Questions for the SET-Plan ETP hearings
March, 22nd 2007

Answers
Prepared by the TPWind Secretariat

European Wind Energy Technology Platform

This document is basically (Part 1&2) based on various bibliographic references, duly identified in the text. It is aimed at delivering key information asked during the hearing on the 22nd, but does not constitute a comprehensive report on the questions it addresses.

This document has been completed with complementary questions focused on the activities on the Platform (Part 3), and complementary questions asked by the Commission during the Hearing.(Part 4).

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1. PLATFORM VISION AND ACTIVITIES

1.1. Current state of play within the sector

***Indicate**: market readiness/penetration of the different technologies within the activity area; on-going or planned public, public-private or private initiatives that might be relevant for the SET-Plan; type and scale of initiatives at which level - International/EU/MS/Regions*

World market *(source: Global Wind Energy Council –Global Wind 2005 Report)*

Globally, the wind energy sector experienced a record year in 2005, with the installation of 11,531 megawatts (MW). This represents a 40.5 % increase in annual additions to the global market, up from 8,207 MW in the previous year.

The total value of new generating equipment installed was over 12 billion euros, or 14 billion USD. The total installed wind power capacity now stood at 59,084 MW worldwide. The countries with the highest total installed capacity were Germany (18,428 MW), Spain (10,027 MW), the USA (9,149 MW), India (4,430 MW) and Denmark (3,122 MW).

In terms of new installed capacity in 2005, the US was a clear leader with 2,431 additional MW, followed by Germany (1,808 MW), Spain (1,764 MW), India (1,430 MW), Portugal (500 MW) and China (498 MW). This development shows that new players such as Portugal and China are gaining ground.

Table 1 reflects the evolution of the world wind energy market from 2001 to 2005 for the leading countries. Europe is world leader, but China, US and India are growing rapidly.

GROWTH RATES IN TOP 10 MARKETS

	2001	2002	2003	2004	2005	Growth rate 2004-2005	4 years average growth
Germany	8,754	11,994	14,609	16,629	**18,428**	10.8 %	20.9 %
Spain	3,337	4,825	6,203	8,263	**10,027**	21.3 %	31.9 %
US	4,275	4,685	6,374	6,725	**9,149**	36.0 %	21.8 %
India	1,502	1,702	2,125	3,000	**4,430**	47.7 %	31.8 %
Denmark	2,489	2,889	3,116	3,118	**3,122**	0.1 %	6.0 %
Italy	682	788	905	1,265	**1,717**	35.7 %	26.5 %
UK	474	552	667	907	**1,353**	49.2 %	30.6 %
China	400	468	567	764	**1,260**	64.9 %	34.4 %
NL	486	693	910	1,079	**1,219**	13.0 %	26.4 %
Japan	274	414	687	936	**1,078**	15.2 %	42.1 %
Total top 10	22,673	29,010	36,163	42,686	**51,783**	21.3 %	23.0 %

Table 1: Growth rates in TOP-10 Markets Worldwide (source: GWEC Global 2005 Wind Report)

Europe *(source: EWEA statistics 2006)*

Europe remains the leading region in the world in terms of installed capacity (48,026 MW by the end of 2006, which represents a growth of 18 % in one year). Figure 1 shows the repartition among Member States. As it can be seen, substantial differences remain in the level of penetration of wind among countries, despite the existence of basic common legislation for them all.

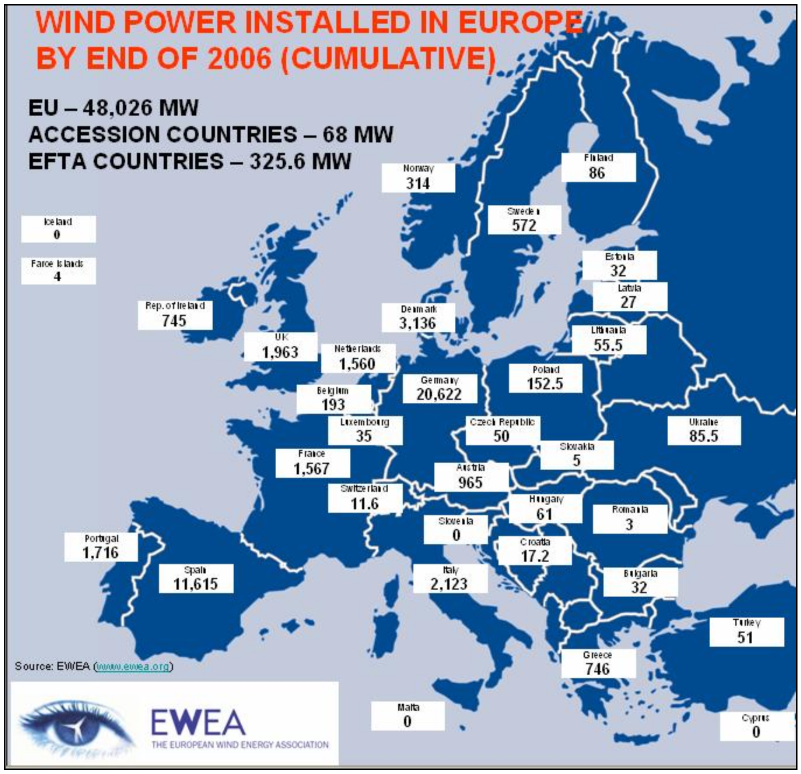


Figure 1: installed capacity at the end of 2006. (source: EWEA).

1.2. Likely evolution of the sector

***Indicate**: major trends in the sector (technology and actors); likelihood of structural changes as a result of liberalisation, globalisation, competition; influence of the market structure on future potential; possible effects of the carbon market etc*

The EU wind energy sector is a competitive industry. According to BTM Consult[1], most of the top-10 world leaders are EU companies, but Suzlon (India) and GoldWind (China) are progressing in the ranking.

Since 1995, the market has evolved towards a higher concentration: join ventures and companies merging occurred several times, as shown on figure 2. These new actors have bigger market shares on bigger markets.

[1] BTM Consult, "International Wind Energy Development – Supply Chain Assessment 2006-20010", Dec. 2006

Today, the main wind turbine manufacturers are companies of thousands of people. A number of them are opening assembly and production factories in new markets, such as China or the US. In the case of developing countries, these factories combine two advantages: vicinity to the demand centres and lower labour costs. On certain occasions, however, these decisions reflect the requirements of host Governments, as it happens in China, where 70% of the production has to be produced locally. The core of the business, though, remains in Europe and is not expected to shift away in the short or medium term –also depending on the perspectives of the EU market-.

Regarding the developer side, in the last few years the sector has experienced the entry of a new type of investor: the large utilities. For utilities, wind and other generation technologies are of interest due to a combination of regulatory pressure, efforts to improve generation business performance, and strategic growth opportunity. Wind energy generation investments also serve to fulfil basic demand in the short term, as wind power projects have shorter lead times than other options.

With the notable exception of Iberdrola (15% of its core business), utilities normally dedicate 5%[2] or less of their core business to renewable energies, although this figure is increasing very rapidly. This will have important consequences also from the political point of view (source, Klein A. 2006 in *Renewable Energy World*). What is clear though is that the entry of large utilities to the wind energy business is subject to the existence of a stable and favourable legislative framework and to the capability of the sector to reduce its generation costs vis-à-vis other technologies –something that depends very much on R&D efforts-.

