The Wind Power Report

Seventh Edition, 2010

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Introduction

This report provides an outline of the world wind energy industry and market, with market surveys of each of 5 major markets and 21 intermediate markets, together with national policies and support plans and incentives. Analysis of the manufacturing base, supply chain, wind power developers and owners.Historical analysis from 1990 and forecasts of capacity to 2012, with forecasts to 2020 for the major markets. National targets and incentives are listed. Factors affecting wind power are outlined and crucial issues such as variability and intermittency, dispatchability, capacity factors and capacity credits are discussed and assessed.

Outline of the report*:* ***please see table of contents for further details***

- The development of wind energy: the market in 2009
- The future of wind power, 2009 to 2012
- Assessment of factors affecting wind power; terminology, issues and the operational experience of the most experienced wind power operators
- National policies for renewable energy – targets, support mechanisms, RPS policy and feed-in tariffs
- National wind power markets – comprehensive surveys of the 5 market leaders, survey of the 21 intermediate wind power markets, brief profiles of 22 new entrants
- Wind Industry Supply Chain- vertical integration, supply chain in the electrotechnical industry, raw material, lead times, turbine production capacity, components balance of plant, tire 1 and tier 2 – rotor blades, gear boxes, bearings, cast iron and forged components, towers, transformers
- O&M issues and delays
- The rare earths supply crisis
- Weather forecasting
- Energy storage
- Development of wind turbine size
- Wind Farm Developers and Owners
- Manufacturing Base
- Off-Shore Wind Power
- Promising technologies

Executive Summary

2009 was a record year for offshore wind investment, which ABS feels is unwarranted given the major bottlenecks in the offshore supply chain – a lack of offshore vessels and subsea cabling. In the onshore sector there are no immediate supply chain bottlenecks. However, the growing trend towards large scale turbines may be slowed somewhat in 2010 due to the logistics of transporting large, bulky turbines and the high costs involved. Additionally, larger turbines require the use of expensive carbon fibres and specialised plastics to replace cheap glass fibre used in small scale turbines. Supplies of carbon fibres may hit a bottleneck by 2017.

With the sector entering the mature phase, there is a greater pressure towards the standardisation of components especially because of the sector's high operating and maintenance costs. To reduce high O&M costs many developers are opting to purchase gearless rather than geared turbines. However, gearless turbines use neodymium, which hit the headlines recently due to concerns that China's export policy for rare earth metals would lead to near term supply shortages.

On the plus side, for European and American manufacturers, competition from manufacturers shipping products from India and China is unlikely to affect their dominance in local markets. Due to the high costs of transporting turbines and towers, and uncertainty over whether carbon emissions reductions will apply to the shipping sector, localised supply chains will be the future of the sector. Complete supply chains have already formed in North America, Europe and Asia.

Overall 2010 is expected to be a good year for the wind sector, especially in the China, the USA and Eastern Europe.

Lack of access to financing and poor grid infrastructure still remains as the biggest barrier to project development.

ABS Intelligence: Market Highlights

2009

The Chinese and American markets performed well, along with some emerging markets - notably Mexico, Canada, Chile, Poland and a few other Eastern European countries.

More mature markets of Japan and the EU experienced slow, and in some cases no growth at all.

Repowering happened at a slower rate than anticipated because of height restrictions on planning permission for some sites, and most turbines are not yet past the 15 year mark.

Offshore wind took off; however, no measures were in place to ease bottlenecks in the supply chain – mainly an anticipated shortage of all types of vessels (installation, O&M etc.) and subsea cabling. No supply shortage is likely for onshore wind sector.

2010 and Beyond

Continued growth in the sector is expected with gearless turbines performing well particularly in the offshore sector, due to their lower operation and maintenance costs.

Several countries may experience slowed growth due to the removal of government incentives, stricter planning or approval regulations or an uncertain political climate – Canada (non-renewal of EcoEnergy), Greece, Spain (introduction of Registry) etc., with the anticipation of less generous subsidies in Italy and other European countries in the future.

