



Wind Energy Factsheets

By the European Wind Energy Association – 2010





Photo: Karpov

1 Statistics & targets

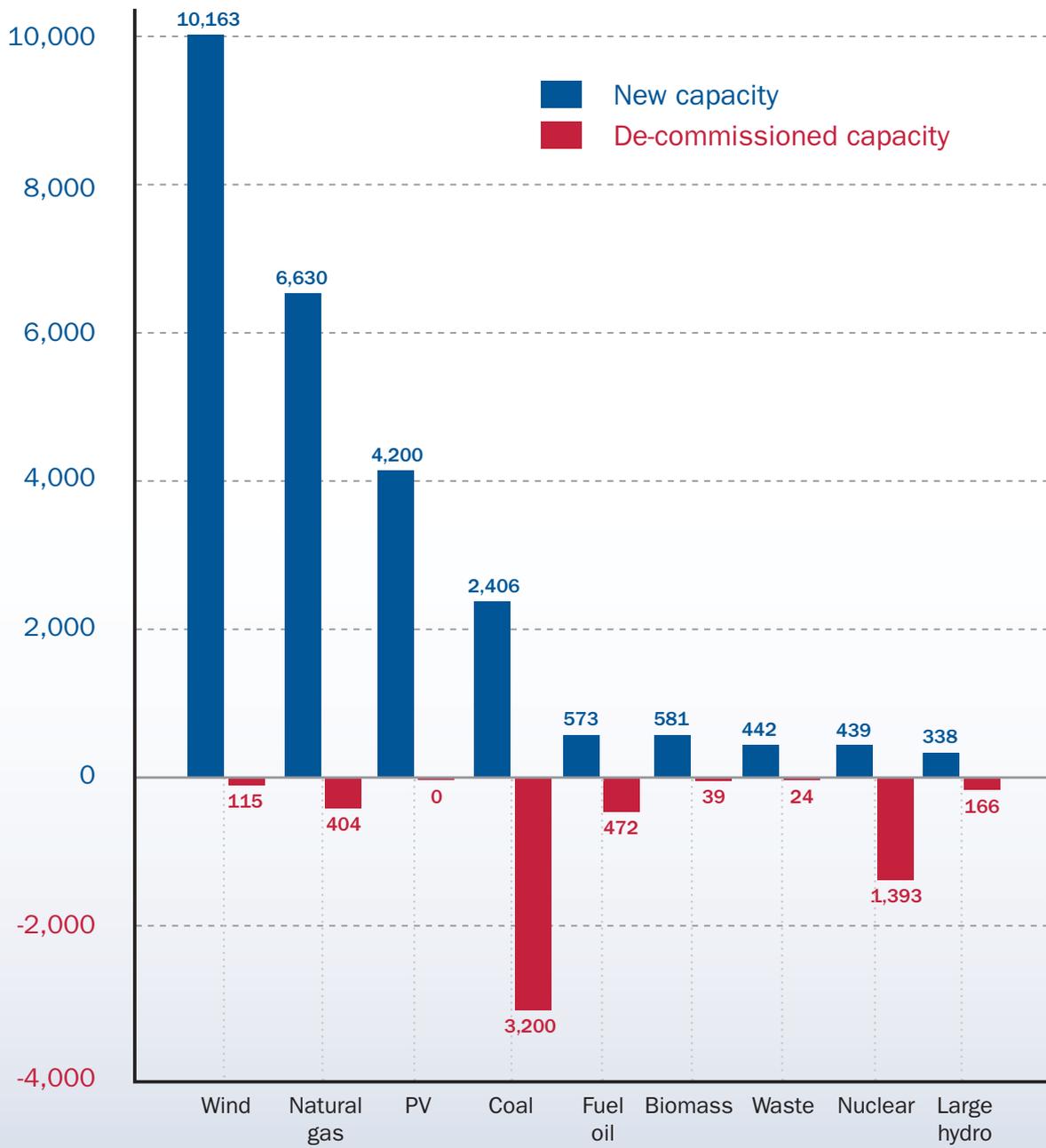
➔ Wind energy is now a mainstream power source. If the right steps are taken, wind energy will be key to meet Europe's 2020 renewables target, tackle climate change, strengthen energy security and create jobs.

Did you know?

- ➔ The wind power capacity installed by the end of 2009 will, in a normal wind year, produce 4.8% of the EU's electricity.
- ➔ In 2009, for the second year running, more wind power was installed than any other power generating technology, accounting for 39% of total new installations.
- ➔ Over 10 GW of wind power capacity was installed in 2009 - 23% more than in 2008.
- ➔ Europe's wind energy in 2009 avoided 106 million tonnes of CO₂ per year, equivalent to taking 25% of cars in the EU off the road.
- ➔ Wind energy saves Europe €6 billion per year in avoided fuel costs.
- ➔ In 2009, 2.8% of Europe's total wind power was offshore.
- ➔ 192,000 people in the EU are employed by the wind industry



New installed capacity and de-commissioned capacity in EU 2009 in MW. Total 25,963 MW



In 2020, EWEA's targets are for:

➔ 230 GW installed wind capacity in Europe: 190 GW onshore and 40 GW offshore

This would:

- ➔ Produce 14-17% of the EU's electricity - depending on total demand.
- ➔ Avoid 333 million tonnes of CO₂ per year.
- ➔ Save Europe €28 billion a year in avoided fuel costs and €8.3 billion a year in avoided CO₂ costs.