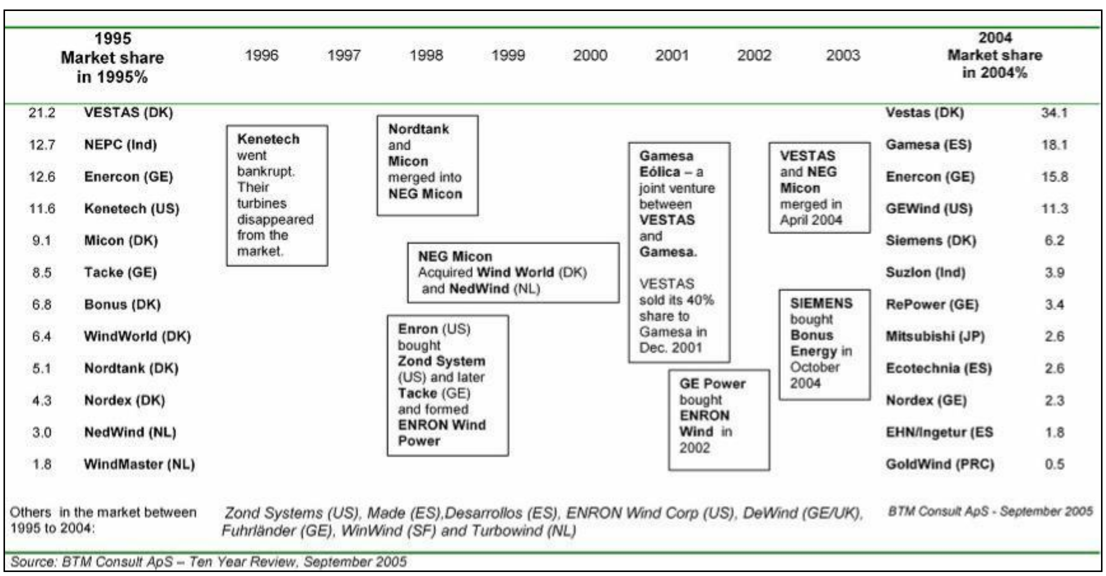


Figure 2: Consolidation of the market between 1995 and 2004. (source: BTM Consult, Ten Year Review, 2005)

[2] Excluding large-scale hydro.

1.3. Technology penetration targets (2020, 2030, and 2050)? What are the main assumptions underlying these estimates? What are the main barriers to overcome to achieve them?

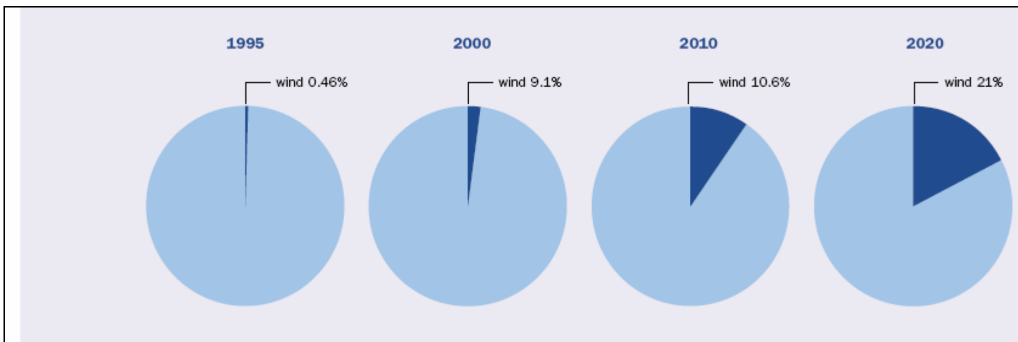
***Indicate**: main constraints and showstoppers, needs for technological breakthroughs, resource/feedstock availability, consequences for the current energy system infrastructure,Etc*

Market growth potential

In its document "Wind Power Targets for Europe: 75,000[3] MW by 2010" (EWEA, 2003), the European Wind Energy Association analysed the likely evolution of the installed wind capacity up to 2020. In the scenario assumed (stable political framework, continued support to R&D), wind energy will represent in 2020 21% of the installed EU generation capacity by that year (180 GW). Figure 3 shows the expected share of wind energy in terms of EU generation capacity between 1995 (0.46%) and 2020 (21%).

Moreover, projections up to 2030 show a penetration of nearly 23 % of wind energy for EU electricity consumption (Figure 4).

The growth of the market is impressive, and comparable to that of the communication sector.



	1995	2000	2010	2020
Total Generation Capacity (GW)	538.8	580.7	706	855.4
Total Wind Generation Capacity (GW)	2.5	12.3	75	180
Share of Wind (%)	0.46%	2.1%	10.6%	21%

Figure 3: Contribution of Wind Power (GW) to electricity generation capacity. (source: EWEA, Wind Power Targets for Europe: 75,000 MW by 2010, 2003)

[3] EWEA targets for 2010 have been raised to 80 GW. *(see: EWEA, Wind Directions, vol. 26 n°1, nov. 2006)*. Some of the figures of this report may be inconsistent with these new targets.

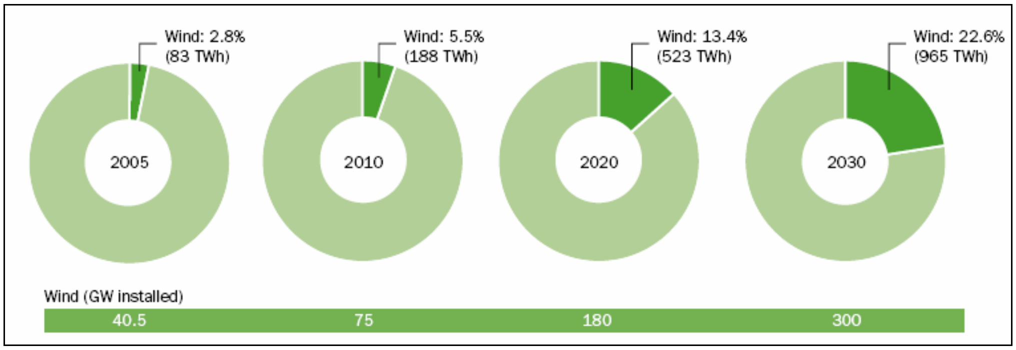


Figure 4: Contribution of wind energy to European electricity consumption 2005-2030.

Barriers and bottlenecks are mostly defined regarding the evolution of costs. Costs are not only technological, but also societal or environmental. As described previously, market is growing and is globalizing. Thus, technologies have to improve their competitiveness to be able to compete outside Europe.

The scenarios that have been presented in the previous paragraphs will become real if the sector overcomes a number of barriers and bottlenecks that are currently affecting it. Some of these have to do with the non-competitive situation of the electricity market in Europe, the existence of some dominant market players, distorted electricity prices and grid integration difficulties. Yet, others are closely linked to R&D. These can be summarized as follows:

Barriers *(Source: EWEA, Prioritising Wind energy Research. Strategic Research Agenda of the Wind Energy Sector, 2005)*

Barriers are defined as being principal physical limitations in current technology, which may be overcome through the opening up of new horizons through applied research over the medium to long-term. A non-limitative list is provided below:

1. Wind Resource: Resource mapping of areas with a high probability of high wind resource potential, but as yet unexplored, including the Baltic, North and Black Seas.

2. Wind Turbines: i) Integrated design tools for very large wind turbines operating in extreme climates, such as offshore, cold / hot climates and complex terrain; ii) State of the art laboratories for accelerated testing of large components under realistic external (climatologic) conditions.

3. Wind Farms: i) Understanding the flow in and around large wind farms; ii) Control systems to optimise power output and load factor at wind farm level; iii) Development of risk assessment methodologies.

4. Grid Integration: Control strategies and requirements for wind farms to make them fully grid compatible and able to support and maintain a stable grid, thus able to provide an electricity production as reliable, available, safe & secure as the

traditional energy sources. This involves prediction, spinning reserves, storage, load shedding, and improved software-based solutions for grid monitoring.

5. Environment and Public Support: i) Effects on ecology, adjacent to wind energy developments; ii) Development of automatic equipment to monitor bird collisions and sea mammals reaction to underwater sound emissions.

