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GLOBAL WIND ENERGY COUNCIL

GLOBAL WIND ENERGY OUTLOOK | 2012

NOVEMBER 2012

The Global Wind Energy Council and Greenpeace International are pleased to present this fourth edition of the Global Wind Energy Outlook for 2012, the latest product of a collaboration that goes back to 1999. A lot has happened in the intervening years.

Wind power has now established itself as a mainstream electricity generation source, and plays a central role in an increasing number of countries' immediate and longer term energy plans. After 15 years of average cumulative growth rates of about 28%, the commercial wind power installations in about 80 countries at the end of last year totalled about 240 GW, having increased by more than 40 times over that same period. Twenty two countries have more than 1,000 MW installed.

The very fact of the size of the industry, however, means that it is not immune to the seismic shocks that have battered the global economy over the past several years. Demand growth is very slow, non-existent or negative in most of the OECD, so demand for new power generation of any kind is slim, and the competition is fierce. China has been the main driver of the growth of the industry for the last five years, but we said it couldn't go on forever, and now it's stopped: we don't expect significant growth in the Chinese market until after 2015, although it is still likely to be the market leader. Brazil, India, Canada and Mexico are very dynamic markets, but cannot yet make up for the lack of growth in the traditional markets in Europe, the US and China. There are many exciting new markets in Latin America, Africa and Asia where we see major potential for growth in the medium to long term; but absent a new means for putting a global price on carbon, new demand growth in the OECD borne on a strong economic recovery, or some other unforeseen development, the industry's rate of growth will slow substantially in the coming few years.

But the Global Wind Energy Outlook isn't about the next few years, it's about what the industry will look like in 2020, 2030 and beyond. Despite the current market turbulence, all of the fundamentals which have driven the dramatic growth of the industry over the past two decades are still there, and will only get stronger over time: energy security; electricity price stability; job creation and local economic development; reducing fresh water consumption and pollution; reducing local air pollution; and of course reducing carbon dioxide emissions.

As in the past, we use the International Energy Agency's World Energy Outlook as a baseline in terms of the definition of regions, GDP, electricity demand, and population growth, etc. But rather than the old 'reference' scenario, which defined a business-as-usual that everyone knew just wasn't going to happen, the IEA's New Policies scenario is now the central scenario in the World Energy Outlook, and we have adopted it as our baseline as well.

With a newly updated Energy Efficiency Demand scenario, we once again examine three development paths for the industry: the IEA New Policies scenario, the GWEO Moderate scenario, and the GWEO Advanced scenario; and measure them against two different demand scenarios to define a range of possible futures for the sector, both regionally and globally. We hope that you find it useful.

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1 | WIND ENERGY AND CLIMATE CHANGE

Burbo Bank, Liverpool Bay, UK © Wind Power Works

Public concern and political pressure to tackle the climate problem had its most recent peak at the UN climate negotiations in Copenhagen in December of 2009. The profound disappointment at the failure of governments to come to grips with the issue resulted in climate change being placed on the back burner for a few years, both politically, and in the press. But the press (and the public) are waking up.

New research from NASA's Goddard Institute for Space Studies[1] demonstrates that recent extreme weather events, particularly the scorching summers in the US and Russia and the drought which has severely impacted this year's US corn crop are a direct consequence of climate change. This year's Climate Vulnerability Monitor[2] cites 400,000 deaths annually already attributable to climate change, with economic costs already reaching 1.2 trillion USD, or roughly 1.6% of global GDP; and this is, of course, set to rise dramatically. The record retreat of the Arctic sea ice this past summer season is a grim reminder that climate change is about physics, not politics; even though the ability of humanity to deal with the problem is ultimately determined by politics, at least for now. A time will come in the not too distant future when the issue is out of hands of the politicians and in the hands of the emergency services.

But the politics don't look very good at the moment. At the UN climate negotiations in Cancún in 2010, governments agreed that their overall objective was to keep global mean temperature rise below two degrees C above the pre-industrial average, with more than 100 countries arguing that it should be even lower. In order to achieve that target, what all models agree is that at a minimum, global emissions need to peak and begin to decline well before the end of this decade. Despite that, a year later at the negotiations in Durban, in what was widely hailed as a 'breakthrough', governments agreed to begin negotiations on a new agreement which would only be completed in 2015 and which would not come into effect until 2020. This means that the new work stream agreed in Durban "to raise collective ambition" will be critical to achieving that first and most important target if we are to avoid the worst ravages of climate change. We do not have time for eight more years of international negotiations before we get started in earnest.

Unfortunately, there is significant evidence that we are going backwards. Despite repeated warnings about the damage to both the climate and the economy from subsidies to fossil fuels, they continue to rise, by as much as 50% over just the past two years, according to the IEA, whose Chief Economist Fatih Birol has been one of the least likely but most vocal critics of the 'inconvenient truth' about achieving agreed climate targets, while governments are spending their money taking us exactly in the opposite direction. The 21st century equivalent of the old Bulletin of Atomic Scientists doomsday clock, The Climate Action Tracker[3], puts us on track at the moment to see about 3.3° C of warming by the end of the century on the basis of existing commitments. There is currently a 'gap' of 10 billion tonnes of CO_2 per year[4] between current confirmed national emission reduction targets and where we need to be by 2020; and even if the pledges made in Copenhagen and confirmed in Cancún are met in full, we're still looking at a gap of 6 billion tonnes per year; and global emissions continue to rise.

Greece © *Harry Michalas/ GWEC*

There are those who now say that 2° C is 'out of reach' and that we're 'too late', and while that may or may not be politically the case, it is certain that we have the technology and the finance to make the shift very quickly should the political leadership appear. We know that this can be achieved with current technologies, in the power sector and elsewhere; and if the political direction was clear, we could probably achieve a great deal more.

1 *Hansen, J., Mki. Sato, and R. Ruedy, 2012: Perception of climate change. Proc. Natl. Acad. Sci., doi:10.1073/pnas.1205276109.*
2 *http://daraint.org/climate-vulnerability-monitor/climate-vulnerability-monitor-2012/*
3 *http://climateactiontracker.org/*
4 *K. Blok, N. Höhne, K. van der Leun, and N. Harrison, Bridging the greenhouse-gas emissions gap, Nature Climate Change 2, 471–474 (2012) doi:10.1038/nclimate1602 - http://dx.doi.org/10.1038/nclimate1602*

WHAT ROLE CAN WIND ENERGY PLAY IN 'BRIDGING THE GAP'[5]?

So where does wind energy fit into this equation?

Unfortunately, there is no silver bullet, and no single answer to the climate problem. It cuts across the entirety of the ways in which 21st century civilization produces and consumes energy, the way it practices agriculture and forestry, the chemicals we make and release into the biosphere, and how we treat our waste. Nonetheless, wind energy has a crucial role to play.

The power sector is responsible for more than 40% of all carbon dioxide emissions from burning fossil fuels, and about 25% of our total greenhouse gas emissions. If we are going to make significant emission reductions in the near to medium term, then we have to look at the power sector. In the period out to 2020, we don't have too many options.

The first of these is energy efficiency. As shown in study after study for the last four decades and more, there are innumerable cost-effective ways to save energy with existing technologies. Why don't we do it? Well, the 600 billion USD or more in subsidies to the fossil industry might be one reason, and the lack of an effective price on carbon is another.

The second is fuel switching from coal to gas - a significant amount of which is happening at the moment in the US and elsewhere, although the development of the cheap shale gas in the US has a climate downside in terms of the increased methane emissions associated with its production – but that problem can be mitigated, if there was the will (and the requirement) to do so.

The third, of course, is renewable energy, and in the time frame out to 2020 and for a good while beyond that, the largest contributor will be wind energy. Wind power will reduce emissions by about 400 million tonnes in 2012. How much can it be by 2020?

Up until two years ago, the industry was on track to meet the GWEO Advanced scenario, on a trajectory to surpass 1,000 GW installed by 2020, and saving 1.6 billion tonnes of CO_2 per year; along the lines set out in the original *Wind Force 10*[6] publication from 1999.

Since the end of 2009, however, we've fallen back towards the Moderate scenario track. Coincidence? Maybe, but the same forces that have put the climate change agenda on the back burner for the past couple of years – recession in most of the OECD, the lack of EU ambition to 'fix' its emission trading system, fickle policy in the US and elsewhere – have contributed to slower growth in the wind energy sector – a flat market in 2010, modest growth in 2011 and again this year; and a very uncertain 2013 market. On the Moderate scenario track out to 2020 we would still see a cumulative capacity of more than 750 GW, and annual CO_2 savings on the order of 1 billion tonnes/annum. Not insignificant, and better than the old IEA reference scenario upon which the 'gap analysis' is based, but not sufficient for wind energy to play its full part in combating the climate crisis.

So what do we need to start growing rapidly again, to make up our own half-a-gigatonne gap?

- An end to the partisan bickering over energy policy in the US which creates the destructive boom-bust cycles in that critical market;
- Resolution of grid, certification, transparency and quality issues in China;
- Flushing the free allocations out of the European Emissions Trading System;
- A re-vitalization of the carbon markets – the Kyoto Protocol's Clean Development Mechanism has more than 100 GW of wind energy projects in the pipeline, but in the absence of a new demand for the credits, reflecting increased emissions reduction ambition from governments, the price for the credits are so low as to be almost immaterial;
- The political courage on the part of at least some governments to tackle the subsidies issue in the conventional energy sector;
- Perhaps most importantly, stable, bankable policy in as many national energy markets as possible.

Any one of the above would contribute significantly to re-establishing rapid growth in the wind energy sector. We can only hope that the resurgence of public concern about climate change and the accompanying political pressure will generate the kind of political leadership necessary to get us back on track towards a sustainable energy future, with wind power making its full contribution towards to protecting the climate system for ourselves and for future generations.

5 *The 'gap' language here is borrowed from work done by ECOFYS, see note 4*
6 *www.inforse.dk/doc/Windforce10.pdf*

Horse Hollow, Texas, US © *Wind Power Works*

2 | THE GLOBAL WIND ENERGY OUTLOOK SCENARIOS

Rio do Fogo, Rio Grande do Norte, Brazil © *Wind Power Works*

The Global Wind Energy Outlook explores the future of the wind energy industry out to 2020, 2030 and up to 2050, with a range of three scenarios: The New Policies scenario from the International Energy Agency (IEA) and two scenarios developed especially for this publication, the GWEO Moderate scenario and GWEO Advanced scenario.

The latter two scenarios have evolved over the years as collaboration between the Global Wind Energy Council (GWEC), Greenpeace International, and the German Aerospace Centre (Deutsches Zentrum für Luft- und Raumfahrt – DLR). These projections on the future of wind energy development have contributed to an on-going series of larger studies on global sustainable energy pathways up to 2050 conducted by DLR and Greenpeace in collaboration with a number of industry associations, including GWEC and the European Renewable Energy Council (EREC).[1]

The current volatility and seismic shifts underway in the global economy, and the uncertainty over international climate policy, makes looking into the future of the wind industry even more hazardous than usual. Here we present three scenarios for each of the IEA-defined regions as well as global totals, looking towards 2020 and then to 2030 – with longer term projections out to 2050 in the annex table. A brief description of the underlying assumptions and purpose of each scenario is outlined below.

IEA NEW POLICIES SCENARIO

Previously, we have used the IEA World Energy Outlook's 'Reference scenario' as the baseline in this exercise. That scenario is basically an assumption of the status quo, and while it still exists within the World Energy Outlook (WEO) framework (as the 'Current Policies' scenario), it is no longer the central scenario. The ''New Policies' scenario is based on an assessment of current directions and intentions both national and international energy and climate policy, even though they may not yet have been incorporated into formal decisions or enacted into law. Examples of this would include the emissions reduction targets adopted in Cancun in 2010, the various commitments to renewable energy and efficiency at national and regional levels, and commitments by governments in such fora as the G-8/G-20 and the Clean Energy Ministerial. The New Policies scenario has taken its place at the center of the WEO analysis, although the difference between that and the old Reference scenario when it comes to wind power is marginal. The IEA scenarios go out to 2035 and were extrapolated out to 2050 for comparison purposes by DLR.

GWEO MODERATE SCENARIO

The GWEO 'Moderate' scenario has many of the same characteristics as the IEA New Policies scenario, taking into account all policy measures to support renewable energy either already enacted in the planning stages around the world, and at the same time assuming that the commitments for emissions reductions agreed by governments at Cancun will be implemented, although on the modest side. At the same time it takes into account existing and planned national and regional targets for the uptake of renewable energy in general and wind energy in particular, and assumes that they are in fact met.

Through the five year period out to 2016, the Moderate scenario is very close to our annual five year market forecast, based on industry orders and planning as well as intelligence from our global network about new and emerging markets. After 2016 it is difficult to make a precise forecast given the current set of global uncertainties.

GWEO ADVANCED SCENARIO

The most ambitious scenario, the 'Advanced' scenario explores the extent to which the wind industry could grow in a best case 'wind energy vision', but still well within the capacity of the industry as it exists today and is likely to grow in the future. It assumes an unambiguous commitment to renewable energy in line with industry recommendations, the political will to commit to appropriate policies and the stamina to stick with them.

It also assumes that governments enact clear and effective policies on carbon emission reductions in line with the now universally agreed objective of keeping global mean temperature rise below 2°C above pre-industrial temperatures. Wind power is an absolutely critical technology to meeting the first objective in the battle to stay below 2°C – which is getting global emissions to peak and begin to decline before the end of this decade.

1 *See http://www.energyblueprint.info*

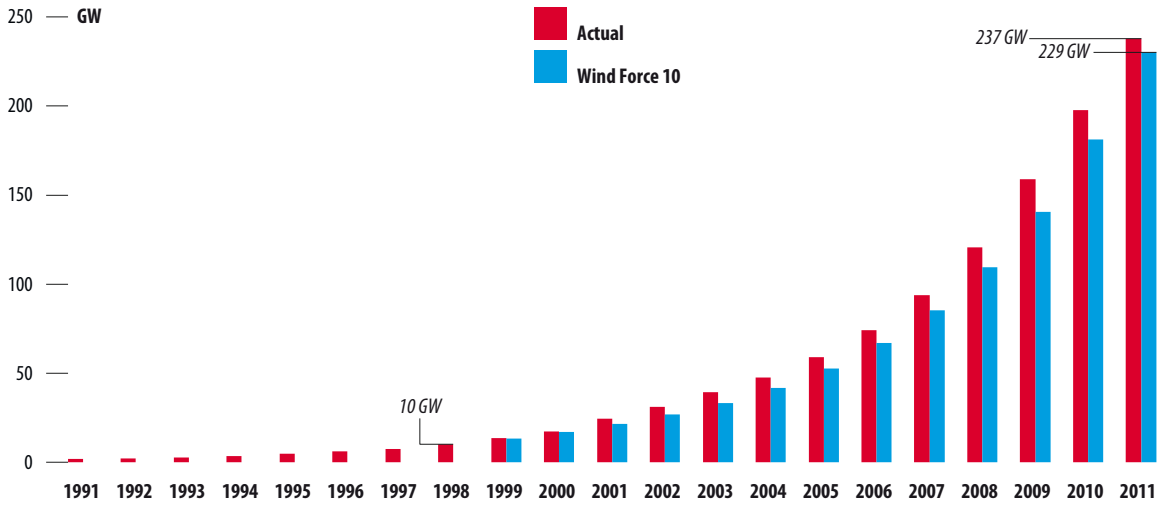
GLOBAL SCENARIO RESULTS

While the IEA New Policies scenario shows a flat and then slightly decreasing market for wind power for the next two decades, the GWEO scenarios paint a picture of two different futures:

The Moderate scenario is more likely in a world which carries on more or less the way it has been, with wind power continuing to gain ground but still struggling against heavily subsidized incumbent energy sources, and with the patchwork of carbon emission reduction measures that exist at present, with a low price on carbon emissions, where one exists at all.

The Advanced scenario shows the potential of wind power to produce 20% or more of global electricity supply in a world where there is strong political commitment and international cooperation to meeting already agreed climate change goals, enhancing energy security, dramatically reducing fresh water consumption and creating millions of new jobs around the world. Which future will we choose?

1999 *WIND FORCE 10* BLUEPRINT AND ACTUAL DEVELOPMENT. TOTAL GW WIND CAPACITY INSTALLED GLOBALLY



A LOOK BACK AT WIND FORCE 10

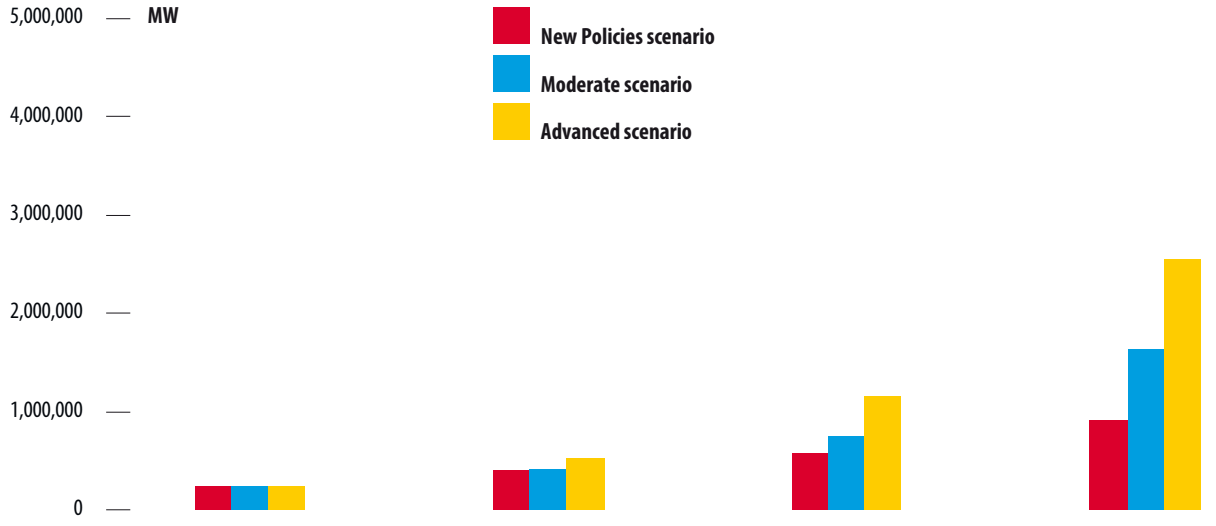
In October of 1999, the wind industry published its first global forecast for 2020, which from that date seemed unimaginably far in the future. Coming off a very successful year for the industry in 1998 when more than 2,500 MW of wind power was installed to bring the global total to over 10,000 MW, the European Wind Energy Association, Greenpeace International, and the Forum for Energy and Development launched *Wind Force 10*[2], outlining a pathway for wind power to achieve 10% of global electricity supply by 2020. With analysis provided by Birger Madsen of BTM Consult, the blueprint was designed to show what was possible with all possible policy support. Many dismissed the analysis as pie-in-the-sky, but the reality of the industry more than a decade later tells a different story.

The scenario was refined and updated several times over the years until with the addition of the MESAP/PlaNet model supplied by DLR in 2006 it became the Global Wind Energy Outlook, a joint bi-ennial publication by the Global Wind Energy Council and Greenpeace International, of which this is the fourth. But the fascinating thing is how closely the actual development of the industry since 1998 has tracked that original scenario as shown in the figure below. The original blueprint has become what we now refer to as our 'Advanced scenario', and although arrived at through much more scientific means, it stays basically the same in total numbers, although the regional distribution is quite different.

Although the industry has developed along the lines of our Advanced scenario up until the last few years, we are now moving more towards the 'Moderate' scenario. We need visionary policymakers to create the conditions to get us back on the Advanced track.

2 See www.inforse.dk/doc/Windforce10.pdf

GLOBAL CUMULATIVE WIND POWER CAPACITY



	2011	2015	2020	2030
New Policies scenario				
[MW]	237,699	397,859	586,729	917,798
[TWh/a]	583	976	1,439	2,412
Moderate scenario				
[MW]	237,699	425,155	759,349	1,617,444
[TWh/a]	583	1,043	1,863	4,251
Advanced scenario				
[MW]	237,699	530,945	1,149,919	2,541,135
[TWh/a]	583	1,302	2,821	6,678

CAPACITY GROWTH

ASSUMPTIONS ON GROWTH RATES

Growth rates in the GWEO scenarios are based on a combination of historical trends, current and planned policies, new and emerging markets for wind power, and assumptions on the direction of overall climate and energy policy. While double-digit growth rates as assumed in both the Moderate and Advanced scenarios out to 2020 may seem high for a manufacturing industry, actual wind industry cumulative growth rates have averaged about 28% for the past fifteen years. Interestingly, annual market growth rates over the period are also about 28%, although the inter-annual variability is much higher due to the vicissitudes of the marketplace and the state of the global economy. The cumulative market growth figures are a more useful way to look at the industry over the longer term.

In the Advanced scenario, cumulative growth rates start off well below the historical average at 21%, recover slightly in the middle of this decade and then taper off to 13% by the end of the decade, dropping to 6% by 2030. The Moderate scenario starts with about 19% growth in 2012, tapering off gradually to 11% by 2020 and then also to 6% by 2030, while the IEA New Policies scenario starts at 16% in 2012, sinking to 6% by 2020 and then to 4% by 2030.

It should be borne in mind that cumulative market growth figures will inevitably drop over time in almost any scenario as the size of the cumulative market grows; although even small percentage increases a decade out from now will mean a large actual increase in the quantity of wind power deployed.