In 2030, EWEA's targets are for:

➔ 400 GW installed wind capacity in Europe: 250 GW onshore and 150 GW offshore

This would:

- ➔ Produce 26-35% of the EU's electricity - depending on total demand.
- ➔ Avoid 600 million tonnes of CO₂ per year.
- ➔ Save Europe €56 billion a year in avoided fuel costs¹ and €15 billion a year in avoided CO₂ costs.²

What needs to happen?

- ➔ The 2009 Renewable Energy Directive, which sets a target of 20% renewables in the EU by 2020, must be effectively and rapidly implemented by Member States.
- ➔ To meet the binding energy target, the share of renewable electricity in the EU must increase from 15% to at least 34% by 2020.
- ➔ A European supergrid must be created by extending and upgrading the existing European electricity network.
- ➔ Competition in the electricity market needs to be improved.
- ➔ Polluters must pay for emitting CO₂, either through carbon taxes or an Emissions Trading System with full auctioning of allowances.
- ➔ Research funding for wind energy must be increased substantially.

¹ Assuming IEA 'World Energy Outlook 2008' forecast: fuel cost equivalent to \$110/bbl of oil).

² Assuming €25/t CO₂.





Photo: Siemens

By 2030 wind should produce 26-35% of the EU's electricity and save Europe €56 billion a year in avoided fuel costs.





Photo: iStockphoto

2 Electricity markets

➔ A single European electricity market with large amounts of wind power will bring affordable electricity to consumers, reduce import dependence, cut CO₂ emissions and allow Europe to access its largest domestic energy source.

Did you know?

- ➔ Until recently, Europe's electricity grids were dominated by power companies that made it difficult for newcomers to access the network.
- ➔ In 2009, the EU institutions adopted legislation (the "third liberalisation package") aiming to open up the power markets and make them fairer.
- ➔ Power companies now have to split up their power transmission and generation assets, although they can choose to retain some ownership over them.
- ➔ For competition to be effective, production and transmission activities of power companies should be completely separate – known as "full unbundling".
- ➔ This must be supported by the development and interconnection of the grids onshore and offshore, so that they become European highways of electricity trade.





Photo: EWEA/Winter

Effective power markets mean:

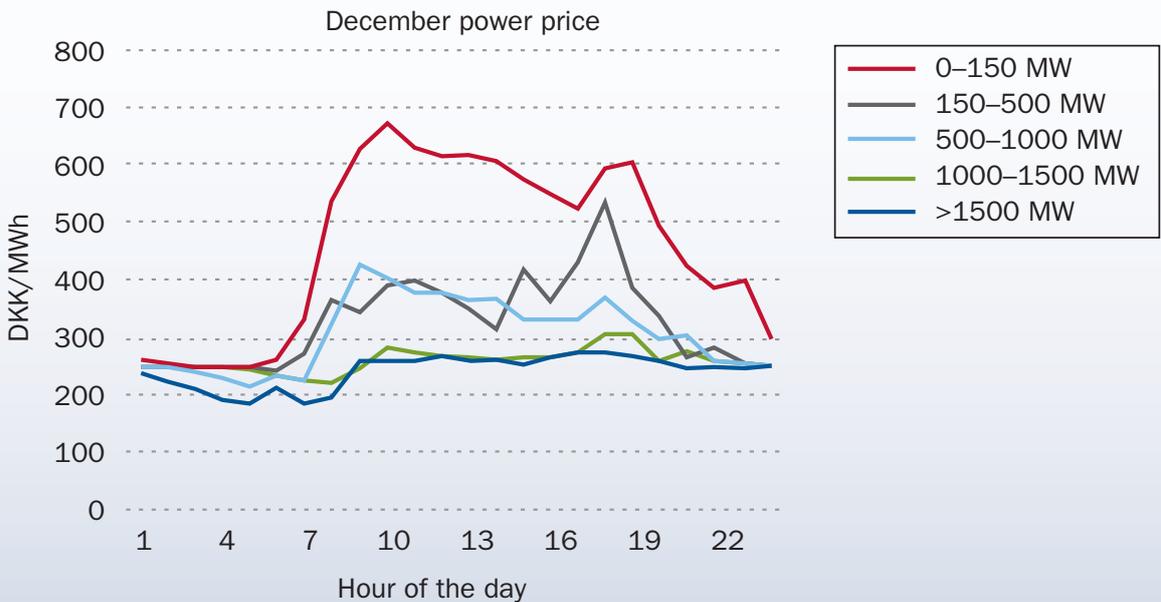
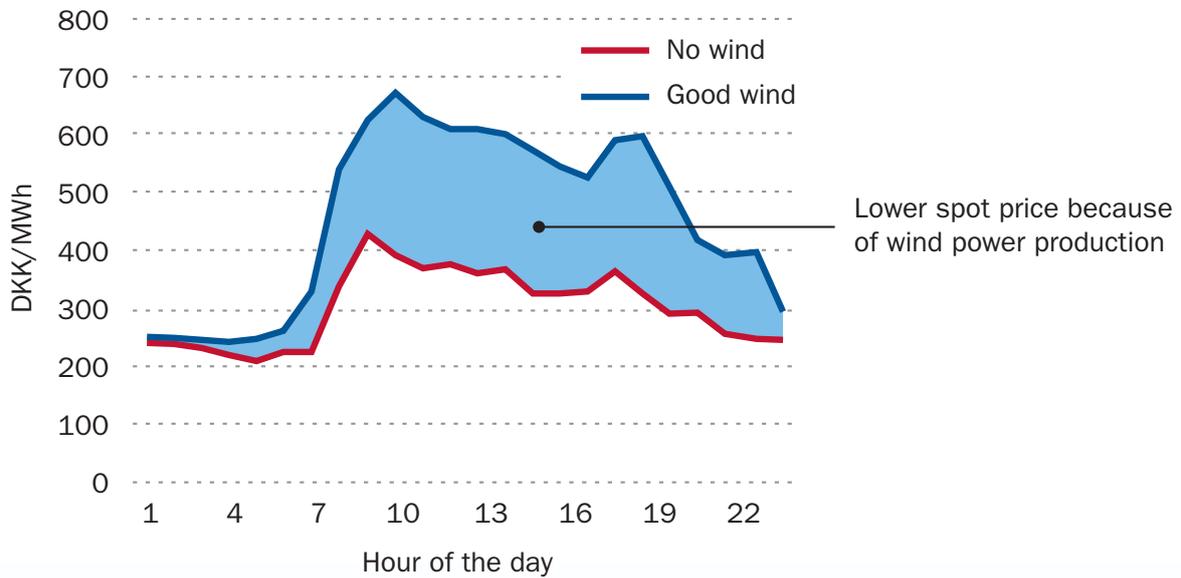
- ➡ Europe will be less dependent on fuel imports at ever increasing prices.
- ➡ Europe's energy security will improve.
- ➡ Power prices will go down as wind's low marginal costs push more expensive (and polluting) power sources out of the system.