6. Standards and Certification: development of the following international standards: i) Energy yield calculation; ii) Grid connection protocols and procedures; iii) Risk assessment methodology; iv) Design Criteria for components and materials; v) Standardisation of O&M mechanisms

Bottlenecks *(Source: EWEA, Prioritising Wind energy Research. Strategic Research Agenda of the Wind Energy Sector, 2005)*

Not to be confused with the above, bottlenecks are problems which can be relatively quickly overcome through additional short or medium term R&D, i.e. through the application of targeted funding and / other resources. A non-limitative list is provided below:

1. Wind Resource: Development of cost-effective measuring units, including communications and processing, and which are easily transportable, for the assessment of wind resource characteristics, such as LIDAR, SODAR and satellite observation.

2. Wind Turbines: Development of component level design tools and multi-parameter control strategies.

3. Grid Integration: Development of electric and electronic components and technologies for grid connection.

4. Environment and Public Support: International exchange and communication of results of R&D into ecological impacts.

5. Standards and Certification: Accelerated finalisation of ongoing standards development activities (certification processes and test procedures, design criteria for offshore wind turbines, project certification).

1.4. If these targets are met, what will be the contribution to EU energy policy goals?

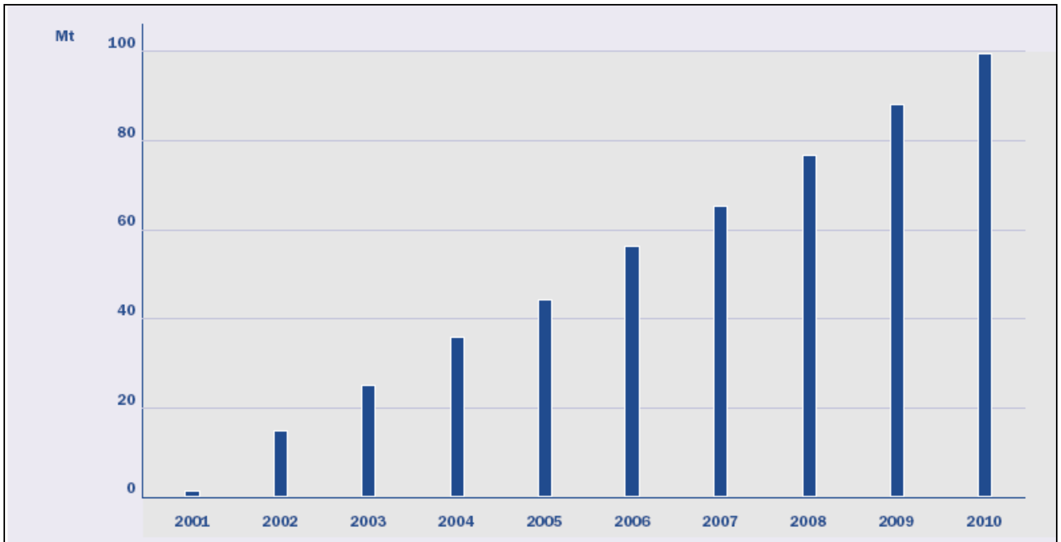
***Indicate**: Contribution to (1) greenhouse gas emissions reduction (e.g. CO2 reduction), (2) security of supply (e.g. imported fuel savings) and (3) competitiveness (e.g. future market sizes for a given technology, European share of new market, additional jobs, export revenues)*

(source: European Wind Energy Platform, Response to the European Commission Document –Guidelines for Identification of Potential Technology Platforms, 2006)

Contribution to greenhouse gas emissions reduction

As it is widely known, the use of fossil fuels is responsible for the majority of GHG emissions (around 70% according to the IPCC). Wind power can make a substantial contribution to the EU emission reduction targets under the Kyoto Protocol. With sufficient emphasis on technological R&D and market development, wind could meet 30% of the Union's obligation by 2010[i].

Figure 5 shows the potential reductions on CO_2 emissions in the 75,000 MW scenario. In 2010, wind energy will avoid 99.2 Mt of CO_2 emissions per year.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CO_2 Reduction Mt/year	7.4	16.5	26.7	36.2	45.8	57.4	67.2	76.8	89.5	99.2
Cumulative CO_2 Reduction Mt/year	7.4	23.9	50.6	86.8	132.6	190	257	334	423	523

Figure 5: Annual CO2 emission reductions from Wind Power. (source: EWEA, Wind Power Targets for Europe: 75,000 MW by 2010, 2003).

Security of supply

Energy is one of the most important raw materials of any economy, and will continue to be unless it is decoupled from economic growth. Wind energy is capable of significantly reducing the impacts of geopolitical risk, external energy dependence and fuel price volatility. According to EWEA, wind energy could supply 23% of European electricity by 2030 if the right policy framework and sufficient Research and Development support scheme are created (see figure 4).

Wind energy can help the European balance of trade not only by reducing the need for imported energy fuels, but through increased exports. It is not only Europe that is waking up to the need for increased energy independence, worldwide markets are opening up from which Europe is in an unique position to benefit if it acts now. European technology has already fuelled the few national wind energy booms outside of Europe.

EU competitiveness on global markets

The European share of the global wind energy market is still predominant, but decreasing. At present European manufacturers build 70% of the world's wind turbines. European developers lead the way in developing wind farms and are responsible for building 69% of them worldwide.

Additional jobs

Wind sector employment has increased considerably in the last two decades, but only in a few countries, while the potential exists in many. According to the figures available, the wind power sector currently employs around 64,000 people in Germany (BWE, 2006); around 21,000 in Denmark (DWEA, 2006) and 35,000 in Spain (AEE, 2006). These figures only reflect some types of direct employment and therefore underestimate the total impact that wind energy has on related and complementary sectors.

Increased wind generated electricity in the European system will yield a net increase in jobs, even after taking into account the number of displaced jobs related to conventional energy[ii]. Moreover, employment will be dispersed around Europe, concentrated approximately in areas with the highest wind resource, including rural, mountainous and marginal areas.

An approximate 'rule of thumb' is that 12 people are employed for every MW of wind energy installed. Looking towards 2020, the *Wind Force 12* scenario produced by the Global Wind Energy Council[iii], projects growth in wind energy employment up to 200,000 if sufficient support is given.

The MITRE study[iv], carried out under the ALTENER Programme, rates the opportunities for wind energy employment even higher. Under its Advanced Renewable Strategy, assuming increased technology and policy development, by 2010 wind energy could be employing 282,000 people; and by 2020, as many as 368,000 (see figure). In both scenarios, new jobs from wind energy constitute about 25% of new renewable energy employment.

The difference in employment under the two scenarios is not only that of nearly 100,000 jobs. It demonstrates a fundamental difference in employment focus. In the advanced scenario, benefiting from more proactive support, around 55% of employment is to be had from offshore wind, as opposed to just 35-45% from offshore under the existing support scenario.

1.5. Contribution to the overall ("well to wheel") energy efficiency?

Indicate: *Effects on energy efficiency in power and fuels supply, as well as in final use; evolution over time and depending on market penetration, etc*

(source: EWEA, Wind Power Targets for Europe: 75,000 MW by 2010, 2003)

According to the IEA's World Energy Outlook 2002 the consumption of electricity is expected to increase by 1.6% per year over the period 2001 - 2020. With this assumption the total electricity demand in the EU will increase from 2,572 TWh in 2000 to 3,064 TWh in 2010 and 3,511 TWh in 2020. The total share of the EU's electricity consumption that is generated by wind power will be 5.5% in 2010 and 12.1% in 2020.