Growth in Eastern Europe, South American and North African countries is expected but concerns about grid capacity will mean that many targets for 2015 will not be met.

Key markets for growth include Finland, Morocco and Turkey.

Manufacturers will experience moderate growth. Several manufacturers have unused stock from 2010 and will not actually manufacture that much new capacity. REpower may perform well with its 5 MW turbine along with Chinese companies producing large, certified turbines.

Chinese manufacturers are likely to enter the export market in a big way because there has been a shift from licensing technology with export restrictions to forming joint venture and conducting in-house research.

This year may see some turbine manufacturers acquiring offshore suppliers (especially cabling and vessel manufacturers), and developers acquiring more offshore companies to ensure security of supply.

More repowering is expected in Europe as there is a significant international market for used turbines and limited on land sites with good wind resources.

Barriers to Development

Growth in demand for gearless turbines in 2015 and beyond will be hampered by shortage of the rare earth metal neodymium. China may further restrict exports in the next year or two because of domestic needs, and government initiatives worldwide to source local or international supplies will not bridge the supply gap. It is estimated that it will take 15 years before a decent US rare earth metal industry is in place.

A supply shortage of carbon fibres may hit the sector from 2017 onwards - carbon fibres are used to reinforce the blades of large turbines.

But, by far, the biggest barrier to development is a poor grid infrastructure. In some Eastern European countries the grid system can't cope with any more than 3 GW of installed capacity without significant investments in the infrastructure e.g. Poland (3GW maximum), Czech Republic (1.2 GW) and Hungary (330 MW). This problem applies to most wind markets. Even when the grid has sufficient capacity of installed projects, intermittency is a huge issue despite denials by the wind industry. Last year there was almost a blackout in Texas because of a sudden loss of wind. In Spain wind turbine had to be switched off due to over-supply in the night at time of minimum demand and the spot price of electricity fell to zero.

With the exception of chemical storage of heat for the solar sector, few of the energy storage technologies are close to commercialisation. Pumped hydro storage looks the most promising, especially as there are over a hundred pumped storage facilities in operation in China.

Turbine Size

The maximum turbine size in operation is 6.5 MW onshore and a 20 MW turbine has been developed. Clipper is planning to manufacturer its 7.5 MW turbine in 2012, with both Clipper and Sway developing a 10 MW prototype.

Although, very large turbines are unlikely to be commercially viable because they require special reinforced materials, bespoke lifting vehicles and the logistics of transporting the turbines will eventually hamper growth in turbine size.

ABS Intelligence Projects the Following

Slowed growth in developing megawatt turbines with efforts focused on streamlining products- reducing the number of parts, increasing efficiency etc, because of the high operation costs of gearboxes and turbine parts.

More M&A's to secure "local" supply chains for wind turbine manufacturers.

Expect growth in cold weather countries following the development of cold resilient turbines, Finland and Russia, for example.

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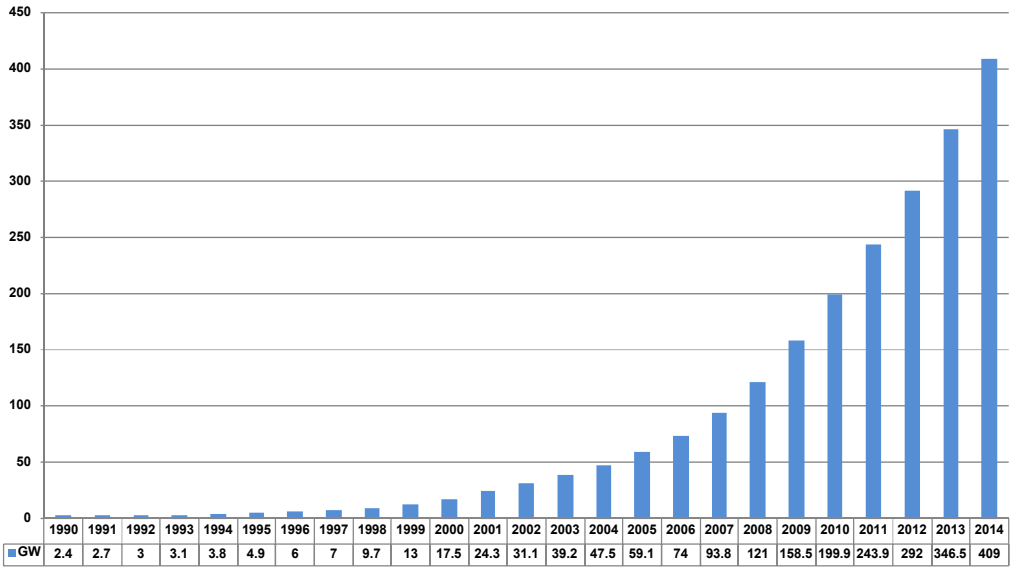
1 The development of wind energy: the market in 2010

