. Offshore structure-related technologies	1 200	310	25%
3. Grid integration	2 100	334	16%
4. Resource assessment and spatial planning	200	36	18%
<b>Total incl. EEPR</b>	<b>6 000</b>	<b>1443</b>	<b>24%</b>
<b>Total excl. EEPR</b>	<b>6000</b>	<b>924 (EEPR 519)</b>	<b>15%</b>



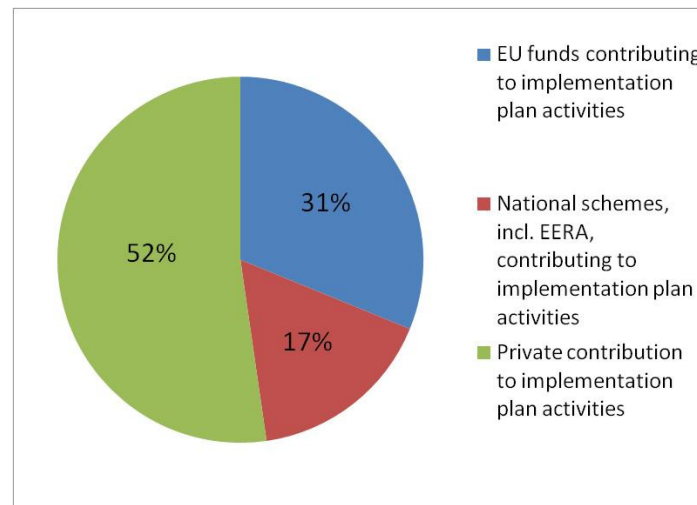
## Budget intensity incl. EEPR



EEPR €519 m  
Ind. €2.1 bn

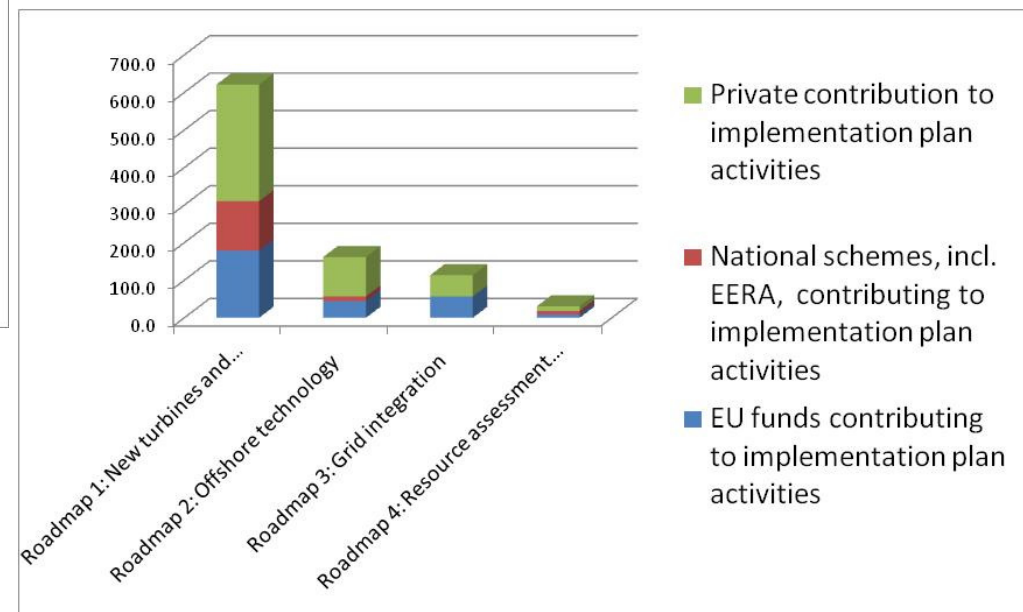
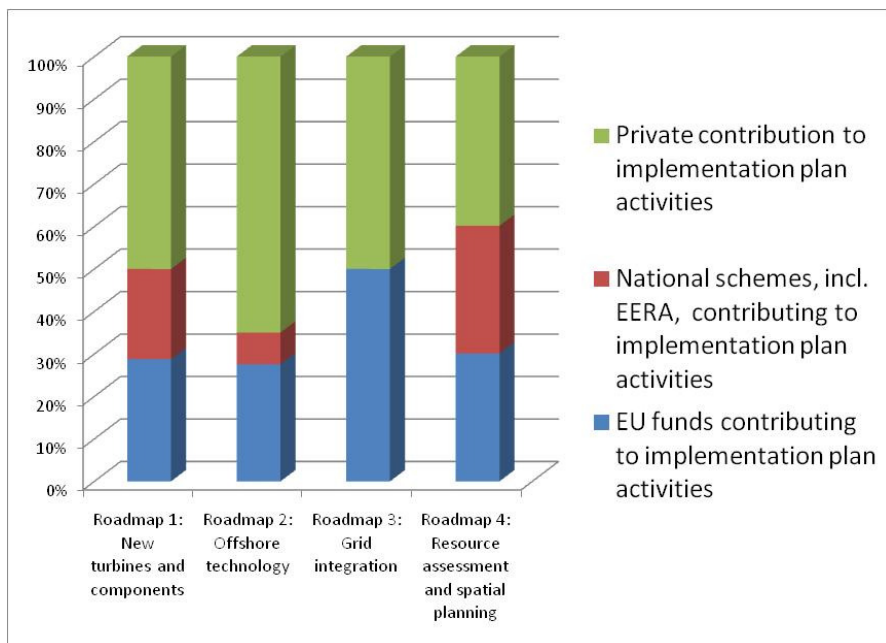