The IEA study estimates that the installed power capacity requirements are expected to increase by some 210 GW during this period and additionally approximately 235 GW of new capacity will be required for the replacement of decommissioned plants. Thus, the EU is projected to build approximately 445 GW of new plants over the 2001-2020 period. According to figure 6, 900 b€ will be invested in the electricity sector on the period 2005-2030. Investment in renewable energy sources represents 324 b€.

Wind power can cover a substantial part of the new production capacity. If the wind industry targets are met, wind will then replace other conventional energies foreseen in the IEA scenario. Assuming that wind power is substituting intermediate loads covered by fossil fuels (gas, oil and coal) with the average efficiency foreseen by the IEA study, the total installed generation capacity of 445 GW will be increased by 63.7 GW in the period 2001-2020.

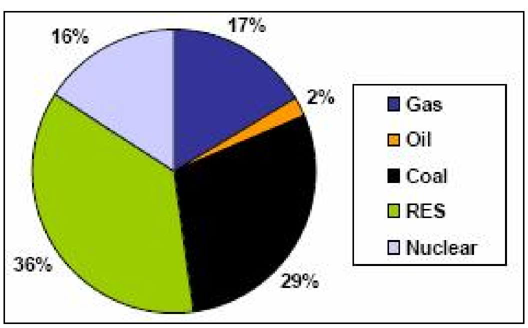


Figure 6: EU-27 Cumulative Electricity Investment (2005-2030): 900 beuros. Source: DG-TREN

1.6. Are there any interactions with other community policies and initiatives?

Indicate*: Potential contribution of the technology to other EU policies; need for measures and initiatives in other policy areas to support the market penetration of the technologies*

International

(source: GWEC, Wind Force 12 (2005) - A blueprint to achieve 12% of the world's electricity from wind power by 2020 (Updated version & country reviews), 2005).

In January 2005, the report 'Meeting the climate challenge '- Recommendations of the International Climate Change Task Force stated that global average temperature has to be prevented for rising more than 2°C above the pre-industrial level. In this framework, G8 governments shall establish national renewable portfolio standards to generate at least 25% of electricity from renewable energy sources by 2025. The key role of renewable energies like wind power in tackling climate change is acknowledged and participates to these objectives.

Inside EU

(source: EWEA, Response to European Commission Stakeholder Consultation on Research Themes in FP7, 2004)

Lisbon Strategy

Wind energy can contribute significantly to all the goals set out in Lisbon: sustainable economic growth, high quality jobs, technology development, global competitiveness, and European industrial and research leadership. Concrete figures have been provided in the precedent sections.

The Barcelona Objectives and Wind Energy

The 'Barcelona Objective 'stemming from the Barcelona European Council of 2002 agreed that investment in European R&D must be increased to 3% of GDP by 2010 (from 1.9 % in 2000). The Council also called for an increase of the level of private funding to R&D, from the (then) level of 56% to 66% of total R&D investment. Wind Energy represents an opportunity not only to make ground towards the Barcelona objective, but also a route to achieving the goals of the Lisbon Strategy.

Wind is also a sector in which companies are already making a substantial effort in terms of R&D: top sector manufacturers are already close or over the level of the 3% recommended by the Barcelona Council. Their R&D efforts, tough, are subjected to budget constraints and scarce public support, and are therefore mainly focused on developing short term market technological demands.

Environmental Technologies Action Plan

In January 2004, the European Commission launched the Environmental Technologies Action Plan (ETAP). This calls for increased research spending in order to develop the potential of eco-industries such as wind energy.

Security of Energy Supply

According to the Commission Green Paper on Security of Energy Supply (EC, 2006), in two decades Europe will be importing 70% of its energy -up from 50% today-, unless it changes direction.

For electricity, the recoverable wind resource in the North Sea alone is large enough to meet more than current EU electricity consumption.

As discussed, wind energy can make a substantial contribution to tackling this problem. Onshore and offshore technologies can deliver substantial amounts of indigenous and clean electricity.

In the particular case of offshore, the technology is still in its infancy - only some 600 MW of the total 30,000 MW of wind power installed in Europe is situated offshore. Nevertheless, wind power in general, and offshore wind power in particular, has partly the potential to plug the gap in European energy supply.

Renewable Electricity Directive

Wind energy has the potential to meet half of the total RES-E Directive target for electricity from renewable sources by 2010. In 2020, based on EWEA estimates, wind power can generate 425TWh; this is 50% of the forecast EU household electricity consumption in that year.

Recent events

During the European Council meeting of 8/9 March 2007, the EU reinforced the role of renewable energy sources for struggling against climate change. [The EU] "*makes a firm independent commitment to achieve at least a 20% reduction of greenhouse gas emissions by 2020 compared to 1990*". In this framework, "*a substantive development of energy efficiency and of renewable energies will enhance energy security, curb the projected rise in energy prices and reduce greenhouse gas emissions in line with the EU's ambitions for the period beyond 2012*".

The agreement on the 20% binding target for renewable energies in overall EU energy consumption by 2020 can pave the way for higher penetration levels of wind in all EU markets. The market efforts should be complemented by clear R&D policies that help achieve the target at the lowest possible cost.

1.7. Which are the main competing or synergetic technologies within the activity area? *(in relation to the indicated market penetration targets)*

Other renewable energy sources for producing electricity are synergetic with wind energy. Each technology has its own advantages, and these technologies are complementary to secure the EU energy mix. An optimal selection process should be based on correcting the market prices so that they incorporate the environmental and social externalities that different technologies have, the effect of uncertain and rising gas and fuel prices and the effect of market dominance on the structure and sales of the pool market.

Despite these limitations, figure 7 shows the prominent role that wind energy has achieved in terms of new installed capacity in the past 5 years, representing now 30% of the new installed capacity in Europe.

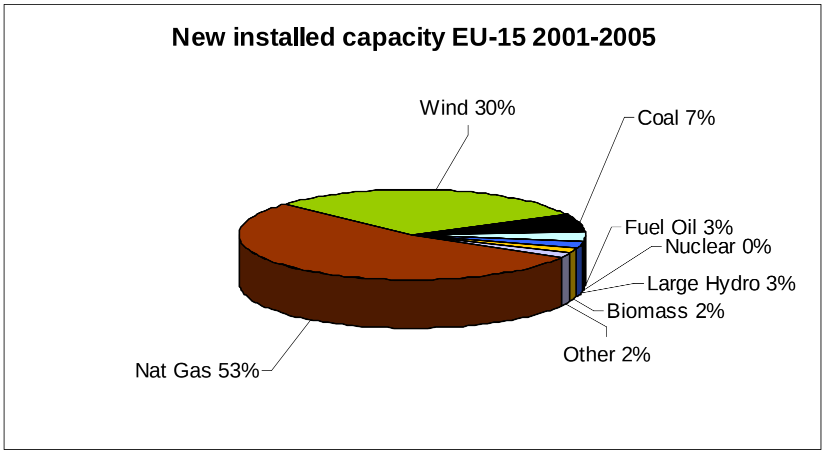


Figure 7: New installed capacity 2001-2005 (EU-15). (source: EWEA, Response to the European Commission's Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy [COM (2006) 105 final], 2006).

The wind energy sector is also linked to certain non-energy sectors, among which clear synergies exist. This is the case of smart grids, aeronautics and steel –needed for the integration of wind into the grid and for the production of adequate material, respectively. The TPWind has established formal contacts with them aimed at making the most of our R&D efforts.

In the case of offshore wind, the sector could explore synergies with fisheries, harbour and sea logistics, offshore platforms and marine biodiversity, to name but a few.

Also future technologies such as (but not limited to) hydrogen, fuel cells or storage pumping stations; in general storage systems –supply and demand- can be of interest for the wind energy sector.

