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**SET Plan Secretariat**



## ISSUES PAPER No.1

### Initiative for Global Leadership in Offshore Wind

#### Purpose of this document

This document<sup>1</sup> is intended to progress the implementation of the actions contained in the SET-Plan Communication<sup>2</sup> and specifically the actions concerned with the priority "Number 1 in renewable energy". It is part of a series of Issues Papers jointly prepared by the services of the European Commission and discussed with the representatives of EU member states and countries part of the SET Plan, working together in the SET Plan Steering Group.

The Issues Papers propose to stakeholders strategic targets in different areas of the energy sector. The input from, and positions of, stakeholders for each area will be used to come to an agreement on targets in a dedicated meeting of the SET Plan Steering Group with a representation of key stakeholders.

Stakeholders are invited to take position on the proposed targets in accordance with the guidelines set out in the paper *The SET Plan actions: implementation process and expected outcomes* and submit their positions to [SET-PLAN-SECRETARIAT@ec.europa.eu](mailto:SET-PLAN-SECRETARIAT@ec.europa.eu) by 20 November 2015 at the latest. All relevant documents and material are available on the SETIS website <https://setis.ec.europa.eu/>.

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<sup>1</sup> This document is a working document of the European Commission services for consultation and does not prejudice the final form of any future decisions by the Commission.

<sup>2</sup> Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation" (C(2015)6317)

## **Introduction – Off-shore Wind**

Wind energy is the renewable energy technology expected to provide the largest contribution to the RE targets for 2020 and beyond. Installed wind power capacity in the EU is currently around 140 GW; approximately 127 GW of the capacity is onshore and just over 13 GW is offshore. By 2020 total installed wind energy capacity could reach 210 GW, that equals a capacity to supply 14% of electricity demand, and by 2030 it could reach 350 GW (i.e. supplying between 21% and 24% of demand). The cost of onshore wind power is already competitive with other sources of electricity in a number of countries and the sector is now developing on the basis of its economic advantages.

Offshore wind represents a significant future opportunity: resources are stable and abundant and public acceptance is higher. Europe is the leader in offshore wind and the sector continues growing. While in other regions of the world the offshore wind industry has just started to develop, European industries can count on over 20 years of experience and on a continuous increase at gigawatt levels in additional annual capacity since 2012. As of July 2015 around 3100 offshore wind turbines in 82 wind farms across 11 countries in European waters are fully grid connected. Another 2.9 GW are awaiting connection and according to EWEA, the European Wind Energy Association, there are 26.4 GW of consented offshore wind farms identified, and a further 98 GW of planned offshore wind farms in the pipeline. Industry cost reduction targets for 2020 vary between €100/MWh to €140/MWh. Targets set by MSs are broadly within this range e.g.: €135/MWh in 2020 for the UK and €108/MWh in 2023 for the Netherlands. Related to it the UK OW programme targets a 20-30% and NL a 40% cost reduction in grid connection costs by 2020. The United States strives for 10GW offshore deployment in 2020 at a cost of €90/MWh and 54GW in 2030 at €65/MWh. Japan on the other hand has deployment targets, 37GW in 2050 out of which 19GW on fixed structures.

The potential of offshore wind is very high but both governments and investors (utilities, project promoters, and financial sector), are looking more and more at the costs of (renewable) energy. To keep them interested in the offshore wind market a major cost reduction is needed. In addition, the leadership of the European industry in offshore wind needs to be sustained to maintain its competitive position in the global markets in a context where worldwide players such as the USA, China, Korea and Japan have increased their support to boost their offshore industry.

## **Targets**

In order to maintain European leadership, competitiveness of the offshore wind energy sector must therefore increase further. Therefore 2 key issues need to be tackled:

1 - Offshore wind costs must be reduced and performance and reliability increased to meet its full contribution to the European energy mix.

2 - Offshore wind in Europe is currently focused mainly on the North Sea which has relatively shallow water. There is a need to develop (floating) substructures or integrated floating wind energy systems for deeper waters and for use in other climate conditions, to increase the deployment possibilities and to improve the European position in the global market.