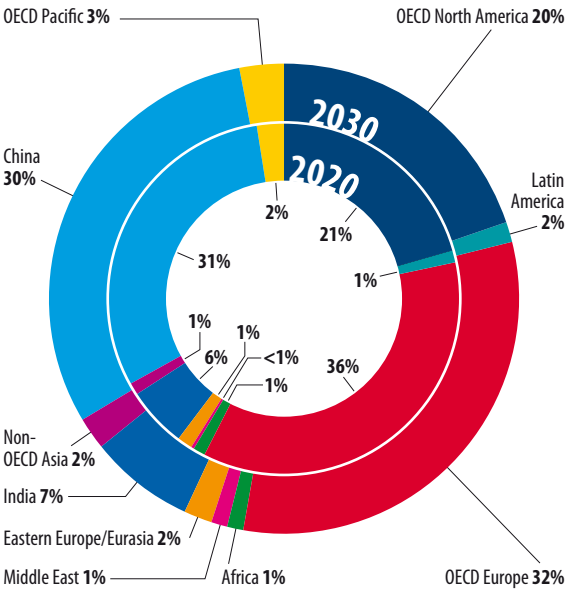
SCENARIO RESULTS

The IEA New Policies scenario projects that annual wind energy markets will stay essentially flat out to 2015, and then shrink to about 10% below the 2011 market for the second half of this decade. It then projects a gradual decrease in the annual market to 2030 and remains flat for the rest of the period. On the basis of this, cumulative installed capacity would still reach 587 GW by 2020, and 918 GW by 2030. Ironically, the 2020 number of 587 GW is almost exactly the same as the IEA Reference scenario predicted for 2030 two years ago.

The GWEO Moderate scenario follows the lines of our short term market projections out through 2016, with annual market size topping 70 GW by 2020 for a total cumulative installed capacity of 759 GW by that date. We have taken into account what looks like a very difficult year in 2013, which contributes to a slightly more conservative projection for 2020 than we made two years ago, even though the market has outperformed the moderate scenario over the past two years. Under this scenario, growth would continue throughout the 2020s, with annual market size approaching 100 GW per year and a total installed capacity of about 1,600 GW by 2030.

The GWEO Advanced scenario maintains ambitious growth rates throughout this decade, assuming that current market difficulties are overcome in the near future. With annual market size topping 130 GW by the end of the decade, it assumes that manufacturing capacity continues to increase while market demand increases to fill it. Total installed capacity reaches 1,150 GW by 2020 and more than 2,500 GW by 2030, reflecting a full commitment to decarbonising the global electricity supply which we need to do sooner rather than later.

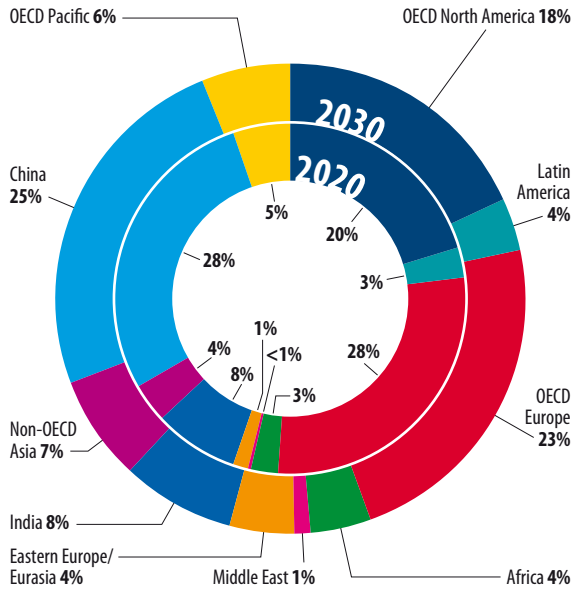
REGIONAL BREAKDOWN: NEW POLICIES SCENARIO



	2020	2030
OECD North America	121,238 MW	182,354 MW
Latin America	6,241 MW	13,868 MW
OECD Europe	211,319 MW	288,333 MW
Africa	5,372 MW	10,789 MW
Middle East	2,317 MW	11,436 MW
Eastern Europe/Eurasia	7,424 MW	17,271 MW
India	32,933 MW	66,400 MW
Non-OECD Asia	6,375 MW	21,222 MW
China	179,498 MW	279,017 MW
OECD Pacific	14,012 MW	27,109 MW
Global Total	**586,729 MW**	**917,798 MW**

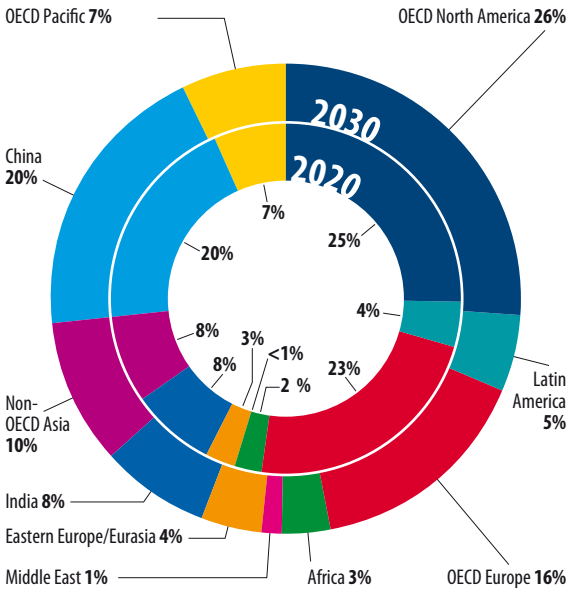
Scroby Sands Offshore Wind Farm, Great Yarmouth © *Ben Alcraft/RenewableUK*

REGIONAL BREAKDOWN: MODERATE SCENARIO



	2020	2030
OECD North America	155,208 MW	296,705 MW
Latin America	21,903 MW	56,075 MW
OECD Europe	211,276 MW	371,627 MW
Africa	19,027 MW	64,336 MW
Middle East	2,150 MW	16,181 MW
Eastern Europe/Eurasia	10,383 MW	70,374 MW
India	59,351 MW	124,826 MW
Non-OECD Asia	27,083 MW	119,476 MW
China	214,445 MW	400,130 MW
OECD Pacific	38,523 MW	97,715 MW
Global Total	**759,349 MW**	**1,617,444 MW**

REGIONAL BREAKDOWN: ADVANCED SCENARIO



	2020	2030
OECD North America	290,805 MW	665,938 MW
Latin America	47,970 MW	134,411 MW
OECD Europe	262,797 MW	396,728 MW
Africa	28,117 MW	82,972 MW
Middle East	2,180 MW	37,024 MW
Eastern Europe/Eurasia	32,369 MW	104,707 MW
India	89,299 MW	191,711 MW
Non-OECD Asia	90,768 MW	250,342 MW
China	230,912 MW	499,614 MW
OECD Pacific	74,702 MW	177,690 MW
Global Total	**1,149,919 MW**	**2,541,135 MW**

PRODUCTION AND SHARE OF ELECTRICITY SUPPLY

ASSUMPTIONS ON TURBINE CAPACITY

The rated output, rotor diameter and average height of wind turbines have steadily increased over the years. While the average size of turbines varies substantially by country and region, the average turbine installed in 2011 was 1.76 MW, against an average of 1.21 MW for all currently operating turbines worldwide. This trend is expected to continue as larger and larger machines are developed for the offshore industry, and larger and more efficient turbines are developed to extract the most energy from new sites as well as for repowering old sites, many of whose turbines are nearing their design lifetimes of 20 years. The need for substantial and increased repowering has been built into the GWEO scenarios.

ASSUMPTIONS ON CAPACITY FACTORS

The 'capacity factor' of a wind turbine or a wind farm refers to the percentage of the nameplate capacity that a turbine will deliver in terms of electricity generation over the course of a year. This is primarily governed by the wind resources in the particular location, but is also affected by the efficiency of the turbine, its suitability for the particular location, the reliability of the turbine and how well the wind project is managed. For example, a 1 MW turbine operating at a 25% capacity factor will deliver 2,190 MWh of electricity during the course of one year.

Average capacity factors globally today are about 28%, but vary widely from region to region, and are generally increasing with rapid new developments in very windy locations in Brazil, Mexico, offshore and elsewhere. However, there is also an increased emphasis on developing new turbines for new locations with lesser wind resources but which may be closer to load centers. Therefore, we have left the average global capacity factor at 28% for the period out to 2030, increasing to 30% after that date. The reality is that it will probably be greater than that, but given the wide variations within the IEA regions we have used for the GWEO scenarios, we have used the same global averages across the regional analyses as well.

PROJECTIONS FOR ELECTRICITY DEMAND DEVELOPMENT

While it is useful to calculate the actual electricity production from the global installations of wind power, it is also helpful to put it in the context of global electricity demand, and to thereby determine what percentage of that growing demand for power wind energy can supply. Each of the three scenarios in this study is set against two different projections for the future growth of electricity demand: the IEA (Reference) demand projection, and the 'Energy Efficiency' demand projection.

IEA DEMAND PROJECTION

As a baseline we have used the IEA's electricity demand projection from the New Policies scenario from the 2011 World Energy Outlook, including its assumptions on population and GDP growth, extrapolated out to 2050 by DLR. Again, this assumes some measures to curb emissions growth and create a more sustainable energy future, but does not foresee major shifts.

With these assumptions, the scenario looks for electricity demand to grow from over 18,000 TWh last year to more than 24,000 TWh by 2020, and to just over 30,000 TWh by 2030; basically double what it was in 2005.

ENERGY EFFICIENCY DEMAND PROJECTION

We also measure our progress against an Energy Efficiency demand projection, originally developed for the Energy [R]evolution scenario by the ECOFYS consultancy, which has now been updated by researchers at the University of Utrecht[3], updating the energy efficiency scenario used in previous editions of this publication. The study includes the implementation of best practice existing technologies and a certain share of new efficiency technologies, while using the same assumptions for population and GDP growth over the period as the IEA, and assuming no structural economic changes beyond those in the IEA scenario. The uptake of e-mobility after 2020 is also included in the study. It does not foresee lifestyle changes or loss in comfort levels, nor does it foresee 'stranded' assets, i.e., the early retirement of inefficient installations in favour of more efficient ones.

This 'Energy Efficiency' demand projection, then, only taps some of the potential for energy savings and increased efficiency which are available to us now, and which will likely be available in the near future. However, it is an indicator of what can be done at very low or no cost if we are to be serious about achieving our climate and energy security objectives.

SCENARIO RESULTS

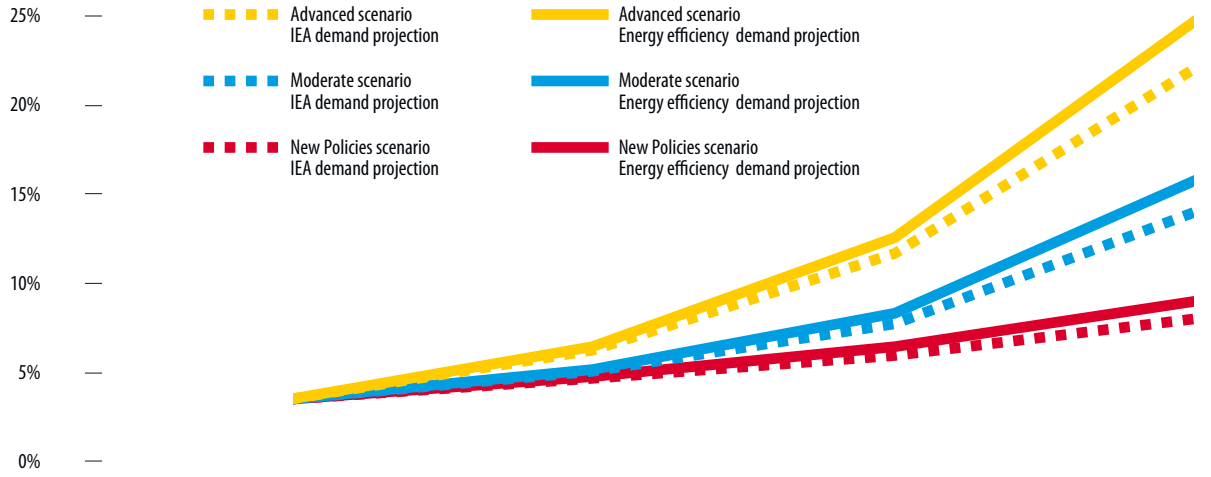
In the IEA New Policies scenario, wind power contributes 1439 TWh of electricity to the global energy mix in 2020, 3 times the 480 TWh produced by wind power in 2011. Measured against the two different demand scenarios, this would count for 6.0 to 6.4% of total global electricity demand, approximately the share that wind power contributed to the European power mix in 2011. By 2030, this number rises to just over 2,400 TWh, accounting for between 8 and 9% of global demand – a respectable number, but far less than wind power's potential contribution.

The GWEO Moderate scenario envisages a substantially larger contribution from wind, which would generate over 1,866 TWh in 2020, rising to almost 4,300 TWh in 2030. This would mean that wind power would meet between 7.7% and 8.3% of global electrical demand in 2020, and between 14.1% and 15.8% in 2030; quite a substantial contribution, but probably not in line with what would be required to meet agreed climate protection goals.

The GWEO Advanced scenario shows that wind power could generate just over 2,800 TWh of electricity by 2020, meeting between 11.7% and 12.6% of global electricity demand, in line with the industry's long term objectives and consistent with the idea of having global emissions peak before 2020. These numbers continue to rise steeply in the subsequent decade, with wind power contributing more than 6,600 TWh in 2030, meeting between 22.1% and 24.8% of total electricity demand.

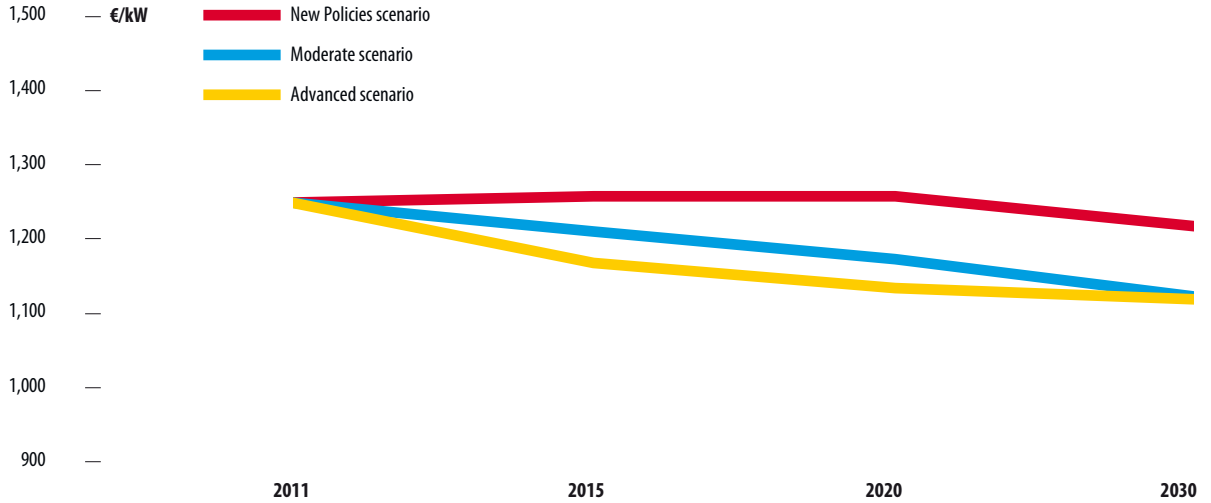
3 *http://www.energyblueprint.info/fileadmin/media/documents/2012/UU_Demand_projections_for_energy_revolution_2012_30-3-12.pdf*

WIND POWER SHARE OF GLOBAL ELECTRICITY DEMAND



	2011	2015	2020	2030
New Policies scenario				
IEA demand projection	3.5%	4.7%	6.0%	8.0%
Energy efficiency demand projection	3.5%	4.8%	6.4%	9.0%
Moderate scenario				
IEA demand projection	3.5%	5.0%	7.7%	14.1%
Energy efficiency demand projection	3.5%	5.1%	8.3%	15.8%
Avanced scenario				
IEA demand projection	3.5%	6.3%	11.7%	22.1%
Energy efficiency demand projection	3.5%	6.4%	12.6%	24.8%

SPECIFIC COSTS PER KILOWATT INSTALLED



INVESTMENT

The capital cost of turbines has been decreasing, precipitously in some markets, over the past several years, both in adjusted and in absolute terms. Of late, this has been largely the result of market forces, but at the same time, continuous design refinements and experience with mass producing an increasing number of the same or similar turbines have decreased the cost of the technology itself. The other major factor, commodity prices, has contributed to the decrease in prices, although the industry is susceptible to price spikes, particularly for steel and copper. There are also significant regional variations, as both competition and other underlying market factors affect the final costs, and there will be inter-annual variations beyond the scope of these scenarios as a result of market forces, commodity prices and the rate of inflation.

Regardless, the growth of the wind power industry is attracting increased investment over the past few years, reaching €50.7 billion in new wind power equipment in 2011.

The development of turbine costs in the GWEO scenarios assumes gradually decreasing costs in absolute terms, reflecting the projected growth of the industry. In the IEA New Policies scenarios the costs remain roughly static over the period out to 2030.

Capital costs per kilowatt of installed capacity were considered to have averaged €1,250 in 2011. For the New Policies scenario they don't change significantly over the scenario period, ending up at €1,267/kw in 2030. In the Moderate scenario prices drop to about €1,200/kw in 2020 and to €1,168/kw by 2030; and in the Advanced scenario, with rapid scale up, costs drop more rapidly, down to €1,147 by 2020 and to €1,137 by 2030.

Annual investments in wind power equipment in 2011 were just over €50 billion. In the Reference scenario, this decreases to €45 billion per year by 2020, and to €42.5 billion in 2030. In the Moderate scenario, annual investment increases to nearly €90 billion by 2020 and to nearly €115 billion per year by 2030. Finally, in the Advanced scenario, annual investments rise to 154 €billion by 2020, and then to €170 billion by 2030.

These figures are indeed large, but they should be seen in the context of total power sector investments, which will according to the IEA, need to be well over €500 billion annually for the period in question.

EMPLOYMENT

As governments struggle with high unemployment rates in many parts of the world, both the current reality and future potential for employment in the wind industry become increasingly significant. The industry creates a substantial number of skilled, semi-skilled and unskilled jobs, and this has taken on an increasing political as well as economic importance of late. The macro-economic effects of the development of the wind power sector as well as the renewable energy sector as a whole is increasingly a factor in political decision making about our future energy choices.

A number of national and regional assessments of employment in the wind industry have been carried out around the world in recent years, although there is no comprehensive authoritative 'ground-up' assessment. The assumption we have made and continue to make, which is verified by such studies as do exist, is that for every new megawatt of capacity installed in a country in a given year, 14 person/years of employment is created through manufacturing, component supply, wind farm development, construction, transportation, etc. While there is regional variation, this seems to work as a global average. As production processes are optimised, we project that this level will decrease to 13 person/years of employment per new megawatt installed by 2020, and to 12 person/years of employment by 2030.

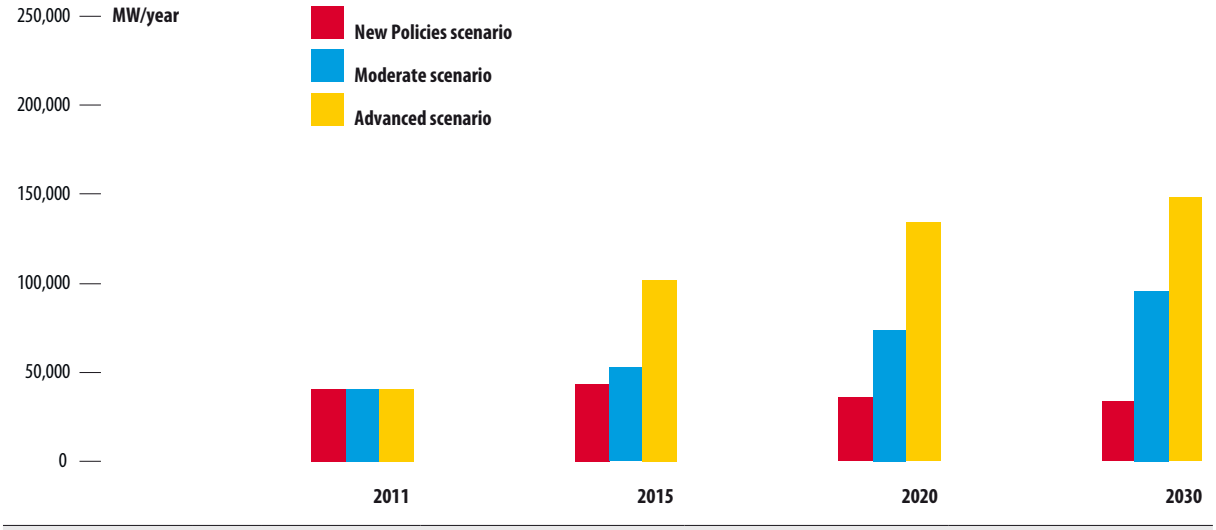
In addition, 0.33 person/years of employment are judged to be needed for operations and maintenance work at existing wind farms.

Under these assumptions, and on the basis of existing studies, the industry currently employs about 650,000 people, as of the end of 2011. Under the IEA New Policies scenario, this number would stay roughly the same throughout the current decade, and rise to just over 700,000 jobs by 2030.

In the GWEO Moderate scenario, a very different picture emerges, with employment levels rising to over 875,000 by 2015, 1.2 million by 2020, and to more than 1.7 million by 2030.

In the GWEO Advanced scenario, employment would need to more than double by 2015, ending the decade with more than 2.1 million jobs, which would rise to 2.6 million in 2030.