## Budget intensity and repartition for new funds

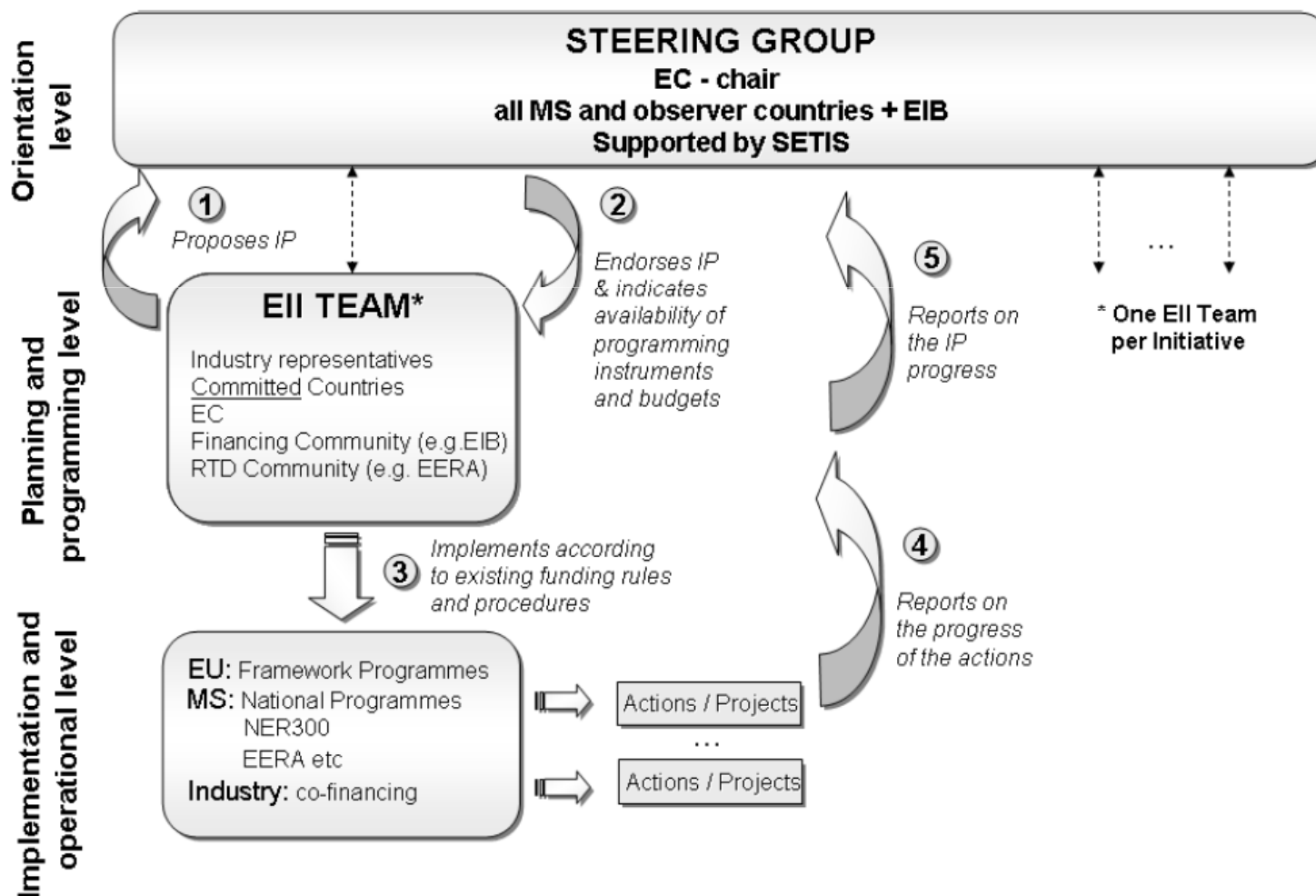


Roadmap strand	EU funds	National schemes, incl. EERA	Private contribution
Roadmap 1: New turbines and components	178.5	132.0	310.5
Roadmap 2: Offshore technology	44.6	12.1	105.3
Roadmap 3: Grid integration	56.7	0.0	56.7
Roadmap 4: Resource assessment and spatial planning	9.3	9.3	12.3
<b>Total</b>	<b>289</b>	<b>153.4</b>	<b>484.7</b>

## Budget intensity and repartition for new funds



# Governance



## One funding instrument: NER300

- ☐ Substantial fund for demonstration of low-carbon power, at the moment worth around €4bn
- ☐ Targeting key technologies of the future with a good technological balance - minimum of 8 CCS projects and 34 RES projects
- ☐ Major support for European leadership in clean technology, green growth and jobs
- ☐ European Investment Bank will assist in swift implementation of the demonstration programme.
- ☐ First call for large-scale demonstration projects mid 2010, with first decisions end 2011, to allow plants to be in operation by end 2015.

## One funding instrument: NER300

- ☐ Off-shore wind (minimum turbines size 6 MW) with nominal capacity 40 MW
- ☐ Off-shore wind (minimum turbines size 8 MW) with nominal capacity 40 MW
- ☐ Off-shore wind (minimum turbines size 10 MW) with nominal capacity 40 MW
- ☐ Floating off-shore wind systems with nominal capacity 25 MW
- ☐ On-shore wind turbines optimised for complex terrains (e.g. forested terrains, mountainous areas): with nominal capacity 25 MW
- ☐ On-shore wind turbines optimised for cold climates (compatible with temperature lower than - 30 °C and severe icing conditions) with nominal capacity 25 MW
- ☐ Award decisions for the first round should be issued by 31 December 2011, and for the second round by 31 December 2013

## NER300 timeline – call 1

### ☐ Website

<http://www.ner300.com/>

Thank you for your attention!

