EWEA
THE EUROPEAN WIND ENERGY ASSOCIATION

Aiming High

Rewarding Ambition in Wind Energy

A report by the European Wind Energy Association – November 2015

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Content

Foreword

It gives me great pleasure to introduce you to Aiming High, a report which explores the potential paths that our industry can go down as we look further beyond 2020 and start planning a future energy landscape where wind is expected to play an ever increasingly important role in the power sector.

Current targets set out for 2030 in Europe will see the wind energy sector and other renewable technologies transform the power sector and bring positive impacts to the European power system and the economy as we pivot towards the new normal of renewable energy becoming our main source of electricity. But perhaps there is something more that we can bring. Targets set in Brussels call for renewables to make up at least 27% of energy consumed, we invite policy makers to reflect on this point, and to go beyond the bare minimum.

Ambition lies at the heart of success. We examine the extra rewards of taking a more progressive view in this report as a reminder to policy makers the opportunity that wind energy presents. The industry has come a long way, and our increasing understanding of how we can make the most of this limitless resource at ever competitive levels means that we are already a significant player today. As we come up to COP21, we bring to the spotlight the extra future gains that are at stake, and the extra reward of higher aspirations.

Giles Dickson,
Chief Executive Officer
The European Wind Energy Association
November 2015

EXECUTIVE SUMMARY

With 392 GW installed, wind energy can be the single largest source of power generation in the EU by 2030 ahead of coal and gas.

Wind energy already plays a significant role in the European power sector. In 2014, the wind industry installed 11,791 MW in the EU - more than gas and coal combined. Today wind energy can meet 10.2% of Europe's electricity demand with a cumulative capacity of 128.8 GW at the end of 2014.

Wind power plants across Europe are operating on a similar scale as traditional thermal power generation, delivering clean, affordable and reliable electricity to European citizens. This deployment has been underpinned by the development of an industrial base making Europe the global leader in wind energy.

The industry has taken strides in cutting technology costs and the finance community sees wind energy as an increasingly valuable asset. Keeping this momentum will be critical to the EU's standing as the global leader in renewables.

Europe should capitalise on its first-mover advantage in developing wind energy, the most cost-effective climate change mitigation technology.

A global climate deal in Paris in December 2015 is only the beginning of a long endeavour to address our climate change challenge as parties will start implementing their Intended Nationally Determined Contributions. This will open new markets for renewables and other climate change mitigation technologies.

To benefit over the long term from its competitive advantage, Europe will need to showcase a successful energy transition building on the large scale deployment of wind energy.

This report quantifies the impacts of the Central and High Scenarios laid out in EWEA's Wind Energy Scenarios for 2030[1].

In the Central Scenario with the EU just meeting its 2030 climate and energy targets, wind energy will fall short of meeting one fourth of EU electricity demand. More importantly, this approach would postpone much of the investments required for the EU to meet its long term greenhouse gas emissions reduction objective.

In contrast, Aiming High and pursuing a more ambitious wind power deployment, will bring significant additional benefits in terms of greenhouse gas emissions savings, energy security and macroeconomic benefits.

In the High Scenario, 53.7% of electricity consumed in Europe will be sourced by renewable energy technologies, with wind accounting for 28.2% of total electricity demand. This scenario will help remove 111.6 Mt CO_2 by not postponing climate mitigation actions to the next generation.

This would be a net positive for the EU economy with an additional €13 bn GDP resulting from the increased deployment of wind and other renewables. The transformation of the energy mix will also lead to a net job creation in the European Union with 366,000 direct and indirect jobs in the wind industry alone.

Wind energy's potential to 2030 and beyond will largely depend on more ambition from policy makers. To this end, a robust governance system should be agreed to ensure Member States collectively deliver on the 2030 binding renewable energy target and are rewarded for additional ambition.

In parallel, the European Commission should make concrete legislative proposals towards a well-functioning energy market driving the transition away from a fossil fuel based economy. Finally, a structural reform of the EU Emissions Trading System should be completed to provide for a high and stable carbon price, dis-incentivising investments in carbon-intensive and inefficient power plants.

1 EWEA. (2015). Wind Energy Capacity Scenarios in 2030.

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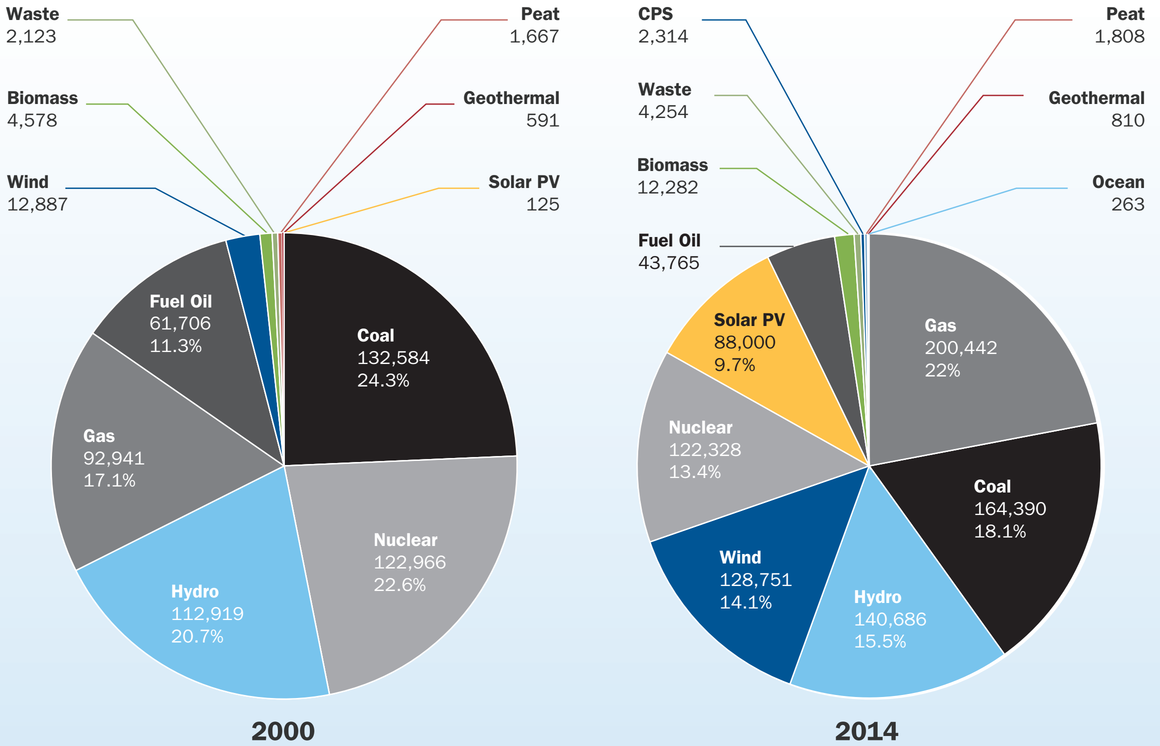
1 EUROPEAN WIND ENERGY TODAY

Wind energy technology is today a mainstream source of electricity generation in Europe. Wind power plants across the continent are operating on a scale similar to traditional thermal power generation, delivering clean, affordable and reliable electricity to European citizens. The wind power produced in certain European countries can already cover significant portions of electricity demand for increasing periods of time[2].

FIGURE 1: THE EUROPEAN POWER MIX BY INSTALLED CAPACITY 2000-2014



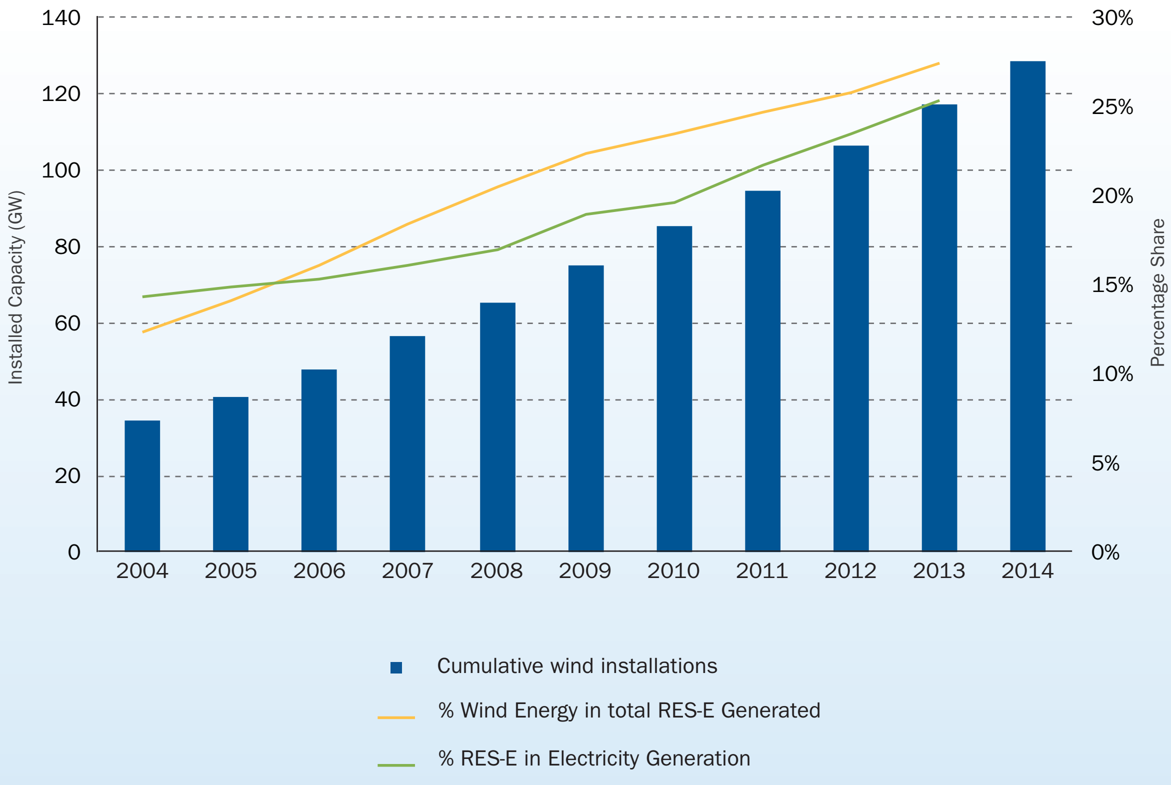
Source: EWEA. (2015). Wind in Power: 2014 European Statistics

2 The Guardian. (2015). Wind power generated 140% of Denmark's electricity demand.
RenewableUK. (2015). Electricity needs of more than a quarter of UK homes powered by wind in 2014.
Greenpeace. (2012). Spanish wind breaks records.

Over the past 15 years, wind energy experienced a remarkable growth in the EU. In 2000 wind met 2.4% of the EU's electricity demand thanks to 12.9 GW of installed capacity. By 2014, 128.8 GW of wind capacity had been installed, enough to meet 10.2% of the EU's electricity demand. The scalability of wind energy has helped it emerge as a viable alternative to fossil fuels for power generation.

This growth, driven by stable and supportive policy frameworks for renewable energy, has placed the European wind industry not only as a global leader in its own sector, but also amongst all renewable energy technologies. Wind energy's share of renewable electricity generation has more than doubled in the previous decade achieving more than one quarter (27.4%) of all renewable generation in 2013. This trend is set to continue according to the European Commission, which expects wind energy to represent at least 43-45% of all renewable energy produced by 2030[3].