What needs to be done?

- ➡ Europe needs a power system characterised by flexibility - with nimble markets (and an increased number of market participants) helping facilitate the integration of wind and other renewables - rather than one in which large-capacity, slow-ramping fossil and nuclear plants provide the bulk of power.
- ➡ Wind power producers should be allowed to give production forecasts as close to real time as possible, which would enable them to provide more reliable information ("reduced gate-closure times").
- ➡ Wind farms should be pooled together to provide power, so that their power levels stay consistent if the wind is blowing harder in one place than another. This would minimise costs.
- ➡ An intelligently managed smart grid using demand-side management techniques and storage capacities should be put in place. It should link generation and consumption of electricity irrespective of distance.



The impact of wind power on the spot power price in the west Denmark power system in December 2005



Source: Risoe DTU

The European Wind Industry calls for effective competition in a European electricity market.



Photo: Stiftung Offshore Energie/Detlef Gehring

3 The power grid

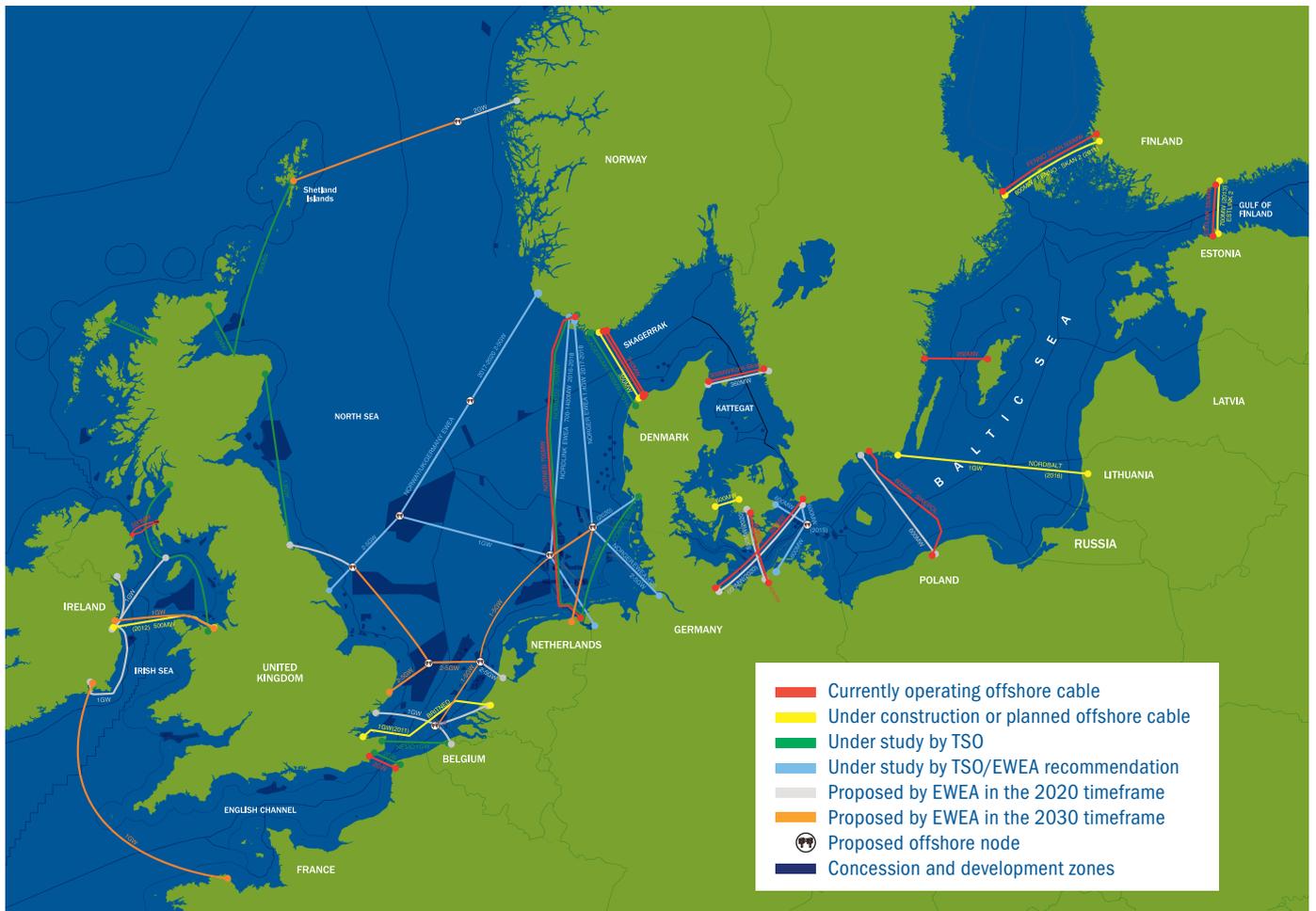
- ➔ We must stop thinking of electrical grids as national infrastructure and start developing them – onshore and offshore – to become European highways of electricity trade.
- ➔ The faster grids are developed, the faster we will have large-scale renewable energy when fuel import supplies are disrupted or the cost of fuel becomes too expensive.