INVESTMENT AND EMPLOYMENT (ANNUAL INSTALLATION IN MW)



	2011	2015	2020	2030
New Policies scenario				
Annual Installation MW	40,594	43,516	35,695	33,552
Cost € / kW	1,250	1,259	1,258	1,217
Investment € billion /year	50,74	54,05	45,03	42,49
Employment job/year	646,751	740,513	657,651	705,503
Moderate scenario				
Annual Installation MW	40,594	52,699	74,060	95,740
Cost € / kW	1,250	1,212	1,173	1,122
Investment € billion /year	50,74	64,74	88,99	112,09
Employment job/year	646,751	878,083	1,213,359	1,682,633
Advanced scenario				
Annual Installation MW	40,594	101,711	134,104	148,483
Cost € / kW	1,250	1,168	1,135	1,119
Investment € billion /year	50,74	118,79	152,14	166,22
Employment job/year	646,751	1,599,173	2,122,821	2,620,369

CARBON DIOXIDE SAVINGS

Wind power has many environmental benefits, including the elimination of local air pollution and nearly zero water consumption. However, the greatest benefit is wind power's contribution to reduction of carbon dioxide emissions from the power sector, which is the single largest anthropogenic contributor to the global climate change problem.

Modern wind energy technology has an extremely good energy balance. All of the CO_2 emissions related to the manufacturing, installation, servicing and decommissioning of a turbine are generally 'paid back' after the first 3 to 9 months of operation. For the rest of its 20 year design lifetime, the turbine operates without producing any of the harmful greenhouse gases which are already disrupting life on earth.

The benefit obtained from wind power in relation to CO_2 emissions depends entirely on what sort of power plant it displaces. If it displaces hydro or nuclear power, the benefit is small; but if it replaces coal or gas, then the benefit is enormous. Emissions from fossil fuel plants range from around 500g CO_2/kWh up to 1200g CO_2/kWh or more for the dirtiest fuels. On the basis of the current electricity distribution, we have calculated that 600g CO_2/kWh is a good average number to characterize the savings generated by wind power, although the regional variations will be significant. While the majority of the existing plant is in regions which may be slightly lower than that number, the majority of new installations, particularly in Asia, are in regions which are much higher.

Azuchi Oshima wind farm, Nagasaki, Japan © *M&D Greenenergy Co. Ltd*

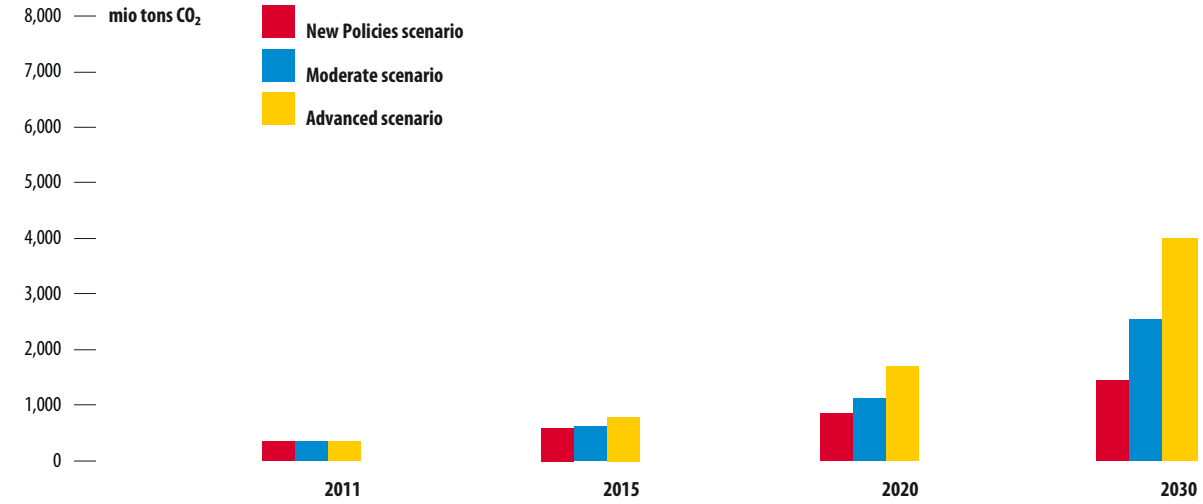
Annual reductions in CO_2 from existing wind power plant was about 350 million tonnes in 2011. Under the IEA New Policies scenario, this is expected to rise to 863 million tonnes annually by 2020 and up to 1447 tonnes per year by 2030.

The GWEO Moderate scenario implies savings of over 1.1 billion tonnes of CO_2/annum by 2020 and more than 2.5 billion tonnes by 2030; while the GWEO Advanced scenario would result in savings of nearly 1.7 billion tonnes of CO_2 per year by 2020, and just over 4 billion tonnes/annum by 2030.

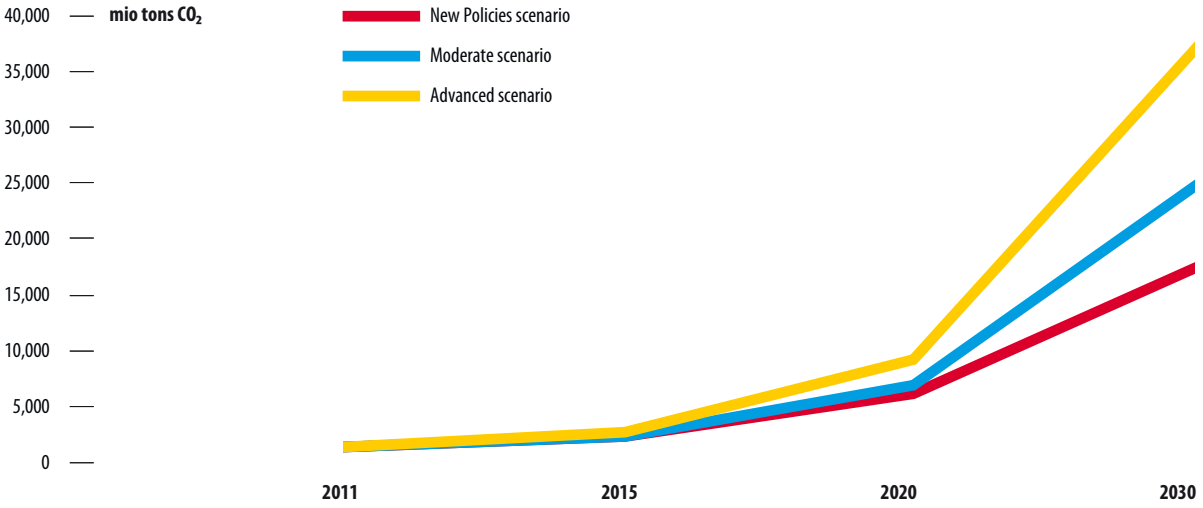
In cumulative terms, the IEA New Policies scenario has wind power saving nearly 6.1 billion tonnes by 2020, and 17.5 tonnes by 2030. The GWEO Moderate scenario results in nearly 7 billion tonnes in cumulative savings by 2020, and just over 25 billion tonnes of CO_2 savings in 2030. The GWEO Advanced scenario yields CO_2 savings of 9.25 billion tonnes per year in 2020, and 37.5 billion tonnes by 2030.

These are significant reductions in all cases, but the critical issue here is not just the total volume of reductions, but the speed at which these savings are achieved, as these are long-lived gases, and the imperative is for early CO_2 emissions reductions to achieve the greatest benefit for the atmosphere. Wind power's scalability and its speed of deployment makes it an ideal technology to bring about the early emissions reductions which are required if we are to keep the window open for keeping global mean temperature rise to 2°C or less above pre-industrial levels.

ANNUAL CO2 EMISSIONS REDUCTIONS



CUMULATIVE CO2 EMISSIONS REDUCTIONS



ANNUAL AND CUMULATIVE CO2 EMISSIONS REDUCTIONS

		2011	2015	2020	2030
New Policies scenario					
Annual CO2 savings	million tons	350	586	863	1,447
Cumulative CO2 savings	million tons	1,368	2,316	6,095	17,522
Moderate scenario					
Annual CO2 savings	million tons	350	626	1,118	2,550
Cumulative CO2 savings	million tons	1,368	2,411	6,958	24,979
Advanced scenario					
Annual CO2 savings	million tons	350	781	1,692	4,007
Cumulative CO2 savings	million tons	1,368	2,690	9,254	37,504

RESEARCH BACKGROUND

THE GERMAN AEROSPACE CENTER

The German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt – DLR) is the largest engineering research organisation in Germany. It specialises, among other things, in the development of solar thermal power station technologies, the utilisation of low and high temperature fuel cells, particularly for electricity generation, and research into the development of high efficiency gas and steam turbine power plants.

The Institute of Technical Thermodynamics at DLR (DLR-ITT) is active in the field of renewable energy research and technology development for efficient and low emission energy conversion and utilisation. Working in co-opoeration with other DLR institutes, industry and universities, its research focuses on solving key problems in electrochemical energy technology and solar energy conversion. This encompasses application-oriented research, development of laboratory and prototype models as was design and operation of demonstration plants. System analysis and technology assessment supports the preparation of strategic decisions in the field of research and energy policy.

Within DLR-ITT, the System Analysis and Technology Assessment Division has long term experience in the assessment of renewable energy technologies. Its main research activities are in the field of techno-economic utilisation and system analysis, leading to the development of strategies for the market introduction and dissemination of new technologies, mainly in the energy and transport sectors.

SCENARIO BACKGROUND

DLR was commissioned by the European Renewable Energy Council and Greenpeace international to conduct the study 'Energy [R]evolution: A sustainable global energy outlook', developing global sustainable energy pathways up to 2050.[1] This study was first published in January 2007 and has been updated several times since then[2], most recently in 2012. It lays out energy scenarios that are significantly lower than current levels, and within the range of scenarios consistent with a 2°C target.

Integral to the analsyis was an examination of the future potential for renewable energy sources, including wind energy. In collaboration with the wind industry, the study looks at regional projections for wind power around the world, and it is this work which forms the basis for the Global Wind Energy Outlook scenarios.

The energy supply scenarios used in this report, which both extend beyond and enhance projections by the International Energy Agency, have been calculated using the MESAP/PlaNet simulation model by DLR covering all 10 world regions as delineated by the IEA. This model has then been developed in cooperation with an energy efficiency study originally developed by the Ecofys consultancy to take into account the future potential for energy efficiency measures, beyond those envisaged in the World Energy Outlook.

ENERGY EFFICIENCY STUDY

The aim of the original Ecofys energy efficiency study[3] developed for the Energy [R]evolution scenario was to develop low energy demand scenarios for the period from 2007 to 2050 on a sectoral basis for the IEA regions as defined in the World Energy Outlook series. Energy demand was divided into electricity and fuels. The sectors which were examined were industry, transport and other consumers, including households and services.

This study has now been updated by researchers at the University of Utrecht[4], maintaining the same parameters as the first study. The study includes the implementation of best practice existing technologies and a certain share of new efficiency technologies, while using the same assumptions for population and GDP growth over the period as the IEA, and assuming no structural economic changes beyond those in the IEA scenario. The uptake of e-mobility after 2020 is also included in the study.

While maintaining the same level of comfort and standard of living, and without 'stranding' assets, i.e., not including retiring inefficient assets before the end of their economic life, the study concludes that savings of up to 36% can be made in electricity use, and up to 28% in fuel consumption. While nowhere near the technical potential for energy efficiency and energy savings, the study shows the enormous potential for emissions reductions offered by such measures, which would be an essential part of any serious efforts to tackle climate change.

1 *Krewitt W, Simon S, Graus W, Teske S, Zervos A, Schaefer , 'The 2 degrees C scenario – A sustainable world energy perspective'; Energy Policy, Vol 35, No. 10, 4969-4980, 2007; and Teske S, Pregger R, Simon S, Naegler T, Graus W, Lins C, "Energy [R]evolution 2010—a sustainable world energy outlook", Energy Efficiency, DOI 10.1007/s12053-010-9098-y*

2 *See http://www.energyblueprint.info*

3 *www.energyblueprint.info/1211.0.html*

4 *http://www.energyblueprint.info/fileadmin/media/documents/2012/UU_Demand_projections_for_energy_revolution_2012_30-3-12.pdf*

Horse Hollow wind farm, Texas © *Wind Power Works*

WORLD MAP: REGIONAL BREAKDOWN OF CUMULATIVE CAPACITY UP TO 2030

OECD NORTH AMERICA

Total capacity in MW

	2010	2011	2015	2020	2030
New Policies scenario	44,707	52,753	85,261	121,238	182,354
Moderate scenario	44,707	52,753	91,314	155,208	296,705
Advanced scenario	44,707	52,753	120,272	290,805	665,938

OECD EUROPE

Total capacity in MW

	2010	2011	2015	2020	2030
New Policies scenario	84,965	94,328	150,169	211,319	288,333
Moderate scenario	84,965	94,328	137,818	211,276	371,627
Advanced scenario	84,965	94,328	161,600	262,797	396,728

EU 27

Total capacity in MW

	2010	2011	2015	2020	2030
New Policies scenario	84,324	93,947	149,622	207,246	280,242
Moderate scenario	84,324	93,947	133,855	210,270	381,122
Advanced scenario	84,324	93,947	160,986	263,220	398,525

LATIN AMERICA

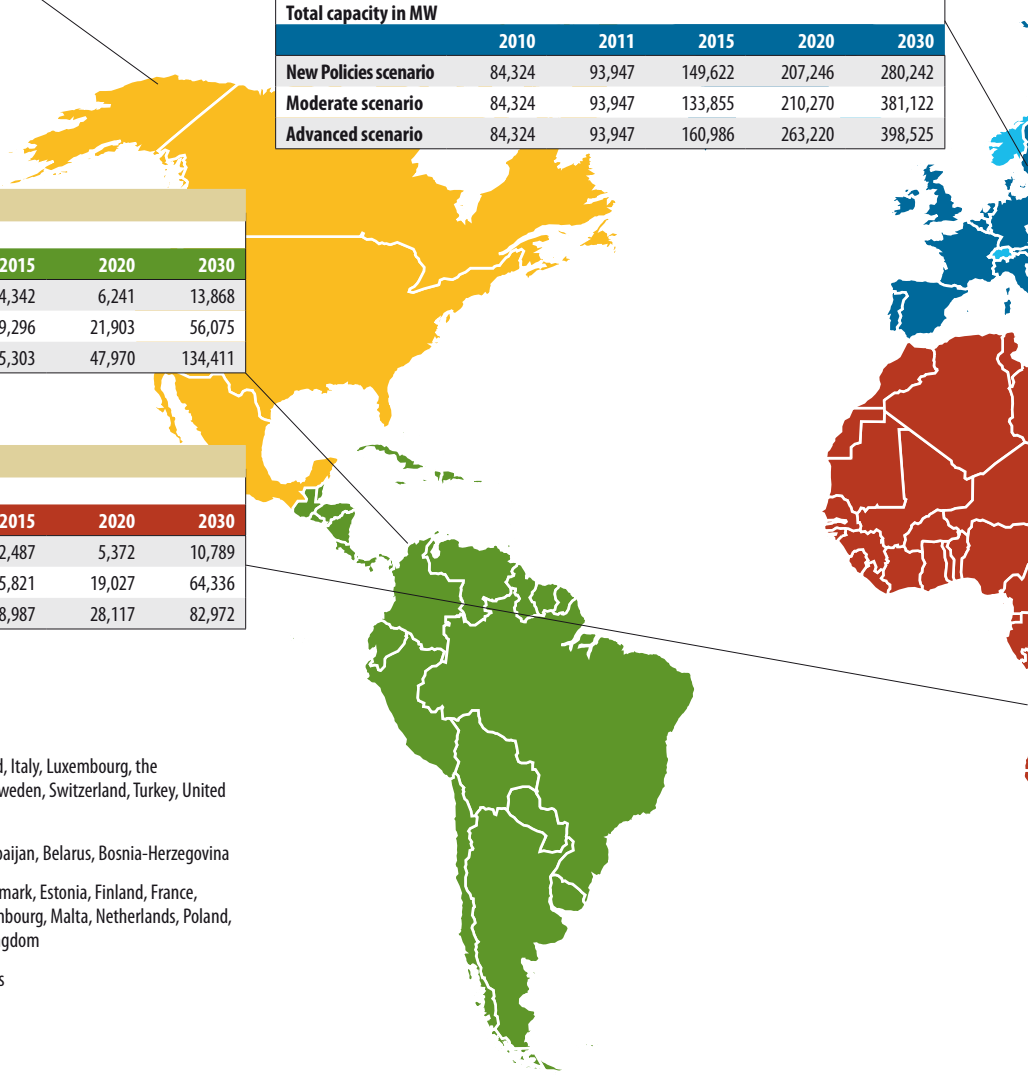
Total capacity in MW

	2010	2011	2015	2020	2030
New Policies scenario	1,489	2,330	4,342	6,241	13,868
Moderate scenario	1,489	2,330	9,296	21,903	56,075
Advanced scenario	1,489	2,330	15,303	47,970	134,411

AFRICA

Total capacity in MW

	2010	2011	2015	2020	2030
New Policies scenario	976	1,024	2,487	5,372	10,789
Moderate scenario	976	1,024	5,821	19,027	64,336
Advanced scenario	976	1,024	8,987	28,117	82,972



DEFINITION OF IEA REGIONS

OECD EUROPE Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom

EASTERN EUROPE/EURASIA Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina

EU 27 Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom

OECD NORTH AMERICA Canada, Mexico, United States

OECD Pacific Australia, Japan, Korea (South), New Zealand

India India

NON-OECD ASIA Afghanistan, Bangladesh, Bhutan, Brunei, Cambodia, Chinese Taipei, Cook Islands, East Timor, Fiji, French Polynesia, Indonesia, Kiribati, Democratic People's Republic of Korea, Laos, Macao, Malaysia, Maldives, Mongolia, Myanmar, Nepal, New Caledonia, Pakistan, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Islands, Sri Lanka, Thailand, Tonga, Vietnam, Vanuatu

MIDDLE EAST Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Yemen

AFRICA Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Democratic Republic of Congo, Cote d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Reunion, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, United Republic of Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe

CHINA People's Republic of China including Hong Kong

TRANSITION ECONOMIES Bulgaria, Croatia, Estonia, Serbia and Montenegro, the former Republic of Macedonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Romania, Russia, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Cyprus 1, Malta 1

LATIN AMERICA Antigua and Barbuda, Aruba, Argentina, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, the British Virgin Islands, the Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, the Dominican Republic, Ecuador, El Salvador, the Falkland Islands, French Guyana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Montserrat, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, Saint Lucia, Saint Pierre et Miquelon, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, the Turks and Caicos Islands, Uruguay and Venezuela

EASTERN EUROPE/EURASIA

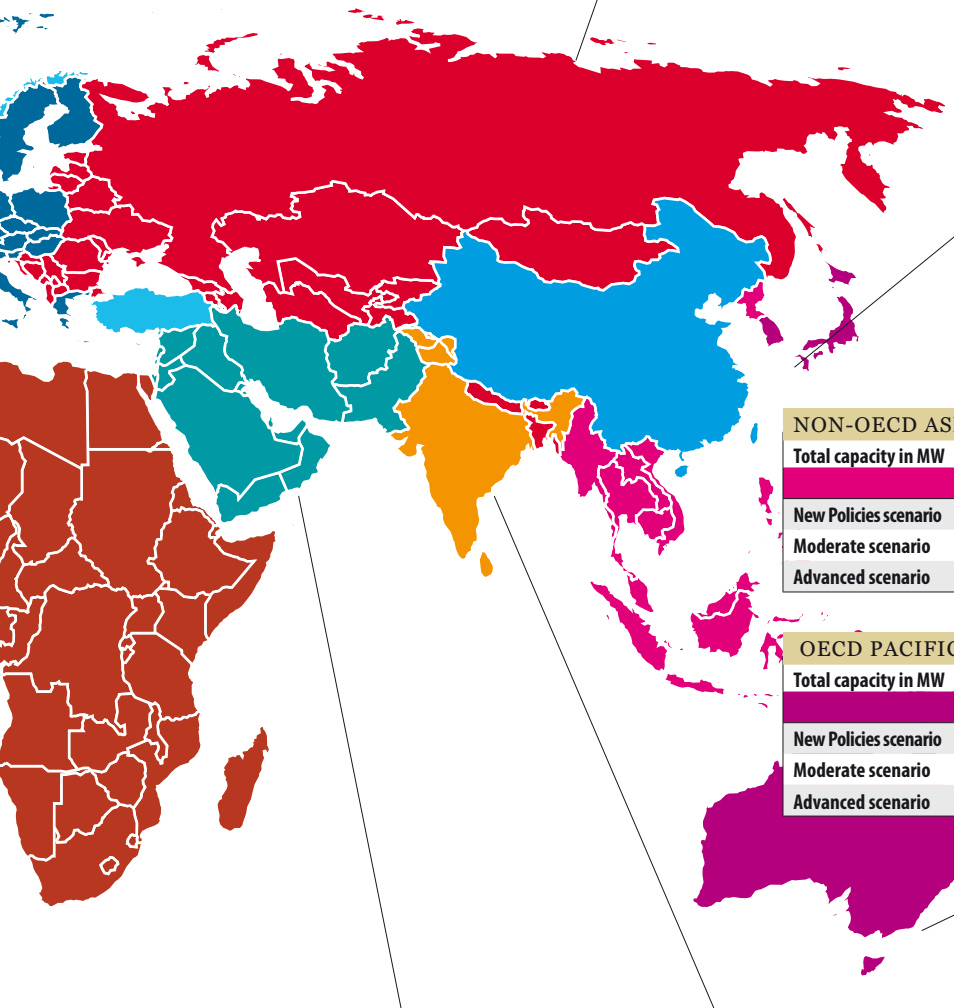
Total capacity in MW

	2010	2011	2015	2020	2030
New Policies scenario	1,355	2,290	4,769	7,424	17,271
Moderate scenario	1,355	2,290	4,127	10,383	70,374
Advanced scenario	1,355	2,290	9,363	32,369	104,707

CHINA

Total capacity in MW

	2010	2011	2015	2020	2030
New Policies scenario	44,733	62,364	114,001	179,498	279,017
Moderate scenario	44,733	62,364	125,835	214,445	400,130
Advanced scenario	44,733	62,364	134,687	230,912	499,614