FIGURE 2: INSTALLED POWER CAPACITY IN EUROPE IN 2000 AND 2014[4]



Source: EWEA. (2015). Wind in power: 2014 European Statistics / Eurostat. (2015). SHARES

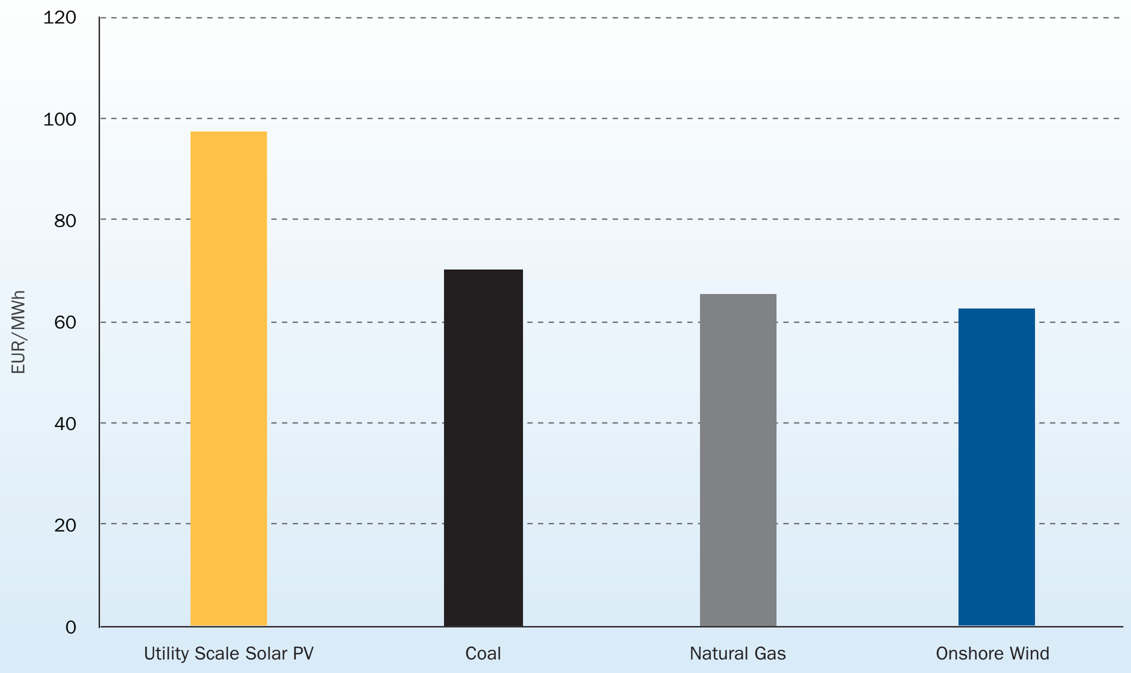
3 European Commission (2013), Impact assessment for a 2030 climate and energy policy framework, p.38.

4 EWEA. (2015). Wind in power: 2015 European statistics.
Eurostat. (2015). SHARES.

As Europe continues its energy transition towards a secure, sustainable, competitive and affordable power system, the wind energy industry is proactively delivering on cost reductions. In terms of Levelised Cost of Electricity, onshore wind is now competitive with fossil fuel thermal generation and cheaper when the environmental, human health and other external costs of fossil fuels are factored in.

With the cost of wind power decreasing, new investors have been attracted to the sector including global business and blue chip companies such as Google, IKEA and Apple.

FIGURE 3: LEVELISED COSTS OF ELECTRICITY IN SELECTED EUROPEAN COUNTRIES IN 2015[5]



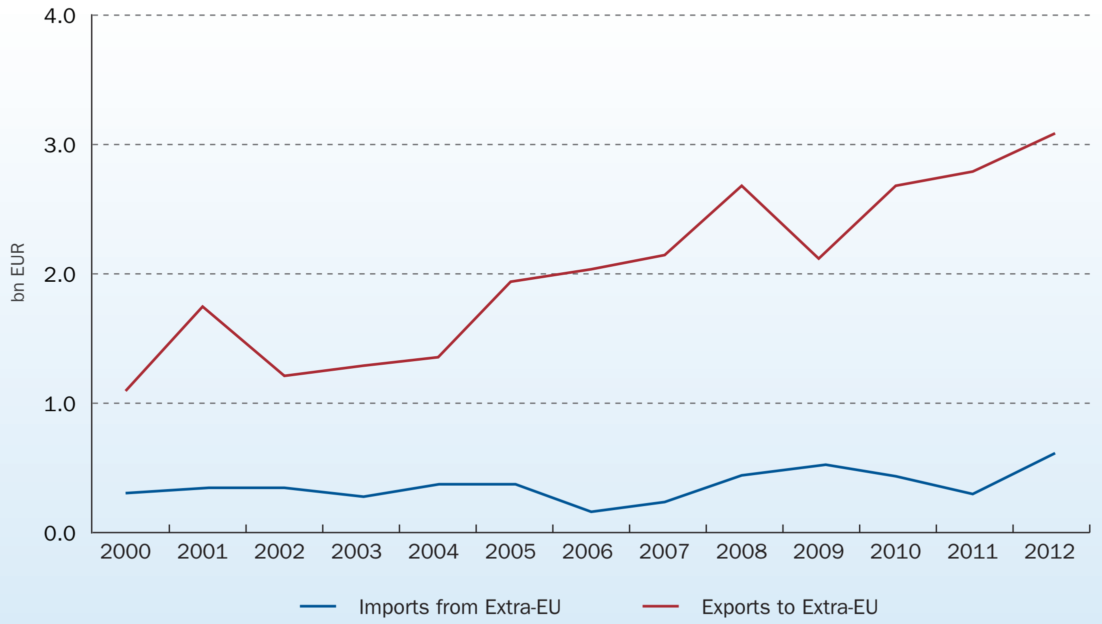
Source: Bloomberg New Energy Finance. (2015)

[5] Bloomberg New Energy Finance. (2015). New Energy Outlook. Converted from USD to EUR at 1.3285 (ECB 2014 average FX rate).

Thanks to its early-mover advantage, European industry has played a significant role in the development of wind in non-European markets. Over 48% of European wind energy companies work outside the EU creating opportunities for exporting goods and expertise[6].

Already in 2012, EU exports of wind-related components generated a trade surplus of around €2.45 bn. This trade performance has been constant since 2008 with an exception of 2009 when the generalised global economic slowdown had a visible impact. 55% of exports went to five countries, one third to US and Canada[7].

FIGURE 4: EU-27 EXPORTS AND IMPORTS OF WIND COMPONENTS[8]

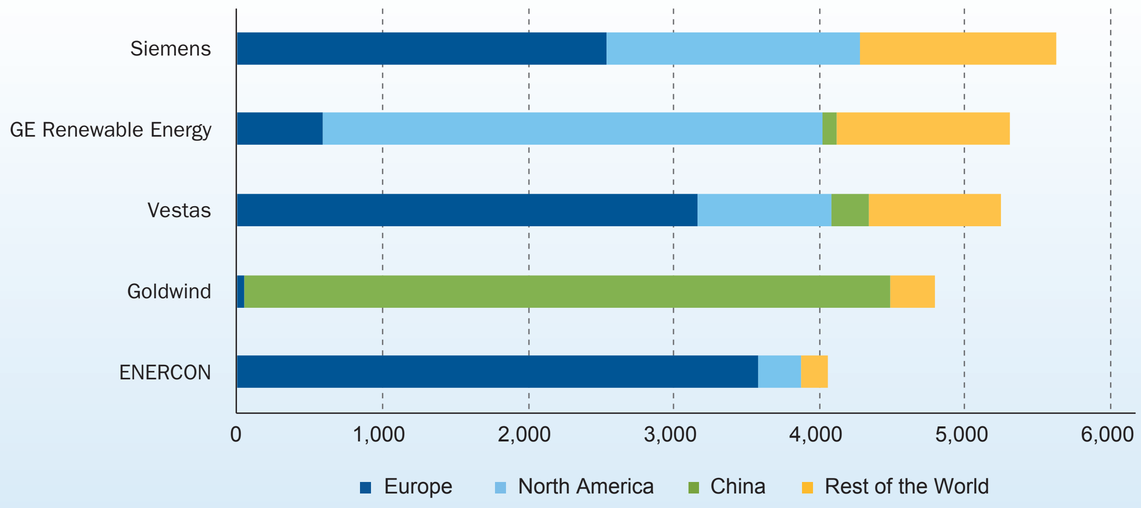


Source: European Commission. (2014). Energy Economic Developments in Europe

[6] EWEA. (2012). Green Growth.
[7] European Commission (2014), Energy Economic Developments in Europe.
[8] Ibid.

In 2014, three out the top five global wind turbine manufacturers were European companies (Siemens, Vestas and ENERCON). In addition, GE Renewable Energy has recently cemented its European business operations. European manufacturers are not only dominant in the EU but have also secured market shares abroad. In contrast, the activities of emerging Chinese competitors are concentrated in their home-market.

FIGURE 5: TOP5 TURBINE MANUFACTURERS: NEW INSTALLED CAPACITY IN 2014 (IN MW)[9]



Source: MAKE Consult. (2014)

9 MAKE Consult. (2014). 2014 Top 15 Wind Turbine OEM Market Share.

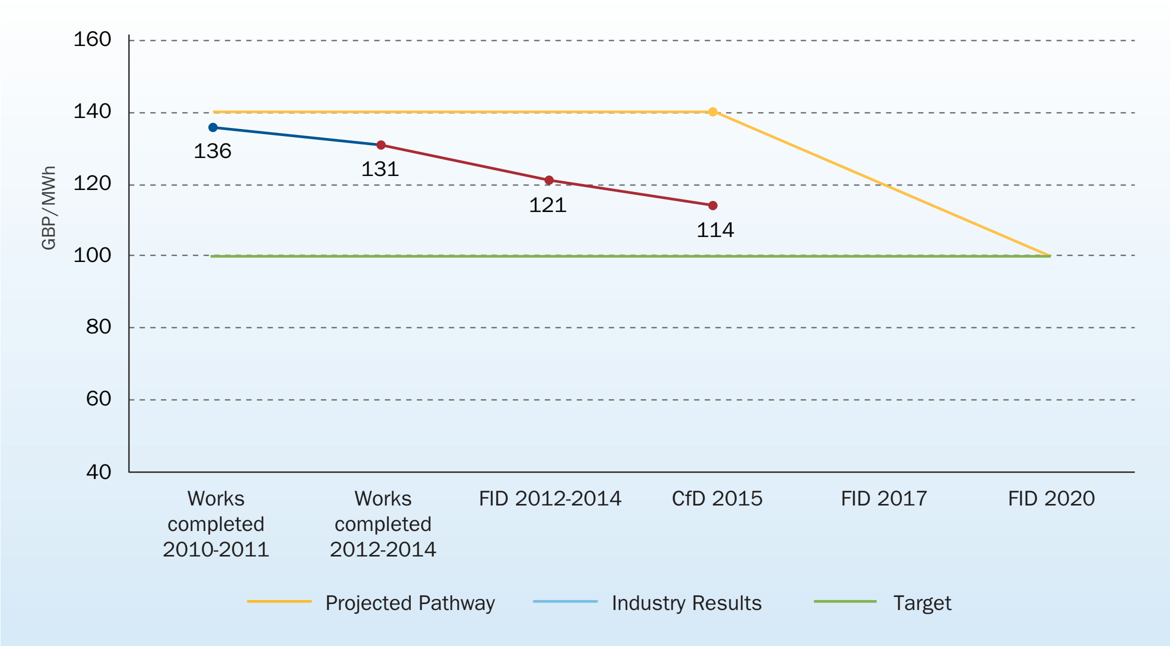
Offshore Wind

Europe accounts for 92% of all offshore wind installations globally[10]. Growing at a five year compound annual growth rate (CAGR) of 31%, the strong build-up of this emerging industry has resulted in total cumulative installations topping 10 GW in 2015.