Did you know?

- ➔ European electricity infrastructure is ageing and far too little has been invested in new grids.
- ➔ By 2020, power capacity equivalent to 42% of the EU's current capacity needs to be built to replace ageing power plants and meet the expected increase in demand.¹
- ➔ This is the ideal opportunity to build a Europe-wide, modern grid that connects offshore and onshore wind farms with consumers.
- ➔ Europe needs just such a grid, and properly functioning electricity markets, to cope with larger amounts of wind power and make electricity trade possible, driving down power prices.
- ➔ The Europe-wide grid will help enhance Europe's competitiveness and energy security, while creating hundreds of thousands of manufacturing and related jobs and technology exports.

¹ EWEA: Pure Power, 2009

EWEA's 20 year offshore network development master plan



EWEA's 20 year offshore network development master plan provides a step by step approach to planning Europe's offshore grid in the North and Baltic Seas, and is based on the:

- ➔ 11 currently operating offshore grids.
- ➔ 21 offshore grids currently under construction, planned or being studied by the grid operators in the Baltic and North Seas.
- ➔ Eight additional offshore grids proposed by EWEA in the 2020 timeframe.
- ➔ Six additional offshore grids proposed by EWEA in the 2030 timeframe.

EWEA urges the European Commission, when drafting its Blueprint for a North Sea Grid, and the European Network of Transmission System Operators, when drafting its biennial Ten-Year Network Development Plans, to incorporate EWEA's Offshore Network Development Master Plan.





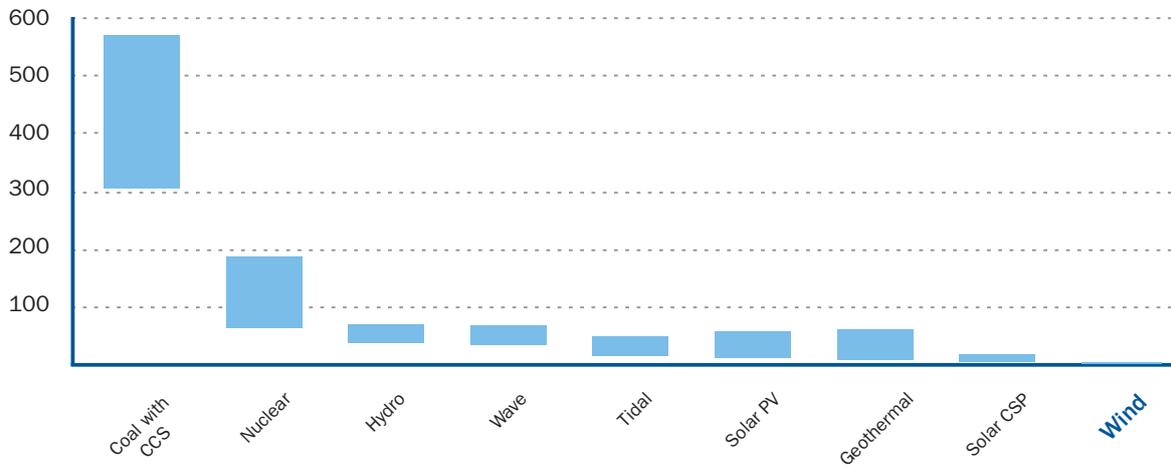
4 Climate

→ Zero-carbon wind energy is already helping tackle climate change, and will continue to do so as it replaces more and more traditional fuels.

Did you know?

