Summary of IEA RD&D Wind – 55th Topical Expert Meeting on

Long-Term Research Needs
In the Frame of the IEA Wind Co-operative Agreement

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Aim and Objectives
The aim of the Topical Expert Meeting (TEM) was to discuss long-term research needs for the timeframe 2020. The objective of the meeting was to try to identify needed future results from R&D both in the 5 to 10 and the 10 to 20 years time frames. The strategic goal of the TEM is to give recommendations to the IEA Wind Executive Committee and to the governments involved which are based at the latest international wind technological stage. The outcome of the meeting will be used to develop a new strategic R&D plan for IEA Wind.

The objectives were also to review the latest wind energy technology and to draw conclusions for a further successful development to expand the place of wind energy in the worlds energy mix by means of R&D.

Participants / Presentations
A total of 35 persons registered for this meeting. They represented the following countries: Canada, Denmark, Germany, Italy, Korea, Norway, Portugal, Spain, Sweden, the Netherlands, the UK and the US. The participants mainly represented National Energy Administrations, Research Organizations and Universities.

The following presentations were given:
1. Introductory Note – Long-Term R&D Needs for Wind Energy
2. Evaluation of the German Renewable Energies Research Programme: Wind
3. Research Needs from a Swedish Perspective
4. R&D Needs for Large Scale Deployment a US Perspective
5. Some Key Points of the Wind Power R&D Programme in Denmark 2007
6. Wind Energy R&D in Canada
7. R&D Tasks in Norway
8. Identification of R&D Necessities in Spain
9. Netherlands LT R&D Needs
10. The UK - Offshore Wind Programme
11. Wind Power as a "base load" - R&D Needs
12. Wind Energy Activities at the University of Massachusetts
13. Long-Term R&D Needs for Wind Energy and ReKnow.net
14. Wind R&D in Vattenfall
15. Research Needs for Wind Industry
16. EP UpWind Project
17. Identifying R&D Key Issues
Summary of discussion
Below is a summary of the topics which were considered essential for the future development of the wind turbine technology and the utilization of the technology.

**Turbine development**

a) Use of new materials e.g. thermoplastics  
b) Special offshore turbine design can be a solution for deceasing the prices  
c) Design validation, current design standards are considered not to be enough in certain areas. E.g. loads and load transmission in drive trains at static and dynamic situations  
d) Lighter structural design. This is not necessarily a design driver, but is a subordinate cost driver  
e) Control strategies for load reduction, adapt turbines to anticipated loads in various situations  
f) Optimization, smooth output as a generation unit, treat it as a power plant  
g) New concept - rotors for larger diameters  
h) Transition from manufacturing to automated serial production – cost reduction potential, economies of scale  
i) Aerodynamics, wakes  
j) Fast up scaling, ‘skip’ the first half of the blade, make it a ‘truss’  
k) Combine passive built-in with multi-variable control  
l) New drive train concepts

“Incremental development is important but new concept development must always be there”.

“Need to develop better technology innovative oriented research; it produces innovations on both short and long-term.” “Up scaling is a method not an objective. Developers and banks want reliable, cost effective turbines rather than JUST larger ones.”

Three levels of industrial technology development:
1) Incremental development focus on reliability  
2) Change of component and subsystem concepts  
3) Change of wind turbine concepts

**Components**

“System improvements are required to meet the necessary cost reduction, single component improvement is not enough.”

a) Adding intelligence to get smart rotors, drive train, flexibility and magnetic bearings  
b) Development of new bearing structures  
c) Generator - problem characterisation and transient behaviour  
d) Better communication between components and grid

**Tower development**

“26% of the wind power cost derives from the tower, something must be done in this area”

a) Methods to decrease the share of steel in the construction is important. Wind power energy is a large steel consumer in Europe. Some manufacturers are preparing for concrete towers.  
b) Everything that minimises loads on towers
**Foundations**

a) Mainly offshore, optimisation of traditional structure and develop new structures  
b) Deeper water solutions - floating wind turbines

**O&M**

“Reliability is a key issue today.” “Design life does not live up to production service life.”

a) Component reliability, studies of rate and type of failures, life length on gear boxes approx 4-12 years.  
b) Condition monitoring maintenance (a lot to learn from the oil and gas industry)  
c) Availability = function of (reliability, accessibility) must be increased  
d) Reliability of small turbines  
e) Security of operation, ship safety  
f) Reliable sensing devices (learn from other industries such as aircraft, gas and oil offshore), remote sensors with intelligent software

**Logistics**

a) A general improvement of logistics, i.e. optimisation of transport and installation  
b) Clever and cheap transport, installation equipment and concepts dedicated for offshore  
c) Access to offshore structures  
d) Procedures if commissioning on quay, transport, assembly etc.