World wind energy installed capacity was 158 GW by the end of 2009, with 37 GW added during the year, this represents a 31% increase on 2008 and is an even greater percentage year on year increase than we saw between 2006 and 2007 (26%).

Last year was a better year than expected with an extra 12.5 GW installed compared to estimates from the GWEC.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
GW	2.4	2.7	3	3.1	3.8	4.9	6	7	9.7	13	17.5	24.3	31.1	39.2	47.5	59.1	74	93.8	121	158.5	199.9	243.9	292	346.5	409

Figure 1. *Global wind power installed capacity, GW 1990-2014*

Source; GWEC

It is estimated that it will reach 200 GW by the end of 2010. This would represent 26% growth on 2009, the slowing in the market due to the global economic environment, continued uncertainty and the difficulty to raise capital.

The growth in 2009 was primarily associated with China, where a record 13.8 GW was added more than doubling the capacity to 26 GW, and USA, where 10 GW was added, increasing the capacity by 40% to 35 GW.

However, outside of these two countries, capacity growth within the remaining Top Ten countries remained at 9%, so in order to maintain momentum we are beginning to see the process of globalisation of the wind industry as more countries begin to make significant investment, particularly in South America, North Africa and Eastern Europe. While the Top Ten countries still accounted for approximately 87% of the global market in 2009 (the same

Figure 43. *DC-grid under construction around Guangzhou*

Source; Siemens

The far north of China experiences sub zeros temperatures, and therefore needs cold resilient turbines.

5.2.5 Present Status of Development

There have been three stages in the development of grid-connected wind farms.

In the initial demonstration period (1986-1993), the main activity was to build small-scale demonstration wind farms by utilising grants from foreign donor countries and loans. Support from the government was mainly in terms of financial backing, such as investment in wind farm projects or in the development of wind turbines.

In the industrialisation period (1994-2003), the former Ministry of Electric Power proposed a wind power industrialisation programme, including the early stages of wind farm construction in 1993. The following year it was decided that the grid utility should facilitate the connection of wind farms to the nearest grid and all the electricity generated by wind farms should be purchased. The grid tariff would be calculated as the sum of power generation costs, loan payments and a reasonable profit. The difference between the wind electricity