NON-OECD ASIA

Total capacity in MW

	2010	2011	2015	2020	2030
New Policies scenario	606	672	2,879	6,375	21,222
Moderate scenario	606	672	5,407	27,083	119,476
Advanced scenario	606	672	18,823	90,768	250,342

OECD PACIFIC

Total capacity in MW

	2010	2011	2015	2020	2030
New Policies scenario	5,069	5,755	9,053	14,012	27,109
Moderate scenario	5,069	5,755	13,841	38,523	97,715
Advanced scenario	5,069	5,755	24,218	74,702	177,690

INDIA

Total capacity in MW

	2010	2011	2015	2020	2030
New Policies scenario	13,065	16,084	23,784	32,933	66,400
Moderate scenario	13,065	16,084	31,499	59,351	124,826
Advanced scenario	13,065	16,084	37,436	89,299	191,711

MIDDLE EAST

Total capacity in MW

	2010	2011	2015	2020	2030
New Policies scenario	99	99	1,116	2,317	11,436
Moderate scenario	99	99	198	2,150	16,181
Advanced scenario	99	99	258	2,180	37,024

GLOBAL TOTAL

Total Capacity in MW

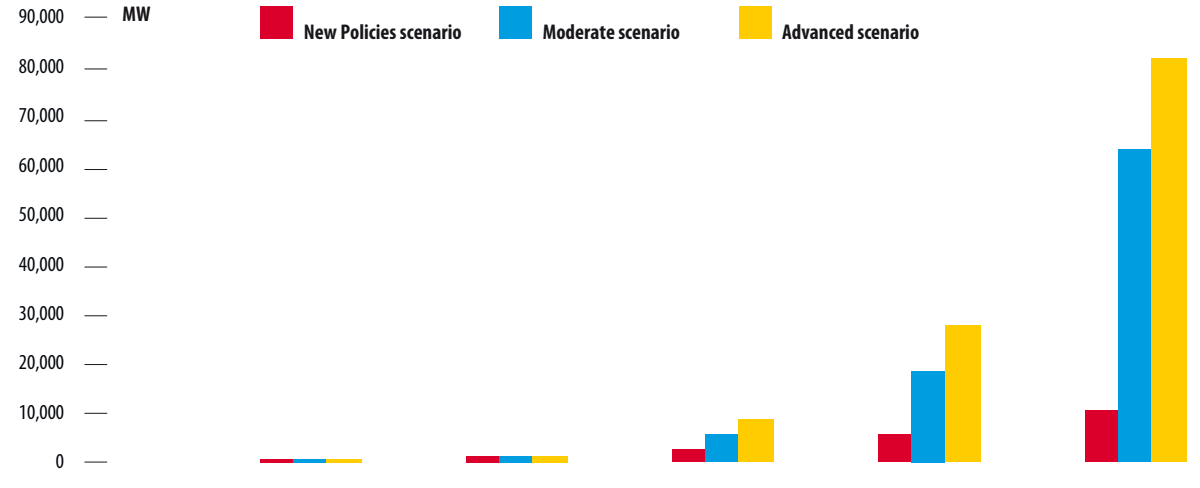
	2010	2011	2015	2020	2030
New Policies scenario	197,081	237,699	397,859	586,729	917,798
Moderate scenario	197,081	237,699	425,155	759,349	1,617,444
Advanced scenario	197,081	237,699	530,945	1,149,919	2,541,135

3 | REGIONAL SCENARIO RESULTS

China © *Greenpeace China*

AFRICA

TOTAL WIND POWER CAPACITY IN MW



	2010	2011	2015	2020	2030
New policies scenario	976 MW	1,024 MW	2,487 MW	5,372 MW	10,789 MW
Moderate scenario	976 MW	1,024 MW	5,821 MW	19,027 MW	64,336 MW
Advanced scenario	976 MW	1,024 MW	8,987 MW	28,117 MW	82,972 MW

Recognizing the importance of energy for sustainable development, the United Nations General Assembly designated 2012 as the International Year of Sustainable Energy for All. Today, 1.4 billion people still do not have access to modern energy, while 3 billion rely on 'traditional biomass' and coal as their main fuel sources. More than 95% of the people without access to modern energy services are living either in Sub-Saharan Africa or Developing Asia[1] .

This problem is especially acute in peri-urban and rural areas in Sub-Saharan Africa. In many African countries, the electricity that is available is likely to be generated by diesel generators or other small-scale plant, often using expensive imported fuel. More small generators keep individual businesses, hospitals and households running. The high cost of relying on imported fuels has a great impact on some African countries' economies, and many of them spend a considerable share of their scarce foreign exchange reserves on energy imports.

Local, national or regional grids – where they do exist – are challenged by the increasing demand from consumer equipment such as refrigerators, lighting, mobile phones, TVs and computers; and outages are frequent. In many countries, it seems that the provision of a stable supply of electric power is either not a government priority, or is a priority that conflicts with other pressing issues such as provision of clean water, education and health care.

Large-scale power production in much of Africa is likely to mean large hydro (as found in Egypt) or the coal-based generation that characterizes South Africa's power system. Given Africa's vast land mass and relatively low population density, it seems likely that a broad mix of decentralized technologies will have the flexibility to meet the needs of many of the countries on the continent. Wind power, because of its scalability, can and is beginning to play a key role in both decentralized and centralized systems.

Africa's wind resource is best around the coasts and in the eastern highlands, but it is in North Africa that wind power has been developed at scale. This, too, is where current national policies are set to grow the sector further. At the end of 2011, over 98% of the continent's total wind installations of just over 993 MW were to be found across four countries - Egypt (550 MW), Morocco (291 MW), Tunisia (114 MW) and Cape Verde (24 MW).

EGYPT

In February 2008, Egypt's Supreme Council of Energy approved a plan to produce 20% of its electric power from Renewable sources by 2020. This target includes a 12% contribution from wind energy, which translates into more than 7 GW of grid-connected wind power.

Egypt's best-developed wind region so far is the Zafarana district, with average wind speeds in the area of 9 m/s. The project consists of a series of linked wind farms, the first of which started construction in 2001. In 2010, Zafarana wind farm's total capacity reached 550 MW. It is owned and operated by the Egyptian New & Renewable Energy Authority.

1 *www.sustainableenergyforall.org*

Due to prevailing political conditions, 2011 and 2012 have seen no new project development across the country. However once there is increased political certainty perceived by the investor community, over 7 GW of wind power could potentially be developed by 2020.

MOROCCO

The Moroccan government, under the integrated Moroccan Wind Power Plan, has set a target of installing 2,000 MW of wind energy by 2020[2] a dramatic increase from the existing 291 MW at the end of 2011. Morocco has excellent wind resources along nearly its entire coastline, as well as inland near the Atlas Mountains.

In 2012, the Moroccan government invited bids from interested parties for an 850 MW project. The project consists of five wind farms that will be structured under a "Build Own Operate Transfer" scheme through a public-private partnership model. The final tender is likely to be launched in the fourth quarter of 2012.

SOUTH AFRICA

South Africa is ideally suited for wind power development, given its abundant wind resources, ample suitable sites and modern high voltage electrical infrastructure. However its electricity market continues to face numerous challenges. The current electricity system, which is primarily based on coal, suffers from low reserve margins. Current power generation infrastructure is now barely adequate to meet demand, and state utility Eskom estimates that South Africa needs to construct 40 GW of new generating capacity by 2025, about 12.5 GW of which is already under construction.

The South African Wind energy Association (SAWEA) estimates that with the right policy framework, wind power could provide as much as 20% of the country's energy demand by 2025, translating into 30,000 MW of installed wind capacity. By the end of 2011, only 8.4 MW of capacity was in operation.

In December of 2011, South Africa announced the preferred bidders for the first round under the 'ReBid' Programme. Wind energy garnered 630MW in the first round out of a total of 1,450 MW of renewable energy.

The second round winners were announced in May 2012, with an addition 562 MW awarded to wind, and a third round is expected in the first half of 2013. This is in within the framework of South Africa's plan for more than 9,000 MW of wind power by 2030.

However the framework conditions (both in terms of policy and market structure) are not conducive to fast wind power development, as several issues remain unresolved. One of these concerns the fact that the vertically integrated state utility Eskom controls generation (which is primarily based on coal), transmission and supply of electricity across the country, making it difficult for independent power producers to access the market.

EAST AFRICA

There have recently been developments in east Africa – with a 50 MW project completed in Ethiopia and a 300 MW project under development in Kenya. Hopefully these early projects will make a substantial contribution to the total generating capacity in each of these countries. If successful, they will herald a much broader uptake of wind on the continent in the coming years.

THE GWEO SCENARIOS FOR AFRICA

Given Africa's vast potential for wind power development, especially in the North, along both the coasts, and in South Africa, the GWEO scenarios differ substantially from those presented by the IEA.

Under IEA's New Policies scenario (NPS), wind power capacity will reach 5.3 GW by 2020, and this would increase to 10.7 GW by 2030 on the entire African continent, producing 13 TWh in 2020 and close to 28 TWh in 2030. This would create between 9,000 and 15,000 jobs.

The GWEO scenarios, however, are considerably more optimistic. Under the Moderate scenario, wind power would deliver nearly four times as much power by 2020 as the IEA's NPS forecasts, with an installed capacity of 19 GW generating 47 TWh every year. This would then grow by 4,000 - 6,000 MW every year up to 2030, when just under 68 GW would be installed, producing over 178 TWh of clean electricity for Africa. This would not only help the continent's electrification and energy independence, but also its economies; more than € 3.58 billion would be invested in wind power every year by 2020, and this would increase to € 6.24 billion annually by 2030; and between 44,000-101,000 new jobs would be created.

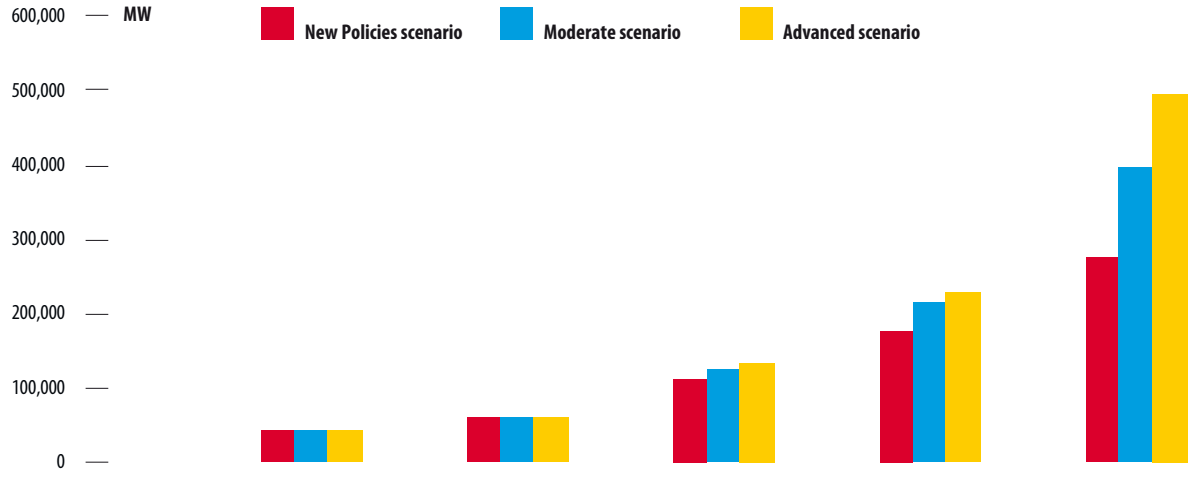
The Advanced scenario assumes that even more effort will be taken to exploit Africa's wind resources. It shows how, by 2020, close to 28 GW of wind power capacity could produce 69 TWh of electricity, growing to almost 83 GW producing 225 TWh of electricity by 2030. Wind power would then be able to play a key role in developing a sustainable energy future, leading to a savings of over 41 million tons of CO_2 every year by 2020 and over 135 million tons by 2030, cleaning the air and increasing energy security at the same time.

2 *http://www.one.org.ma/*

Economically, too, this development could have a substantial impact in Africa's wind rich nations. With annual investments to the order of € 5 billion in 2020 and close to € 7 billion in 2030, wind power could grow to become a considerable industry in Africa. The development of local manufacturing facilities would provide thousands of high quality jobs for people across the continent, and the avoided costs of imported fuel would have a very positive effect on these nations' foreign exchange.

CHINA

TOTAL WIND POWER CAPACITY IN MW



	2010	2011	2015	2020	2030
New policies scenario	44,733 MW	62,364 MW	114,001 MW	179,498 MW	279,017 MW
Moderate scenario	44,733 MW	62,364 MW	125,835 MW	214,445 MW	400,130 MW
Advanced scenario	44,733 MW	62,364 MW	134,687 MW	230,912 MW	499,614 MW

In 2011, the new annual installed wind power capacity in China (excluding Hong Kong, Macao and Taiwan) was an astonishing 17.63GW. In 2011, wind power generated 71.5 billion kWh, accounting for 1.5% of national power generation. By the end of 2011, the cumulative installed capacity nationwide was over 62 GW, with China maintaining its lead globally in terms of installed wind power capacity.

By the end of 2011, thirty Chinese provinces, cities and autonomous regions (excluding Hong Kong, Macao and Taiwan) had their own wind farms. The Inner Mongolia Autonomous Region remained the leader of China's wind power development story, having a cumulative installed capacity of over 17.5 GW, followed by Hebei, Gansu and Liaoning, each having a cumulative installed capacity of over 5 GW. Overall more than 10 provinces had a cumulative installed wind power capacity of over 1 GW, including 9 provinces with a capacity of over 2 GW each.

The astonishing growth of China's wind sector since 2006 has managed to surprise even many optimists in the industry. Industry analysts believe that the Chinese wind power market is now beginning to enter a more steady development and refinement stage.

The phenomenal growth in the Chinese wind energy market has outstripped the ability of the grid and system operators to manage it. Curtailment of electricity generation has become a new challenge for wind power projects. In 2011, more than 10 billion kWh of wind power was lost because the grid had no capacity to absorb it[3] .

POLICY FRAMEWORK AND OFFICIAL TARGETS FOR WIND ENERGY

2012 was the second year of the twelfth Five-Year plan (2011-2015). Early in 2011, the National Energy Administration (NEA) released the 12th Five-Year plan for renewable energy. This includes a target of 100 GW of wind by 2015, consisting of 70 GW from the large Wind Base programme, 30 GW from smaller projects, and an additional 5 GW from offshore wind.

3 *China Wind Energy Outlook, 2012 www.gwec.net*

REGIONAL GROWTH

The unprecedented growth experienced by China's wind industry over the past seven years has been driven mainly by national renewable energy policies, as well as very active participation in the UNFCCC's Clean Development Mechanism. However since the beginning of the 12th Five-Year Plan period (2011-2015), the NEA has promoted the concept of focusing on both centralized and decentralized development, supported by corresponding administrative measures. As a result of this guidance from the central government, inland regions began to plan wind power development projects according to local conditions, thereby opening up opportunities for mid and small-sized wind power investment enterprises.

TRANSMISSION

China's best wind resources are mainly distributed in the three northern regions (northeast, north and northwest), but electrical loads are mainly distributed in coastal regions and in the south. In China, the grid infrastructure is proving to be a serious issue, especially in areas with high wind speeds. This problem has both institutional and technological aspects.

The 'China Wind Power Construction Results Statistics and Assessment Report: 2011' provided data and analysis of the curtailment situation in 2011. According to its analysis of 584 wind farms in the three northern regions, East Inner Mongolia and Jilin were the areas in which curtailment was the most severe, with a curtailment rate of over 20% of total generation. The curtailment problems in West Inner Mongolia, Gansu and Heilongjiang were also quite severe, with a rate of over 10%.

Xiao Yan Kau Wind Farm, China © *Wind Power Works*

Though under the existing legislation grid companies are obliged to buy power generated from renewable sources, there are no penalties for non-compliance with this provision, and no compensation is paid to wind farm operators for the losses they incur when failing to sell their power. The lack of sufficient transmission capacity discourages grid operators from accepting more wind power into the grid.

Overall, however, there is no doubt that given the need for fuelling the country's growing economy, more interconnectors between areas with high wind power output and areas with high power demand will be built in the coming years.

In addition, a number of recent incidents have led to the introduction of a grid code, along with 17 other technical standards for the industry. The vast majority of manufacturers now equip their turbines with low voltage ride-through capability (LVRT), and this is now a requirement, along with other measures to ensure smooth grid integration, effective as of 1 June 2012.

Another new initiative introduced was the 'Wind Farm Development and Management Interim Rules and Regulations'. Among other things, the regulations state that wind farms cannot start construction before the approval process is completely finished, or the project will not be granted the feed-in tariff and grid access. In addition, all wind farms are now required to have a formal evaluation one year after beginning operation, and all performance data needs to be reported. The objective is to have more control over the quality of the projects, rather than merely encouraging quantity.

The second policy of great importance put forward by the NEA was to encourage the development of wind farms in lower wind speed regions closer to load centers. Up until now, the emphasis has been on the wind base mega-projects, which are located primarily in remote regions and need major transmission upgrades to transport the power to load centers. The NEA and State Grid are working to solve the transmission bottlenecks and other grid issues. In the meantime, however, the NEA is actively encouraging wind farm development in lower wind zones closer to the load centers, which will have the added benefit of encouraging manufacturers to develop more sophisticated machines with longer blades and taller towers to extract the maximum energy from lower speed winds.

OFFSHORE WIND DEVELOPMENT

By the end of 2011, the cumulative installed offshore capacity in China was 258.4 MW, which placed it in the third spot globally behind the U.K. and Denmark. According to the 12th Five-Year Plan [2011-2015] of the NEA, it is expected that by 2015 China will have built 5 GW offshore wind power and will have developed a supply chain to meet its offshore

development needs. After 2015, the Chinese market is likely to enter a large-scale development phase, with a target of 30 GW of offshore installations by 2020.

As of the end of 2011, the offshore wind power planning for Shanghai, Jiangsu, Shandong, Hebei, Zhejiang and Guangdong had already been completed. The offshore wind power planning for Dalian in Liaoning Province as well as provinces such as Fujian, Guangxi and Hainan are still under development. The completed preliminary plans identified an exploitable offshore wind potential of 43 GW. Currently, there are already 38 projects of 16.5 GW that are in early stage development.

In 2011 the NEA prepared a report on 'Implementation Rules of the Interim Measures for the Management of Development and Construction of Offshore Wind Power', as a supplement to its earlier report 'Interim Measures for the Management of Development and Construction of Offshore Wind Power' issued in 2010, which was jointly published with the State Oceanic Administration. This report provides specific provisions regarding development issues; various requirements during offshore wind farm planning including pre-feasibility study and its stages and clearly define the duties of individual roles of each of the managing departments.

Moreover, these reports laid out requirements regarding the construction and operation of o ffshore wind farms. The rules expressly specified that offshore wind farms must, in principle, be deployed in coastal areas that are at least 10km from the coast and where the seawater depth is at least 10m; and that such locations must avoid sea-use conflicts between competing interests. The implementation of these policies has increased the difficulty of developing offshore wind power and forced all 4 offshore wind power projects tendered in 2010 to relocate, a very expensive undertaking which underscores the need for planning coordination between different government agencies if the long-term targets are to be met.

STATE INVESTMENT IN WIND

Several large state owned enterprises are still the major players in China's wind development, with close to 90% of all wind power projects constructed and completed having investments by these corporations. By the end of 2011, a total of some 700 state-owned enterprises nationwide had invested in wind farm construction, and offered a cumulative grid-connected capacity of 37.98 GW, accounting for over 79 % of the country's total grid-connected wind capacity.

Further in an effort to strengthen its Renewable Energy Development Fund, the Ministry of Finance, NDRC and NEA jointly issued guidelines in 2011 to increase the renewable energy electricity price surcharge from RMB 0.4 cents/kWh today to 0.8 cents/kWh. Lastly, the China Development Bank is one of the largest lenders for renewable energy projects both domestically and internationally. In 2010 alone its lending portfolio for wind projects was over $600 million. As recently as September 2012, a British private equity company Terra Firma was planning to set up a renewable energy fund with the China Development Bank. The fund is set to be in the $3-5 billion range[4] .

THE GWEO SCENARIOS FOR CHINA

In our previous Outlook, published in 2010, the 2020 projections for total installed capacity in China were 70 GW under the Reference scenario, 200 GW under the Moderate growth scenario, and 250 GW under the Advanced growth scenario. Projections for cumulative capacity in 2010 were 32 GW (Reference), 39 GW (Moderate) and 41 GW (Advanced). However – by the end of 2010 China's total installed capacity had already reached 44.7 GW, and 62.3 GW by the end of 2011. If 2012 sees the same level of new build as 2011; China will have close to 80 GW of wind power installed by the end of this year.

With these developments in mind, the scenarios presented in this report have been updated radically, while the IEA's New Policies scenario remains rather pessimistic.

In the New Policies scenario, the Chinese wind energy market will experience a considerable decrease in the rate of annual installations leading to a total installed capacity of 179 GW by 2020, which is significantly lower than the unofficial conservative Chinese target of over 200 GW by 2020.

This slump in the market would have a dramatic effect on investment and jobs in China, with investment figures dropping from the current €22.6 billion per year to €15.9 billion by 2015, and employment plummeting from an estimated 263,000-301,000 jobs to only 210,000 in this timeframe.

Given the Chinese government's commitment to developing its wind resources, the GWEO Moderate scenario foresees a more realistic continuation of wind power growth in China, with annual installations increasing from the current 17.6 GW to 18.5 GW by 2020. By 2015, the total installed capacity would rise to reach 125 GW, and this would grow to 214 GW by 2020 and 400 GW by 2030.

As a result, €23 billion would be invested in Chinese wind development every year by 2020. Employment in the sector would grow from the currently estimated 260,000 jobs to reach close to 312,000 by 2020 and 355,000 by 2030.