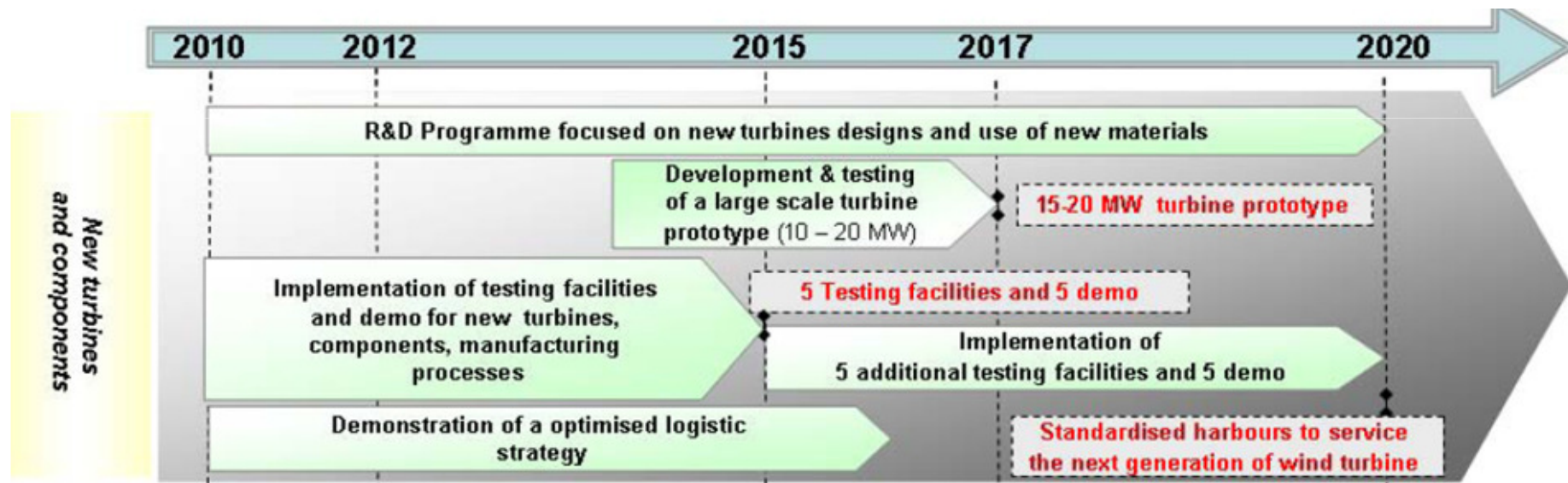


<http://www.windplatform.eu/>

[secretariat@windplatform.eu](mailto:secretariat@windplatform.eu)



# New turbine and components



# R&D programme focused on new turbine designs, materials and components

1.1.1	<p>Large scale turbines and innovative design for reliable turbines rated 10 – 20 MW</p> <ul style="list-style-type: none"> <li>• Advanced aerodynamic modeling, design and testing, including flow devices for distributed aerodynamic control of very large rotor blades and aero tools for turbines on floating structures.</li> <li>• Characterization and development of materials and components for wind turbines, including upscaling effects.</li> <li>• Detail development and integration of drive trains – mechanical transmission, generator and power electronics – both theoretical and sub-system validation.</li> <li>• Sensing, algorithms and actuation in control strategies and systems</li> </ul>
1.1.2	<p>Improved reliability of large turbines and wind farms</p> <ul style="list-style-type: none"> <li>• Analysis of flow in and around large wind farms and through control optimization of power performance and minimizing dynamic loading.</li> <li>• Smarter O&amp;M with a.o. preventive maintenance and condition monitoring; optimizing life-cycle cost.</li> </ul>
1.1.3	<p>Turbine optimisation and demonstration for complex terrain and cold climates</p>

# KPI

- ❑ 1.1.1 – Innovation for the very large concepts should be included by stage, and include upscaling. This programme should enable the demonstration of a 15-20 MW prototype on period 2017-2020, as stated by the Wind Energy Roadmap:
  - Develop and test a generator and drive train for turbine in the 10-20 MW range: 10 MW in 2012, 12 MW in 2016, over 15 MW in 2018;