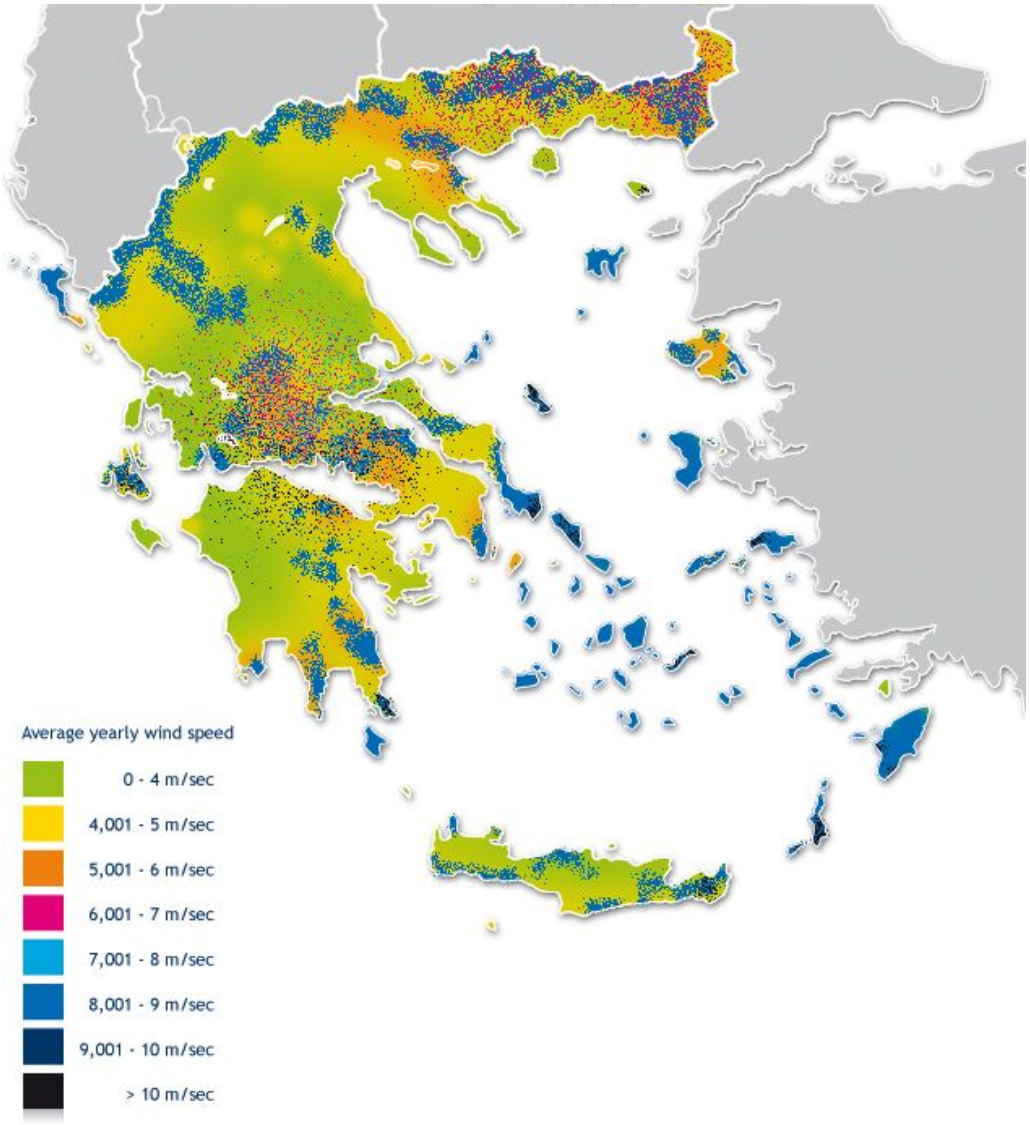


Figure 90. Wind resources in Greece

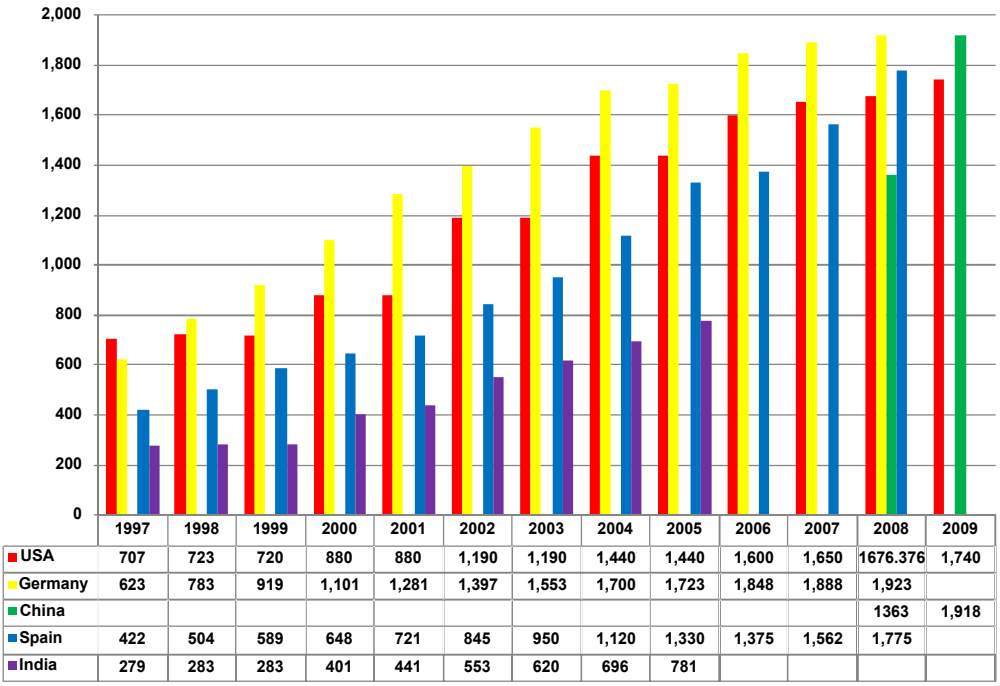
Source; CRES

6.4.3 Offshore

Greece has extensive offshore wind resources.

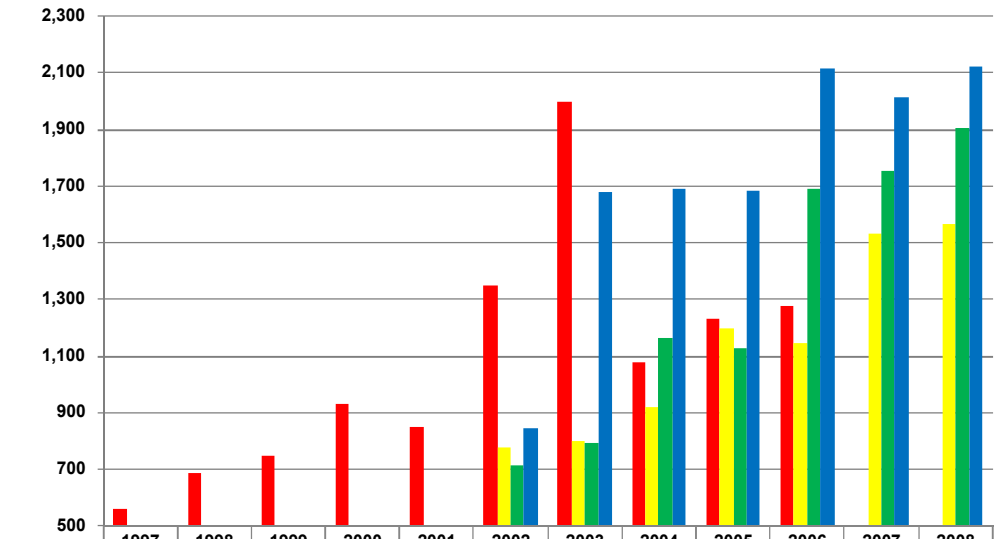
Several offshore projects are in the planning stages:

- 216 MW project off the coast of Thrace being developed by Copelouzos;
- 600 MW project off the coast of Thrace being developed by Terna;



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
USA	707	723	720	880	880	1,190	1,190	1,440	1,440	1,600	1,650	1676.376	1,740
Germany	623	783	919	1,101	1,281	1,397	1,553	1,700	1,723	1,848	1,888	1,923	
China												1363	1,918
Spain	422	504	589	648	721	845	950	1,120	1,330	1,375	1,562	1,775	
India	279	283	283	401	441	553	620	696	781				

Figure 217. *Average turbine size top 5 countries, MW*



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Denmark	560	687	750	931	850	1,351	1,996	1,079	1,233	1,279		
Italy						776	802	918	1,198	1149	1534	1567
France						713	795	1,162	1,132	1,689	1,752	1,907
UK						843	1,678	1,691	1,688	2,119	2,017	2,124

Figure 218. *Average turbine size key European countries, MW*

Source; Country reports

capacity blades. Only one turbine manufacturer, Vestas, has submitted patents for composite materials for wind turbines so far.