4 *http://www.windpowermonthly.com/news/1154028/China-Development-Bank-build-fund-UK-private-equity-co/*

The GWEO Advanced scenario shows that wind development in China could go even further, reaching a total installed capacity of 134 GW by 2015 and 230 GW by 2020. This would grow to reach almost 500 GW by 2030, with annual markets growing to 33 GW over that period.

This kind of very large-scale deployment of wind energy would entail significant economic and environmental benefits for the world's most populous country. By generating 330 TWh of clean electricity in 2015, wind power would start to make up a considerable share of China's overall power demand, and this would grow to 566 TWh by 2020 and as much as 1,313 TWh by 2030.

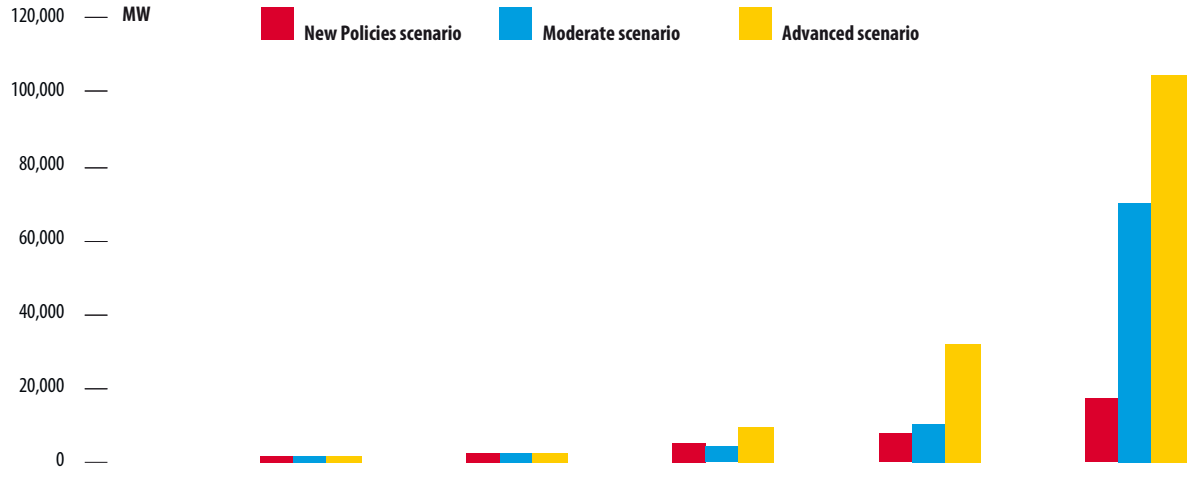
Such development would also result in more than €39 billion of investment flowing into the Chinese wind sector every year by 2030, which would go along with a doubling of the wind sector work force from the current estimates of 267,000 to reach close to 560,000 jobs in this timeframe.

And, last but not least, exploiting the country's wind resources to this level would significantly improve China's carbon emissions balance. By 2015, wind power would help save 198 million tons of CO_2 every year, and this figure would grow to 788 million tons by 2030.

However, in order for China to fully exploit the economic and environmental benefits that wind power can offer, certain remaining obstacles need to be addressed. This concerns the issue of grid infrastructure to not only accommodate ever increasing amounts of wind power in the national electricity grid but also to build transmission lines from the windy but often remote regions to population and industry centers.

EASTERN EUROPE/EURASIA

TOTAL WIND POWER CAPACITY IN MW



	2010	2011	2015	2020	2030
New policies scenario	1,355 MW	2,290 MW	4,769 MW	7,424 MW	17,271 MW
Moderate scenario	1,355 MW	2,290 MW	4,127 MW	10,383 MW	70,374 MW
Advanced scenario	1,355 MW	2,290 MW	9,363 MW	32,369 MW	104,707 MW

This IEA region ranges from new European Union members such as the Baltic states, Malta and Cyprus, through Bosnia and Herzegovina, Croatia, Serbia, Slovenia, Romania and Bulgaria and then eastwards into Russia and Ukraine, and finally south-eastwards into the Central Asian countries of the former Soviet Union.

The group covers profoundly diverse economies and power systems. Some countries, such as Turkmenistan or Azerbaijan, have massive reserves of oil and gas; others, such as Tajikistan and Albania meet their power needs almost entirely from hydropower, while some countries have to import electricity or fuel or both. However the region's energy economy is dominated by Russia, which also is the world's fourth largest power generator, behind the US, China, and Japan[5] .

All these areas have been assessed to some extent for their renewable energy potential, and much of this vast Eastern Europe/Eurasian landmass has excellent wind resources[6] .To date, the main wind developments have been in those eastern

5 *Much of the information in this chapter is derived from the EBRD's Renewable Development Initiative (www.ebrdrenewables.com)*
6 *3-Tier wind map www.3tier.com/en/support/resource-maps/*

European and Baltic states which became members of the European Union in 2004[7]. These new member states were required to apply the 2001 EU renewables Directive, and their accession treaty set national indicative targets for renewable power production for each state. They are of course now also bound by the EU's new legislation for 20% of the bloc's energy consumption to come from renewable sources, which include a binding target for each country.

By 2011 there was significant wind power capacity installed in Romania (982 MW), Bulgaria (607 MW), Cyprus (133.5 MW), Ukraine (151.1 MW) and the Baltic states like Lithuania (179 MW) and Estonia (159.9 MW).

Another driver for the introduction of wind development across the Eastern Europe/Eurasia region has been the Joint Implementation mechanism that forms part of the Kyoto Protocol. Under this arrangement, any Annex 1 (industrialized) country can invest in emissions reduction projects in any other Annex 1 country as an alternative to reducing its own emissions. This mechanism was targeted at the so- called 'transition economies', but as many of these have now become EU members, the main focus for JI is now on Russia and Ukraine. In August 2010, there were 30 wind energy projects in the JI pipeline, totaling an installed capacity of 1,280 MW. The largest one of these, at 300 MW, is located in Ukraine.

Romania, which according to the EU Directive must meet 24% of its energy demand by renewables in 2020, had installed 921 MW of wind power at the end of 2011, up from 14 MW in 2009. Romania's 921 MW of operating wind farms are mainly located (97%) in Dobrogea on the Black Sea coast, which boasts average wind speeds of 7 m/s at 100m altitudes. The renewable energy law adopted in November 2008 was a major step forward for wind development in Romania, introducing a green certificate (GC) scheme for renewable electricity for a period of 15 years, as well as loan guarantees and tax exemptions for renewable energy investments.

The situation in **Bulgaria** was considered promising through 2011. With a renewable energy target of 16% under the EU Directive, the country introduced favourable policies to promote renewable energy development, and wind power installations have been growing considerably in recent years, with a total of 607 MW operating at the end of 2011. Bulgaria adopted the Law for Energy from Renewable Sources in May of 2011, which replaced the former Law for Renewable and Alternative Energy Sources and Biofuels. While this was long awaited with expectation of clear regulations to invigorate the market, the new law actually hinders the development of the renewable energy sector. With an amendment introduced in 2012, the FIT term was reduced to 12 years. Further the tariff is fixed for the entire term (12 years) only after construction of the project is completed; and in September 2012, the Bulgarian energy regulator SWERC decided to cut tariffs for all existing wind energy projects by 10%[8] .

Germany © *Anja Gerseker/ GWEC*

The **Baltic States** have also started to develop wind power, with 159.9 MW of installed capacity in Estonia, 179 MW in Lithuania and 31.3 MW in Latvia at the end of 2011. Under the new EU Directive, these countries have binding targets of meeting 25%, 23% and 40% respectively of their energy needs with renewable sources, and they all have significant wind resources, especially along the coastlines, which can go a long way towards achieving their goals.

Russia is one of the top producers and consumers of electric power in the world, with more than 220 million kilowatts of installed generation capacity[9]. However renewable energy is not yet on the forefront of Russia's policy agenda. Russia produces 67% of its power from thermal power generation, 17% from large hydro plants and 16% from nuclear power.

7 *Note that some of these countries, such as Poland, are covered in the OECD Europe section*

8 *http://www.windpowermonthly.com/news/1150227/Warning-Bulgaria-cuts-wind-farm-tariffs/*

9 *http://www.eia.gov/countries/country-data.cfm?fips=RS*

Russia's massive reserves of gas, coal and oil lead to a low cost of energy, which poses a challenge for the development of renewable energy sources. However, Russia does have a significant potential for renewable energy development, not least due to its size and geography. Russia has huge potential for wind power development, according to the EBRD, with the windiest regions concentrated along the coastline, in the steppes and in the mountains, mainly in the North and West of the country. To date, the development of the wind sector has been slow, with only a little over 9 MW of wind installed.

In January 2009 the government had set a target for renewables to supply 4.5% of energy demand by 2020. In a system as large as Russia's, this signified an additional 25 GW of new renewable energy based generation. There were interim targets of 1.5% by 2010, 2.5% by 2015 – currently renewables account for less than 1% of the total installed capacity. To add to that almost three years after the announcement of the 4.5% target, there is still no functioning regulatory framework at the national level to make renewable energy commercially viable[10] .

Ukraine also has a vast landmass, has good wind resources and a rapidly developing economy. According to EBRD estimates, over 40% of the country's territory would be suitable for wind generation. About 5,000 MW of wind power could be developed in the mid-term, and as much as 20-30% of the country's total electricity demand could be met by wind. In 1996, the Ukrainian government announced a target of installing 200 MW by 2010, but by the end of 2011 had reached only 151.1 MW.

Further east, several countries including **Kazakhstan, Turkmenistan, Azerbaijan** and **Uzbekistan** have areas with excellent wind resources, but large oil and gas reserves have to date been a disincentive to any renewable energy development. Kazakhstan has huge wind potential, but has not yet perfected regulations to cover renewable energy development. Countries with fewer fossil fuel resources, such as **Kyrgyzstan** and **Tajikistan** might be more promising for wind power development in the short and medium term, but no development has taken place to date.

THE GWEO SCENARIOS FOR EASTERN EUROPE/ EURASIA

Apart from the new EU member states in this region, which are undertaking considerable efforts to catch up in terms of renewable energy deployment, no significant development has taken place in Eastern Europe/Eurasia. Projection of the installed wind power capacity in the near and mid-term future is particularly difficult here, as this will largely depend on political decisions in some key countries, especially Russia and Ukraine. If these governments decide to exploit the tremendous resource at their doorstep and provide the necessary incentives for attracting investors, wind power generation could play a key role in fuelling these growing economies. Without this political will, however, the wind markets will not begin to reach their potential.

According to the IEA's New Policies scenario, this is exactly what will happen. This scenario sees annual markets across the whole region (including the new EU member states) decrease from 791 MW in 2011 to 548 MW by 2015, and then rise slightly to 573 MW by 2020. This would result in a total installed capacity of close to 7.4 GW by 2020 and 17 GW by 2030, up from under 2.2 GW in 2011.

Such development would not have a major impact on power generation, economic growth or emissions savings in these countries. In 2020, wind power would produce 45 TWh across the entire region – compared to an estimated electricity consumption of 880 TWh in Russia alone at that time and 1,500 TWh in the whole region of eastern Europe/ Eurasia. Investment in wind equipment would amount to about € 1.6 billion in 2020, and employment in the wind sector would stand at around 21,000 jobs by then.

The Moderate scenario is slightly more optimistic, assuming that both the EU member states and some other countries with existing renewable energy targets will meet these as planned. This would result in annual markets increasing nearly thirteen fold between 2011 and 2030, and reaching more than 9.3 GW by 2030. The installed capacity would then stand at 10 GW in 2020 and 70 GW by 2030.

The resulting benefits for power generation and climate protection would be more sizeable under this scenario. In 2020, wind power would produce close to 25 TWh of clean electricity saving 15 million tonnes of CO_2, and this would grow to 185 TWh by 2030 saving 111 million tonnes of CO_2 annually. If we consider that the region's electricity demand is forecast to reach 1,800 TWh by 2030, though, the overall share of wind power in the electricity system would still be rather small compared to other regions in this scenario.

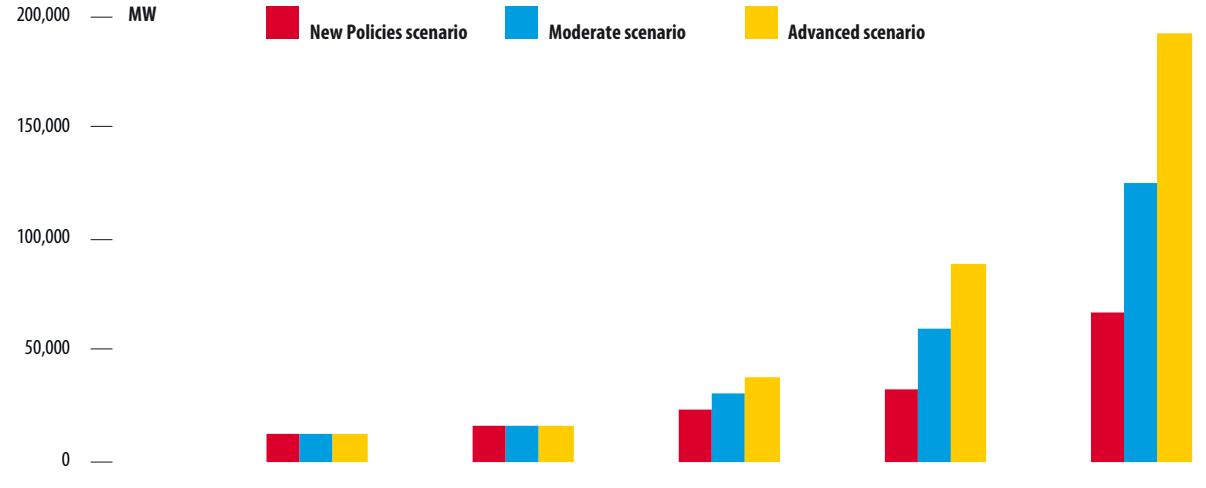
In terms of investment and jobs, the GWEO Moderate scenario figures would translate into investments worth €2.9 billion in 2020, creating approximately 30,000 jobs, and €9 billion in 2030 with a workforce of 135,000 people in the wind sector.

The figures in the GWEO Advanced scenario are slightly higher. Here, 32.3 GW of wind power would be installed by 2020, producing 79 TWh and saving 48 million tons of CO_2. Annual markets of around 5.4 GW in 2020 would attract €5.8 billion in investment every year, and this would increase to close to 8.9 GW by 2030, which would translate into €9.2 billion worth of investment in the sector. More than 141,000 people would by then be working in the field of wind energy.

10 *RE Policy in Russia: Waking the Green Giant (IFC Russia RE Program, 2011) http://bit.ly/QT9A2n*

INDIA

TOTAL WIND POWER CAPACITY IN MW



	2010	2011	2015	2020	2030
New policies scenario	13,065 MW	16,084 MW	23,784 MW	32,933 MW	66,400 MW
Moderate scenario	13,065 MW	16,084 MW	31,499 MW	59,351 MW	124,826 MW
Advanced scenario	13,065 MW	16,084 MW	37,436 MW	89,299 MW	191,711 MW

India's rapidly growing economy and expanding population make it hungry for electric power. In spite of major capacity additions over recent decades, power supply struggles to keep up with demand. Electricity shortages are common, and a significant part of the population has no access to electricity at all. India's electricity demand is projected to more than triple between 2005 and 2030. The IEA predicts that by 2020, 327 GW of power generation capacity will be needed, which would imply the addition of 16 GW per year.

India's wind industry had another record year in 2011, installing more than 3 GW of new capacity for the first time to reach a total of 16,084 MW. As of January 2012, renewable energy accounted for 12.1% of total installed capacity, and about 6% of electricity generation, up from 2% in 1995. Wind power accounts for about 70% of this installed capacity.

India's economic policy is based on its Five Year Plans, and its fiscal year runs from April to March. In 2011 the state-run Centre for Wind Energy Technology reassessed India's wind power potential as 102,778 MW at 80 metres, up from the earlier estimate of approximate 49,130 MW at 50 metres at 2% land availability.

MARKET DEVELOPMENTS

India introduced a Renewable Energy Certificate (REC) market in 2011, adding to the list of available support mechanisms such as the Generation Based Incentive (a fixed premium of INR 0.5 per kWh). The volumes traded in the REC market have steadily increased since trading started in February 2011. The REC Registry as of October 2012 had issued 3,120,528 RECs, and wind made up approximately 56% of this accredited generation capacity.

The market clearing price for each REC ranges from between INR 1,500 (€ 22.8) to INR 3,900 (€59.2). These high volumes suggest that more and more States are looking to meet their prescribed Renewable Purchase Obligations through the REC market. This augurs well for the wind power market in India.

After the enactment of the Electricity Act (2003), the wind sector has registered a compound annual growth rate of about 28.8%. The central and state governments' policies have provided policy support for both foreign and local investment in renewable energy technologies. In 2011, India saw € 7.76 billion invested in clean technology of which €3.4 billion was invested in wind energy. This accounted for 4% of the world's clean technology investments in 2011 [GWEC, 2011].

TARGETS

The report of the sub-group for wind power development appointed by the Ministry of New and Renewable Energy to develop the approach paper for the 12th Plan Period (April 2012 to March 2017) has fixed a reference target of 15,000 MW in new capacity additions, and an aspirational target of 25,000 MW for the next five-year period. Importantly the report recommends the continuation of the Generation Based Incentive scheme during the 12th Plan Period. The report has prioritized the issue of transmission which was a weak link in the value chain until now. This is being dealt with by a joint

Kutch, India © *Wind Power Works*

working group of the MNRE, the Ministry of Power, the Central Electricity Authority and the Power Grid Corporation of India.

However, for India to reach its potential and to boost the necessary investment in renewable energy, it will be essential to introduce clear, stable and long-term support policies, carefully designed to ensure that they operate in harmony with existing state level mechanisms and do not reduce their effectiveness.

TRANSMISSION

Inadequate grid infrastructure is an increasing challenge. However, the possibility of linking the southern regional grid with the national grid, which is currently scheduled for 2013-2014, will play an important role in fast-tracking the development of the REC market. This inter-linkage of regional and national grids is important to enable the high wind states to continue to increase wind power penetration in the state grids without resorting to curtailment. One way to mobilize higher outlays of financial resources to create improved grid infrastructure could be to tap the National Clean Energy Fund created by the Government in 2010. The Central Electricity Regulatory Commission is mandating scheduling and forecasting in the next plan period that will help raise the credibility of wind energy.

Ongoing government initiatives to provide long-term policy certainty are very likely to attract large quantities of private investment to the sector. Recently, the Centre for Wind Energy Technology reassessed India's wind power potential of over 102 GW at 80 metres. This more than doubled the officially exploitable wind resource in the country, up from the earlier estimate of 49 GW. This study could have a significant impact on future policy and regulatory framework for the wind sector in India.

THE GWEO SCENARIOS FOR INDIA

Under the IEA New Policies scenario, India's wind power market would shrink considerably from the current annual additions of around 3000 MW to only 1900 MW per year by 2020. The result would be a total installed capacity of 32 GW by 2020 and 66 GW by 2030. Wind power would then produce close to 81 TWh every year by 2020 and 174 TWh by 2030, and save 48 million tons of CO_2 in 2020 and 105 million tons in 2030. Investments in wind power in India would also drop from the current levels of €3.7 billion per year to only €2.4 billion by 2020.

Under the GWEO Moderate scenario, we expect that between 18.6 and 19 GW of wind power capacity will be installed in India by the end of 2012. Under the Moderate scenario, the total installed capacity would reach almost 31.4 GW by 2015, and this would go on to grow to 59 GW by 2020 and 124 GW by 2030.

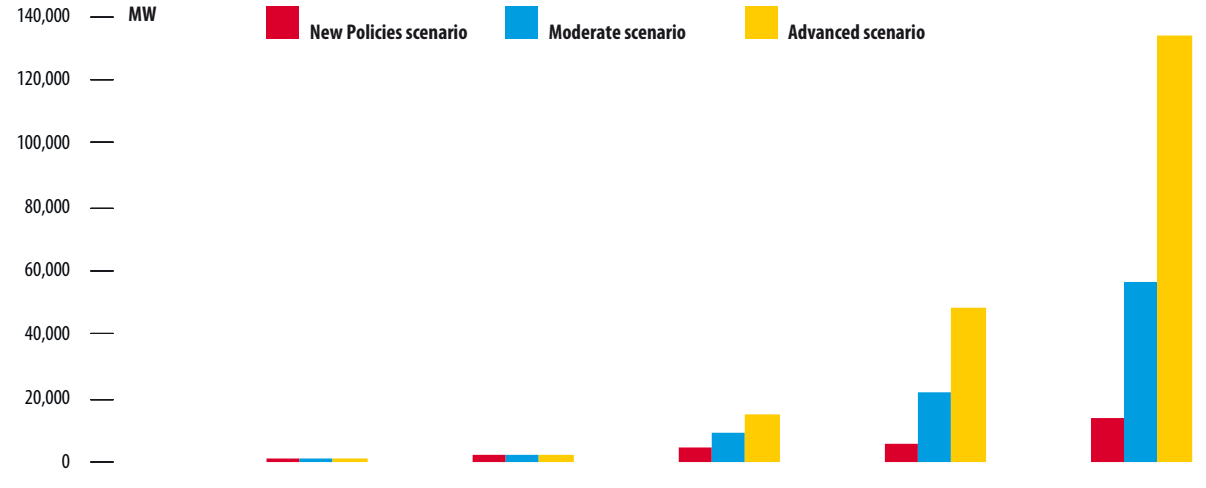
By 2015 the wind industry will see investments of €5.3 billion per year, €7.2 billion per year by 2020 and €8.3 billion per year by 2030. Employment in the sector would grow from the currently estimated 47,500 jobs to over 98,000 by 2020 and over 126,000 jobs ten years later.

Nevertheless the GWEO Advanced scenario shows that the wind development in India could go much further: by 2020 India could have almost 89 GW of wind power in operation, supplying 219 TWh of electricity each year, while employing over 179,000 people in the sector and saving almost 131 million tonnes of CO_2 emissions each year. Investment would by then have reached a level of €13 billion per year.