  - Design and testing of very large blades including smart aerodynamic control over 80 m length. Goals: 80 m in 2014 (8-10 MW), 100 m in 2016 (12 MW), over 110 m in 2018 (15 MW+).
- ❑ 1.1.2 - Development and implementation of a smart control strategy minimizing the loads and improving the efficiency of a large offshore wind farm of 1 GW scale. The objective is to improve power output of the turbines in the center of the array by 5 to 10%.
- ❑ 1.1.2 – Increased availability of current large offshore designs by 10%, measured in number of hours.
- ❑ 1.1.3 – Designs and methodologies available in 2012, enabling to build two demonstrations funded by the New Entrants Reserve.

## A network of 5-10 European testing facilities

Number	Description
1.2.1	Definition of methods and standards for testing large wind turbine components. In close cooperation with the EERA.
1.2.2	Improvement of size and capabilities of system-lab testing facilities for 10 – 20 MW turbines. In close cooperation with the EERA.
1.2.3	Field testing facilities for 10 – 20 MW aimed at increasing reliability. In close cooperation with the EERA. Aberdeen offshore test centre included, funded by the EEPR.

1.2.1 – Methods and standards for testing large components available in 2011

1.2.2 – Improved and additional system-lab testing facilities:

- 2 additional drive-train testing facilities for 15 MW+ turbines in 2015
- 2 additional blade testing facilities for 15 MW+ turbines in 2015
- 1 dedicated wind tunnel for large-scale designs in 2015

1.2.3 - 2 additional full-scale field testing facilities established in 2015, in addition to Aberdeen offshore wind farm. In 2012, sites are identified in agreement with national governments.