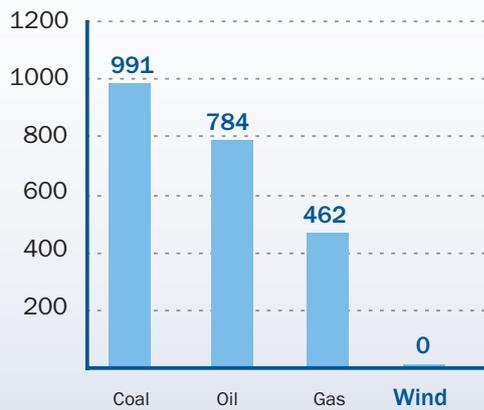
- ➔ Wind energy replaces polluting fossil fuels, and can be deployed and begin reducing CO₂ emissions immediately.
- ➔ In 2009, wind power in the EU avoided the emission of 106 million tonnes of CO₂, equivalent to taking 25% of cars in the EU – 53 million vehicles – off the road.
- ➔ In 2020, wind power in the EU will avoid the emission of 333 million tonnes (Mt) of CO₂ – 29% of the EU's 20% greenhouse gas reduction target.
- ➔ The marginal cost of wind power is minimal, so an increase in the amount of wind power in the electricity mix means more expensive and polluting technologies (oil, coal and gas) are pushed out of the market.
- ➔ It takes a wind turbine three to six months to produce the energy that goes into producing, operating and recycling the wind turbine after its 20 to 25 year lifetime.

Lifecycle greenhouse gases emissions per technology (g/kWh)



Source: Mark Jacobson - Stanford University - February 2009

Average CO₂ emissions from fossil fuel in EU



Source: IEA – World Energy Outlook 2008 – Emissions from fossil fuels

Wind energy emits no CO₂ in generating electricity, and has the lowest lifecycle emissions of any energy technology.



The EU's Emissions Trading System:

- ➡ Puts a cost on emitting CO₂. By auctioning permits to the power sector for emitting CO₂ from 2013, major polluters will have to pay for releasing greenhouse gases.
- ➡ This sends a clear message to investors: the cost of climate change, currently borne by society, will be increasingly shifted towards the polluter.

What is more:

- ➡ Wind energy emits no other greenhouse gases or air pollutants.
- ➡ It emits no particles (PM) which are carcinogenic and severely affect human health.

What do we need internationally?

- ➡ The EU to keep on leading the way on climate change.
- ➡ An international legally binding agreement on emissions reductions to be agreed as soon as possible to keep temperatures under the 2°C rise considered essential to avoid dangerous climate change.
- ➡ As part of an international agreement, the EU and other industrialised countries to commit to at least 40% reduction in greenhouse gas emissions by 2020 compared to 1990, with at least three-quarters of that coming from domestic action.
- ➡ By 2020, we need an overall global reduction of 25%-40% and by 2050 of 80-95% to give us a 50% chance of avoiding the 2°C temperature rise.
- ➡ The more advanced developing countries must end the use of fossil fuels and move rapidly to a renewable energy economy, with ambitious 2020 renewable targets.



Photo: Dave Walsh



5 Nature protection

- ➔ Wind energy is one of the cleanest, most environmentally friendly energy sources. Turbines' potential negative impacts are very limited, site specific and far outweighed by the environmental benefits.

Did you know?

- ➔ Wind energy emits no greenhouse gases or air pollutants.
- ➔ Wind energy can have positive local effects on biodiversity, and offers an opportunity to practice ecological restoration onshore and offshore, such as creation of new vegetation and animal habitats, improved fish stocks and other marine life.
- ➔ Wind farm developers are required to undertake an Environmental Impact Assessment to gauge all potential environmental effects before construction.
- ➔ Potential environmental impacts can be avoided and minimised by careful planning and siting, mitigation and compensation measures.

What about birds and bats?

- ➔ Wind power's overall impact on birds, bats, other wildlife and natural habitats is extremely low, compared with other human (and feline)-related activities.
- ➔ Bird protection NGOs recognise climate change as the main threat to bird species and wind energy is a key solution to climate change.
- ➔ Extensive efforts are made to avoid siting wind farms in areas which might attract large numbers of birds or bats, such as migration routes.



Causes of bird mortality	Annual bird mortality estimate
Buildings/windows	550 million
High tension lines	130 million
Cats	100 million
Vehicles	80 million
Pesticides	67 million
Communication towers	4.5 million
Wind turbines	28.5 thousand
Aeroplanes	25 thousand

Source: Erickson W., Johnson, G. and Young, D. (2005)

Wind power's impact on wildlife and natural habitats is extremely low, compared with other human (and feline) activities.





6 Public support

- ➔ Wind farms are popular. They bring a wealth of benefits to their local area.
- ➔ According to a 2007 survey, 71% of EU citizens support wind energy, while gas is supported by 42%, coal by 26% and nuclear power by just 20%.

Are turbines noisy?

- ➔ Noise from turbines is rarely heard at distances further away than 300m. Background noise from wind in trees, for example, would be louder.
- ➔ A Canadian study found "there is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects."¹
- ➔ The French Agency for Sanitary Security, Environment, and Work (AFSSET) concluded "noise generated by wind turbines does not have any direct health impact."

Do wind farms affect nearby property prices?

- ➔ According to a 2009 US Department of Energy funded report, there is no statistical evidence of changes in property values from wind energy projects.

What benefits do wind farms bring to local communities?

- ➔ Renting out land for wind farms can provide income.
- ➔ Local and regional taxes obtained from wind energy can enhance services.
- ➔ Jobs in maintaining turbines. The jobs and other benefits may help enhance property prices.

¹ 'Wind Turbine Sound and Health Effects: An Expert Panel Review', by W. David Colby, M.D. Robert Dobie, M.D. Geoff Leventhall, Ph.D. David M. Lipscomb, Ph.D. Robert J. McCunney, M.D. Michael T. Seilo, Ph.D. Bo Søndergaard, M.Sc.