With the acute need for electrification and higher energy production in the country, wind energy is going to provide an increasingly significant share of the renewables based capacity. By 2030 wind power would generate almost 504 TWh per year and avoid the emission of 304 million tons of CO_2 each year.

LATIN AMERICA

TOTAL WIND POWER CAPACITY IN MW



	2010	2011	2015	2020	2030
New policies scenario	1,489 MW	2,330 MW	4,342 MW	6,241 MW	13,868 MW
Moderate scenario	1,489 MW	2,330 MW	9,296 MW	21,903 MW	56,075 MW
Advanced scenario	1,489 MW	2,330 MW	15,303 MW	47,970 MW	134,411 MW

Latin America[11] has some of the best wind resources in the world, and wind power is poised to play a greater role in meeting the region's growing demand for electricity. With a broad commitment to environmental protection across the region, it is considered one of the best areas for the deployment of wind power.

At the end of 2009 over 1,072 MW of wind power capacity had been installed across the entire region. By the end of 2011, this had more than doubled to almost 2,330 MW of total installed capacity, with Brazil accounting for over two thirds of this capacity.

There are signs that wind power is now finally reaching critical mass in a number of Latin American markets, and the region has begun developing a substantial wind power industry to complement the its rich hydro and biomass (and potentially solar) resources. In the medium to long-term the demand for diversity of supply is expected to grow wind generation in Latin America.

However, we have to bear in mind that Latin America, like the Eastern Europe/Eurasian economies, has a diversity of economic and political regimes within its boundaries. In fact its constituent countries are at vastly different stages of economic development. There are a number of emerging economies in the region whose per capita income is similar to or greater than that of some new EU member states; yet at the same time the region is still plagued with extreme poverty and limited development in several countries and sub-national regions.

11 *Please note that Mexico is now part of OECD North America*

BRAZIL

Brazil, Latin America's largest economy, is also the leader in wind power installations. Brazil has historically relied heavily on hydropower generation, which until recently supplied 80% of the country's electricity needs. As wind and hydropower work well together within a power system, this combination forms an ideal basis for large-scale wind power development. The country has tremendous potential for wind energy, coupled with a growing electricity demand and a solid industrial base.

After a fairly slow start to wind power development in the first half of the last decade, the Brazilian wind market now seems to be taking off. In 2011, 582 MW were added to bring its cumulative installed capacity to 1,509 MW. This is an increase of 63% in installed capacity, and a 56% increase in terms of annual market growth. Brazil reached the 2 GW milestone in August 2012 and has more than 7,000 MW in the pipeline to be completed by 2016.

Brazil is one of the most promising onshore markets for wind energy for at least the next five years. The country's support framework and the sector's experience have been adapted to meet local conditions. This puts Brazil in an excellent position to be the regional leader in wind energy generation and development. However, achieving sustained development requires a new regulatory framework, which would provide certainty in terms of development volumes in the medium and long term. Current government projections foresee 16,000 MW of wind power installed in the country by the end of 2021.

CHILE

Unlike many of its neighbours, Chile has limited indigenous fossil energy resources, and relies heavily on imports, the disruption of which has led to periodic energy shortages over the past decade. Chile is also vulnerable to long dry spells during the summer months. As a result, energy prices in Chile have nearly tripled in the last five years. Fortunately, Chile is blessed with abundant renewable energy resources, including wind, solar and geothermal, but to date they represent less than 1% of the energy mix.

Chile has good wind resources from the northern deserts to the extreme south, including the south-central zone that is home to around 80% of the country's population and two thirds of its industry. Chile's wind energy potential is estimated at more than 40 GW.

Chile's renewable energy portfolio grew considerably in 2011 and more than 5,000 MW of renewable energy projects are currently under development. Wind projects account for more than 3,000 MW, including both installed capacity as well as projects under development. Although the market is moving, there are still major obstacles to the construction and implementation of these projects, and actual installed capacity for renewables is only about 600 MW. In terms of installed capacity, wind power represents about a third of the total installed capacity of renewables. In 2011, 33 MW of new wind capacity became operational, including new projects and the expansion of existing ones. Overall, this represents nearly 20% growth compared to 2010 figures, bringing the cumulative installed wind capacity to 202 MW.

OTHER MARKETS

Uruguay had installed 43 MW by 2011. It has a plan to integrate wind energy as a resource, having already auctioned 500 MW of wind projects. The expectation is that Uruguay will have 2 GW of wind power installed by 2020. A prospect for increasing wind power in the region could be a planned interconnection between Uruguay and Brazil.

Another promising market is **Argentina,** which had nearly 130 MW in operation at the end of 2011. Argentina also has massive wind resources. A number of large wind power projects are under development, and they are desperately needed to help alleviate chronic electricity shortages. Some analysts claim that the winds in Argentina are sufficient to supply Latin America's entire electrical demand seven times over.

Other wind power markets in the region include: **Costa Rica,** with about 132 MW of wind power at the end of 2011; **Honduras,** with 102 MW of wind power at the end of 2011; **Nicaragua,** which boasts 62 MW of total capacity; and the **Dominican Republic** added 33 MW of new capacity in 2011, thereby joining the list of countries with commercial-scale wind power development.

Finally, although there is some development of wind power in the island economies in the **Caribbean,** which currently mostly rely on imported fossil fuels, wind power could play a much more substantial role in helping grow their economies on a more sustainable basis. **Jamaica** has 23 MW of installed wind capacity and **Aruba** had over 30 MW of installed wind power capacity at the end of 2011.

Unfortunately, however, all of these early markets suffer from the lack of a clear, long-term policy framework for the development of a wind power industry, which continues to hamper market development. Signals are needed from governments indicating to the private sector and the finance community that there is clear political commitment to develop renewable energy in general and wind power in particular. This would at the same time foster economic development, attract investment and create the 'green' jobs that have been the object of government policy in many other parts of the world – as the scenario figures underline.

THE GWEO SCENARIOS FOR LATIN AMERICA

GWEC expects wind energy installations in Latin America to be considerably stronger by 2020, with encouraging developments in markets such as Brazil, Chile and Uruguay.

Under IEA's New Policies scenario (NPS), wind power could provide Latin America with 36 TWh of electricity every year while saving 22 million tons of CO_2 emissions by 2030; or it could, under the Advanced scenario, generate nearly ten times as much (353 TWh) and save 212 million tons of CO_2 emissions per year by then. This stark difference under- lines the enormous impact that a positive political framework can make across this wind-rich continent.

Under the IEA's New Policies scenario (NPS), there would be 13.8 GW of wind installed across the entire continent by 2030. This would, in fact, mean that the annual market would shrink from the 852 MW installed in 2011 to as little as 349 MW by 2015. Only by 2027 would it again reach its current size, according to the IEA's NPS.

The Moderate scenario foresees a much more rapid development, with annual additions reaching 3 GW as early as 2020. This would bring the total installed wind capacity to 21.9 GW by 2020 and 56 GW by 2030. The impact on electricity production would be considerable, with 54 TWh of wind power generated in 2020 and 147 TWh in 2030.

The Advanced scenario outlines that even more could be achieved, given the extraordinary wind conditions in many Latin American countries. If fully exploited, wind power could boom here, with more than 15 GW of wind power installed across the continent in 2015. This could then go on to increase to 47.9 GW by 2020 and as much as 134 GW by 2030.

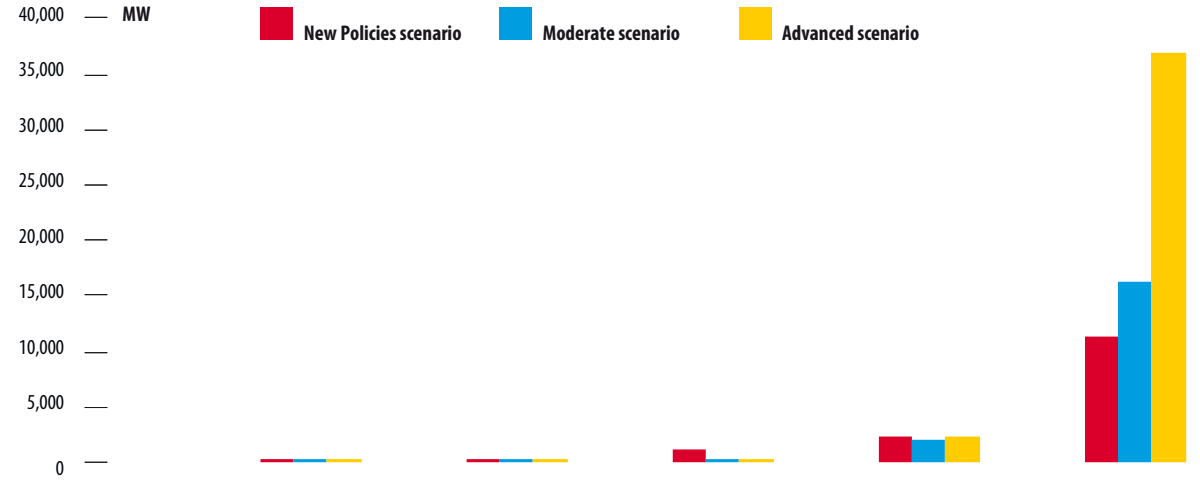
With such a development, wind power would start to account for a significant part of electricity supply, producing more than 118 TWh by 2020 and 353 TWh by 2030. Wind power developed at such a scale would not only strengthen Latin America's energy independence, but it would also have a direct impact on regional economic development and jobs.

In terms of employment, there were about 12,600 jobs in the Latin American wind sector in 2011. Under the NPS, this number would halve to about 6,300 by 2015 and only reach current levels again in 2025. The Advanced scenario shows that by 2015 alone Latin America could have employment figures more than ten times the job figures under the NPS in 2015, reaching 149,000 by 2030.

Equally, wind power would attract substantial investment; the Advanced scenario estimates that Latin America's wind sector could channel over € 9 billion by 2030, compared to just € 2.9 billion in 2011.

MIDDLE EAST

TOTAL WIND POWER CAPACITY IN MW



	2010	2011	2015	2020	2030
New policies scenario	99 MW	99 MW	1,116 MW	2,317 MW	11,436 MW
Moderate scenario	99 MW	99 MW	198 MW	2,150 MW	16,181 MW
Advanced scenario	99 MW	99 MW	258 MW	2,180 MW	37,024 MW

As a region, the Middle East has abundant oil and gas reserves. The IEA defines the region as: Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates and Yemen. However the economies of this region, like others, reflect the fact that these reserves are unevenly distributed, with members of the Gulf Cooperation Council (UAE, Bahrain, Kuwait, Saudi Arabia, Oman and Qatar) generally the most affluent. While these countries are major exporters of oil, others are importers, often at a very high cost compared to their overall GDP. Increased prosperity in much of the region means that the demand for power has been growing rapidly for industrial and consumer needs, with extra loads for cooling and desalination. Some of the wealthiest countries in the Middle East region are among the world's most carbon intense economies.

As regards wind power, the region had 99 MW installed at end of 2011. While less evenly distributed than solar, the region's wind resource is excellent in some countries such as Iran, Oman, Syria, Saudi Arabia and Jordan. In the last couple of years a number of governments in the Middle East are beginning to develop comprehensive national plans for renewable energy.

Iran is the only country in the region with any large-scale wind power installations with a total of 91 MW installed at the end of 2011. The country currently has two wind farms: the Manjil wind farm in Giland province, and the Binalook wind farm in Khorasan Razavi province, which have an installed capacity of 91 MW. There are plans for expanding wind capacity to reach 400 MW in the coming years. Studies have shown that overall, Iran has a potential for wind power development of around 15 GW[12]. Iran offers tax and investment credits to support renewables development. In addition, Iran is home to the region's only wind turbine manufacturer, Saba Niroo.

12 *Recent Advances in the Implementation of Wind Energy in Iran by Mohammad Ameri*, Mehdi Ghadiri and Mehdi Hosseini, 2006, University of Tehran www.jgsee.kmutt.ac.th/see1/cd/file/B-002.pdf*

Binalood, Iran © *Parsian Nasim Pishro/GWEC*

The Iranian government set a new target of 1,500 MW of wind power by 2013, but it seems unlikely that this target can be met. Despite the sluggish growth of wind energy in Iran, there is infrastructure capacity for rapid deployment. To date, more than 120 data collection sites are feeding detailed information into the Iranian wind database. A wind atlas is available for three different altitudes (40m, 60m and 80m) and 42 sites have been identified as appropriate for wind power development, spread over 26 regions across the country.

Jordan does not have significant oil or gas reserves. Its Energy Strategy (2008-2020) aims to reduce its dependence on imported products from 96% (in 2010) with renewables meeting 10% of energy demand by 2020. Of this, about 1,200 MW will come from wind energy according to the Energy Strategy.

In April 2012, the Renewable Energy and Energy Efficiency Law was enacted, which allows for the necessary indicative pricing, interconnection and net metering regulations to be completed. Jordan's best wind resources are in Aqaba and the Jordan Valley. Additionally the government has launched the Jordan Renewable Energy and Efficiency Fund. The aim of this fund is to support energy-saving and renewable energy initiatives. The Jordanian government and international donor agencies such as the French Development Agency and the World Bank will finance the fund. Private investors, both domestic and international can apply for the fund.

The IFC is promoting wind energy in Jordan through its 'Wind Power Market Project' with investments of over €110 million (~$141.9 million[13]). The Ministry of Energy and Mineral Resources is in talks with private sector investors for two wind projects Al Kamsheh (40 MW) and Fujeij (90 MW) to begin construction in 2013. The government intends to expand the Fujeji project to 250 MW after the initial 90 MW phase is built[14] .

Oman is a small country with only 2.6 million inhabitants, and considerable reserves of natural gas and crude oil, and a total installed power generation capacity of around 3.5 GW. According to a Study published by the Authority of Electricity Regulation in Oman[15]to meet growing electricity demand, the total installed capacity is forecast to grow to 5 GW by 2015 by when the power system in the north and in the south will likely be interconnected. The technical future potential for wind power in Oman is expected to be at least 750 MW.

Natural gas and oil exports account for around half of Oman's GDP, and preserving its reserves and reducing the water usage intensity of its energy system are the key incentives for the government to consider developing its renewable energy resources. Interestingly, the measured wind speeds were highest in summer months, when electricity demand in Oman is at its peak[16] .

Finally, construction is about to begin on the **United Arab Emirates'** first commercial wind farm, a 30 MW project on Sir Bani Yas island; and the UAE is currently looking at the potential for offshore wind power.

THE GWEO SCENARIOS FOR THE MIDDLE EAST

Considering the significant potential for wind power in some Middle Eastern countries, the GWEO scenarios for the region are by far more optimistic than the IEA's New Policies scenario, which forecasts that the region's total installed wind capacity will grow to around 2.3 GW by 2020 and 11.4 GW by 2030.

Under the Moderate scenario, which takes into account current and anticipated government targets and a growing interest in reaping the benefits wind power can bring to the region, the Middle East's installed wind capacity would grow to just over 16 GW by 2030. In the Advanced scenario, this would grow even further, to reach 37 GW by 2030.

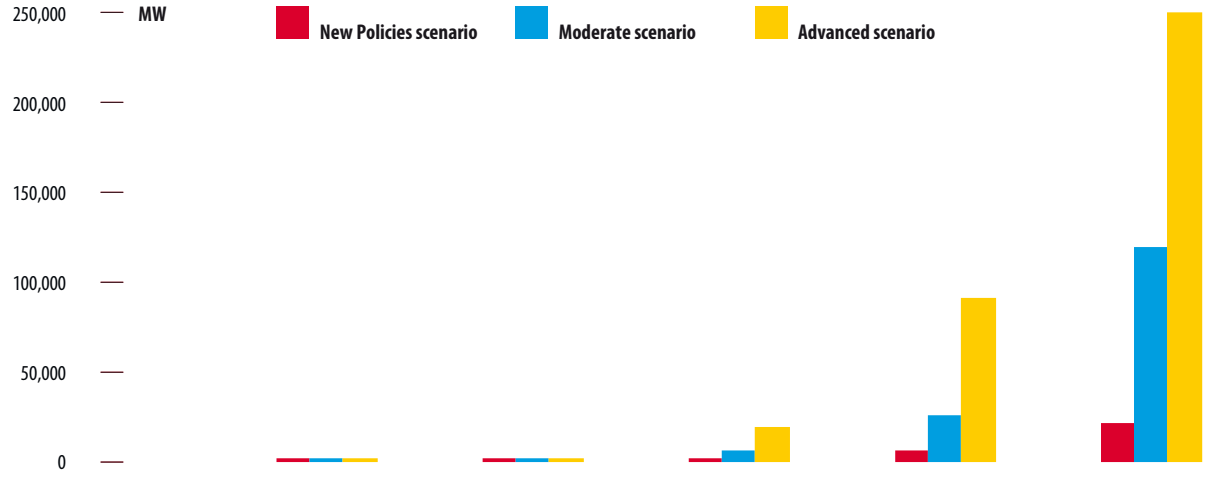
The electricity generated through wind power in these scenarios would enable some of the Middle eastern countries to improve their energy independence and help those rich in fossil fuel resources to realise considerable fuel savings and reduce their carbon footprints.

By 2030, between 73 TWh (Moderate scenario) and 97 TWh (Advanced scenario) could be produced every year. Accordingly, CO_2 emission savings would be between 44 (Moderate scenario) and 58 million (Advanced scenario) tons per year by 2030.

13 http://www.worldbank.org/projects/P093201/promotion-wind-power-market?lang=en
14 http://www.nortonrose.com/knowledge/publications/62385/renewable-energy-in-jordan
15 www.aer-oman.org/pdf/studyreport.pdf
16 www.aer-oman.org/pdf/studyreport.pdf

NON-OECD ASIA

TOTAL WIND POWER CAPACITY IN MW



	2010	2011	2015	2020	2030
New policies scenario	606 MW	672 MW	2,879 MW	6,375 MW	21,222 MW
Moderate scenario	606 MW	672 MW	5,407 MW	27,083 MW	119,476 MW
Advanced scenario	606 MW	672 MW	18,823 MW	90,768 MW	250,342 MW

This IEA region groups together all Asian countries apart from China, India, Japan and South Korea, which are covered in other sections of this report. This mega diverse 'region' ranges from Afghanistan through Mongolia, to Southeast Asia, and the islands of the Pacific (see p. 22-23 for a full list of countries).

At present, there is limited development of wind power in many of these countries. However, that is not to say that there is no potential, or no plans. The potential for development in countries such as Thailand, Philippines, Vietnam or Laos may come as a surprise; for it is often believed that there is not a viable wind resource in the tropics – where many of these countries are located. But there is a range of countries in this list that have tremendous wind resources, as do Mongolia, Pakistan, and Sri Lanka.

Factors other than pure wind resource potential are involved in projecting when (or indeed if) wind power is likely to be developed and how much: demographic factors, dependence on fuel imports, economic growth and consequent increase in electrical demand, state of the transmission and distribution system, etc. One potential enabler open to many of these countries was the clean Development Mechanism of the Kyoto Protocol (CDM). However unlike their Asian neighbours, China and India in particular, only a few wind power projects have entered the CDM pipeline from this region – two in the Philippines, and one each in Mongolia, Vietnam and Sri Lanka.

Across the region covered here there are at least a dozen vibrant and rapidly growing markets in which wind energy could play a significant role. There is also a noticeable shift in the attitude of policymakers and utility executives to wind power. Today the continuing success of the technology in an ever widening group of Asia-Pacific countries has changed that attitude to one of dramatically increased understanding about wind generation and the role that it can play in a country's power mix.

The markets covered below give some idea of the technical potential, and also the wide range of background conditions in this diverse grouping. In some cases, an acute need for additional power capacity comes together with an excellent resource – and such is the case for countries such as Mongolia, Vietnam or Pakistan. Quite a few of the countries in this region do have targets in place – though that does not necessarily mean that incentives are also in place to support the achievement of those targets.

For instance, Bangladesh wants 5% of its electricity to come from renewables by 2015. Mongolia plans to increase its share of renewable electricity from the current 3% to 20–25% by 2020. Sri Lanka wants to go from the current 5% to reach 10% by 2017 and 14.1% by 2022, Tonga is targeting 50% by 2012, and Indonesia wants to build 255 MW of wind capacity by 2025 (alongside other renewable technologies such as 6 GW of geothermal).

Some wind power development has already taken place in this region, including:

In the **Philippines,** 33 MW of wind power were operating at the end of 2011, but the technical potential is estimated at around 55 GW, over three times the country's total installed

generation capacity in 2010, according to UNEP's Solar and Wind Resource Assessment (SWERA)[17]. The government has set a target for 40% of its electricity to be generated by renewable sources by 2020, up from the current 33%. Both the Philippines government and the Asian Development bank (ADB) have set up funds to help with this process. In a very positive move forward the Energy Regulatory Commission (ERC) of Philippines, in July 2012, approved the initial Feed-in Tariffs (FITs) that shall apply to generation from renewable energy sources, particularly, run-of-river Hydro, Biomass, Wind and Solar.

Vietnam's (purely technical) wind potential could support 642 GW of wind power according to SWERA figures. In addition, Vietnam has a fast-growing economy and a growing demand for electric power. The country has been expanding its generating capacity, including through new large hydro dams, but still needs to import electricity from china. The Vietnamese government is aiming for renewable power to provide about 5% of the nation's electricity by 2020. By the end of 2011, Vietnam had 30 MW of operating wind power capacity in the country's central Binh Thuan province. Eventually the project is expected to total 80 turbines, with a nameplate capacity of 120MW[18]. Vietnam's Power Master Plan-7 set out wind power generation targets of 1GW by 2020 and 6.2 GW by 2030, with an obligation on Electricity of Vietnam Group (EVN) to purchase all electricity generated by on-grid wind plants at a price of VND 1,614/kWh (~$7.8/kWh) which includes a subsidy of 207 VNĐ/ kWh (~ 1.0 $cent/ kWh) through the Vietnam Environmental Protection Fund. There is considerable investor interest in the Vietnamese wind market[19]. By June 2012, 37 wind-power projects with a total capacity of 4,296 MW were at various stages of development in Vietnam.