The cost challenge remains, but industry is steadily reducing costs, despite the difficulties in operating within the marine environment. Results this year confirmed an 11% decline in LCOE in the UK, ahead of a predicted cost reduction pathway set out by the Crown Estate. A similar story can be found in Denmark, with the tender results at Horns Rev 3 project coming in 32% cheaper than the previous tender at Anholt[11]. Offshore wind is an increasingly attractive infrastructure investment to non-power sector investors such as institutional investors. EWEA analysis has shown that offshore wind will see €10 bn worth of investment over the next two years in the EU[12].

Improved supply chain integration and larger capacity turbines have been key factors in lowering costs[13]. In the first half of 2015, the average turbine size of turbines installed was 4.2 MW, a 20% increase from the same period in 2014[14]. This trend will continue as new sites will take advantage of the 5 MW+ sized machines now reaching the market.

FIGURE 6: UK OFFSHORE WIND COST REDUCTION RESULTS FROM ORE CATAPULT, INCLUDING LATEST CFD RESULT AT NEART NA GAOITHE



Source: ORE Catapult. (2015)

10 GWEC. (2014). Global Wind Statistics.
11 Danish Energy Agency. (2015). Vattenfall Vindkraft AS wins Horns Rev 3 tender.
12 EWEA. (2015). The European offshore wind industry – key trends and statistics 1st half 2015.
13 ORE Catapult. (2015). Cost Reduction Monitoring Framework Summary Report to OWPB.
14 EWEA. (2015). The European offshore wind industry – key trends and statistics 1st half 2015.

The Global Green Race is on

Renewable energy investments are on the rise globally. Both industrialised nations and emerging economies are pursuing targeted policies to strengthen their competitiveness and create their own global companies. Whilst Europe still leads in innovation, other parts of the world are rapidly catching up in wind energy deployment.

China already leads in global capacity installed in onshore wind. The United States comes second, and strives for 10 GW of offshore wind by 2020. Japan on the other hand has deployment targets of 37 GW in 2050. China, Korea, and India are other promising markets for offshore wind[15].

Over the last decade, wind power has become an increasingly attractive investment thanks to strong policy choices. In the post-2020 period, ambition from policy makers will still be required to drive the sector forward.

A clear pathway for the next investment cycle must therefore be a high priority at EU level. This will enable the industry to make decisions on projects with multi-year lead times and national policy makers to set out a clear strategy for achieving local and global climate change commitments.

The UN climate summit in Paris this November will give a new drive to the fight against climate change. A global climate deal in Paris will only be the beginning of a long endeavour to address our climate change challenge as parties will start implementing their Intended Nationally Determined Contributions. This will open new markets for renewables and other climate change mitigation technologies. Europe should capitalise on its first-mover advantage in developing wind energy, the most cost-effective climate change mitigation technology.

Delivering on Innovation

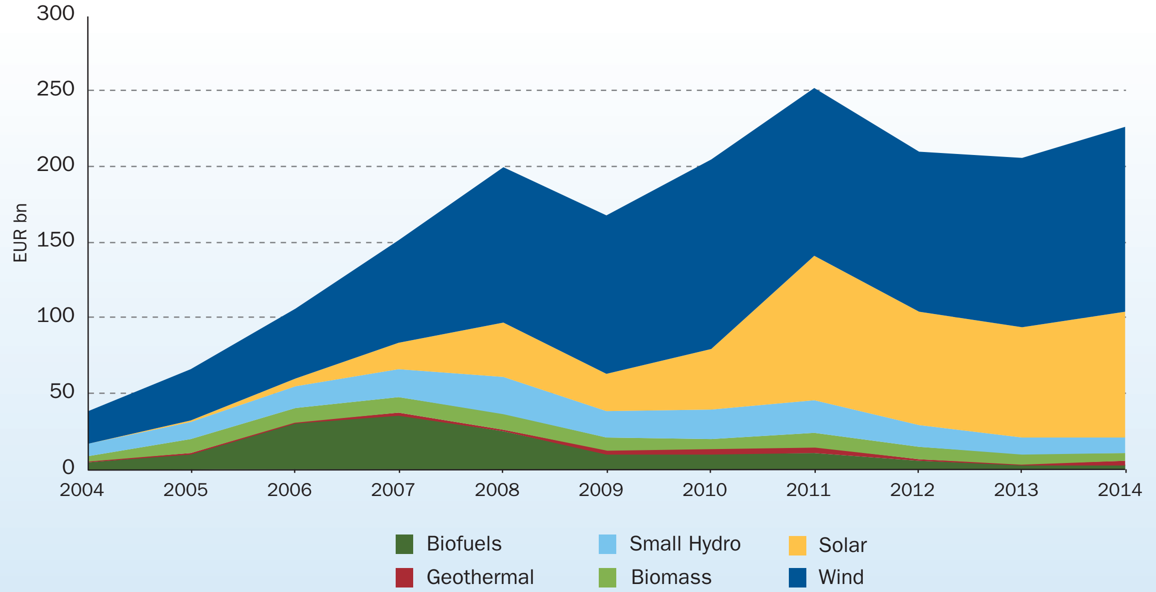
Innovations in wind turbine designs are opening up new sites for wind power production. New turbine designs enabling operations in low wind sites have been introduced in the market. The development of modular blade designs has allowed for larger rotor diameters which otherwise would have presented logistical problems in transportation. These innovations have enabled development in sites that may have not been viable a few years ago.

Site optimisation is another research area which has helped increase production. Taking advantage of advances in communication and networking, modern wind turbines are able to share data with one-another. These digital wind farms optimise production leading to an improved performance of up to 20% in certain sites.

The offshore wind sector has also seen remarkable innovation. In moving further away from shore to harness a high and stable wind resource, developers and technology groups are examining floating offshore wind, which has the potential of opening up the Atlantic and Mediterranean seas. Trials for vertical axis turbines on floating foundations are underway in the South of France, which could see full deployment within the next decade.

[15] GWEC. (2015). Global Wind Report: 2014 Annual Market Update.

FIGURE 7: GLOBAL ASSET FINANCE ON NEW INVESTMENTS BY SECTOR[16]



Source: UNEP, Bloomberg New Energy Finance. (2015)

Paris, COP21

On 30 November 2015, policy makers from around the globe will meet at the 21st Conference of Parties to attempt to broker a deal that succeeds the Kyoto Protocol.

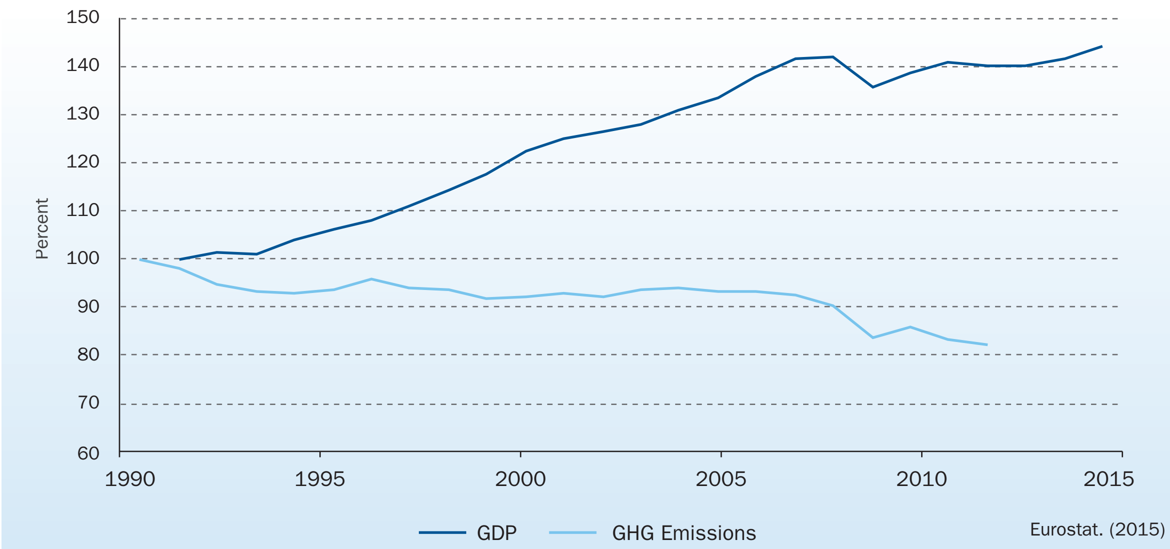
The landmark climate deal signed in Kyoto in 1997 helped establish the EU as a global leader in the fight against climate change. In this context, the EU saw a decoupling between emissions and growth, with a 23% decline in GHG emissions from 1990-2012, and 46% growth in GDP over the same period[17].

> ***"Let me be very clear to our international partners: the EU will not sign just any deal. My priority, Europe's priority, is to adopt an ambitious, robust and binding global climate deal".***
>
> **Jean-Claude Juncker**
> European Commission President discussing COP21
> in his State of the Union speech

[16] UNEP, bnEF. (2015). Global trends in renewable energy investment 2015. Converted into EUR from USD via yearly average FX rates from ECB.

[17] European Environmental Agency. (2014). Why did greenhouse gas emissions decrease in the EU between 1990 and 2012?

FIGURE 8: EUROPEAN GDP GROWTH AND GHG EMISSIONS REDUCTION[18]



% of global GHG emissions covered

90 %

by INDCs

In Paris, the challenge will be to obtain a global deal for all nations to act on. Intended Nationally Determined Contributions (INDCs) have given the world indications about the scale of ambition ahead of the talks. In a positive step forward, the US (which did not ratify the Kyoto Protocol), China and other countries that did not previously have targets have submitted INDCs marking the first stage of committing to climate change mitigation.

With at least 149 countries submitting INDCs[19] representing roughly 90% of global GHG emissions[20] there is increasing momentum for a political solution to remain within the 2 degree Celsius increase in global warming. Wind energy is referenced in 54 INDCs with ambitious and time-bound objectives for wind energy deployment mentioned in the INDCs of countries such as China and India.

18 Eurostat. (2015). Greenhouse gas emissions by sector – tsdcc210.
Eurostat AMECO. (2015). Gross Domestic Product at 2010 reference levels – EU15.
19 UNFCCC. (2015). Intended Nationally Determined Contributions (INDCs).
20 Climate Action Tracker. (2015). Tracking INDCs.

EU Energy and Climate Change Policies to 2030 and 2050

In October 2014, EU Heads of States and governments agreed on a 2030 climate and energy framework including a binding 40% greenhouse gas emissions reduction target, a binding target for renewable energy of at least 27% and an energy efficiency target of at least 27%. In the European Commission's reference scenario[21] the renewable energy target translates into at least 46% of electricity consumption being met by renewables.