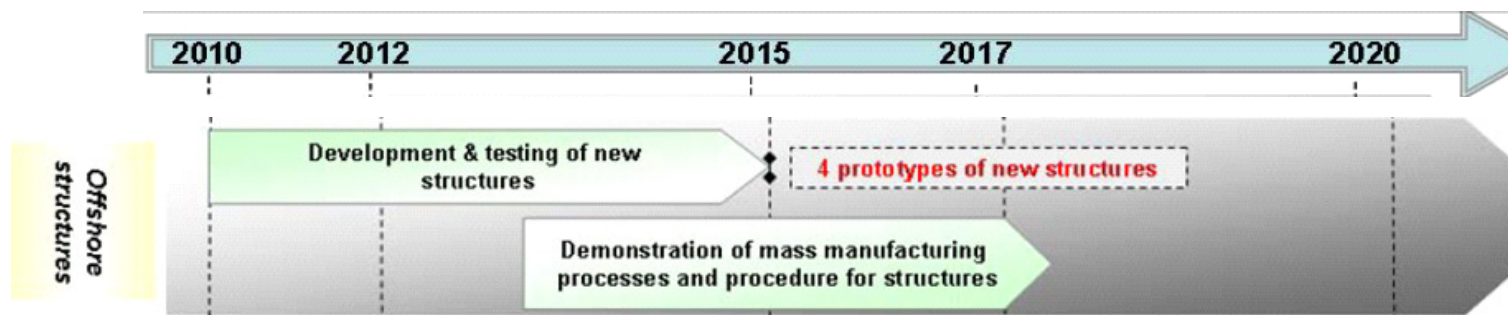
## An EU cross-industrial cooperation and demonstration programme drawing upon the know-how from other industrial sectors for mass production of wind systems

Number	Description
1.3.1	Development of five large scale manufacturing and logistics processes, both size and numbers for in and out-of-factory and site erection. The EEPR provides € 92 m, through the financing of demonstrators.

### Relevant KPI:

5 to 10 automated production facilities to mass manufacture wind turbines in the 10 to 20 MW range established: 6 MW facilities ready in 2012; 8-10 MW facilities ready in 2016; over 12 MW facilities ready in 2018.

# Offshore technology



## Development and testing of new structures

Number	Description
2.1.1	<p>Site identification for demonstration of large-scale substructures. This activity is carried on in parallel to activity 1.2.3 under sub-programme 2 of the <i>New turbine and components</i> priority</p> <p>Development of deep-offshore concepts. Builds on 2009 FP7 call, and EERA activity for new offshore concepts.</p>

2.1.1 – KPI 1.2.3 applies for site identification.

2.1.1 – Design and demonstration of future substructure concepts, including floating, implemented through current FP7 programme, and EERA activity.

## Automation of substructures manufacturing

Number	Description
2.2.1	<p>Industry-wide initiative on mass-manufacturing of substructures to supply the upcoming large European markets. Public-private partnerships built with the European Investment Bank under the Risk Sharing Finance Facility scheme. EEPR provides € 153 m through grants.</p>

KPI – Development of the necessary manufacturing capacity to manufacture substructures suitable for water depths > 30 m, able to supply substructures for a project volume of 2 GW in 2012, 3.1 GW in 2015, and 6.9 GW in 2020.



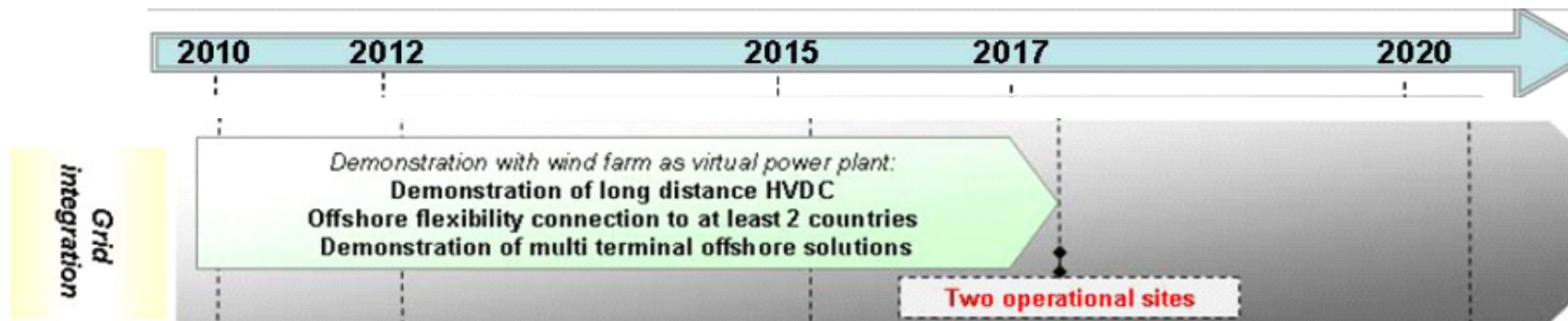
## Technology transfer from the oil&gas sector