2. ACHIEVING THE VISION

2.1. Is your vision achievable under a 'business as usual' scenario?

Indicate*: Current support programmes and policy measures and their expected impact*

Business as usual scenario

The projections for wind energy are achievable, but require the support of the public authorities. As pointed out by the International Energy Agency (IEA, 2002) the cost reductions of wind energy can be explained by economies of scale and by R&D progress. If wind energy is to become mainstream, these need to be reinforced. On the one hand, the stability of the market and a supportive legislative framework are essential. On the other hand, higher R&D support becomes essential.

Figure 8 shows the possible development paths of wind energy, and gives concrete examples for a number of countries. Counties with adequate market incentives (support mechanisms but also other measures that safeguard competition and allow the entry of new actors) will be able to produce wind electricity locally, thus benefiting from higher security of supply and reduced environment impact. However, only the countries that complement market incentives with a strong R&D policy aimed at technological leadership will see the growth of local wind energy companies capable of supplying required systems. In the opposite, turbines will be imported and local wind energy sector will simply be non-existent.

This is the dilemma that the European Commission has to solve now: only the wise combination of enhanced R&D support and market incentives can achieve the triple goal of sustainable indigenous security of supply, local economic growth and world technological leadership.

Under the business as usual scenario, wind energy penetration will be substantially lower. The European Commission itself has quantified it in its document SEC(2006) 1719 "Renewable Energy Road Map - Renewable energies in the 21st century: building a more sustainable future – Impact Assessment". According to it, the renewable energy market for Europe will only grow to between 10.4 and 12.6% by 2020.

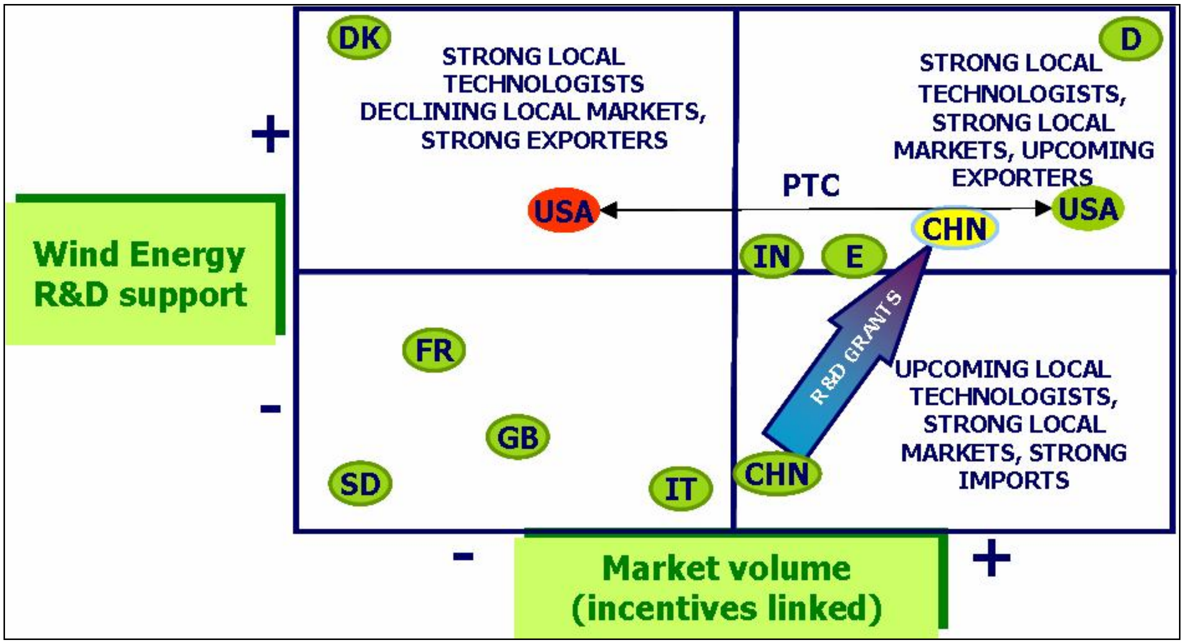


Figure 8: EU countries market position as a function of incentives and R&D support. (Adapted from: REOLTEC – Spanish Technology Platform's R&D Strategy document, March 2007).

Current support programmes

(source: European Commission, the States and Prospects of European Energy Research – Comparison of Commission, Member and non-Member States R&D Portfolios, 2006)

There is an enormous imbalance between the funds that the different Member States dedicated to R&D in their national programmes. Three countries: Germany, Denmark and the Netherlands are making a noticeable effort in that area and are responsible for approx. two-thirds of the average annual wind energy RTD funding of the European Union (EU 15, 2000 to 2004).

Germany's level of funding is growing: €12.1 M (2004), €16.1 M (2005), €16.7 M (2006). Over the last few years (2001-2004), wind energy has had a share of about 20% of the renewable RTD budget. Denmark's average funding in 2000-2004 was € 7.8 M per year. In the Netherlands wind energy receives the third-highest level of funding behind solar PV and biomass. The average annual funding over the period 2000-2004 was € 11 M per year. Not surprisingly, most of the "Top-10" manufacturers come from those countries.

On the other hand, a number of countries dedicate virtually nothing to wind energy R&D; this is often combined with poor market support mechanisms. In that case, the national sector is weak.

At the EU level, framework programmes (FP5&6) have traditionally dedicated little effort to renewable energies in general and to wind energy R&D in particular. The

Strategic Research Agenda demonstrates that non-nuclear energy (NNE) research funding as a percentage of all EU R&D funding has been reduced to near 20% (in FP6) of the level it had twenty years ago. This reduction is not in line with the energy preoccupations of our politics / civil society concerns and should be addressed quickly.

The €10 million on wind energy R&D in the first half of FP6 have been dedicated to short term and demonstration projects, administered by the Directorate General responsible for energy, DG TREN. For the same period of FP6, the funding of long term research in wind energy was zero. In the same period the funding received by "clean" coal (CO_2 sequestration) was four times the total funding for wind energy.

The decrease in funding for wind R&D appears to be the result of the mistaken impression that wind energy is technologically sufficiently mature, that it no longer requires significant support for R&D. While wind energy has indeed made great progress during the period of the framework programmes, further work remains in both the short and the long term if wind energy is to achieve its potential to become Europe's cleanest and largest energy source.

In that sense, the approval of FP7 budget constitutes a step in the right direction but still constitutes a very limited source of funding for European companies, notably for those in the Wind sector which are not fostered by strong national support programmes.

2.2. Are there barriers to innovation? Is there a need for change in the innovation system?

***Indicate**: For the sector in question any weaknesses in the current system*

(Source: EWEA, Prioritising Wind energy Research. Strategic Research Agenda of the Wind Energy Sector, 2005.)

Increasing collaboration

The European wind industry, together with national ministries and other stakeholders in the development of wind energy, has proposed to the European Commission that a technology platform for wind energy be established. The overall objective of the platform, in R&D terms, is to increase cooperation and research into European wind energy, thus maintaining and develop Europe's position as world leader in wind energy.

The European Wind Energy Technology Platform (TPWind) can be very useful in bringing key actors together, also in identifying "must haves" versus "nice to haves", but will not solve the funding problem that there exists.

Funding

The creation of a truly European leading and integrated sector requires an effort at the EU level, possibly fostered by the European Commission through the framework programmes or new tools (e.g. JTI).

Also other ways of access to public-private R&D funding have to be explored. In this sense, the European investment Bank and the different public/ semi public financial institutions that exist in Member States should focus more clearly on financing R&D RES projects, including wind.

2.3. Does your sector already benefit from or plan to set-up initiatives to bridge the gap between the current state of technology and a cost-effective market entry? What would be the critical mass (e.g. investment) needed for such initiatives? What new approaches could be considered to accelerate innovation?