Thailand's growing affluence has led to a startling rise in per capita electricity consumption, which has grown by almost 25% in the past five years. According to SWERA figures, Thailand's technical wind resource could support the development of 190 GW of wind power. The government launched its 10 years Alternative Energy Development Plan (AEDP-Master Plan 2012-2021) that set a target for 25 % of renewable energy in Thailand's total energy consumption by 2021.

By the end of 2011, Thailand had installed 7.2 MW of wind, although there is a 207 MW project currently under construction, scheduled to come on line in early 2013. In 2011, Thailand revised its wind target from 800 MW to 1,200 MW by 2021. The government had received proposals totaling over 1,600 MW (for projects ranging in size from 10-90 MW) in June 2012.

17 *http://www.climateplanning.org/tools/swera-rrex*
18 *http://www.windpowermonthly.com/news/1127995/Vietnams-first-turbines-online/*
19 *http://www.windenergy.org.vn/index.php?page=overview*
20 *http://www.aedb.org/Main.htm*

The **Taiwan** government has proactively promoted wind power along with other renewable energy technologies over the last ten years. In 2010 Taiwan set a target to have 16% of installed power capacity from renewable energy sources by 2025. During 2011, Taiwan installed 45 MW of new wind power, bringing its total to 563.8 MW. In 2011, a consortium called the Taiwan Offshore Wind Power Alliance was formed to develop the country's first wind farm in Changhua, comprising 18 Taiwanese companies from engineering, manufacturing, and energy sectors. The first phase of 10MW is expected to be completed by 2013, and a further 610MW by 2016.

In **Pakistan,** there is an acute power shortage, and a strong increase in power demand. Most of the country's power needs to date are met by fossil fuels. Today almost 65% of Pakistan's electricity is generated with fossil fuels, of which 80% is imported. The Pakistani government wishes to exploit indigenous resources and reduce dependence on imported fuel. According to Pakistan's Alternative Energy Development board, wind power offers a technical potential of 350GW; with the Gharo-keti Bandar wind corridor in Sindh alone accounting for almost 50GW of this potential. In October 2011, Pakistan introduced a FIT scheme that is planned to be available only for 2012. It is set at PKR 12.61/kWh (€0.105/ kWh) for foreign-financed projects and PKR 17.28/kWh (€0.143/kWh) for locally financed projects and is limited to a total of 1,500MW.

2012 witnessed the financial closing of the 56.4 MW project being constructed by Zorlu Enerji (a Turkish company) and on successful completion of this phase Zorlu Enerji is considering further investments for a 200 MW wind project[20]. The Pakistan Alternative Energy Development Board also announced the financial closure of another wind project for 50 MW located at Jhampir, in the Sindh region. A consortium led by the Fauji Fertilizer Company backs this project.

THE GWEO SCENARIOS FOR NON-OECD ASIA

Across the whole region, 82.6 MW of new capacity was installed in 2011, and the total stood at 672 MW at the end of the year.

Under the New Policies scenario, the speed of wind power development will not increase substantially in non-OECD Asia, and the annual market across this vast region will grow to 699 MW by 2015, and total capacity will reach 6.3 GW by 2020. Thereafter the annual market will increase gradually to 1.95 GW by 2030, which would result in a total capacity of 21 GW by that date.

Given the excellent wind resources in some of the Asian countries, and recent government initiatives to help exploit them, the Moderate scenario describes a more positive development. More than 2,538 MW of new wind capacity would be installed in the region every year by 2015, and

this would gradually increase to an annual market of over 13,600 MW every year by 2030. The result would be a total installed capacity of 27 GW by 2020, and 119 GW by 2030.

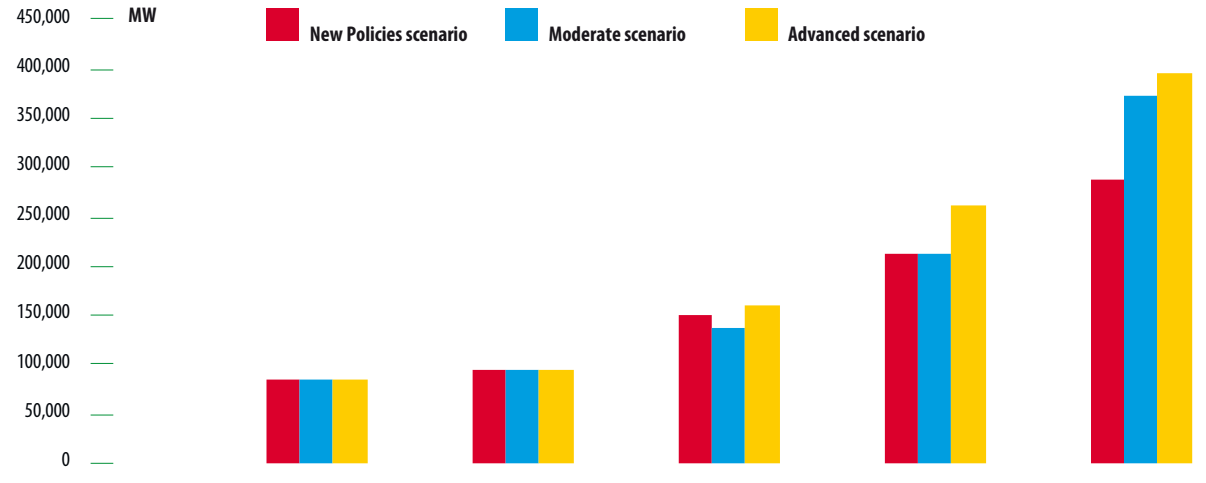
The difference in terms of power produced and consequent CO_2 savings would be considerable. While under the New Policies scenario, wind energy would produce only 16 TWh by 2020 and save 9 million tons of CO_2, the Moderate scenario would achieve a production of 66 TWh in this timeframe, thereby saving the emissions of 40 million tons of CO_2 every year. This would grow to close to 314 TWh by 2030 and savings of 188 million tons of CO_2. Economically, also, such a development would have a considerable impact. By 2020, wind energy could attract around €4.3 billion worth of investment to the region every year, and create around 77,000 jobs.

The Advanced scenario assumes that current efforts to promote renewable energy are intensified, reflecting governments' aim of making the most of the natural wind resources and reaping the related benefits. This would attract annual investments in the region of € 9-10 billion, and create 270,000 jobs by 2030.

It is in this scenario that wind power would start to make a noticeable contribution to the region's electricity supply. A total installed capacity of 18 GW would produce around 46 TWh of clean power by 2015, and this would rise to 90 GW generating 223 TWh only five years later. By 2030, the installed capacity would increase to 250 GW, with an annual power production of 658 TWh.

OECD EUROPE

TOTAL WIND POWER CAPACITY IN MW



	2010	2011	2015	2020	2030
New policies scenario	84,965 MW	94,328 MW	150,169 MW	211,319 MW	288,333 MW
Moderate scenario	84,965 MW	94,328 MW	137,818 MW	211,276 MW	371,627 MW
Advanced scenario	84,965 MW	94,328 MW	161,600 MW	262,797 MW	396,728 MW

OECD Europe covers twenty-three countries (See page 22-23 for full list of countries). While individual markets within this group of countries may move at different rates from year to year, the overall trend has been one of steady upward growth. 9.4 GW of new wind power were added during 2011, bringing the total installed capacity to 94.3 GW.

In 2011 Germany and the UK were the two largest annual markets for wind power, with (2,086 MW and 1,293 MW of new installations respectively), followed by (Spain 1,050 MW), Italy (950 MW), France (830 MW) and Sweden (763 MW). A further four countries Poland (436 MW), Turkey (470 MW), Portugal (377 MW) and Greece (311 MW) each installed over 300 MW in 2011. Fifteen of these countries now have more than 1 GW each of total installed wind energy capacity.

While the distribution of the market changes from year to year, the industry marches forward towards its 2020 target of supplying 14-16% of Europe's electricity by the end of the decade. The total wind capacity installed by the end of 2011 will, in a normal wind year, produce 204 TWh of electricity, enough to meet 6.3% of overall EU electricity consumption [GWEC, 2011[21]].

21 *GWEC Annual Market Update, 2011 www.gwec.net*

OFFSHORE WIND

Offshore installations declined very slightly in 2011 to 866 MW, just 17 MW less than in 2010, bringing total installations to 3,813 MW, accounting for about 9% of the European market. The majority of these installations were in the UK, cementing the UK's position as the European (and global) leader in offshore deployment, passing 2,000 MW installed in 2011. Denmark is in second place with 857 MW.

The UK and Denmark remain the two biggest markets for offshore wind in Europe, followed by the Netherlands (247 MW), Germany (200 MW), Belgium (195 MW), Sweden (164 MW), Finland (26 MW) and Ireland (25 MW) Norway and Portugal each have a full-scale floating turbine.

More than 90% of the world's offshore wind power is currently installed off northern Europe, in the North, Baltic and Irish Seas, and the English Channel. Most of the rest is off China's east coast. Offshore wind is an essential component of Europe's binding target to source 20% of final energy consumption from renewables by 2020.

By early 2012 almost 6 GW of offshore wind capacity was under construction in Europe, 17 GW has been consented, and there are plans for a further 114 GW. It is expected that during this decade, offshore wind power capacity in Europe will grow tenfold. The European Wind Energy Association (EWEA) estimates that by 2020, 40 GW of offshore wind power will produce 148 TWh annually, meeting over 4% of the EU's total electricity demand and avoiding 87 million tonnes of CO_2 emissions.

GERMANY

In 2011, the German wind market recovered from the financial and economic crisis of 2010. Germany maintained its position as the European leader in wind energy with 29,060 MW of installed capacity and 22,297 operating wind turbines. In 2011, a total capacity of 2,085 was added, including 238 MW in repowering and 108 MW offshore. Onshore turbines with an installed capacity of 123 MW were decommissioned in 2011. Compared to 2010, the annual German wind market grew by 30%.

Wind energy generated 48 TWh of electricity in 2011, which accounted for 7.8% of the country's net electricity consumption. In total, 20% of electricity was generated from renewable sources in Germany in 2011, with wind being the single largest contributor.

In the summer of 2011, the German parliament voted in favour of fully phasing out nuclear energy by 2022. This decision will have a significant impact on Germany's energy planning up to and beyond 2020. Further the amended Renewable Energy Sources Act (EEG), which entered into force on 1 January 2012, continues to provide stable support for onshore wind power and has improved support conditions for offshore wind power; it is expected to support further growth in the German wind sector in the future. The amended EEG sets Germany's target for renewable energy in final energy consumption at a minimum of 35% by 2020 and 80% by 2050.

In 2012, the German wind industry expects new installations of about 2,200 MW including 200 MW of offshore wind.

UNITED KINGDOM

The UK has some of the best wind resources in Europe and is the world leader in offshore development; but onshore development has become increasingly controversial in some parts of the country.

The total market size for the UK is just over 6.5 GW, with 1,293 MW of new capacity installed in 2011, including 752.45 MW of offshore capacity. The two biggest onshore sites in the UK are located in Scotland: Clyde South with 56 turbines (128.8 MW) and Arecleoch with 60 turbines (120 MW). Major manufacturing capacity was added in 2011 in both the onshore and offshore wind sectors.

Despite the financial crisis, the UK wind industry made steady progress in 2011, meeting 12% of the UK's electricity demand on 28 December, and supplied an average of 5.3% of the UK's electricity for the month [GWEC, 2011]. According to the latest research, published in RenewableUK's annual State of the Industry report in October 2011, the country is set to retain this competitive advantage in offshore wind in years to come, with a total of 8 GW of capacity installed by 2016, and a further 10 GW by 2020.In fact, the UK already gets close to 2% of its net electricity consumption from offshore wind, and this share is set to grow to between 17% and 20% in ten years' time.

SPAIN

Spain is endowed with significant wind power resources. According to estimates by the Institute for Energy Diversification and Saving (IDAE), published in the National Renewable Energy Plan for 2011-2020, the technical-economical potential for onshore wind power is more than 100 GW by 2020, and more than 150 GW by 2030.The objective set for 2020 stands at 35 GW of installed wind capacity. For offshore wind power the current potential is estimated at 85 GW with a target of 750 MW by 2020.

Up until 2010 the Spanish wind energy market has seen tremendous growth, and the country led Europe in 2009 with 2.46 GW of new installations, taking total wind capacity up to 19.1 GW. This made wind power Spain's third-largest power generation technology behind combined cycle gas and

nuclear power. Spain is home to some leading international wind power companies.

In 2011, the Spanish wind market shifted into a lower gear due to the economic recession and experienced only modest growth According to the Spanish Wind Power Association 1,050 MW of new capacity was added, bringing total installations up to 21,673 MW.

2011 was again a windier year than average in Spain, and the country's wind farms generated 42 TWh of electricity, accounting for over 15% of net power consumption. All renewable energy sources combined produced around 33% of Spain's electricity needs, with wind being the largest single contributor [GWEC, 2011].

In January 2012, the newly elected government adopted a temporary moratorium on all new renewable energy installations. The moratorium doesn't apply to existing installations or to wind power installations connected to the grid in 2012. However, due to this new legislation adding considerable complexity and delays to wind farm approval, and a lowering of the premium granted to wind power, future market developments are less than certain.

FRANCE

France has good wind resources, and Europe's second largest wind potential. Although the country had a late start, wind power development has been rapid over the past decade.

The French government has set a target of 25 GW of wind power, including 6 GW offshore, as part of its obligation under the EU Renewables Directive, which requires France to meet 23% of final energy demand with renewable sources by 2020. 25 GW of wind energy would produce 55 TWh every year, thereby accounting for 10% of the country's total electricity consumption.

In 2011, 830 MW of new wind power was connected to the French electricity grid, reaching a total installed capacity of 6,800 MW, with 4,000 operating wind turbines spread across the country. Overall, wind power now produces 2.5% of France's electricity demand.

In July 2011, the French government launched a first call for tender for 3 GW of offshore wind development in five zones in the Atlantic, the North Sea and the Channel. A second call for tender for offshore wind capacity is anticipated for late 2012. The latest tender offer is for one wind farm off Le Treport in northern France with a capacity of 705 MW and a second off the island of Noirmoutier with a capacity of 600 MW.

There is no certainty about the scale of onshore wind development in 2012 yet, but the recent regulatory changes, along with the lack of grid capacity in certain regions are likely to slow down the pace. Also, the real impact of the economic crisis for financing wind projects still remains to be seen.

Blades ready for lifting', Out Newton, UK © *EON*

TURKEY

Turkey's wind sector has made rapid progress, with installed capacity increasing from 30 MW in 2007 to 1,800 MW at the end of 2011. Turkey has excellent wind resources, particularly in the Çanakkale-İzmir, Balıkesir and Hatay basins.

The total feasible potential for wind energy has been estimated at 47 GW, allowing for significant growth for the Turkish wind market over the coming years. Installed wind capacity is expected to grow between 500-1,000 MW per year reaching more than 5 GW by 2015 Turkey hopes to install up to 20 GW by 2023, helping the country to source 30% of its electricity from renewable energy by that date.

The biggest obstacles to wind development in Turkey at present are the complex and bureaucratic administrative procedures. More clarity is needed in the applicability of the new local content regulations, and once clarified these should be extended until 2020. The wind sector could easily supply 20% or more of Turkey's electricity, and with grid improvements, it could even be more.

THE GWEO SCENARIOS FOR OECD EUROPE

Due to the 2020 targets for EU member countries, the New Policies scenario and the GWEO Moderate scenario follow slightly different growth paths to get to the 2020 target of 211 GW.

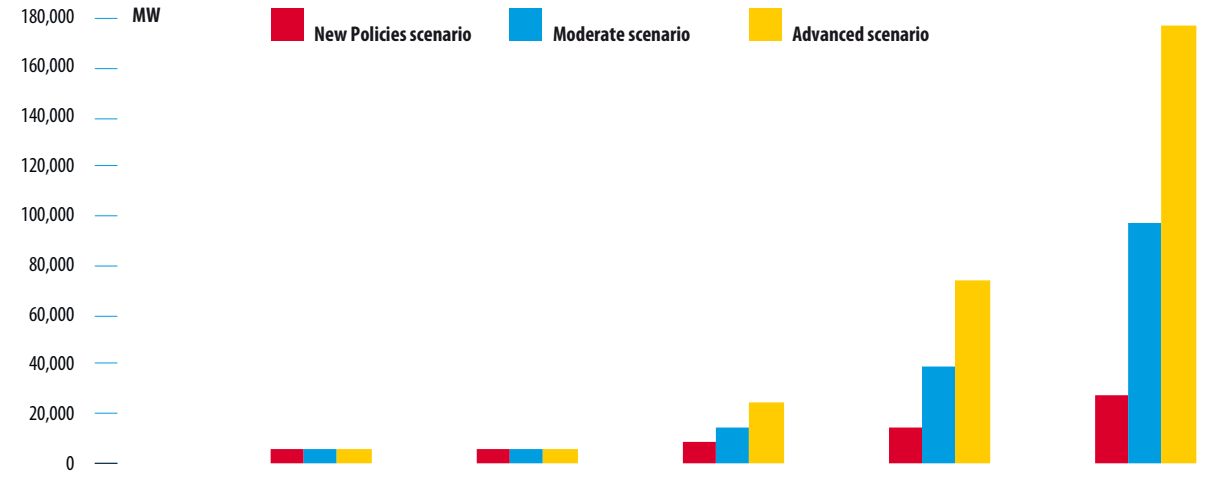
The IEA New Policies scenario anticipates that the market will see 150 GW by 2015 and 288 GW by 2030. The Moderate scenario anticipates that the market will see 138 GW of cumulative capacity by 2015, and see the markets rise at a healthier rate beyond 2015 to reach 211 GW by 2020 and 372 GW by 2030. That steady trend would ensure that wind power would deliver about 977 TWh of electricity to the region each year by 2030, saving the emission of over 586 million tonnes of CO_2 annually.

Interesting here is the contrast between these first two scenarios when it comes to employment. The new policy scenario sees employment peak early, in 2015, by when the sector would employ about 292,000 people across Europe, then dropping off to 180,000 by 2030. In the Moderate scenario, however, a longer, sustained growth curve shows an expansion of jobs between 2012 and 2020, by when the wind sector would employ close to 271,000 people. This trend continues onwards and the wind sector is projected to employ 315,000 people by 2030 in the region.

By 2020, the Advanced scenario forecasts a total capacity of close to 262 GW. This would trigger annual investments of around €24 billion by 2020 and almost 350,000 people would be employed by the wind sector at that time. In terms of electricity generation and resulting CO_2 savings, the Advanced scenario also shows what could be achieved: wind power would generate close to 1,043 TWh of electricity every year, while avoiding the emission of 626 million tons of CO_2 every year in 2030.

OECD PACIFIC

TOTAL WIND POWER CAPACITY IN MW



	2010	2011	2015	2020	2030
New Policies scenario	5,069 MW	5,755 MW	9,053 MW	14,012 MW	27,109 MW
Moderate scenario	5,069 MW	5,755 MW	13,841 MW	38,523 MW	97,715 MW
Advanced scenario	5,069 MW	5,755 MW	24,218 MW	74,702 MW	177,690 MW

The geographies and populations of the four countries covered here – Australia, New Zealand, Japan and South Korea – are very different. Situated in different hemispheres and separated by a vast stretch of the Pacific Ocean, South Korea and New Zealand are ten thousand kilometers apart. However what they have in common is high per capita energy consumption, and all except South Korea have emission reduction obligations under the Kyoto Protocol.

AUSTRALIA

Historically, Australia has relied heavily on coal and hydro for its electric power. Yet it has some of the world's best wind (and solar) resources. Australia's exceptional wind resources have allowed wind energy to make an increasing contribution to Australia's energy mix. Although it is still a relatively new industry, wind power today supplies over 6,400 GWh annually, which represents more than 2% of national electricity consumption. At the end of 2011, Australia had 1,211 operating wind turbines across 58 wind farms with a total installed capacity of 2,224 MW. The total installed capacity of wind power has grown by an average of 35% per year over the past five years.

The Australian Government's Renewable Energy Target (RET) Scheme is designed to deliver 20% of Australia's electricity supply from renewable sources by 2020. The Large-scale Renewable Energy Target and the Small-scale Renewable

Energy Scheme provide incentives designed to bridge the gap between the price of black electricity and renewable energy, and are expected to yield more than 45,000 GWh in 2020.

The Australian government has introduced new legislation on carbon pricing, setting the foundation for a national strategy to cut carbon pollution. In August of 2012, the Australian government and the European Commission reached an agreement to link their carbon trading platforms in a shared marketplace. Beginning 1 July 2015, Australia's carbon pricing scheme will be linked to the EU's Emissions Trading System (ETS) under an interim link that will synchronise carbon prices in the two markets and allow for global permit trading. A full linkage is scheduled to take place no later than January of 2018[22] .

NEW ZEALAND

New Zealand has abundant renewable energy resources, and renewables supply 73% of the country's electricity (55% large hydro, 15% geothermal and 3% wind). Overall, with a population of only about 4.5 million, the country's total installed power generation capacity stands at just less than 10 GW, but electricity demand is growing and there are plans to phase out 500 MW of coal-fired generation.

The New Zealand government has a target for renewable energy to supply 90% of the country's electricity by 2025, which is creating good opportunities for wind, especially as wind power and hydro combine so effectively. Within 20 years, wind power's share of New Zealand's electricity supply could potentially grow to 20%. New Zealand installed 109 MW in 2011 for a total of 623 MW, a 20% increase in cumulative installed capacity. Wind now supplies just over 4% of New Zealand's electricity with no subsidy or special treatment whatsoever.