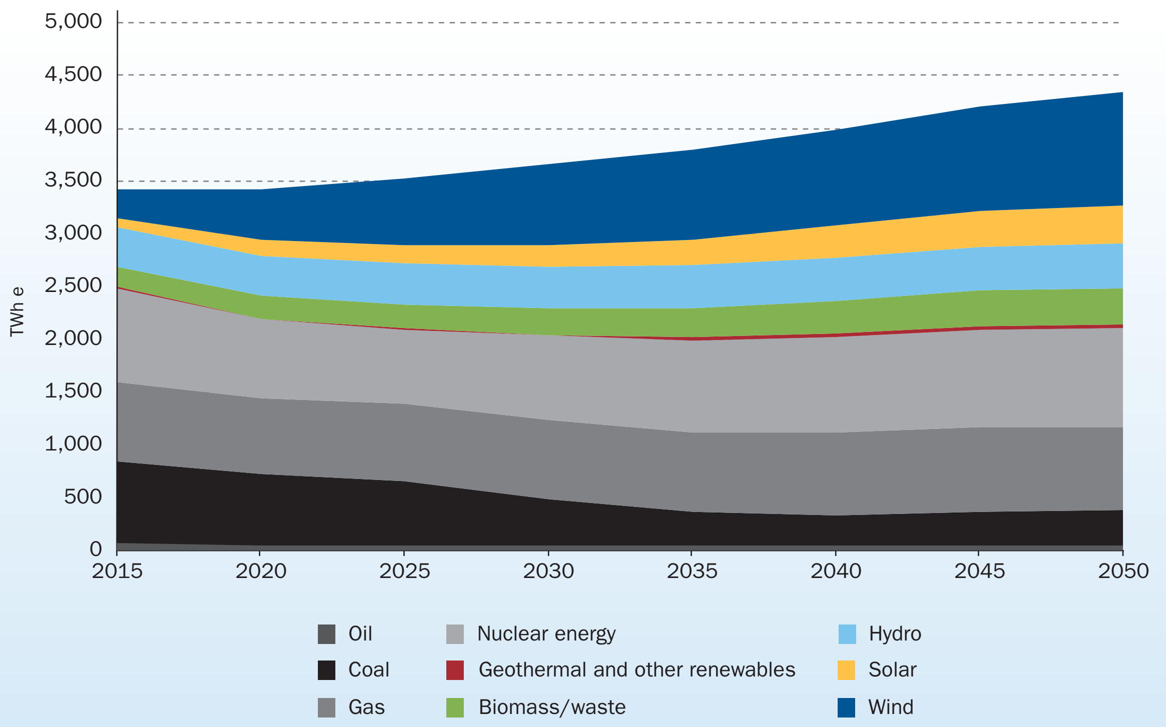
While the renewable energy target is designed to be a minimum, there is currently no clarity on how Member States will be incentivised to go beyond this objective.

In addition, there is no official national breakdown of the EU renewable energy target raising questions on its enforceability and bankability for renewable energy investors.

A modest ambition of 46% of renewables in final power consumption by 2030 will require additional investments in renewables during the post-2030 period if Europe is to decarbonise the European economy by 80-95% by mid-century.

Europe has economic and strategic interests in front-loading its climate mitigation ambition. By speeding up decarbonisation of the power sector, Europe will provide a clear signal to investors. Furthermore, this will strengthen strategic industrial sectors, such as wind energy, maintaining its competitive advantage globally. It will help the region decrease reliance on energy imports and ultimately move to a smart, resilient energy system.

FIGURE 9: THE EVOLUTION OF THE POWER MIX GOING INTO 2050 FROM THE EU REFERENCE SCENARIO



Source: European Commission, 2050 Roadmap

[21] European Commission. (2014). Impact Assessment on policy framework for climate and energy in the period from 2020 up to 2030.

Wind Energy's Road to 2030

The potential of wind energy to 2030 and beyond will depend on an increased ambition from policy makers and a robust governance regime to deliver the EU climate and energy framework. With uncertainty about national targets for the post-2020 period, a growing emphasis is emerging on the need for a strong legislative framework to support the renewable energy pathway to 2030.

To this end, the European Commission should provide guidance to ensure Member States collectively deliver on the agreed EU-wide target. Policy makers in EU countries should provide predictable and stable frameworks, supporting the growth of domestic industries that are global leaders, and provide net benefits to their economies, such as wind energy.

The post-2020 regime should maintain existing building blocks such as national renewable energy action plans, reward early movers and ensure all Member States deliver on national pledges developed considering the EU-wind binding renewable energy target.

The European Commission's vision for an Energy Union, presented in February 2015 builds on the 2030 Climate and energy targets as a milestone towards moving away from a fossil fuel based economy. Wind energy is perfectly suited to deliver the Energy Union's objectives of a secure, affordable, and sustainable energy supply for Europe.

In this context, ongoing initiatives to reform the European energy market and bring structural reform to the EU Emissions Trading System will be crucial for Europe to make the most of wind energy's potential. In addition, legislative proposals for a new Renewable Energy Directive should also be presented at the end of 2016. This will be the key policy instrument to deliver the agreed EU binding renewable energy targets to 2030.

TABLE 1: EUROPEAN TARGETS ON CLIMATE CHANGE AND ENERGY

	2020	2030
GHG reduction from 1990 levels*	20%	40%
RES Usage in energy consumption*	20%	≥27%
Share of RES in Electricity	34%	46%
Energy efficiency compared to business-as-usual	20%	27%

* Binding target

In September 2015, EWEA published Wind Energy Scenarios for 2030[22], where three growth pathways for wind were posited. EWEA's Central Scenario indicates that if the EU meets its 27% RES-E target, wind energy installations amount to over 320 GW in 2030. This translates to 254 GW of onshore and 66 GW of offshore wind.

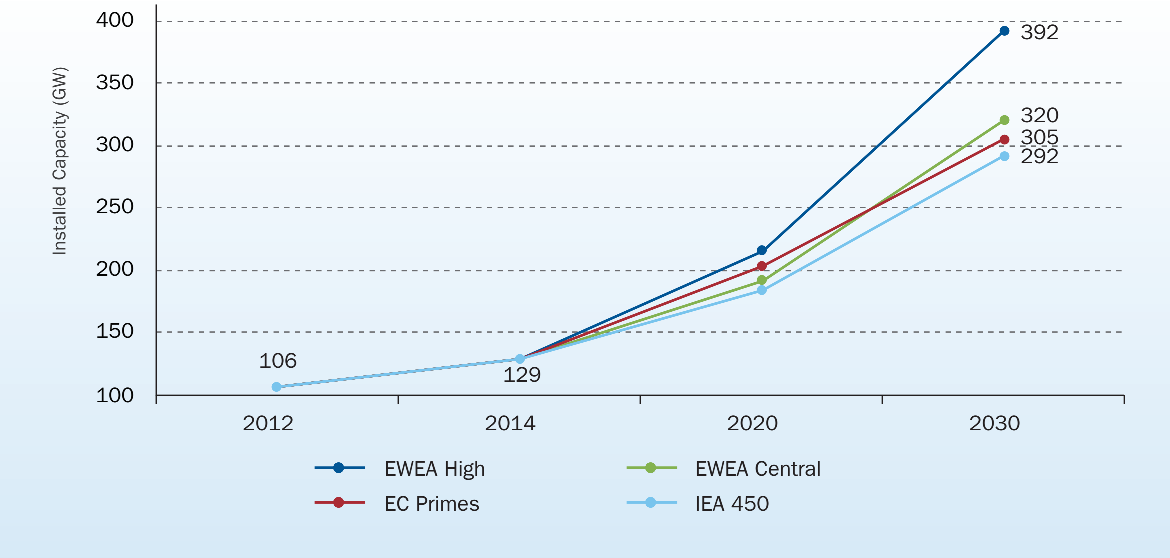
A High Scenario displays 392 GW of wind power capacity installed in 2030, 23% higher than the in the Central Scenario. 294 GW will be onshore and 98 GW offshore wind.

The EWEA Central Scenario has been calibrated with two of the most referenced scenarios, the International Energy Agency's 450 scenario[23] and the European Commission's Trends to 2050 Reference Scenario[24].

Depending on the scenario, wind energy will produce different level of economic benefits in Europe. In the high scenario the wind industry represents 366,000 jobs while generating €591 bn in investments. These figures are only 334,000 and €474 bn respectively in the central scenario.

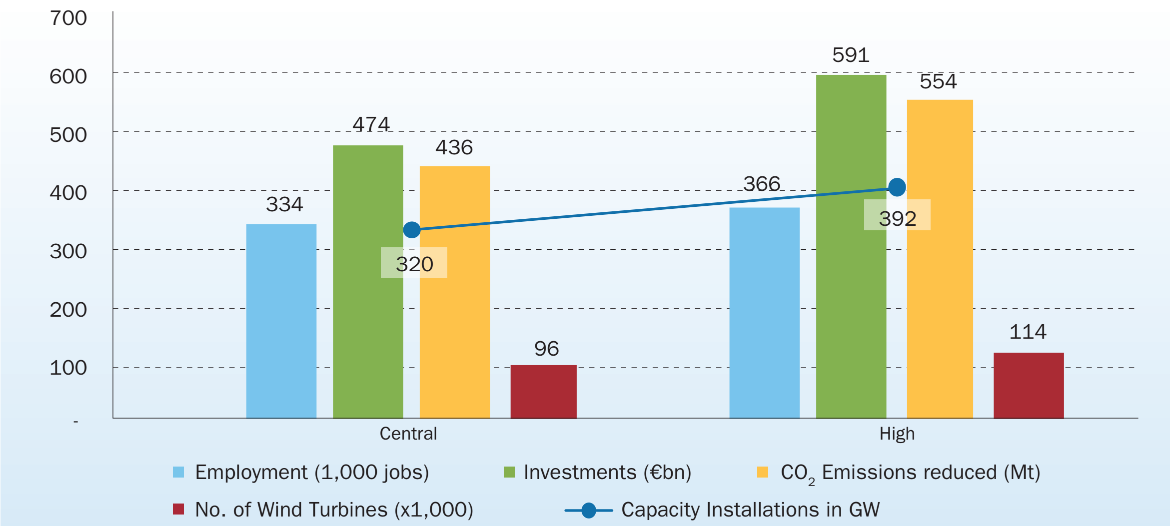
22 EWEA. (2015). Wind Energy Scenarios for 2030.
23 International Energy Agency. (2014). World Energy Outlook 2014.
24 European Commission. (2013). EU energy, transport, and GHG emission trends to 2050.

FIGURE 10: 2030 WIND ENERGY SCENARIOS COMPARISON[25]



Source: EWEA. (2014)/ European Commission. (2013)/ International Energy Agency. (2014)

FIGURE 11: 2030 SCENARIOS AND MACROECONOMIC BENEFITS[26]



Source: EWEA. (2015)

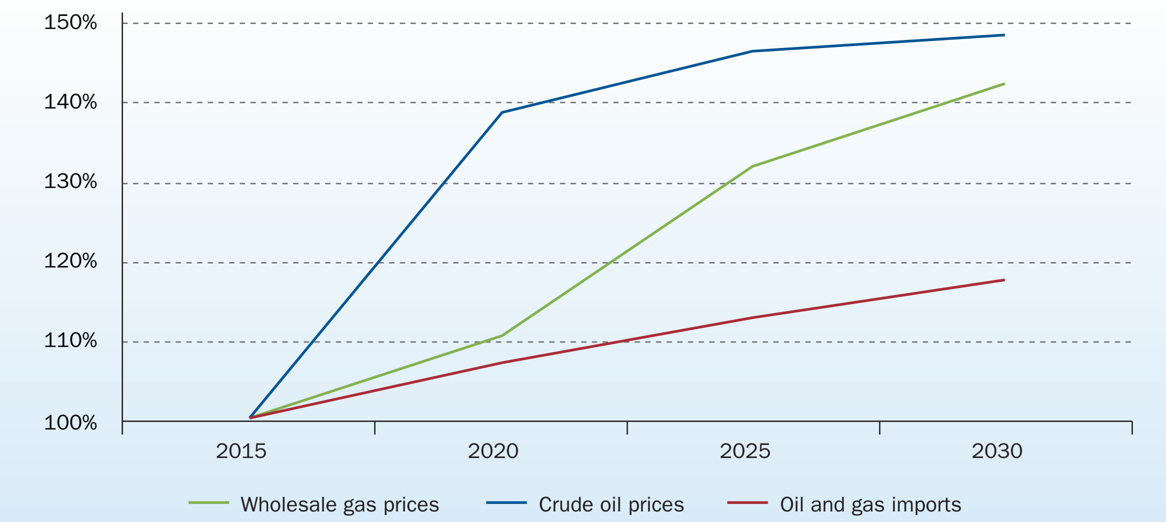
25 EWEA. (2015). Wind Energy Capacity Scenarios in 2030.
European Commission. (2013). EU Energy, Transport, and GHG Emissions on the Trends to 2050. Reference Scenario 2013.
International Energy Agency. (2014). World Energy Outlook 2014.