**Grid system/integration - local grid (AC/DC) and national level**

a) Impact and operation in power system with high wind penetration – system operation, balancing of the system when realising the ambiguous deployment plans  
b) Improvement of energy production forecasting for system operation  
c) Regulation of power  
d) Better communication between components and grid  
e) Security of supply

**Wind field knowledge**

a) Resource assessment and forecasting - develop forecasting tools with increased accuracy  
b) Remote and satellite measuring systems  
c) Offshore wind measurements needed – today very little data, important with measurements for the learning curve  
d) Methods to mix new air in wake of turbines/farms  
e) Knowledge of wind field in front of the turbine, for control

**Deployment**

a) Deployment in forest terrain – challenges: Wakes and turbulences, wind models do not comply with reality that is a problem from a financial perspective. Most of the available sites are in forestry landscape, sometimes in combination with low density of population and weak grid  
b) Measurement programme is needed (see also Wind Field Knowledge)  
c) Deployment in cold climate areas – challenges: Rime ice forecasting, predict when ice will occur, turbulence and snow covered blades
d) Deployment in deeper water

**Financing/insurance**
The warranties get shorter (from 5 to 2 years) with less content. This is not considered to be a R&D issue, but was mentioned as an observation.

**Portfolio management**
Control system for all the wind power plants in the portfolio.

**Environmental impacts**
Bird (especially eagles) and mammal behaviour have to be studied. Bats may be in the risk zone for damages if not treated properly.

**Competence**
Hard to find the right competences, better to educate “general engineers” in-house.

Competition on skilled people within the industry, important with education already at university level.

Knowledge transfer network.

International cooperation - establish a common state-of-the-art facility and pooling its R&D spending of wind energy?

**New applications**

a) Plug-in vehicles (benefits: Energy storage and transportation) - need for demonstration
b) Clean water
   a) Hydrogen
   b) Wind power plant in combination with hydro power station incl. pumped storage - need for demonstration
   c) Combine wind and wave plant suitable for shallow water

**Test facilities**

“Need for test facilities for onshore and offshore wind energy”

a) Testing large blades, drive trains and new materials to verify models
b) Testing facilities and methods for cold climate are needed

**Recycling**
Recycling of materials is becoming more important when older turbines are exchanged to newer ones. The “cradle to cradle“ concept has to be developed and implemented.

**What’s new compared to 2001**
Operating agent Sven-Erik Thor made a comparison of the outcomes of today’s meeting and of the meeting in 2001.

The CO2-issue is a greater topic today. Wind is underestimated in CO2-terms when making the primary energy comparison, CO2-issue as an effect of increasing oil prices.
It was noted that there are new initiatives coming from other organisations which are looking into R&D needs. It is obvious that there are a number of new players in the R&D arena today. Examples of ongoing activities which aims at identifying R&D topics:

Structured initiatives for identifying R&D
- EU/EWEA TPWind
- REOLTEC
- MEGAWIND
- AWEA

Wind power with its application in a broader sense is now discussed. Examples are:
- wind – hydro – pump storage
- plug in hybrids

Education and Knowledge Transfer Networks are now considered to be a crucial topic for the industry and utilities. IEA Task 11 has an important role to play here. In some areas it is difficult to recruit persons with adequate knowledge within some technologies.

Reliability and Operation & Maintenance are becoming more and more important, especially when considering the number of failures that occurs in wind turbines.

**Other challenges**

Other challenges, (except direct research needs) that the wind industry is facing today, are:

1. Military issues involving radar and radio link issues
2. Commodities price increase; infrastructure is not in place to meet national goals
3. Offshore; cost is increasing instead of going down as expected in the 2001 long-term report
4. Compensation to fishermen; or is offshore wind a recreation area for fish (reef effects)
5. Legal aspects; protection of property offshore

**Miscellaneous**

It is important to keep track on other technologies and how they develop.

It was suggested that IEA IA Task 11 arranges expert meetings on how to collect statistics from turbines and radar conflicts, respectively.