Number	Description
2.3.1	<ul style="list-style-type: none"><li>• Standards for safety and operation, including standard safety factors</li><li>• Standardisation of subcontracting, in partnership with the oil&amp;gas and maritime sectors</li></ul>

Relevant KPIs:

- Safety factors agreed in 2012
- Standards developed in 2012 and implemented in 2015
- Standard contracts developed in 2012 and widely used in 2015

# Grid integration



# Grid connection and power transmission

Number	Description
3.1.1	Combined solutions for wind farm grid connection and interconnection of at least two countries. Different grid interconnection techniques (DC or AC) (demonstration of Kriegers Flak DC solution, covered by the EEPR)
3.1.2	<p>Controllable HVDC multi-terminal offshore and onshore solutions.</p> <ul style="list-style-type: none"> <li>• Development of requirement to grid connection of wind power plants to multi terminal HVDC grids.</li> <li>• Development of standards and requirements, which ensure compatibility between components from system security in normal and fault operation, and ensure compatibility between components from different (competing) suppliers.</li> <li>• Onshore and offshore demonstration of compatibility between components from different suppliers.</li> <li>• Budget from EEPR brings € 74 m under this priority.</li> </ul>

## Relevant KPIs:

3.1.1 – HVDC multi terminal solutions implemented in Kriegers Flak.

3.1.2 – Standards and requirements for multi terminal DC networks based on VSC technologies, including the interconnector voltage levels (HV) as well as the wind farm voltage levels (MV) defined in 2012.

3.1.2 – Demonstration of compatible HVDC VSC technologies ready to start in 2012.

## Secure and stable system dynamics

- 3.2.1 Wind Power Plants requirements and solutions to wind farms supporting the system dynamics. Activities (R&D and Demonstration) to enable wind farms and wind farm clusters (large VPP's) to provide services and to offer characteristics similar to conventional power plants.
- Validation of standard generic wind farm models as a basis for harmonisation of grid codes, and demonstration of the benefits of generic models and harmonisation, standardisation and certification of grid code capability.
  - Aggregation of wind farms with flexible generation and loads (covered by the TWENTIES project – Danish demonstrator)
  - Contribution of wind energy to the system demonstrating the possibility of aggregated wind farms to provide system services, with existing wind power technologies (covered by TWENTIES – Spanish demonstrator)
  - Investigation and definition of future need for system services for AC as well as DC connected wind power plants, and Wind power plant delivery of ancillary services to a DC network.
  - Integrated design of wind power plant grid integration with respect to system support and with optimal performance focused on systems with very large wind power penetration.
  - Integrated design and control of new concepts for large wind farms and virtual wind power plants, operated in a meshed DC offshore grid in the north sea
  - Development and demonstration of test procedures to validate the system support of the wind power plants.

### Relevant KPIs:

3.2.1 – Development and demonstration of advanced technology and tools for system support by wind power plants enabling secure operation with a minimum of conventional generation online, equivalent to 50% wind penetration in 2013.