26 EWEA. (2015). Wind Energy Scenarios for 2030.

Taking the capacity scenarios for 2030 from EWEA, a further analysis has been carried out using an advanced economic commitment and dispatch model coupled with macroeconomic modelling to examine a series of indicators that shed light on additional effects of wind energy deployment in Europe by 2030. The underlying assumptions of this analysis are:

- A baseline macroeconomic scenario in 2030 for the European Union with a Gross Domestic Product (GDP) of €18.99 tn, a Gross Value Added of €17.09 tn, with an active labour force of 233.2 million people. Based on latest economic growth forecast and public available information from Eurostat
- An EU energy demand growth in 2030 of 11% compared to 8% in the EU Reference Scenario
- An increase of 18% on the cost of imports of oil and gas in 2030 compared to 2015
- Rising imported fuel prices for both oil and gas to 2030 according to figure 11

FIGURE 12: GROWTH TRAJECTORIES IN CRUDE OIL PRICES, GAS PRICES, AND OVERALL EU SPENDING ON FOSSIL FUEL IMPORTS



Source: Data from Pöyry. (2015)

Data Analysis

EWEA commissioned Pöyry and Cambridge Econometrics to produce further quantitative analysis into the energy market and macroeconomic effects of the deployment scenarios for wind energy to 2030, with details available in the Methodology section. Numerical findings from the modelling in the following chapters have been complemented with additional analysis from EWEA. Conclusions and recommendations are the sole responsibility of EWEA and does not represent the views of Pöyry and Cambridge Econometrics.

2 WIND ENERGY IN 2030 - MEETING EXPECTATIONS

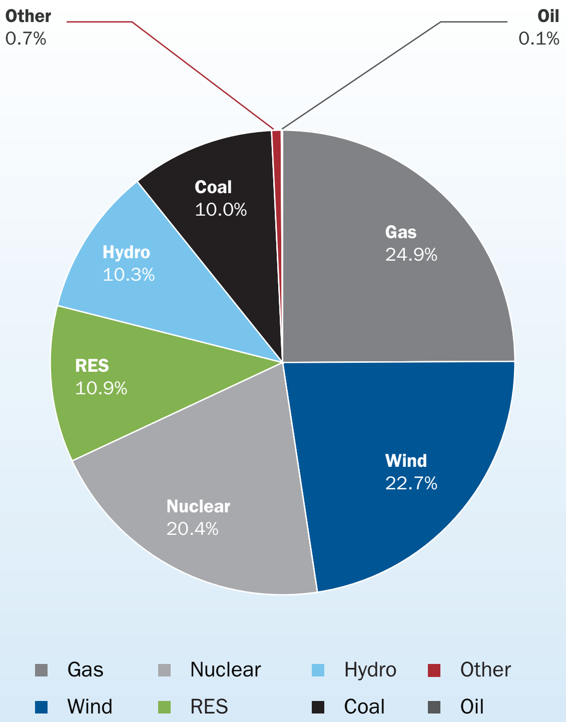
Electricity produced from wind energy in 2030	Increase in wind generation from 2015	Wind share in electricity consumption
759 TWh	179 %	23 %

Following the EWEA Central Scenario for 2030, onshore wind becomes the most deployed technology in Europe with 254 GW installed by 2030 producing 759 TWh. This is 2.5 times more than in 2014.

Offshore wind moreover grows by six times, and generates 7.2% of Europe's electricity by 2030, with a total installation capacity of 66 GW

> *Onshore wind becomes the most deployed technology in Europe in 2030".*
>
> **EWEA**

FIGURE 13: EUROPEAN GENERATION MIX IN 2030 CENTRAL SCENARIO

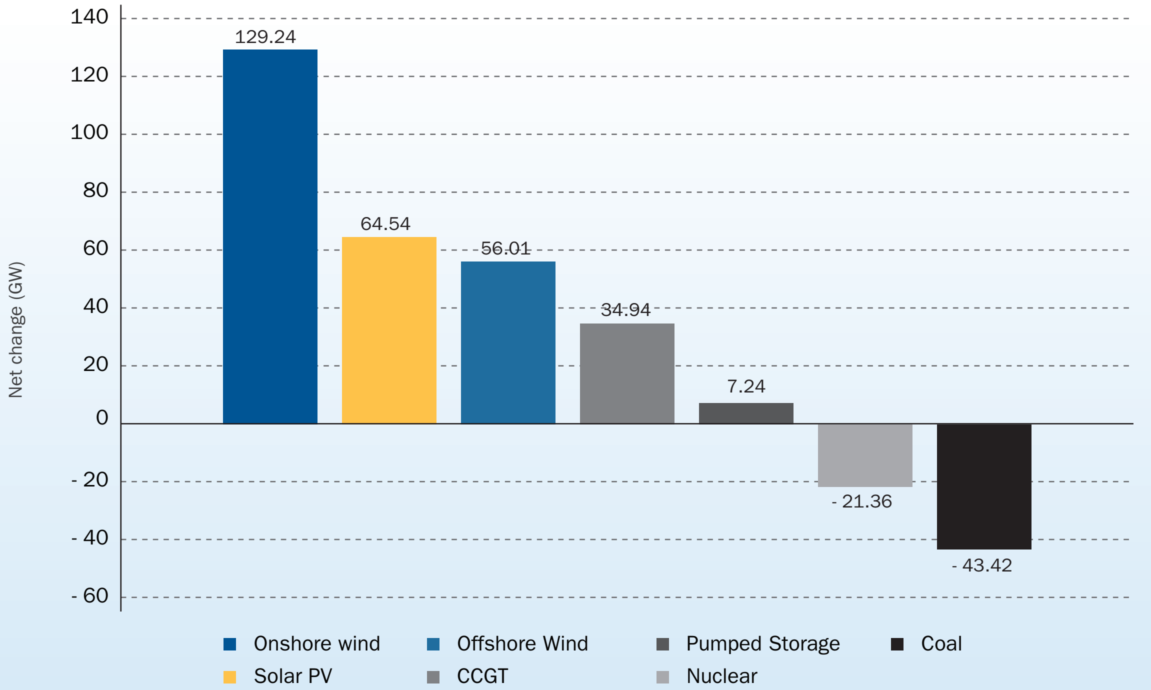


Source: Data from Pöyry. (2015)

The European power system moves away from most thermal power generation, particularly coal. Germany and Poland have significant coal fleets today, but will reduce their size by 55% and 52.9% respectively. The United Kingdom cuts 78.9%. Austria, Belgium, Hungary, Portugal, Romania, and Slovenia remove coal almost entirely.

The EU's own impact assessment suggests that renewables cover 44.8% of the EU's rising electricity demand by 2030[27]. Wind energy meets 22.8% of electricity needs, contributing the lion's share of renewables to electricity,

FIGURE 14: NET CHANGE IN INSTALLED CAPACITY FOR KEY TECHNOLOGIES 2015 VS 2030 CENTRAL SCENARIO

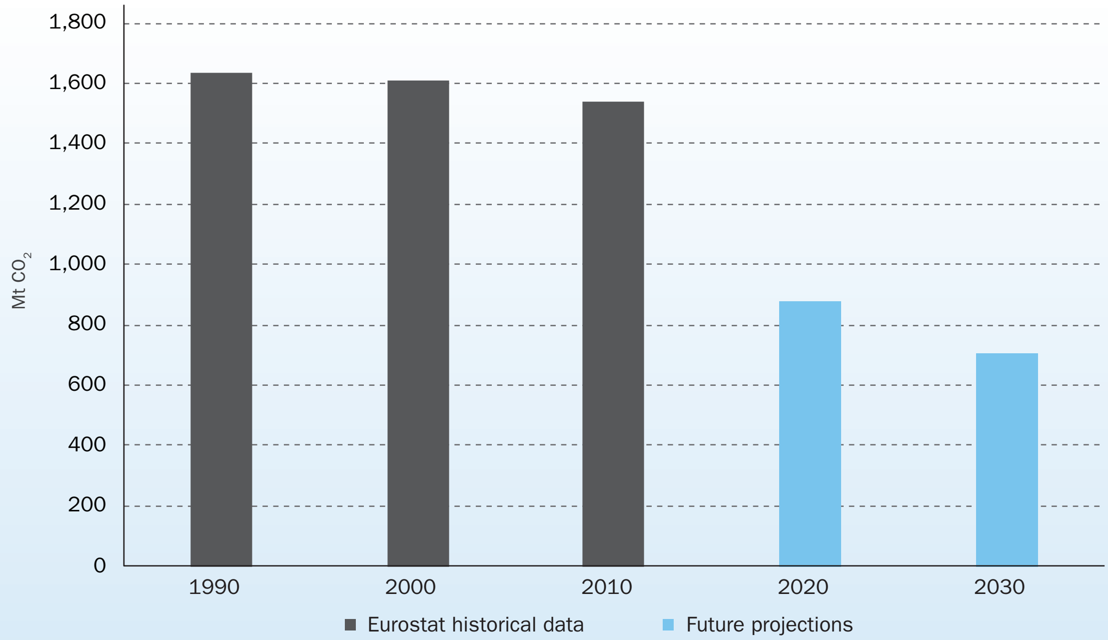


Source: Data from Pöyry. (2015)

[27] European Commission. (2013). Impact Assessment for a 2030 climate and energy policy framework.

CO_2 Emission Reduction from the Electricity Sector

FIGURE 15: CO_2 EMISSIONS FROM THE ELECTRICITY SECTOR IN THE CENTRAL SCENARIO



Source: Data 1990-2010: Eurostat/EEA[28], 2020-2030: EWEA/Pöyry

CO_2 emission reductions in the power sector in 2030 with respect to 1990 levels
56.9 %

Emissions from the power sector decline to 56.9% from 1990 levels to 705 Mt CO_2 in 2030, far beyond the 40% reduction target.

As a consequence of decommissioning more than half of today's coal capacity of today, the European coal sector will plummet to 37 GW by 2030. In this scenario, capacity from CCGT power plants could increase by almost 35 GW. This is equivalent to one fifth of the expected capacity growth of wind power.

[28] Eurostat. (2015). Greenhouse gas emissions by sector – Energy industries (tsdcc210).

3 WIND ENERGY IN 2030 – AIMING HIGH

Current European climate and energy policies for 2030 have not fully factored–in the EU's long term objective to cut CO_2 emissions by 80% to 95%. The current back-loaded trajectory for CO_2 emissions reductions sees the bulk of innovations and installations occurring between 2030 and 2050.

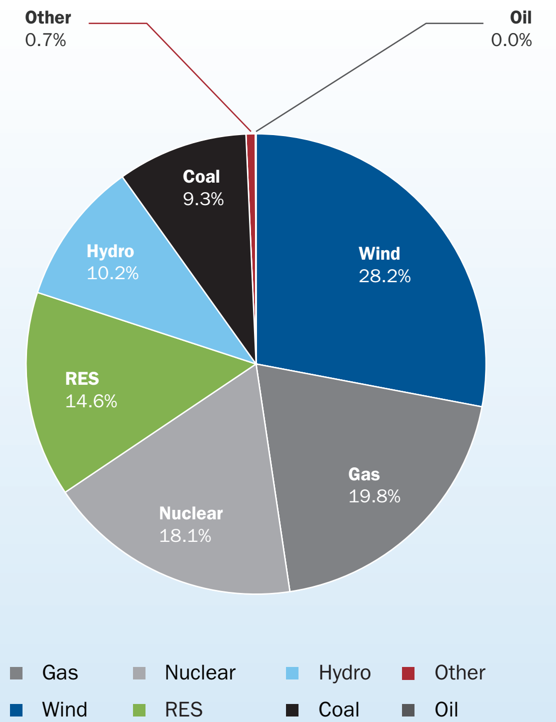
In contrast, an ambitious deployment of wind energy, as mapped out in EWEA's High scenario, would allow for a smooth transition to a decarbonised economy while generating net macro-economic benefits.