Over the next seven years the market for 1.5 MW+ will increase to meet demand for larger turbines. There will still be a market for small turbines, mainly from developing countries, remote locations and for companies generating their own electricity needs. Forecast of market share for different turbine sizes, %:

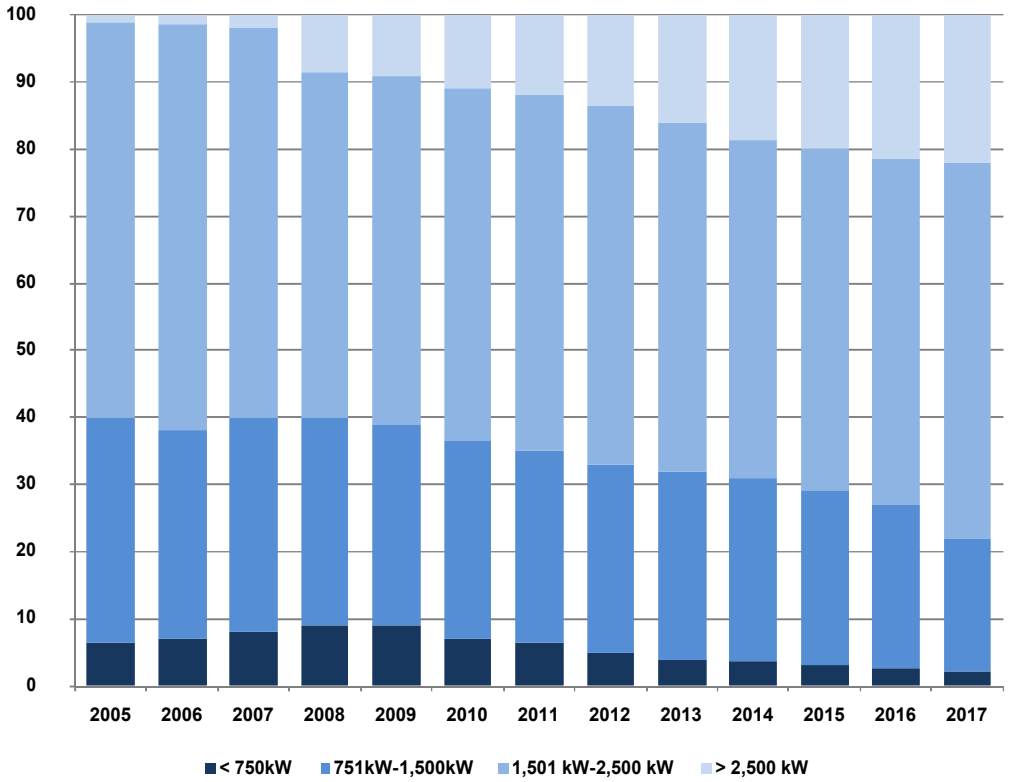


Figure 220. *Expected market increase to meet demand for larger turbines*

26.2 Offshore

Since the first offshore turbine was installed in 1992, offshore turbines have been increasing in size both size and capacity at a faster rate than onshore turbines. Between 2001 and 2009 there was an in the average rating of new installed capacity in Europe. The largest turbines in operation are the 5 MW Multibrid and 5 MW REpower turbines at the Alpha Ventus and Hooksiel wind farms in Germany. REpower claims its 5 MW offshore turbine can operate at 6 MW.

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