Comparative noise for common activities

Source/activity	Indicative noise level (dB)
Threshold of hearing	0
Rural night-time background	20-40
Quiet bedroom	35
Wind farm at 350m	35-45
Busy road at 5km	35-45
Car at 65km/h at 100m	55
Busy general office	60
Conversation	60
Truck at 50km/h at 100m	65
City traffic	90
Pneumatic drill at 7m	95
Jet aircraft at 250m	105
Threshold of pain	140

Source: CIEMAT

Noise from wind in trees is louder than wind turbines at 300m.





7 Competitiveness



Photo: LM Glasfiber

- ➔ Wind energy hedges against unpredictable fuel and carbon costs, helps bring down the power price and is an industry in which Europe is a world leader.

Did you know?

- ➔ Because wind power uses no fuel, its cost can be predicted with great certainty unlike the fluctuations in the price of oil, gas, coal or carbon.
- ➔ The increase in the price of a barrel of oil from \$20 to \$80 has added \$45 billion to the EU's annual gas import bill.
- ➔ In 2008, wind power avoided fuel costs of €6.5 billion and CO₂ costs of €2.3 billion.

What about the future?

- ➔ Wind power will avoid carbon costs of €8.3 billion in 2020 and €15 billion in 2030.
- ➔ Wind energy will avoid fuel costs of €27.7 billion in 2020 and €55.5 billion in 2030.

Can wind make a difference to our economy?

- ➔ Wind power can reduce the electricity price because it has a low marginal cost, pushing out more expensive power generating technologies from the market.
- ➔ Investing in wind means that money going to fuel-exporting nations is put to work at home. In 2008, European manufacturers had a 60% share of the global market for wind turbines.





Photo: Oetkler



Photo: Siemens

8 Employment

- ➔ The wind energy sector generates thousands of green jobs and will be at the heart of a renewable energy economy. But more well-trained workers are needed to fill the vacancies now and in the future.

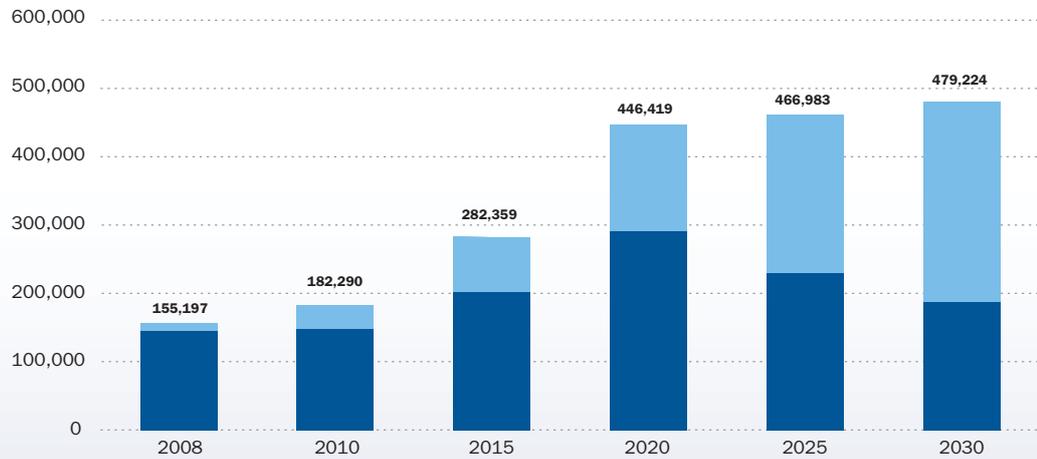
Did you know?

- ➔ Wind power generates jobs ranging from manufacturing to project management.
- ➔ The European wind energy sector employs 192,000 people.
- ➔ Between 2002 and 2007, direct employment in the sector increased by 125% - an average of 33 new jobs every day, seven days a week in Europe.
- ➔ Jobs in wind energy have transformed cities and regions such as Bremerhaven in Germany, Nakskov in Denmark and Navarre in Spain.

What about the future?

- ➔ There should be 446,000 jobs in wind in Europe by 2020, and 479,000 by 2030.
- ➔ According to the European Commission the green energy sector could create 2.8 million new jobs and add 1.1% to GDP growth if the EU's 2020 renewables target is met.
- ➔ The wind industry needs more people to fill the available and future jobs – schools and universities need to promote careers in renewables, and training must be provided to allow workers to transfer to the wind power sector.

Wind energy sector employment (2008-2030)



■ Onshore	143,782	148,057	200,870	290,276	228,104	185,478
■ Offshore	11,415	34,232	81,489	156,143	238,879	293,746