EWEA's High Scenario

Electricity produced from wind energy in 2030	Increase in wind generation from 2015	Wind share in electricity consumption
941 TWh	**245** %	**28** %

> *Wind energy will be the single largest source of power generation in Europe".*
>
> EWEA

FIGURE 16: EUROPEAN GENERATION MIX IN 2030 HIGH SCENARIO

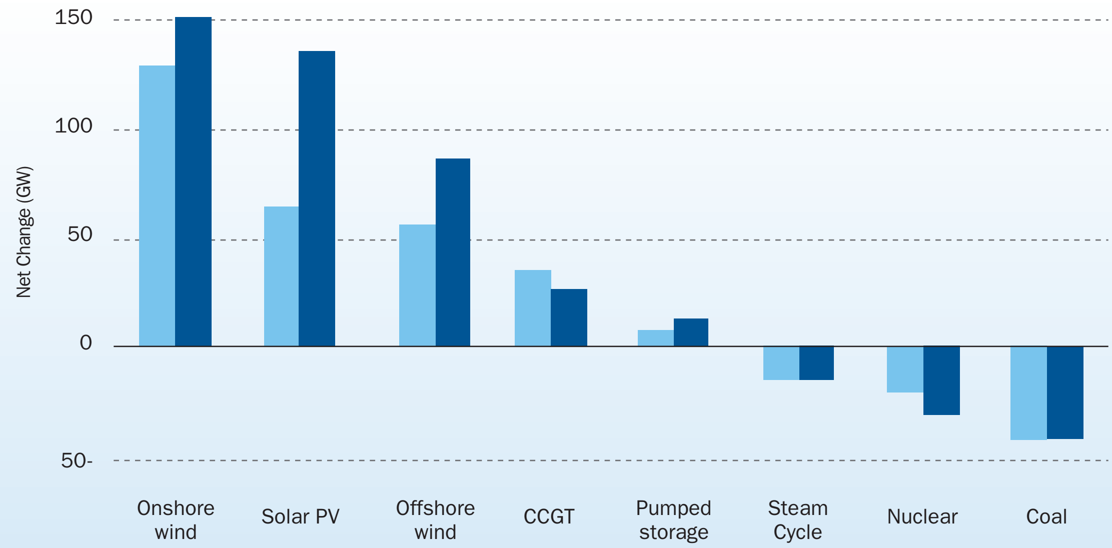


Source: Data from Pöyry. (2015)

Under the High Scenario, the deployment of wind energy is accelerated, producing electricity at nearly 3.5 times the levels today.

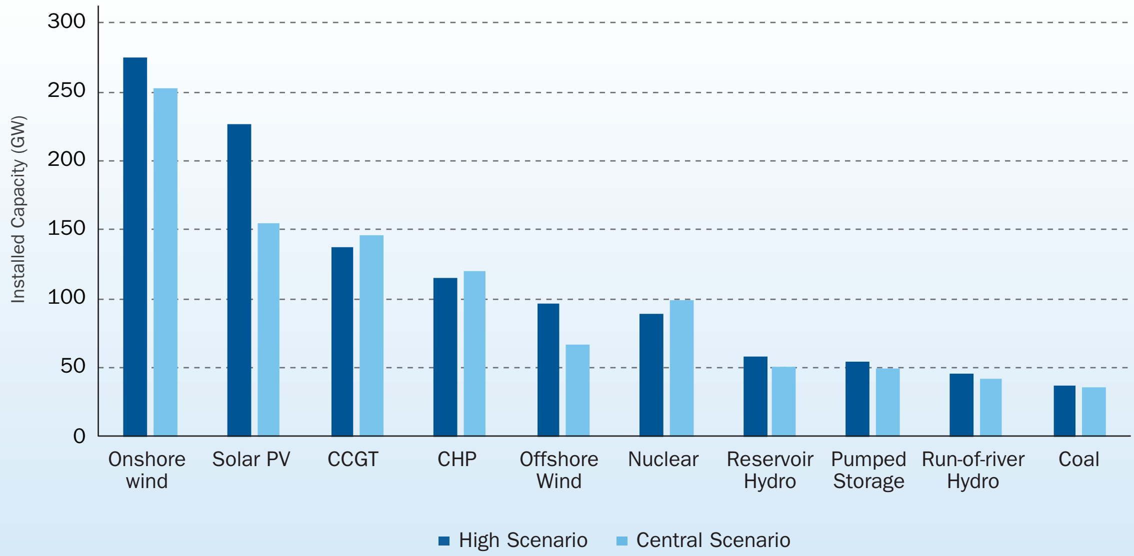
With 392 GW installed, wind energy will be the single largest source of power generation in Europe, ahead of coal and gas.

FIGURE 17: NET CHANGE IN INSTALLED CAPACITY FOR KEY TECHNOLOGIES 2015 VS 2030 CENTRAL SCENARIO



Source: Data from Pöyry. (2015)

FIGURE 18: TOP 10 GENERATION TYPES IN 2030



Source: Data from Pöyry. (2015)

In the High Scenario, the share of offshore wind is significantly increased, alongside other renewable technologies. Renewables will account for just under two thirds of all installed capacity in Europe. Pursuing a high growth scenario ensures the phase out of coal and other thermal generation.

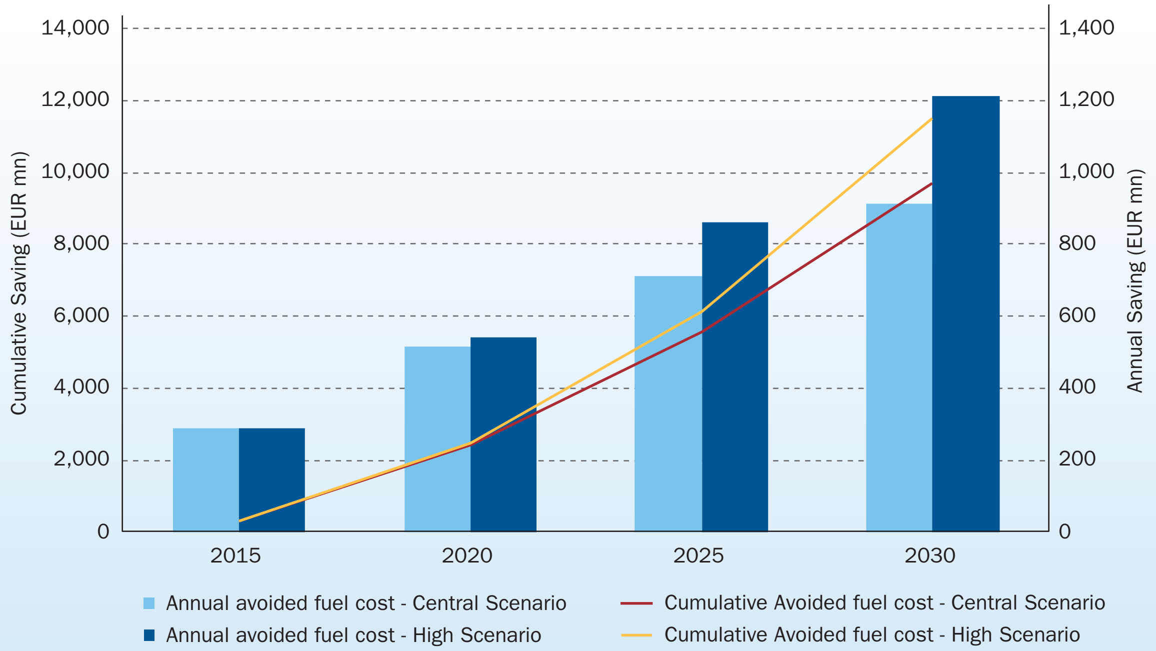
Generation of electricity from renewables under the High Scenario doubles to 1,793 TWh compared with 2015, and representing a near 20% increase compared with the Central Scenario. As a result, 53.7% of electricity consumed in Europe comes from renewables. Wind accounts for more than half, with 28.2% of total electricity demand.

Avoiding Fuel Costs

The EU imports more than half of its energy needs today. Wind power reduces energy dependence and already delivers significant macroeconomic benefits. The High Scenario below shows that ambitious deployment of wind will generate an additional 18.7% in cumulative fossil fuel savings by 2030, amounting to €11.5 bn.

Total avoided fuel costs through wind energy in the High Scenario 2015-2030	Additional saving compared against the Central Scenario
€11.5 bn	+18.7 %

FIGURE 19: AVOIDED FUEL COSTS THROUGH DEPLOYMENT OF WIND ENERGY IN CENTRAL AND HIGH SCENARIOS

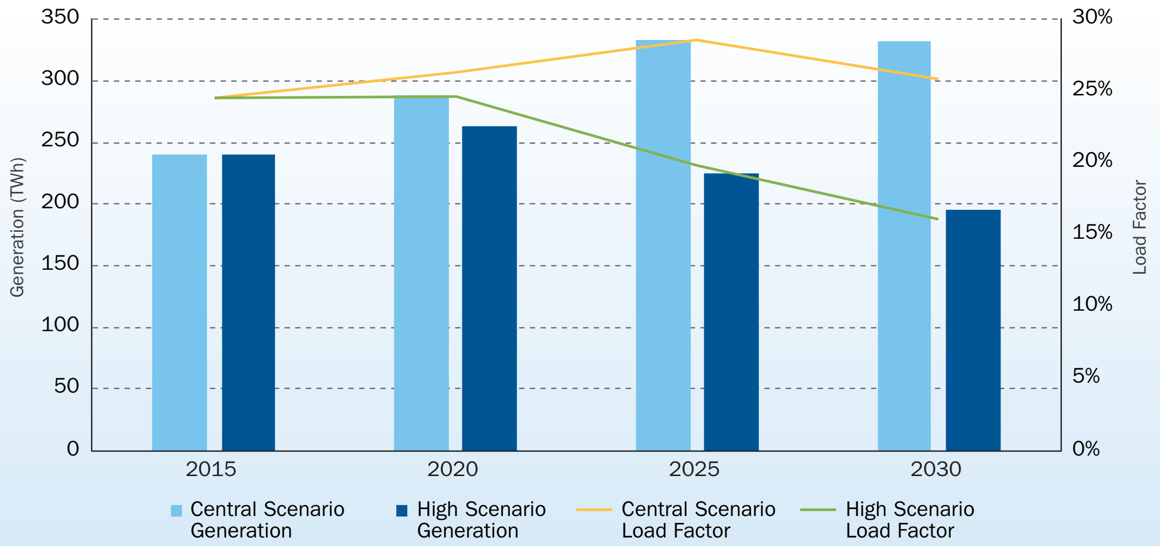


Source: EWEA. (2015)

In the High Scenario, the increased deployment of wind and other renewables continues to displace thermal generation, particularly CCGTs. With more wind power, there is less need to activate more expensive technology. CCGT generation declines by 41.6% in 2030 when compared to the Central Scenario. The reduced demand for the technology also impacts the load factor of CCGTs, dropping to 16.1% in the High Scenario.