Building on the Integrated Roadmap of the SET Plan, public (EC and Member States/Regions) and private investment must focus on targeted R&I actions to achieve the following goals in terms of performance and

cost-reductions. Regional cooperation, also in the field of R&D, may contribute to reduce costs. The proposed targets are:

### **Proposed targets in offshore wind energy**

1. **Reduce the levelised cost of energy (LCoE) 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;**
2. **Increase the reliability of offshore wind turbines to 99% and the capacity factor to 55% by 2020;**
3. Develop cost competitive **integrated wind energy systems** including substructures which can be used in **deeper waters (>50m)** at any distance from shore and for use in different climate conditions with LCoE of:
  - **less than 14 ct€/KWh by 2020** and to
  - **less than 9 ct€/KWh by 2030**

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

The proposed, ambitious targets are associated with high reliability, superior performance and low-maintenance equipment which should give an edge to EU manufacturers, with much more cost-effective and innovative installation, maintenance, and logistics, and with achievement of more facilitating framework conditions.

These targets possibly involve the following elements:

#### **- 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.

#### **- Supply chain**

Standardisation; better infrastructure for large scale deployment of the offshore sector – including common test and validation centres -, effective methods for repowering and recycling and lighter, stronger, cheaper materials; 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 (reduction of the day ahead forecast error of 35%-45% by 2020 should be reached).

#### **- 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**

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 techniques to minimise it, increase social acceptance and support for wind energy.



## Annex: Relevant actions of the 'Towards an Integrated Roadmap' document of the SET Plan

Concrete targeted R&I actions for the long, medium and short term for wind energy development in general are proposed in the Annex 2 of the 'Towards an Integrated Roadmap' document<sup>3</sup>. Action 1 from the Advance Research Programme, Action 1 and 2 of the Industrial Research and Demonstration programme and Action 1 of the Innovative and Market-uptake Programme seem to be the most relevant ones for realising the targets defined in the Issues Paper.

### **A. Proposed targeted R&I actions**

#### ***Advanced Research Programme***

##### ***Action 1: New turbines, materials and components***

**Scope:** Developing cost-effective and reliable large turbines will contribute to making wind power fully competitive. This embraces from the development of cost-effective manufacturing processes for more performing materials to the scaling up of research projects, which often leads to the development of better or less expensive applications for smaller turbines in a cascading effect. Supporting these actions, therefore, contributes to the overall competitiveness of wind power. To create the conditions for designing, producing and installing larger turbines. As a result, a number of prototypes of turbines between 10 and 12 MW should be installed and tested between 2017 and 2020.

##### **Deliverables:**

- Higher-performance steels, blade materials, permanent magnets etc.
- Low-maintenance power electronics and other components.
- Tested prototypes of 10-, 12- and 15-MW generators and drive trains.
- Tested prototype blades of up to 110m in length.

##### ***Action 2: Resource assessment – (Key issue: wind conditions)***

**Scope:** One of the most important drivers for reducing the cost of energy is minimising uncertainty and improving the predictability and availability of wind energy production. A detailed knowledge of the climatic conditions (specially wind but also waves, ice, temperatures and so on) is fundamental for minimising investment risks; reducing financing costs from a reduction in resource assessment uncertainty; reducing cost of energy through lean turbine designs with less allowance for the uncertainty in climatic conditions; mitigating technical constraints and improving understanding of environmental constraints interacting with climatic conditions. An effective and standardised evaluation of uncertainty within each stage of the life cycle of a wind project is a priority. Cost competitiveness of wind energy is closely linked to accurately quantifying uncertainty. It has an impact on the cost of finance and is therefore as important as the annual energy production (AEP) estimates.

##### **Deliverables:**

- Interaction flow on wind turbine generators (WTG) (single and in wind farms), comprising: Experimental campaigns.
- Ad-hoc models tailored to large rotors and large wind farms.
- Updated synthetic data for wind turbine codes.
- New standards, certification procedures and methodologies.
- Improved wake models both onshore and offshore quantifying loads and wake losses.
- Open platform for design condition models.
- Quantification of other extreme condition risks, comprising: Mapping of such conditions.
- Load measurements campaigns.
- Development of extreme condition standards.
- Mitigation strategies for extreme conditions.
- Uncertainty of yield and load prediction.