Source: EWEA

European wind power = European jobs





9 Offshore

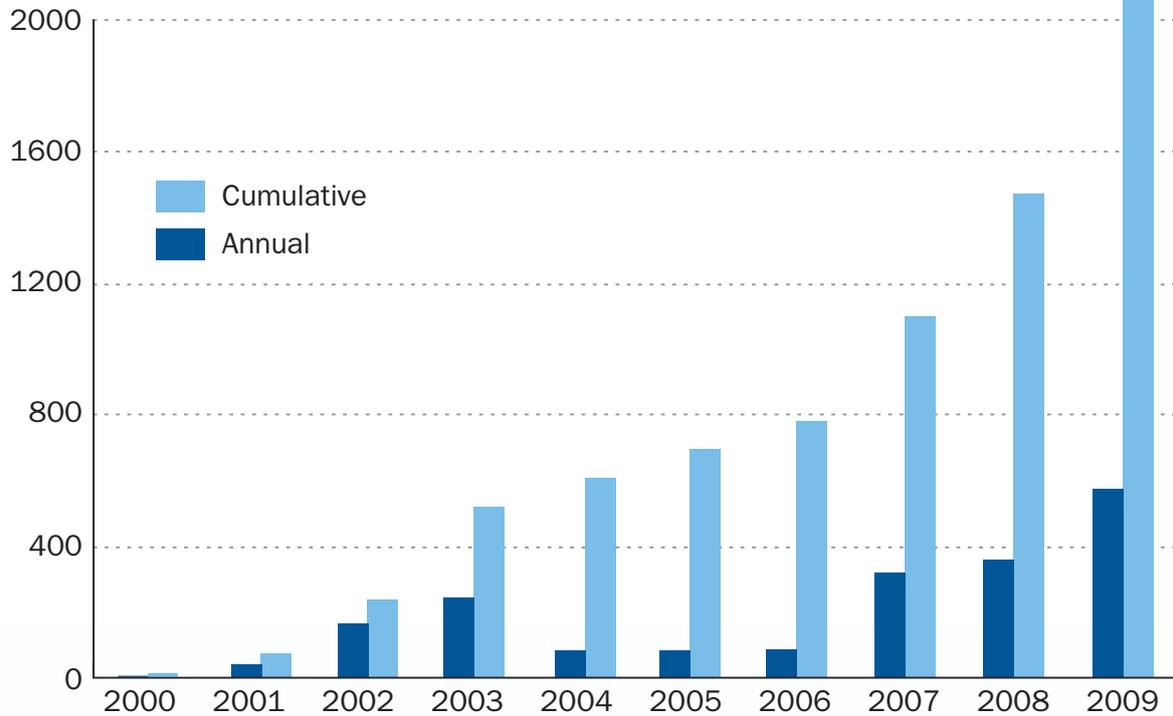
→ Europe's offshore winds can bring a new, multi-billion euro industry with thousands of green jobs, a new renewable energy economy, with Europe established as the world leader in a technology that provides clean, indigenous and affordable electricity.

Did you know?

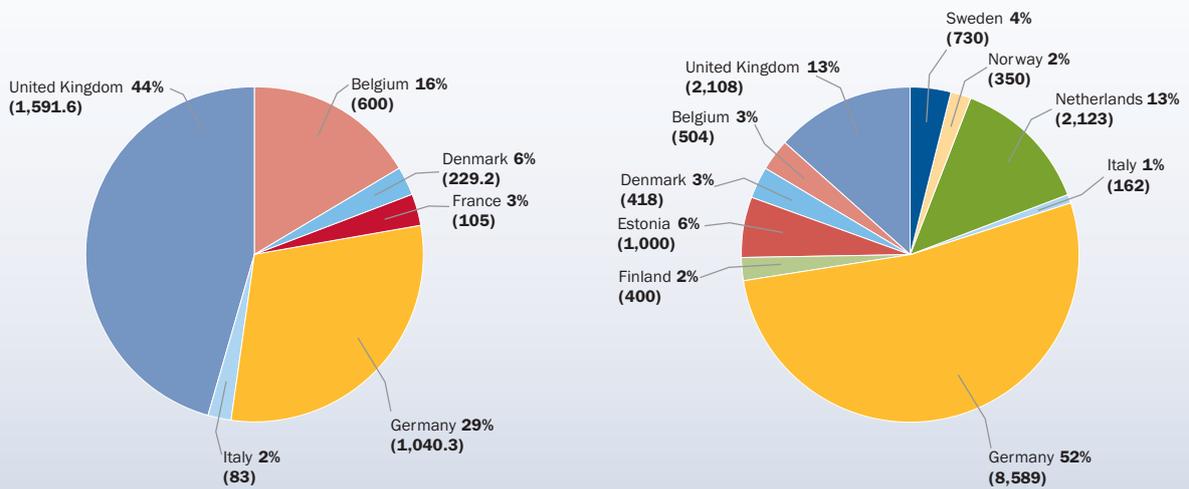
- ➔ There is enough wind around Europe's coasts to power Europe seven times over.
- ➔ Europe is the world leader in offshore wind with a cumulative capacity of 2,063 MW spread across 39 offshore wind farms in nine European countries.
- ➔ Other offshore wind projects totalling over 100 GW are already in various stages of planning. If realised, these projects would produce 10% of the EU's electricity whilst avoiding 200 million tonnes of CO₂ emissions each year.

Photo: Risø Institute

Annual and cumulative installed offshore capacity in MW 2000-2009



Share of offshore wind capacity under construction / Share of consented offshore wind capacity per country



Source: EWEA

Offshore wind energy could become a new multi-billion € industry.

What are the offshore figures?

- ➡ In 2009, 582 MW were connected to the grid in Europe. This represents a growth rate of 56% compared to the 374 MW installed during 2008.
- ➡ The UK and Denmark are the current leaders, with a 44% and 30% share of total EU capacity. In 2009, five countries built new offshore wind farms: UK (284 MW), Denmark (237 MW), Sweden (30 MW), Germany (30 MW), Norway (2.3 MW).
- ➡ EWEA has a target of 40 GW of offshore wind in the EU by 2020, implying an average annual market growth of 28% over the coming 12 years.
- ➡ For 2010, EWEA expects the completion of 1,000 MW more of offshore wind capacity, equivalent to a market growth of 71% compared to 2009.
- ➡ 2009 market growth was 56% compared to 2008, so provided certain other steps are taken, EWEA's 2020 target could be met and even surpassed.