Indicate*: i.e. how could the SET-Plan help the sector; which actions of it would be most effective; what impact could be expected with respect to 'business as usual (i.e. No SETPlan)?*

Wind energy development is a consequence of political choices, traduced into greenhouse gases emission limitation targets, and through directives. Support for this development is provided at national level through different instruments (feed-in tariffs, certificates …). If the economic reliability (profitability, legal …) of the sector is ensured for a sufficient duration, the market takes interest into Wind energy development.

In such a scheme, the innovation is continuous, and costs decrease constantly, but technological breakthrough – leading to significant cost reductions - are hardly possible. Indeed, such breakthrough requires long-term costly and risky research. Such research has to be supported by public funding (see cancer research, nuclear fusion …). This is not the case today (please, see 2.1).

As a complement, appropriate tools for funding medium and short term R&D could be grants or tax exemptions. However, this issue has to be studied in more detail in the TPWind R&D Finance Working Group.

An attempt of quantifying the investment level for such initiatives is provided at point 3.6.

New approaches for accelerating innovation could be:

- to create a sufficiently wide consortium for long-term R&D activities. Existing structures could be used for that purpose, such as TPWind or the European Academy of Wind Energy;
- the contribution of the European Institute of Technology (proposed by the Commission) could help to fill the gap between education, research & innovation;
- in that framework, a Join Technology Initiative could be of great interest for securing long-term public-private partnerships (please, see 4.4.).

2.4. What actions of the SET-Plan need to be carried out at European level? What actions would be better implemented at national and or regional level? Is there a need, or a potential benefit, to integrate or to better coordinate action carried out at different levels?

- R&D plans: European-level initiatives have to be coordinated with national efforts to build the European Research Area. European level manages the issues common to most of the countries, whereas national programs focus on local specificities;
- Specialization of EU or national funds on short or long term R&D is not desirable;
- Support mechanisms: can be better coordinated (not necessarily homogenised) between the Member States.

2.5. International Dimension - Is there a potential for international cooperation? What type of cooperation?

***Indicate**: Major initiatives in other countries; assessment of specific opportunities for international cooperation*

A specificity of Europe is to have put at the front of the scene the environmental issues. The goal is to de-carbonize economic growth and social welfare. For energy, this has the advantage to secure our economy from abroad suppliers, mostly based in politically unstable countries.

In this context, Europe is world leader in environmental engineering, and has developed a strong internal market in this sector. This high-level expertise can be exported worldwide.

Environmental engineering exportation could lead to a "win-win" scheme, providing new markets to our companies (thus improving our commercial balance), bringing Europe a leading role in global economy (increasing the political weight of Europe), and preserving the environment.

Wind energy is one of the sectors of environmental engineering where Europe is already World leader, but its impact is decreasing steadily. In this framework, international cooperation for wind energy is desirable. As an example International cooperation could be based on:

- non-competitive R&D, thus exporting knowledge and ensuring the intellectual influence of Europe;
- providing services for wind energy development, ensuring a de-carbonization of the global economy;
- factories in Non-EU countries, thus ensuring the market shares of our industrial leaders;
- implementation of standards for wind energy (e.g. resource assessment, testing, certification …).

3. SPECIFIC QUESTIONS RELATED TO THE SET-PLAN HEARING OF WIND ETP

3.1. Do you think that the Wind ETP is the answer to the erosion of the EU manufacturer market leadership in the past years?

If the European Union has the objective to remain the world market leader for wind energy, three complementary aspects have to be dealt with:

- EU has to remain leader on innovation into the sector (thus compensating labor costs effects),
- EU has to take advantage of its huge internal market,
- EU has to ease foreign market penetration of its companies.

The TPWind can help to identify key areas for R&D funding, improve the co-operation between key agents (exchange of information, exploit synergies between national/ EU programmes, etc.) but cannot solve the lack of R&D public funds that the sector is experiencing. This is a tool that remains in the hands of the EC and Member States and cannot be tackled by the TPWind.

R&D funds are indispensable for maintaining the competitiveness and the weight of the sector. The main reasons are: (a) labour costs are lower in emerging economies, such as China –whose wind sector is developing very fast-; also the cost of some raw materials such as steel is increasing fast. The European wind energy sector can only compete by lowering its generation costs and by offering advanced technological solutions. These will be achieved only thanks to strategic and breakthrough R&D projects; (b) wind energy markets will tend to move away from Europe (figure 9) –US, India and China are already world leaders in terms of new capacity installed. In that scenario, the EU wind energy sector will need to increase its export vocation. Given the high transport costs of the turbines and blades, exports will be in the form of protected technology. Such technology is the result of intense R&D effort.

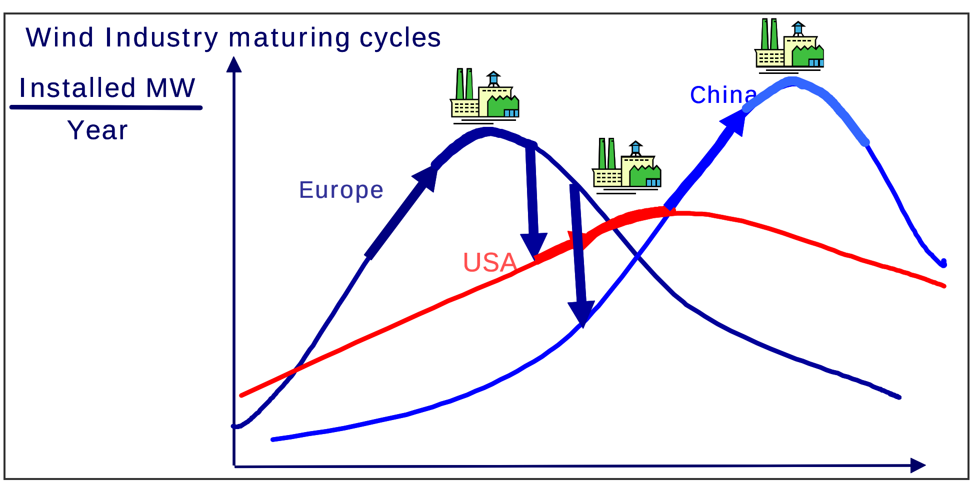


Figure 9: illustration of the European Wind Energy sector facing a critical change in trends. When the annual installed capacity is decreasing, factories have the tendency to move to more dynamic markets. (Adapted from: REOLTEC - Spanish Technology Platform's R&D Strategy document, March 2007).

3.2. What are the practical actions to coordinate between the Wind and other platforms, in particular with Smart Grids (as concerns the grid integration issues), Steel ETP (with regard to foundation and other structures) and Hydrogen and Fuel Cell (for the storage issues)?

TPWind has just been established and therefore the practical steps still need to be taken. However, some actions have already been agreed. These include the following: (a) a TPWind representative is involved in the Smart Grids platform and vice versa, possibly through their respective steering committees; (b) contacts have been made with the steel technology platform and will probably result in the same type of agreement; (c) the TPWind is looking to establish a co-operation with the hydrogen technology platform and has been invited to participate in a joint meeting on the 19th of April.

3.3 What about the cooperation of the Wind ETP with other industrial sectors (aeronautics, oil & gas off-shore, etc…)?

This will be made through the working groups. For instance, the WG on offshore wind energy will probably engage some experts from the gas and oil off-shore facilities. The same applies to platforms dealing with marine biodiversity and even with the sector of marine/ harbor transport.

3.4 Which representatives from the civil society are you looking for with respect to consumers and public acceptance?

The civil society and the relevant NGOs can participate in TPWind as observers of the steering committee and as members of the appropriate working groups (for instance, on environmental impacts of wind).

The TPWind issued an open call for expressions of interest for the steering committee in which a special category for civil society/ other interest groups had been created. Only three applications (out of 141) were received. This is a low figure, which may be due to the "technological" nature of the platform; the TPWind members are aware of the public interest that exists in promoting wind.