# Balancing and market operation

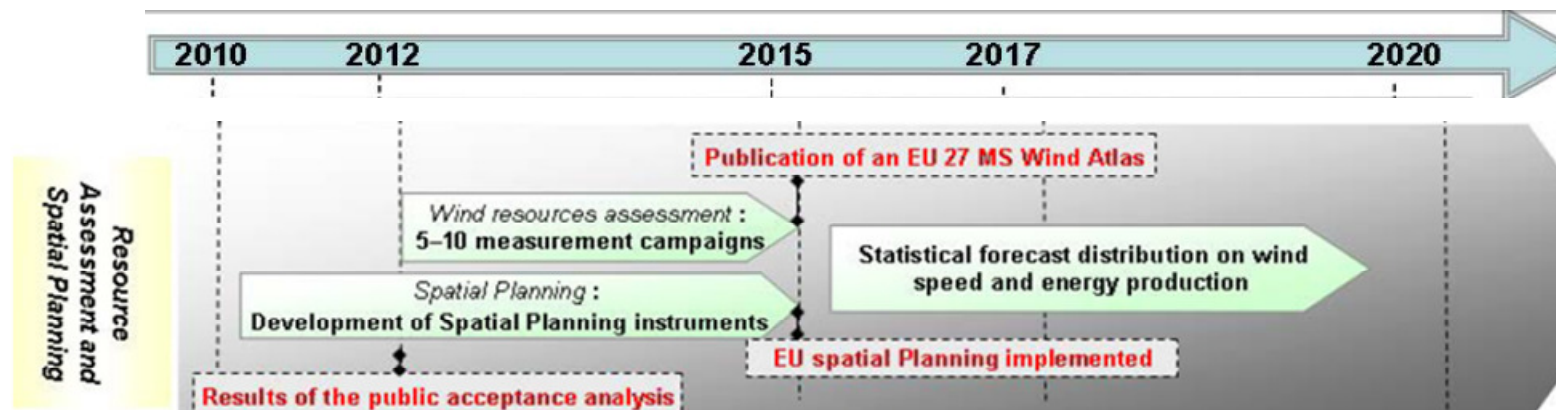
3.3.1	<p>Balancing technologies for large scale wind power penetration:</p> <ul style="list-style-type: none"> <li>• Power priming, increasing flexibility of conventional power plants, storage, demand side options. The project should focus on technologies with large scale potential. (covered by TWENTIES)</li> <li>• New tools for probabilistic planning and operation of the system, enabling to design and simulate system long term operation (to be covered by ENTSO-E R&amp;D programme)</li> </ul>
3.3.2	<p>Market integration:</p> <ul style="list-style-type: none"> <li>• Deployment of European wide electricity markets to increase flexibility and smooth out variability of wind power. Improving the local balancing area operation with coordinated TSO actions and congestion management (to be covered by ENTSO-E R&amp;D programme).</li> <li>• European wide short- and mid-term wind power forecasting tools to enable and to foster full market integration.</li> <li>• The impact of wind on other actors of the electricity market and on electricity prices, with high penetration of wind power.</li> </ul>

## Relevant KPIs:

3.3.1 – Balancing technology and tools for large scale power penetration identified and tested in 2012 (result to be achieved by the TWENTIES project).

3.3.1 and 3.3.2 – Validation of market integration methods, tools and network architecture scenarios enabling the integration of 20% of wind energy in 2020, 33% in 2030 and 50% in 2050.

# Resource Assessment, spatial planning and social acceptance



# Wind resource assessment

Number	Description
4.1.1	<ul style="list-style-type: none"> <li>•Generation of a series of unique data sets to evaluate and develop new models for wind energy related physics (public database) – phase 1 – programme definition, site identification for new measurement stations, networking and upgrade of existing facilities.</li> <li>•White paper on the European Handbook for Integrated Spatial Planning of Renewable Energy resources: Part I Wind Energy resources. (EU Roadmap activity)</li> <li>•Activity coordinated by EERA. Potential synergies with the European Space Agency programmes.</li> </ul>

## Relevant KPIs:

- 4.1.1 – Measurement sites and techniques identified in 2012, relevant sites upgraded
- 4.1.1 – White paper on the European Handbook for Integrated Spatial Planning of Renewable Energy resources: Part I Wind Energy resources published in 2010



## Development of spatial planning instruments

Number	Description
4.2.1	<ul style="list-style-type: none"><li>•Coordination process for onshore and offshore spatial planning in the framework of an integrated maritime policy.</li><li>•Wind energy cooperation between Member States on onshore spatial planning in the framework of the NAPs implementation.</li></ul>

### 4.2.1 – Spatial planning processes:

- Agreement on spatial planning methodologies and tools specifications in 2011
- Implementation of EU-27 onshore and offshore spatial planning in 2013

# Public acceptance analysis

Number	Description
4.3.1	European wind study on the social economic value of wind energy in the EU

Relevant KPIs:  
Societal economic benefits assessed in 2012.

Thank you for your attention!



<http://www.windplatform.eu/>

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