What other steps need to be taken?

- ➡ A Europe-wide offshore electricity grid must be put in place to bring power from where the wind is blowing offshore to where the electricity is consumed.
- ➡ This would smooth the variability of the wind power produced and improve the ability to trade electricity within Europe, boosting Europe's energy security.
- ➡ The supply chain needs to be developed so there are no bottlenecks, such as a lack of installation vessels.
- ➡ Maritime spatial planning should be put in place to give the industry long-term visibility and allow forward planning.
- ➡ Offshore research and development needs to be well funded to maintain Europe's technological lead.





Photo: E.ON

There is enough wind around Europe's coasts to power Europe seven times over.



10 Research & technology

Photo: LM Glassfiber

- ➔ Europe needs more research funding to maintain global leadership in wind energy, and ensure technology develops to allow the EU to meet its 2020 and 2050 targets.

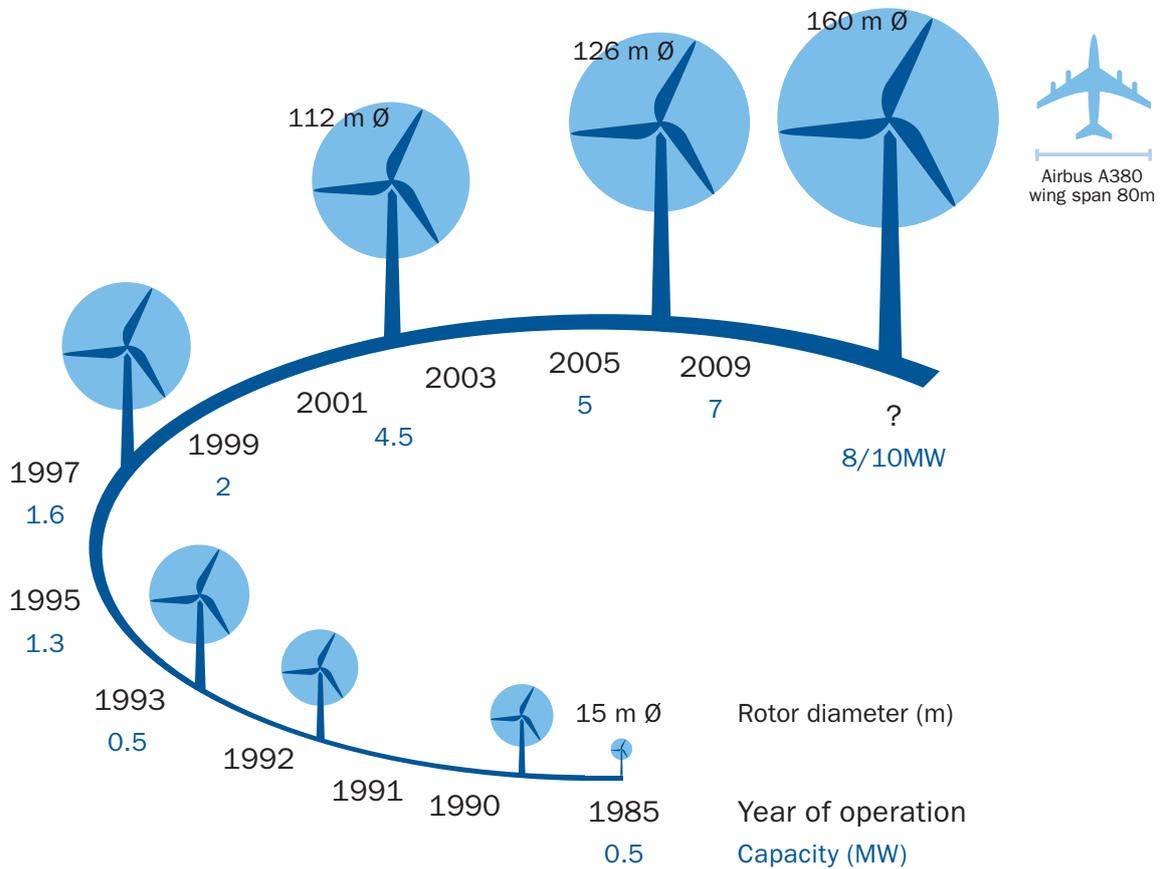
Did you know?

- ➔ Europe is the global leader in wind energy technology, yet before 2002 only 1% of EU energy research funds were allocated to wind energy.
- ➔ The European Commission's 2009 Communication "Investing in the Development of Low Carbon Technologies" proposes investing €6 billion of private and public funds in wind power research between 2010 and 2020.
- ➔ Europe is the global leader in wind energy technology, although in 2007 the European Commission provided only 3% of R&D investment in wind energy, while 76% came from the private sector.

Key areas for wind energy research:

- ➔ Improving the design and layout of wind farms.
- ➔ Increasing the reliability, accessibility and efficiency of wind turbines.
- ➔ Optimising the maintenance, assembly and installation of offshore turbines and their substructures.
- ➔ Demonstrating large wind turbine prototypes and large, interconnected offshore wind farms.
- ➔ New methods of grid management to allow high levels of wind power in the system.
- ➔ Expansion of education schemes and better training facilities.

Size evolution of wind turbines over time



In 25 years wind energy technology has developed enormously. With more R&D investment it can continue to become even more efficient and high performing.