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<sup>3</sup> [https://setis.ec.europa.eu/system/files/Towards%20an%20Integrated%20Roadmap\\_0.pdf](https://setis.ec.europa.eu/system/files/Towards%20an%20Integrated%20Roadmap_0.pdf)

### **Industrial Research and Demonstration Programme**

#### **Action 1: Offshore technology – (Key issue: production value chain performance/cost competitiveness)**

**Scope:** Short-to medium term research actions need to be addressed to allow the rapid deployment of offshore wind in Europe's waters. Focus should be on increasing reliability and availability of offshore wind turbines and their components; reducing cost of offshore wind from components to power production including through advanced manufacturing capabilities and developing infrastructure for the sector.

Make offshore wind power costs competitive with conventional electricity generation by 2030, develop technology in sites with a water depth beyond 50m and at any distance from shore.

#### **Deliverables:**

- Improved sensors and measurement technologies e.g. for extreme conditions.
- New bottom fixed substructures to minimise lifecycle costs.
- Improved offshore wind farm modelling techniques.
- Development and demonstration of WTG floating platforms.
- Development and validation of improved systemic WTG and substructure design models and practices.

#### **Action 2: Logistics, assembly, testing, installation and decommissioning – (Key issue: supply chain)**

**Scope:** Latest developments in onshore and offshore turbines with larger rotor diameters and new foundations required dedicated logistics infrastructures (ports, vessels, testing facilities).

The objective by 2020 is to achieve a serial large scale implementation of offshore wind with known technologies and achieve cost reductions by improving current methods.

#### **Deliverables:**

- New offshore installation processes.
- Definition of methods and standards for testing 10-15 MW wind turbine components.
- Improvement of size and capabilities of system-lab testing facilities for 10-15 MW turbines.
- Field testing facilities for 10-15 MW turbines aimed at increasing reliability.
- Development of five large scale manufacturing and logistics processes, both size and numbers for in and out-of-factory and site erection.
- Facilities, infrastructures and logistics for offshore wind:
  - New and better ports management strategies;
  - New and better vessels management strategies;
  - Improved installation methods and logistics
- Recycling and end-of-life scenarios.
- Turbine life-time extension and decommissioning.

## **B. Framework conditions – policy measures**

### **Innovative and Market-uptake Programme**

#### **Action 1: Grid integration – (Key issue: system integration)**

**Scope:** The successful transformation of the power system requires R&D and demonstration projects on connection technologies for offshore and onshore wind power plants to AC and DC networks (including multi-terminal HVDC grids); wind power capabilities for system support and virtual power plant (VPP) operation; and a better fit of wind energy in the power market.

To develop grid integration techniques enabling secure and cost-effective integration of high penetration levels of wind power; to develop and demonstrate optimal solutions for connecting offshore wind farms and clusters to future offshore networks; to develop and demonstrate methods for wind power management providing system support services with regard to market integration and combined operation with other power plants.

#### **Deliverables:**

- Demonstration of a multi-terminal offshore connection.
- The experience from existing HVDC-connected wind power plants is shared among the industry.
- Better wind plant modelling within electricity system models.
- Grid support services design and provision/VPPs.

- Testing of wind power plant capabilities (methods and facilities).
- Better knowledge of impact and operation of wind power on electricity markets.
- Improved wind power forecasting techniques and utilisation.
- Understanding of interaction between existing offshore wind farms and a future North Sea grid, including the definition of standards e.g. for connection.

**Action 2: Spatial planning, social acceptance and end-of-life policies – (Key issue: non technological aspects)**

**Scope:** to develop spatial planning methodologies and tools taking into account environmental and social aspects; to analyse and address social acceptance issues of wind energy projects including promotion of best practices; and to better define end-of-life options and policies including recycling.

**Deliverables:**

- EU offshore atlas capturing wind, wave, soil and bathymetry.
- Increased knowledge on noise issues (underwater, atmospheric propagation, monitoring and control, human perception of wind turbine noise).
- Assessment of the possible impact of wind turbine on health (noise, flickering/shadow, etc.).
- Development and validation of more accurate and robust noise propagation models.
- New passive and active aerial markings.
- Reduced local environmental impacts and increased environmental benefits (e.g. regarding birds, bats, fisheries, or the treatment of cumulative impacts).
- Improved siting and spatial planning techniques.
- Better offshore planning.
- Increased social acceptance.
- By 2018 a scheme will be consented to quantify/evaluate levels of acceptance/perception.
- Clearer guidance, methodologies and tools to assess the cumulative impact of wind farms in Europe.