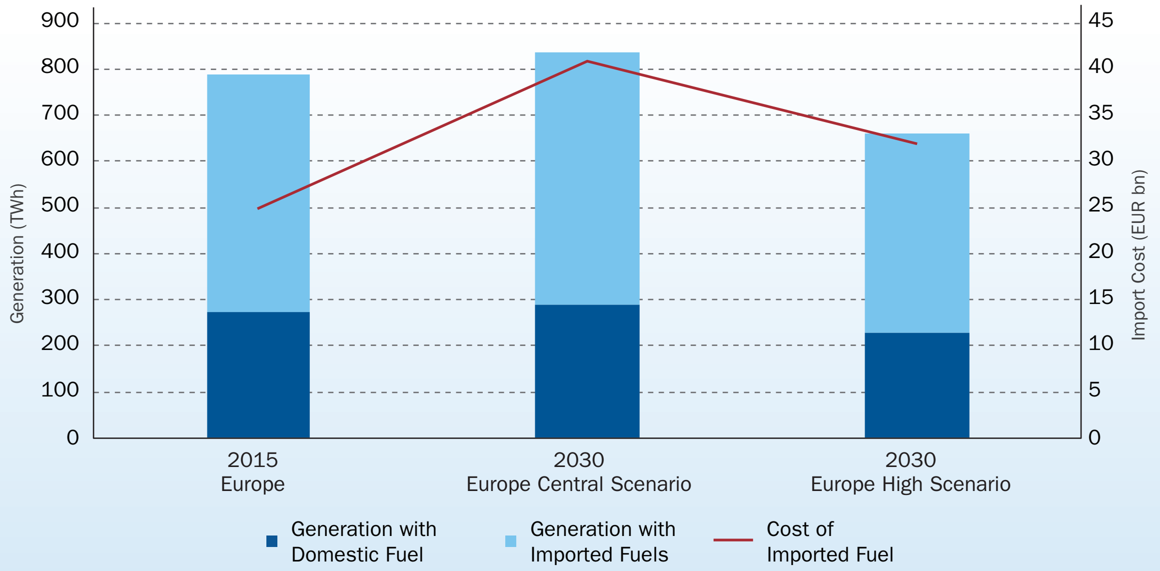
This decrease in gas generation reduces the bill of imported gas for Europe in 2030 by one fifth in comparison to the Central Scenario. This amounts to €31.9 bn[29], compared with €40.9 billion in the Central Scenario. Considering that Europe's energy bill has steeply increased over the last five years, turning this trend around would be a notable achievement.

FIGURE 20: GENERATION LEVELS AND LOAD FACTOR FOR CCGTS ACROSS EUROPE 2015-2030



Source: EWEA/Pöyry. (2015)

FIGURE 21: TOTAL GAS GENERATION AND COST OF FUEL IMPORTS



Source: EWEA/Pöyry. (2015)

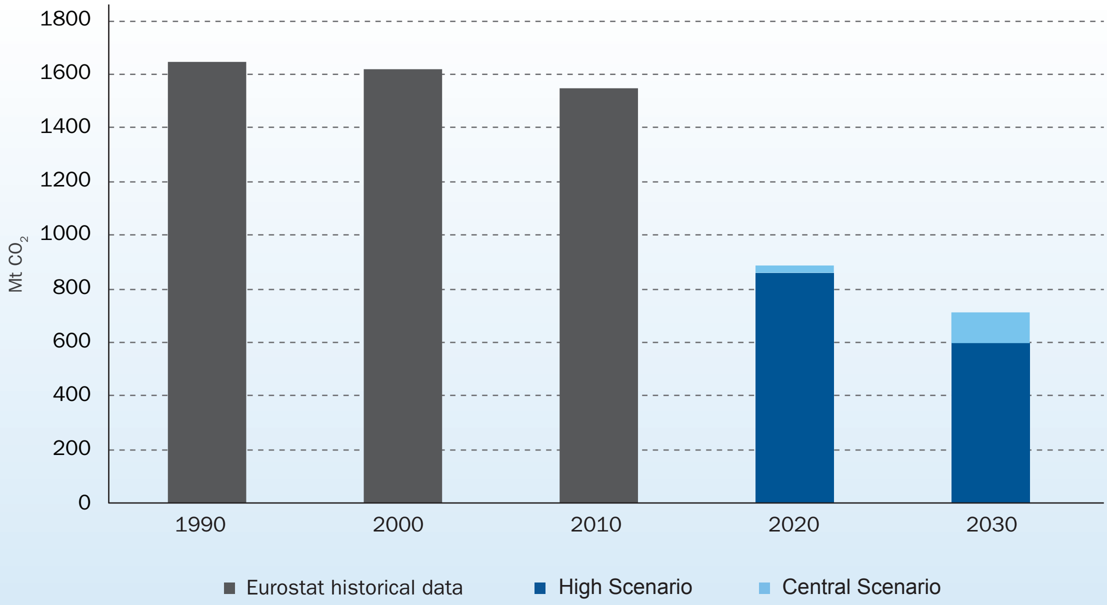
[29] Assumes gas dependency rates stay unchanged from 2013 levels in Eurostat tdscc310.

Cutting More Emissions

Adopting the High Scenario development path places the EU firmly on the linear reduction pathway, whereas the Central Scenario sees insufficient CO_2 reductions and makes the EU rely on future, potentially costly innovations such as CCS to aid the mitigation of emissions.

The High Scenario leads to a sharper drop in CO_2 emissions. Pursuing a more ambitious pathway allows the power sector to reduce CO_2 emissions to 36.3% of 1990 levels, removing an extra 111.6 Mt CO_2 compared to the Central Scenario.

FIGURE 22: CO_2 EMISSIONS FROM THE ENERGY SECTOR IN THE HIGH SCENARIO AGAINST THE CENTRAL SCENARIO



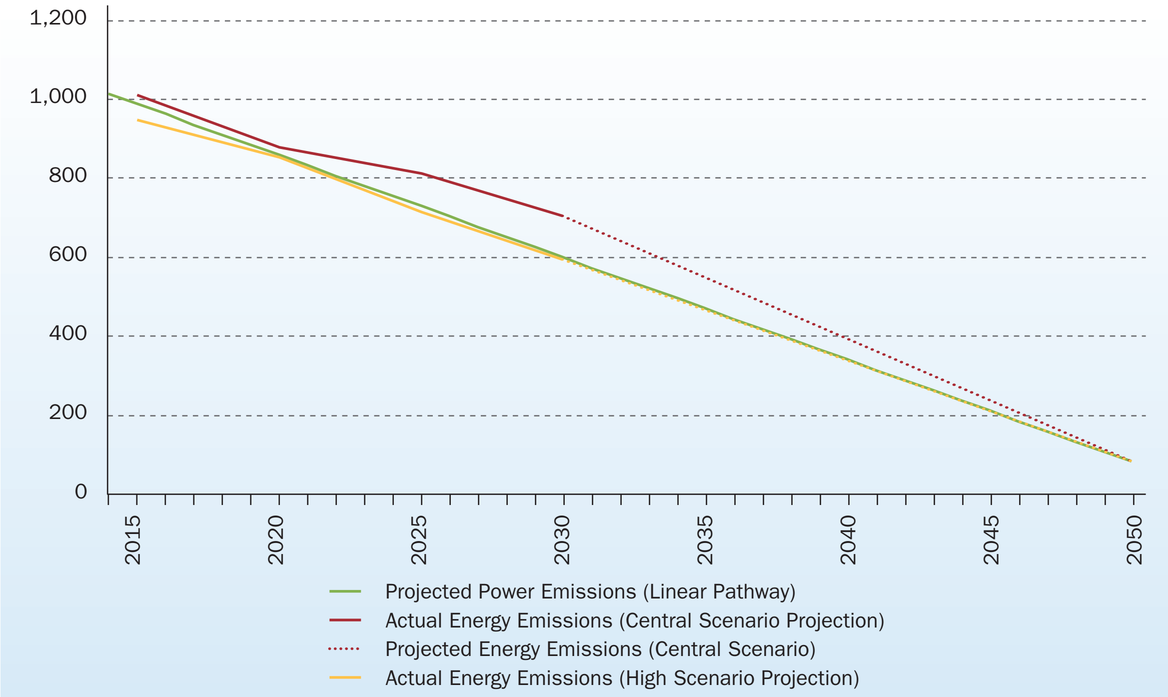
Source: Data 1990-2010: Eurostat/EEA[30], 2015-2030: EWEA/Pöyry

GHG emissions reductions in the power sector from 1990 levels

63.7 %

[30] Eurostat. (2015). Greenhouse gas emissions by sector – Energy industries (tsdcc210).

FIGURE 23: CO_2 REDUCTION PATHWAYS TOWARDS 2050



Source: Data 1990-2010: Eurostat/EEA30, 2015-2030: EWEA/Poyry

Boosting the Economy

The accelerated path of the High Scenario would slow the rate of climate change and improve European energy security by reducing reliance on imported fossil fuels. This scenario would also lead to a net positive effect on the European economy.

Taking account of all direct and indirect effects associated with the renewables investment and the financing of it, the High Scenario would boost economic growth and competitiveness in 2030 rather than represent a pure cost. Under the High Scenario, the EU28 should expect a net additional €13 bn GDP over the baseline scenario.

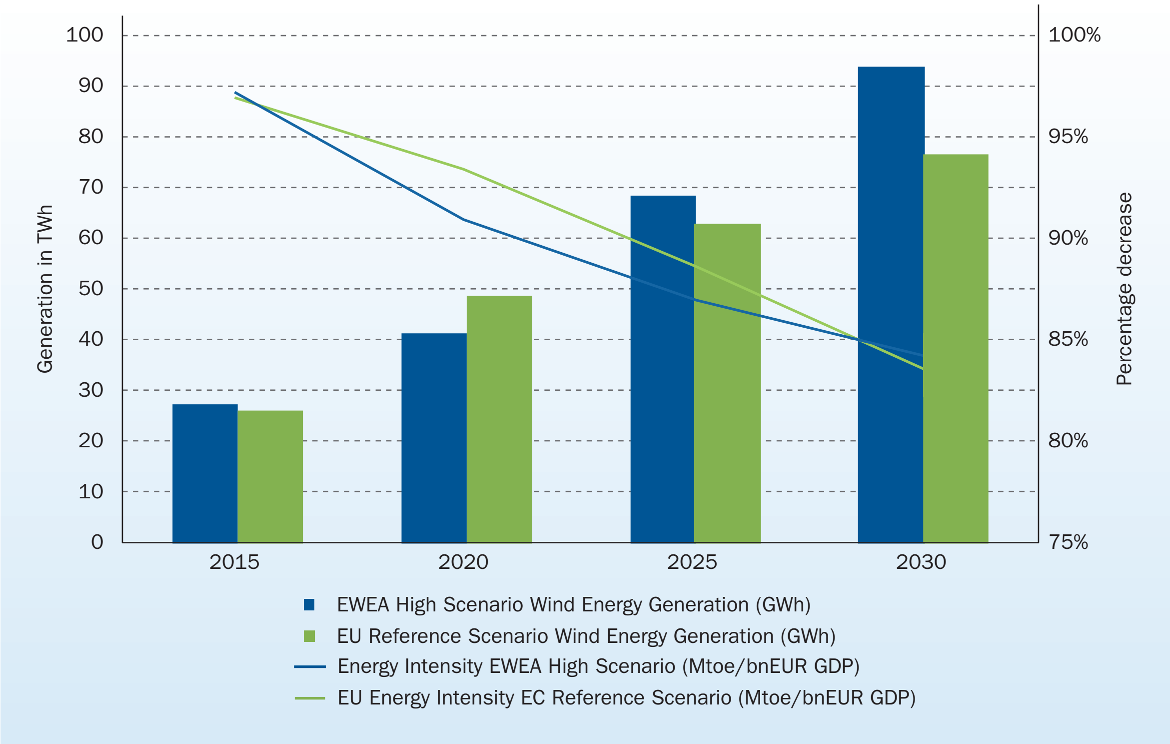
Similarly, the GVA to the European economy in 2030 would increase by €12.7 bn in the High Scenario relative to a baseline scenario, due to an expansion of the low-carbon supply chain (as a direct result of the increase in renewables investment) and a reduction in industry unit costs (due to lower industry electricity prices and a lower carbon price).