3.5. Will the Wind ETP be open to international collaboration and how this will be organized?

TPWind can be open to international co-operation by two mechanisms: through specific working groups which are of interest to third parties and through the category of observer in the steering committee. Until now, only the American Wind Energy Association has expressed its willingness to participate in the TPWind, but this can be due to its limited "lifetime" – launched in October 2006 and operational since March 2007.

3.6. Could you estimate the yearly budget needs for R&D to achieve the vision objectives of 2030?

Figure 4 indicates the expected share of wind energy in terms of EU generation capacity between 1995 and 2020. This share is expected to be 21% in 2020, corresponding to 180 GW installed. The installed capacity in 2006 was 48 GW (48,026 GW).

Reaching the 21% penetration level thus implies a mean yearly installed capacity of 9.42 GW/y. If we consider a mean investment cost of 1.3 €/W (which is a low figure when considering both offshore and offshore projects), the yearly investment level is then 12.25 b €/y.

If we refer to the Lisbon objectives, and consider a Research and Development effort of 3% of the annual investment, this assumption leads us to an effort of 367.7 M €/y. If 2/3 of this budget is invested by the private sector, and 1/3 comes from the public, the mean public annual support is then 122.6 M €/y. Finally, if 50% of this support is provided at national level, and 50% at EU level[4], the effort at EU and national level is 61.3 M €/y.

Nota Bene:
This figure is very conservative, as does not take into account the investment that is needed for technological breakthrough (please, see 2.3 and 3.1), and interaction with other concerns (grid development, large-scale storage capacities…). Additional inputs shall be considered from e.g. the Smart Grids and Hydrogen platforms.

Moreover, the 3% assumption coming from the Lisbon Strategy refers to the European GDP and not to the turnover of the individual industrial sectors (since GDP is not only coming from the industry). When a technology takes-off, this number might be double and triple (see Hydrogen for instance), and wind is still in a take-off position. Thus, the investment in R&D is expected to be significantly higher, and evolve to 3% by 2020.

A consultation among the members of TPWind provided us the above elements:

- *the sector would need 10 MEUR for a programme on "Wind Energy Breakthrough proof of concepts", which would aim to secure technological leadership;*
- *in order to comply with the renewable scenario, there would be a need of an "20% renewable compliance" programme of 20 MEUR to provide technological solutions for prediction, grid connection, energy storage, offshore, etc.*

[4] Based on current figures, see 2.1.

3.7. Do we need a differentiated/selective approach "onshore-offshore" to give an impulse to regional deployment of Wind Energy? Please describe it.

There are substantial differences – both in technological and market terms- between onshore and offshore technologies. Onshore technology is already in the market and thus needs to concentrate its R&D effort on certain well defined areas; while offshore wind also has to prove its economic feasibility – public demonstration projects may be needed.

The challenges are also very different in terms of infrastructure needed, mainly the grid and access tools. Both areas are especially suitable for R&D.

TPWind intends to establish a group on offshore wind, which will be dedicated to the particular nature of this technology. The other working groups will be more horizontal, thus encompassing measures that can be applied in both.

3.8. How can the Wind ETP contribute to the development of Wind Energy in the new Member States?

This can be managed through the exchange of experience. At the Mirror Group level, Governments from new Member States will have the opportunity to analyse how the wind energy sector has been supported in other countries and to choose the formulas that are best suited to their situation. In the working groups, stakeholders from new Member States can benefit from the experience of successful companies located in the EU-15. However, main barriers for wind energy deployment in some new Member States are not so much related to the lack of knowledge, but to a hesitant political will and low national/ EU R&D budgets.

3.9. What type of indicators do you plan to establish to monitor the impact of the Wind ETP and the evolution of the sector to satisfy the targets set by the vision document?

Indicators could be:

- Budget devoted to R&D in the wind energy sector at the EU and national levels,
- Investment linked to new R&D projects,
- Evolution of generating cost of electricity from wind,
- Evolution of wind energy targets in the short, medium and long term (2010, 2020 and 2030),
- Evolution of offshore wind energy in terms of global installed capacity and relative weight inside the wind energy sector,
- Patents.

4. QUESTIONS RAISED DURING THE HEARING

4.1. What are the elements for long term research?

Vision:

- To develop the European Wind Energy Market at its larger extent, meeting and exceeding the 2020 European RES Targets (RES-electricity in our case)
- To maintain and further enhance the European Industry leadership as Wind Energy Technology Provider

Directions:

To fulfill our vision we need to work along three (at least) lines:

a) ***Wind Energy Resources***. On European grounds this has to focus on areas where wind exploitation is still poor. Particular emphasis shall be put on offshore and extreme climate resources. In the international scene we should aim at maintaining Europe's leading role as a technology provider in the services sector for both onshore and offshore applications. Key areas in this thematic include: *Wind resource mapping, advanced sitting techniques including remote sensing, advanced wind/power forecasting techniques.*

b) ***Wind Turbine Technology***. We anticipate that at a certain time wind industry has to work on different design platforms for onshore and offshore turbines, taking account of the specific particularities of these two distinct application fields. Evidently, a third -horizontal line- is needed where basic technology themes (design tools, materials, etc.) are to be developed. Key areas include:
Horizontal*: Integrated design tools, advanced materials for blades, MIMO (multi-input, multi-output) control strategies, reliable lightweight drive trains, power control and conditioning (including fault ride through capabilities), condition monitoring and preventive maintenance.*
Onshore: *Medium-large size WT, environmental constraints (noise and visual in particular), enhanced reliability, optimized logistics (emphasis on transportation and erection for sites with poor infrastructure).*
Offshore: *Large-huge size WT, relaxed noise and visual constraints emphasis on the marine environment, cost-effective support structures, enhanced reliability, optimization of O&M strategies and logistics, floating concepts (probably combined with wave/tidal converters)*

c) ***Wind Energy Integration.*** This extends from the single (large) wind farm level to the large-scale integration in the power system level. Key areas include: *Grid connections planning and development (bringing power to customer), Wind farm power performance and quality control, advanced power transmission technology, smart grid technology, storage, advanced power system design and operation tools (regional to pan-European level).*

Some Long term RTD Themes

Hereunder, we illustrate some particular long term RTD themes in some of the above key areas. It is the mission of the TPWind to complete the exercise, thus, at this stage we can only express some first ideas, projecting to the future research directions already in place.

In ***wind energy resources*** we expect that future developments will heavily rely on state-of-the-art satellite applications and telecommunication technology for data collection, processing and transfer. Numerical simulations for siting will rely upon advanced computational fluid dynamics techniques including probabilistic elements. Remote sensing will be probably based on cost-effective SODAR and LIDAR techniques. Global forecasting meteorological models, running on super-fine spatial and temporal grids and supported with spread-around remote sensing observations to increase accuracy, will drive the future wind and power forecasting tools. An integrated IT environment of sensors and models will provide information and alarms to the power system operators.