SOUTH KOREA

South Korea is the world's tenth-largest consumer of energy, and its greenhouse gas emissions have doubled since 1990, partly through the heavy use of coal. South Korea was globally the eighth largest greenhouse gas emitter in 2010, with 579 million tonnes of CO_2 emissions[23] .

South Korea has a target for renewables to provide 11% of the country's primary energy (not just electricity) by 2030. A bill was passed in March 2010 that required utilities to increase the share of renewable energy in their total power generation (excluding large hydro) from 1% (in 2010) to 4% by 2015, growing to 10% by 2022. In 2010, the Ministry of Knowledge and Economy (MKE) released a roadmap for offshore wind development, with the first priority given to a 2.5GW offshore wind farm project located in the West-South Sea.

22 *http://europa.eu/rapid/press-release_MEMO-12-631_en.htm*
23 *https://www.cia.gov/library/publications/the-world-factbook/geos/ks.html*

Kamaishi Wind farm, Japan © *M&D Green Energy Co. Ltd.*

Wind capacity grew by only 298 MW in 2011, an 8% increase, bringing total installed capacity to 407 MW. The sector generated 857 GWh in 2011, an 18.8% increase over the previous year; but a combination of complex permitting procedures and continued local opposition to onshore wind farm development hampered the sector's growth. There is evidence, however, that the attitudes of local governments and residents are gradually becoming more positive towards wind power.

Wind power development in Korea has also been facilitated by the fact that several major Korean based international companies have recently entered the wind business. The Korean wind power industry has set a target of 23 GW to be met by 2030, which would, with production of around 50 TWh, meet about 10% of the country's total electricity demand.

Like Australia and New Zealand, South Korea too is looking to implement a domestic cap-and-trade regime. In May of 2012, its National Assembly passed a bill to establish a cap-and-trade program that requires companies exceeding their emission quotas to buy permits from those with lower emissions, with the backing of ruling and opposition parties. The bill calls for emissions trading to start in 2015. The expectation is that by 2020 this will be linked to the Australian and Chinese cap-and-trade regimes.

JAPAN

Japan entered a new era after the Eastern Japan earthquake/tsunami and nuclear disaster of 11 March 2011: an overwhelming majority of the Japanese public now rejects nuclear power, and is calling for a transformation of the

Austria © *Klaus Rockenbauer / GWEC*

energy system towards reliance on renewable energy. Since the share of renewables in the energy mix in Japan is low, major efforts are required to replace the old energy system with a more modern and flexible system, suitable for large deployment of renewables.

At the end of 2011, 2,501 MW of wind capacity had been installed in Japan consisting of 1,832 operating wind turbines supplying about 4,200 GWh annually. This represents around 0.5% of the total power supply in Japan. The 2011 market saw the installation of 78 turbines producing 166 MW of new wind power, a 34% decrease from the 252 MW installed in 2010.

On a positive note the wind power industry in Japan is maturing. By the end of 2011, the sector employed about 3,100 people in 75 companies with an estimated annual turnover of about € 23 billion, according to a report published by the Economic Research Institute of the Japan Society for the Promotion of the Machine Industry. The Japanese manufacturers of large bearings and electrical components are particularly competitive.

In a pro-renewables move, Japan's new renewable energy feed-in tariffs were announced on 1 July 2012. They have already attracted about €1.54 billion in investment, with no less than 33,695 companies and individuals having registered to sell renewable energy under the new scheme by September of 2012. MITI estimates that total investment in renewables could be in the vicinity of €495 billion by 2030. The early investments have tended to favor solar PV, but in September plans were announced for a 1,000 MW wind project on Hokkaido, as well as a smaller project in the south.

Despite this positive move, several concerns exist regarding the future of wind power development in Japan. Among other things an integrated plan for the promotion of wind power is urgently required. Currently both supportive and obstructive policies coexist, hindering large-scale growth in the sector. One of these restrictions comes with new environmental regulations, which will slow down wind power development. However, the most serious problem in Japan is the monopolistic and vertically integrated structure of its utilities. The future of Japan's electricity sector post Fukushima remains a major subject of debate.

THE GWEO SCENARIOS FOR OECD PACIFIC

Given the diversity of the four countries covered, it is worth drawing a quick side-by-side comparison:

Japan has a massive power sector market – over three times the size of Korea's, five times the size of Australia's, and 25 times the size of New Zealand's. So far, Japan has this group's highest installed wind capacity, at 2501 MW (in 2011). Both Australia and New Zealand have excellent wind resources, but given that New Zealand has such good hydro and limited power demand, the total market likely to be developed here is likely to remain modest. Korea has the smallest and youngest wind market of the four, but has several homegrown turbine manufacturers and a long-term plan to expand renewable energy.

The New Policies scenario for OECD Pacific expects wind market annual growth to reach 982 MW by 2015, and then remains flat with installations of approximately 992 MW out to 2020, to rise up slowly to reach a 1615 MW per year level by 2030. This would bring the total installed capacity of 14 GW in 2020 to 27 GW in 2030.

The effects on both economy and climate would be marginal, compared to these countries total economic power. Annual investments hover around €1.1 billion from 2016-2020; to rise just marginally to reach € 1.8 billion until 2030.

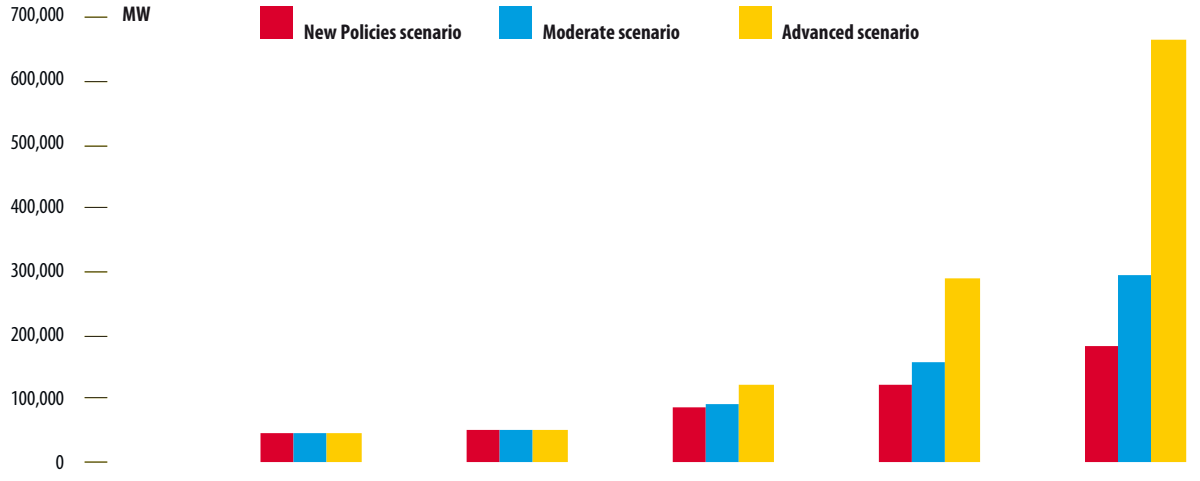
In terms of climate change, wind power would, in this scenario, not play a major role in helping these countries achieve their targets – only 21 million tons of CO_2 would be saved every year across the whole region by 2020, compared to over 579 million tonnes currently emitted by South Korea alone.

The Moderate scenario shows that with a more positive operating framework, there could be 98 GW of wind power in operation by 2030 – more than three times the New Policies scenario's capacity – while the Advanced scenario anticipates 178 GW.

With 178 GW of wind power in place, these countries would produce close to 467 TWh and save the emissions of 280 million tonnes of CO_2 per year. Almost € 9.4 billion worth of investment would flow into these countries wind markets every year by 2030, and the sector would employ over 182,000 people, compared with the 9,400 individuals employed in 2011.

OECD NORTH AMERICA

TOTAL WIND POWER CAPACITY IN MW



	2010	2011	2015	2020	2030
New Policies scenario	44,707 MW	52,753 MW	85,261 MW	121,238 MW	182,354 MW
Moderate scenario	44,707 MW	52,753 MW	91,314 MW	155,208 MW	296,705 MW
Advanced scenario	44,707 MW	52,753 MW	120,272 MW	290,805 MW	665,938 MW

North America as defined by the IEA includes Canada, the USA and Mexico, and thus includes a variety of geographic areas. Some of these, especially the plains and coastlines, have excellent wind resources.

UNITED STATES

The US market posted annual market growth of more than 30% in 2011, adding 6,810 MW in 31 states for a total installed capacity of almost 47 GW, and cumulative market growth of nearly 17%. While the US market still struggles with uncertainty surrounding the extension of the federal Production Tax Credit (PTC), wind power is now established in 38 states, and the footprint of the US turbine and component manufacturing industry covers 43 states. This means that US manufacturers were able to supply about 60% of the content for the US market in 2011, up from just 25% a few years ago. All things point towards exceptional growth in 2012, although this is clouded by dim prospects for the 2013 market, depending on the fate of the PTC.

For reasons that often seem to have more to do with Washington politics than the national interest, US energy policy has been short-term and inconsistent, with the industry either speeding to catch the green light, or braking hard. Although the last few years have seen more stability, as this report is being written (early October 2012) the American Wind Energy Association (AWEA) has for the umpteenth time highlighted that layoffs are mounting in the U.S. wind energy and related industries due to Congress's delay in extending the PTC. This has already caused thousands of job losses; and a full expiration will cost almost 37,000 domestic jobs[24] .

Wind power now generates close to 2% of US electricity needs, but experts estimate that with the right policies in place, the potential is much greater. In its 2012 report the US Energy Information Administration calculates that energy-related CO_2 emissions grow by a total of 3% from 2010 to 2035, to a total of 5,806 million tons in 2035. Over this period, total electricity consumption, including both purchases from electric power producers and on-site generation, grows from 3,879 billion kWh in 2010 to 4,775 billion kWh in 2035[25] .

With growing electricity demand and the retirement of 88 GW of existing capacity, 235 GW of new generating capacity (including end-use combined heat and power) are projected to be added between 2011 and 2035, and wind can make a powerful contribution.

In 2011, the US wind industry continued to see increased geographic diversity. The number of states with installed utility-scale wind projects sits at 38, with 31 states adding new capacity in 2011. The most active states in 2011, installing between 500 MW and 920 MW of new wind power, include California, Illinois, Iowa, Minnesota and Oklahoma. While long-time leaders in the wind industry installed the largest number of megawatts, states seeing the largest growth rates in 2011 were Ohio, Vermont, Massachusetts, Michigan, and Idaho; all of which doubled or nearly doubled their installed wind capacity in 2011. These states have emerged as active wind regions as a result of new state policies, as well as

24 *http://awea.org/blog/index.cfm?customel_dataPageID_1699=18982*
25 *http://www.eia.gov/forecasts/aeo/er/early_elecgen.cfm*

benefiting from new technology using higher hub heights and larger rotor diameters, which capture more energy.

The US wind power industry's greatest challenge for 2012 is one with which the industry has lived with for many years: short-term, unstable policy. The federal Production Tax Credit (PTC), a performance-based tax credit for kilowatt-hours produced by a wind farm once it is built, has typically been extended in only one- and two-year increments. This stands in sharp contrast to the permanent entitlements that fossil-fuel industries have received for 90 years or more. Stable policy is needed for the wind industry to begin to live up to its potential, attracting massive new investment and creating thousands of new jobs. Nevertheless wind power is an established mainstream energy source in the US today - adding 35% of all of the United States' new electric generating capacity between 2007 and 2010. The US wind power industry is well positioned to benefit from a more stable policy environment.

Colorado, US © *Stan Tehee/ GWEC*

CANADA

Canada has an immense wind resource. Wind energy enjoyed a record year in 2011 with 1,267 MW of new wind energy capacity, representing an investment of almost € 24.5 billion and creating 13,000 person-years of employment. Canada ended 2011 with a total of 5,265 MW of installed capacity. Each of the provinces now has some wind installed. In 2011, new wind energy projects were commissioned in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, and Nova Scotia.

Ontario is the current provincial leader, with 1,969.5 MW of wind energy installations, and in 2011 the first projects were approved under Ontario's Green Energy Act (GEA). Alberta and Quebec follow at 891 MW and 918.4 MW respectively. Nova Scotia and British Columbia are also seeing new developments with a total of 285.6 MW and 247.5 MW now in place. Looking ahead, there is a contracted pipeline of more than 5,000 MW of wind energy projects over the next five years.

The national 'WindVision 2025' strategy, along with the regional 'WindVision' targets proposed for Quebec and now British Columbia, are part of the industry's attempt to kick start discussion on what Canada's long-term wind energy future could look like. 2012 is expected to be another record year with approximately 1,500 MW of new developments to come online in Quebec, Ontario, Alberta, British Columbia, Prince Edward Island and Nova Scotia. With similar or higher levels of growth expected over the next four years, Canada's wind energy industry will surpass 10,000 MW of total installed capacity by 2015 – keeping the country on track to meet the national 'WindVision' target of supplying 20 per cent of Canada's electricity needs by 2025.

One area where policy clarity is still required is in Canada's approach to climate change. The absence of any national carbon-pricing framework in Canada that recognises wind energy's environmental attributes in market prices is critical to future wind energy development. It will be up to the industry to make the case that wind is an economically efficient and sensible investment from an electricity pricing perspective.

MEXICO

Mexico, too, has an outstanding wind resource, especially in the Oaxaca region. The wind potential has not yet been fully mapped, although according to meso-scale and regional studies there are several large areas with favourable conditions for wind farm development with high capacity factors and mean annual wind speeds above 8 m/s; some of them as high as 11 m/s.

The Mexican Wind Energy Association (AMDEE) conservatively estimates the country's wind power potential at around 30 GW, which includes sites with capacity factors above 25%; of these, 21 GW are above 30% and 16 GW are in the range of 35% to 45%. A national wind energy target of 12 GW by 2020 is feasible, yet an official target is still to be determined.

At the end of 2010, Mexico had a total of 519 MW of installed wind capacity connected to the grid, with only 10 MW

installed outside of the State of Oaxaca (in Baja California). In 2011, an additional 50 MW were installed and interconnected, but this figure is misleading in terms of the progress made by the Mexican wind industry in 2011, since construction work was completed for a further 304 MW, which came online in early 2012, bringing the total up to 873 MW. A new milestone for the Mexican wind sector was reached in 2011 when projects in states outside Oaxaca were started and are now under construction.

THE GWEO SCENARIOS FOR OECD NORTH AMERICA

Within this region we are looking at the three distinct markets of the United States, Canada and Mexico. And with the various states and provinces having policies of their own, there is potentially more variability here than in the single market of China, for instance.

Our three possible projections start with 2011, and the New Policies scenario anticipates a flat market of some 8 GW per year across North America out to 2015, slowing to 6.7 GW by 2020, and further down to some 5.9 GW over 2022-2029 period.

The New Policies scenario numbers would result in a total wind power capacity of 182 GW by 2030, which would produce 479 TWh of electricity and save the emission of 288 million tonnes of CO_2 every year.

However, the GWEO scenarios show wind taking a much more significant role across this continent. The Moderate scenario shows that by 2020, the annual market for new wind installations could be growing by 14 GW out to 2030. Further that by 2030 wind power would be producing over 780 TWh of electricity per year while saving CO_2 emissions of over 468 million tonnes each year. Under this scenario, investments in wind power would peak around 2020, reaching some € 16 billion per year, but then stabilizing over the decade out to 2030.

If the Advanced scenario of 665 GW by 2030 could be realised, all these figures would be dwarfed: massive CO_2 savings of over 1,050 million tonnes would be made each year by 2030, the sector would be employing some 670,000 people, and wind power alone would be providing 1,750 TWh of electricity per year across North America.

ANNEX

Year	Cumulative [GW]	Global Annual Growth Rate [%]	Annual [MW] incl. Repowering	Capacity factor [%]	Production [TWh]	Wind power penetration of world´s electricity in % (IEA demand projection)
NEW POLICIES SCENARIO						
2011	238		40,594	28	583	3.5
2015	398	12	43,516	28	976	4.7
2020	587	6	35,695	28	1,439	6.0
2025	754	5	32,631	28	1,849	
2030	918	4	33,552	30	2,412	8.0
2035	1,089	3	78,053	30	2,862	
2040	1,275	3	74,606	30	3,349	9.3
2045	1,451	2	66,727	30	3,814	
2050	1,623	2	68,071	30	4,264	10.3

Year	Cumulative [GW]	Global Annual Growth Rate [%]	Annual [MW] incl. Repowering	Capacity factor [%]	Production [TWh]	Wind power penetration of world´s electricity in % (IEA demand projection)
MODERATE SCENARIO						
2011	238		40,594	28	583	3.5
2015	425	14	52,699	28	1,043	5.0
2020	759	11	74,060	28	1,863	7.7
2025	1,160	8	84,618	28	2,846	
2030	1,617	6	95,740	30	4,251	14.1
2035	2,010	4	141,830	30	5,282	
2040	2,417	4	174,548	30	6,351	17.6
2045	2,856	3	192,464	30	7,505	
2050	3,324	3	208,673	30	8,736	21.2

Year	Cumulative [GW]	Global Annual Growth Rate [%]	Annual [MW] incl. Repowering	Capacity factor [%]	Production [TWh]	Wind power penetration of world´s electricity in % (IEA demand projection)
ADVANCED SCENARIO						
2011	238		40,594	28	583	3.5
2015	531	24	102,349	28	1,302	6.3
2020	1,150	13	135,464	28	2,821	11.7
2025	1,824	8	136,804	28	4,475	
2030	2,541	6	151,392	30	6,678	22.1
2035	3,199	4	220,656	30	8,408	
2040	3,760	3	241,719	30	9,880	27.4
2045	4,292	3	242,250	30	11,279	
2050	4,814	2	252,339	30	12,651	30.6

Wind power penetration of world´s electricity in % (Energy efficiency demand projection)	CO_2 reduction (with 600g CO_2/kWh [annual Mio t CO_2]	Avoided CO_2 since 2007 [cumulative Mio t CO_2]	Capital Costs [€/kW]	Investment [€1000]	Jobs total
3,5	350	1368	1,250	50,742,000	646,751
4,8	586	2,316	1,242	54,051,980	740,513
6,4	863	6,095	1,261	45,026,673	657,651
	1,110	11,159	1,268	41,382,091	673,004
9,0	1,447	17,522	1,267	42,494,537	705,503
	1,717	25,565	1,265	43,691,658	773,810
10,5	2,010	35,014	1,260	49,010,602	887,524
	2,288	45,911	1,263	43,057,671	853,994
12,3	2,559	58,162	1,263	43,580,385	915,188

Wind power penetration of world´s electricity in % (Energy efficiency demand projection)	CO_2 reduction (with 600g CO_2/kWh [annual Mio t CO_2]	Avoided CO_2 since 2007 [cumulative Mio t CO_2]	Capital Costs [€/kW]	Investment [€1000]	Jobs total
3,5	350	1,368	1,250	50,742,000	646,751
5,1	626	2,411	1,229	64,742,320	878,083
8,3	1,118	6,958	1,202	88,992,215	1,213,359
	1,708	14,284	1,185	100,313,306	1,482,937
15,8	2,550	24,979	1,171	112,086,170	1,682,633
	3,169	39,598	1,118	158,605,978	2,365,257
20,0	3,810	57,349	1,095	191,084,487	2,892,039
	4,503	78,457	1,084	208,627,623	3,059,507
25,1	5,242	103,172	1,075	224,360,164	3,392,429

Wind power penetration of world´s electricity in % (Energy efficiency demand projection)	CO_2 reduction (with 600g CO_2/kWh [annual Mio t CO_2]	Avoided CO_2 since 2007 [cumulative Mio t CO_2]	Capital Costs [€/kW]	Investment [€1000]	Jobs total
3,5	350	1368	1,250	50,742,000	646,751
6,4	781	2,690	1,168	117,884,880	1,599,173
12,6	1,692	9,254	1,135	151,639,135	2,122,821
	2,685	20,684	1,133	154,205,510	2,380,523
24,8	4,007	37,504	1,119	165,658,684	2,620,369
	5,045	60,750	1,075	135,227,856	2,483,133
31,1	5,928	88,658	1,065	122,237,052	2,532,046
	6,767	120,824	1,065	119,990,275	2,576,188
36,4	7,590	157,134	1,063	118,312,093	2,730,958

GWEC
GLOBAL WIND ENERGY COUNCIL

GWEC is a member-based organisation that represents the entire wind energy sector. The members of GWEC represent over 1,500 companies, organisations and institutions in more than 70 countries, including manufacturers, developers, component suppliers, research institutes, national wind and renewables associations, electricity providers, finance and insurance companies.

GWEC works at the highest international political level to create a better policy environment for wind power. GWEC and its members are active all over the world, educating local and national governments and international agencies about the benefits of wind power.

Working with the UNFCCC, the IEA, international financial institutions, the IPCC and the International Renewable Energy Agency (IRENA), GWEC represents the global wind industry to show how far we've come, but also to advocate new policies to help wind power reach its full potential in as wide a variety of markets as possible.

Find out more about GWEC's policy work, publications, events and other membership benefits on our website at **www.gwec.net**

Join GWEC today!

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GREENPEACE

Greenpeace is a global organisation that uses non-violent direct action to tackle the most crucial threats to our planet's biodiversity and environment. Greenpeace is a non-profit organisation, present in 40 countries across Europe, the Americas, Asia and the Pacific. It speaks for 2.8 million supporters worldwide, and inspires many millions more to take action every day. To maintain its independence, Greenpeace does not accept donations from governments or corporations but relies on contributions from individual supporters and foundation grants.

Greenpeace has been campaigning against environmental degradation since 1971 when a small boat of volunteers and journalists sailed into Amchitka, an area north of Alaska, where the US Government was conducting underground nuclear tests. This tradition of 'bearing witness' in a non-violent manner continues today, and ships are an important part of all its campaign work.

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