Cross-cutting fields: *meteorology, space, IT, telecommunication.*

Wind turbines

- Will be designed in integrated CAD-based environments with multi-disciplinary multi-objective optimization tools. Probabilistic design methods will first apply to structural design and later to the Aero^3 (aerodynamic, aeroelastic, aeroacoustics) design. Advanced computational fluid dynamics techniques with prevail in the Aero^3 design.
- The aerodynamic shape of the blades might look different. Slender lightweight smart blades, equipped with active aerodynamic control devises to increase lift and mitigate loads, will prevail. Larger blades intended for offshore operation will turn at higher speeds (due to the relaxed noise constraint), have thinner chords and larger airfoil thickness to further reduce weight.
- Blades will be fabricated from cost-effective composite hybrids will increased strength to mass ratio. Add-ons in the composite matrix, nano-particles included, will enhance material damping, yield stresses and fatigue resistance. These add-ons might even allow for detailed health monitoring of the blades.
- MIMO control schemes (multi-input, multi-output) will apply aiming to control the power output and, at the same time, the turbine loading. Control input shall be given by "global-motion" sensors (rotating speed, individual blades) but also distributed sensors (active aerodynamic control, for instance).
- Drive-trains will be customized designs for wind-turbines. Aiming to reduce weight, integrated gearbox designs might be combined with multi-pole generators in a minimal-cost/weight configuration.
- New-generation power electronics will attribute in cost-effective power and power-quality control. At the longer run, they might even drive on-board storage devices.
- Advanced component manufacturing and assembling techniques will be developed to facilitate massive production and reduce the cost of the turbines.

- Advanced condition monitoring techniques will allow for preventing maintenance and reduce O&M costs for offshore wind, in particular.

Cross-cutting fields: *Aeronautics*, *IT, nano-technology*

Wind Energy Integration

Interconnections, Smart grids, storage (and demand-side-management) are crucial elements for achieving large-scale wind integration into the power system. Planning and operation tools for the European TSOs designed for electrical system operation under stochastic demand and production (still well-forecasted) conditions are also necessary. Storage possibilities should identify fast-response/small-volume to longer-response/large-volume options, each one valuable for different needs of the electrical system.

Looking longer ahead, electricity and hydrogen economies might be closely linked together. To that extent, particular emphasis should be given to wind-hydrogen production and storage, both at the local and at the system's level.

Cross-cutting fields: *IT, Smart-Grids, Hydrogen (Production and Storage)*

4.2. Please, provide figures on CO2 emissions reduction integrated at global scale (transformation cost).

Accurately answering this question in the present document is not possible. This issue is extensively addressed in the document: EWEA, Wind Energy The Facts – Vol. 4 Environment, 2004. Available online at:

http://www.ewea.org/fileadmin/ewea_documents/documents/publications/WETF/Facts_Volume_4.pdf

4.3. Please, provide us the cost of R&D including other linked technologies (grid, storage..). Some other technologies are spending more than 3% in R&D. What about wind energy?

Please, see 3.6.

4.4. How is R&D split between short term & long term / industry & academy / pre-competitive & competitive research?

This is a crucial issue to be solved by the TPWind. A definite and concerted answer can not be provided. Considering the previous points, some research objectives are exposed in points 1.3 (barriers & bottlenecks) & 4.1 (long-term). In a Science / Technology / Market strategy (figure 10), long-term objectives are prospected by the academic bodies. These bodies progressively transfer the research results to industry (figure 11). Coordination is needed to ensure Wind Energy R&D benefits from a "virtuous" cycle.

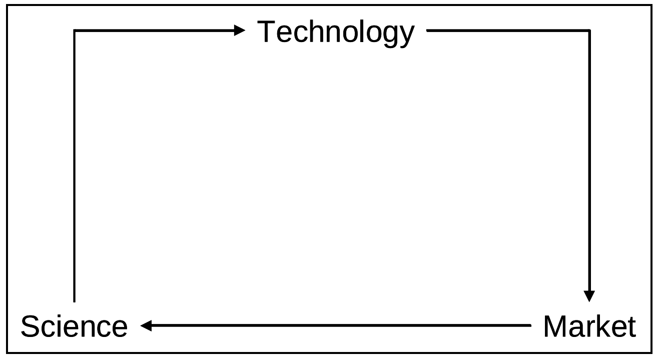


Figure 10: “Virtuous” Science to Market development scheme.

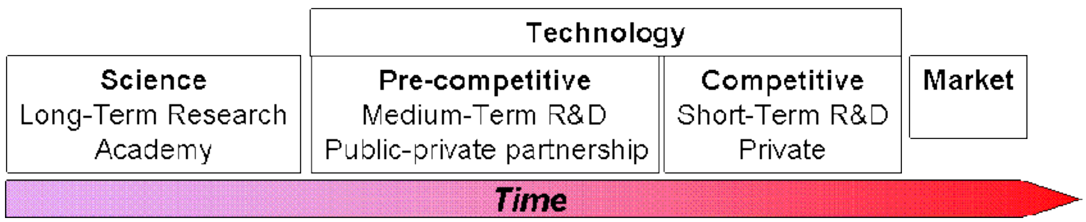


Figure 11: In a “virtuous” scheme: evolution of the nature of research and partnerships from Long-term Research to the Market.

4.5. What is the involvement of SMEs in the sector?

(Please, see preliminarily point 1.2) In the 80’s, the Wind energy sector was mainly leaded by SME’s. As the market grew, the size of the leading companies increased. Mergers and acquisition then happens. Top-10 manufacturers global companies, but some small market-share manufacturers are still at SME size. Moreover, main SME pool of the sector is sub-suppliers, service providers and developers.

4.6. How could the Marie Curie actions could help to produce experts?

Marie Curie and other human capital initiatives are extremely important for the expansion of the ERA in the wind sector. The European Academy for Wind Energy (EAWE) is already prepared and self-organized to accommodate and train young researchers through the Marie Curie program and produce the future wind energy experts. To some extent this has already be done. Nevertheless, human capital and mobility actions have to be one of the elements of a greater and, most important, stable research environment. Marie Curie can only be successful when combined with existing European and National collaborative RTD programs in the wind sector.

4.7. What kind of research infrastructure does the sector need?

Some examples are listed below. It is linked to the long-term research perspectives described in 4.1.:

- European meteorological observatory for large-scale Wind Integration into the EU electricity grid *(a physical or virtual (distributed) infrastructure using a number of wind measuring points per country, for: on-line processing of the measurements –presentation of wind data; dynamic revision of the European Wind Atlas; improvement of initial meteorological conditions for wind forecasting; regional and global Wind Power forecasts; objective: facilitation of Wind Penetration in the EU electricity grid),*
- Wind Tunnels – Aerodynamic testing *(Split for scale in partnership with Aeronautics, for: full rotor testing (scale 1); profile testing including acoustic behaviour (scale 2); Educational (scale 3)),*
- Large Wind turbines testing facilities (8-10 MW),
- Fully Instrumented RTD Wind Farms – Condition monitoring *(Three nodes (offshore, flat terrain, complex terrain) for complementarity usages: Infrastructures for the development of condition monitoring techniques, - blades, drive trains, electrical; O&M and logistics; Development of a common fault detection database),*
- Blade and material testing techniques, at different blade scales *(Synergies with other material testing laboratories; Development of non-distractive blade testing and health monitoring techniques; Development of a European material properties database (for composite structures) including smart materials).*
- Drive train testing devices,
- Generators, power electronics, testing.

4.8. What kind of collaboration could be implemented with other countries?

Please, see 2.5 and 3.5.

Collaboration could mainly focus on upstream (resource oriented) and downstream (integration) themes rather than the core wind-turbine and components technologies. Indeed, collaboration is easier in a framework of pre-competitive research rather than competitive or near-market activities.

Also important is the international collaboration on standardization. Technology exchanges and foreign market penetration at sustainable costs are eased with common standards.

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[i] Based on the assumption that one terawatt hour (TWh) of electricity produced by wind power will save 0.65 million tonnes of CO_2 in 2010, and that installed capacity increases from 34 GW by the end of 2004 to 75 GW in 2010.

[ii] MITRE 2004: Monitoring and Modeling Initiative on the Targets for Renewable Energy, ALTENER, DG TREN

[iii] *Wind Force 12 : A blueprint to achieve 12% of the world's electricity from wind power by 2020*

[iv] MITRE 2004: Monitoring and Modeling Initiative on the Targets for Renewable Energy, ALTENER, DG TREN