In the European Commission's reference scenario, the European economy is expected to grow by 1.6% year-on-year over the period to 2030. Such economic growth would induce pressure on energy production to meet the increased demand.

However, the ambitious goals in EWEA's High Scenario show that the European Union can be more efficient in decoupling fossil fuel consumption from GDP growth. Even with increasing generation and demand, energy intensity in the power sector would go down by 15% in 2030 making the EU's economy more energy efficient.

The transformation of the energy mix could moreover lead to a net job creation in the EU. To put this into perspective, the EU's economy could benefit from an additional 61,000 workers, against the Central Scenario, taking into account both jobs created and displaced.

FIGURE 24: ENERGY INTENSITY IN THE POWER SECTOR – COMPARISON BETWEEN THE EC REFERENCE SCENARIO AND EWEA'S HIGH SCENARIO[31]



Source: Data from Pöyry. (2015) / European Commission. (2013)

The growth and consolidation of the wind industry in Europe is expected to have a major impact on employment. While there are considerable variations per technology, the wind sector remains one of the highest employment impact per MW. Not only does the wind sector create jobs in turbine manufacturing and electricity production (direct employment) but also indirectly in research institutes, the insurance and finance sector.

With the expansion of wind energy to other large economies and emerging markets along with a booming offshore wind sector, EWEA expects the wind industry to support 366,000 direct and indirect jobs[32].

[31] European Commission. (2013). EU Energy, Transport, and GHG Emissions on the Trends to 2050. Reference Scenario 2013.
[32] EWEA. (2015). Wind Energy Scenarios for 2030.

Policy Priorities

- A robust governance system should be agreed to ensure Member States collectively deliver on the 2030 binding renewable energy target and are rewarded for additional ambition;
- The measures for the delivery and oversight of this binding target should be enshrined in a renewable energy directive to be tabled by the European Commission in 2016;
- For the post-2020 period, Member States should develop national renewable energy action plans considering the EU's long term greenhouse gas emissions reduction objective;
- National permitting procedures should be streamlined to allow for the cost-effective deployment of wind energy;
- The European Commission should make concrete legislative proposals towards a well-functioning energy market driving the transition away from a fossil fuel based economy;
- A structural reform of the EU Emissions Trading System should be completed to provide for a high and stable carbon price, dis-incentivising investments in carbon-intensive and inefficient power plants.

Methodology

Pöyry and Cambridge Econometrics were commissioned to produce further quantitative analysis into the energy market and macro-economic impacts of the deployment scenarios in Wind Energy Scenarios for 2030. A study was performed with the following considerations and definitions:

Country Coverage

Modelling of the power system included Norway and Switzerland as part of overall interactions in interconnected Europe. However, European aggregated figures do not include Norway and Switzerland, and are demand-weighted averages.

Generation

Differences in generation amounts are noted between Aiming High and Wind Energy Scenarios in 2030. Analysis in Aiming High uses Pöyry generation data.

Macroeconomics

Data on GDP, GVA, employment, fuel dependency are generated as outputs of the entire energy scenario, looking at the total resulting power mix in each year and the effect on the European economy as a whole. Gas import data and energy intensity used Pöyry generation data, but was otherwise calculated by EWEA. Fuel cost mitigation from the wind was also entirely derived by EWEA.

Prices

Energy price projections for gas, oil, and coal are from Pöyry.

About Pöyry
Pöyry is an international consulting and engineering company. We serve clients globally across the energy and industrial sectors and locally in our core markets. We deliver strategic advisory and engineering services, underpinned by strong project implementation capability and expertise. Our focus sectors are power generation, transmission & distribution, forest industry, chemicals & biorefining, mining & metals, transportation, water and real estate sectors

About Cambridge Econometrics
Cambridge Econometrics is a leading independent consultancy specialising in applied economic modelling and data analysis techniques. We aim to provide rigorous, accessible and relevant independent economic analysis to support strategic planners and policy-makers in business and government, doing work that we are interested in and can be proud of.

ANNEX

INDC Submissions by country as of 12th October 2015

* Indicates not yet officially submitted
^CO_2 Intensity Target

Country	Reduction Goal (%)	From	By	Utilising International Carbon Markets?
Afghanistan	-13.6	Business As Usual	2030	N/A
Albania	-11.5	Business As Usual	2030	Yes
Algeria	-7 to -22	Business As Usual	2030	N/A
Andorra	-37	Business As Usual	2030	No
Argentina	-15 or -30	Business As Usual	2030	N/A
Armenia	N/A	N/A	2015-2050	Yes
Australia	-26 to -28	2005	2030	Maybe
Azerbaijan	-35	1990	2030	N/A
Bangladesh	-5 or -15	Business As Usual	2030	Maybe
Barbados	-44	Business As Usual	2030	Yes
Belarus	-28	1990	2030	No
Belize	N/A	N/A	N/A	Maybe
Benin	N/A	Business As Usual	2030	No
Bhutan	N/A	N/A	N/A	Yes
Bolivia	N/A	N/A	N/A	No
Bosnia	-2 or -23	1990	2030	Maybe
Botswana	-15	2010	2030	Yes
Brazil	-37	2005	2025	Maybe
Burkina Faso	-6.6 or -18.2 or -55.15	Business As Usual	2030	N/A
Burundi	-3 or -20	Business As Usual	2030	N/A
Cabo Verde	Pending on GHG inventory H2 2016	N/A	N/A	Yes
Cambodia	-27	2010	2030	Yes
Cameroon	-32	Business As Usual	2035	Yes
Canada	-30	2005	2030	Yes
Central African Republic	-5	Business As Usual	2030	Maybe
Chad	-18.2 or -71	Business As Usual	2030	Maybe
Chile	-30 or -35-45^	2007	2030	N/A
China	≤ -60 to -65^	2005	2030	N/A
Colombia	≤ -20	Business As Usual	2030	Maybe
Comoros	-84	Business As Usual	2030	N/A
Congo, Dem. Rep. of	-17	Business As Usual	2030	Maybe
Congo, Rep. of	-48/-55	Business As Usual	2025/2035	N/A
Costa Rica	-24.7	2012	2030	Yes
Cote d'Ivoire	-28 to -36	Business As Usual	2030	Yes
Djibouti	-40 or -60	Business As Usual	2030	No
Dominica	-39.2/-44.7	2014	2025/2030	Yes
Dominican Rep.	-25	2010	2030	Maybe
Ecuador	-25 or -37.5 to -45.8	Business As Usual	2025	N/A

Source: Carbon Pulse. (2015). INDC Tracker

Country	Reduction Goal (%)	From	By	Utilising International Carbon Markets?
Eritrea	-39.2 or -80.6	Business As Usual	2030	No
Eq. Guinea	-20	2010	2030	Yes
Ethiopia	-64	Business As Usual	2030	Yes
EU	≤ -40	1990	2030	No
Gabon	≤ -50	Business As Usual	2025	Yes
Gambia	-45.4	2010	2030	Maybe
Georgia	-15 or -25	Business As Usual	2030	N/A
Ghana	-15 to -45	Business As Usual	2030	Yes
Grenada	0.75	2010	2025/2030	Maybe
Guatemala	-11.2 or -22.6	Business As Usual	2030	N/A
Guinea	-14	1994	2030	Yes
Guinea Bissau	N/A	N/A	N/A	No
Guyana	N/A	Business As Usual	2025	Maybe
Haiti	-5 or -26	Business As Usual	2030	Yes
Honduras	-15	Business As Usual	2030	N/A
Iceland	-40	1990	2030	No
India	-33 to -35^	2005	2030	N/A
Indonesia	-29/-41	Business As Usual	2030	Yes
Israel	N/A	2005	2030	N/A
Japan	-26	2013	2030	Yes
Jordan	-1.5 to -14	Business As Usual	2030	Yes
Kazakhstan	-15 or -25	1990	2021-30	Yes
Kenya	-30	Business As Usual	2030	Maybe
Kiribati	-13.7	Business As Usual	2025	Maybe
Kyrgyzstan	-11.49 to -13.75 or -29 to -30.89	Business As Usual	2030	N/A
Laos	N/A	N/A	2030	N/A
Lebanon	-15 or -30	Business As Usual	2030	Maybe
Lesotho	-10 or -35	Business As Usual	2030	Yes
Liberia	-15	Business As Usual	2030	N/A
Liechtenstein	-40	1990	2030	Yes
Macedonia	-30 or -36	Business As Usual	2030	Maybe
Madagascar	-14	Business As Usual	2030	No
Malawi	N/A	2010	2030	N/A
Maldives	-10 or -24	Business As Usual	2030	N/A
Mali	N/A	Business As Usual	2030	N/A
Marshall Islands	-32	2010	2025	No
Mauritania	-22.3	Business As Usual	2030	N/A
Mauritius	-30	Business As Usual	2030	N/A
Mexico	≤ -25	Business As Usual	2030	Yes
Moldova	-67 to -67	1990	2030	Maybe
Monaco	-50	1990	2030	Yes
Mongolia	-14	Business As Usual	2030	Maybe
Montenegro	-30	1990	2030	Yes
Morocco	-13 to -32	Business As Usual	2030	Yes

Country	Reduction Goal (%)	From	By	Utilising International Carbon Markets?
Mozambique	N/A	N/A	2030	Yes
Myanmar	N/A	N/A	N/A	N/A
Namibia	-89	Business As Usual	2030	Maybe
New Zealand	-30	2005	2030	Yes
Niger	-2.5/-3.5 or -25/-34.6	Business As Usual	2020/2030	Yes
Norway	≤ -40	1990	2030	Yes
Pakistan*	-30	2008	2025	Yes
Paraguay	-10 or -20	Business As Usual	2030	N/A
Papua New Guinea	N/A	Business As Usual	2030	N/A
Peru	-30	Business As Usual	2030	Yes
Philippines	-70	Business As Usual	2030	N/A
Russia	-25 to -30	1990	2030	No
Rwanda	N/A	N/A	N/A	Yes
Samoa	N/A	N/A	2025	Maybe
San Marino	-20	2005	2030	No
Sao Tome and Principe	0 or -24	2005	2030	Yes
Senegal	-4/-5 or -15/-21	Business As Usual	2025/2030	N/A
Seychelles	-29	Business As Usual	2030	No
Serbia	-9.8	1990	2030	N/A
Sierra Leone	N/A	N/A	2035	Yes
Singapore	-36^	2005	2030	Maybe
Solomon Islands	-12/-30 or -27/-45	Business As Usual	2025/2030	Maybe
South Africa	-34 or -42	Business As Usual	2025	Yes
South Korea	-37	Business As Usual	2030	Yes
Suriname	N/A	N/A	N/A	N/A
Swaziland	N/A	N/A	2030	N/A
Switzerland	-50	1990	2030	Yes
Tajikistan	-10 to -20 or -25 to -35	1990	2030	N/A
Tanzania	-10 to -20	Business As Usual	2030	N/A
Thailand	-20 or -25	Business As Usual	2030	Yes
Togo	-11.14 or -31.14	Business As Usual	2030	Yes
Trinidad & Tobago	-15	Business As Usual	2030	No
Tunisia	-13 to -41^	2010	2030	Yes
Turkey	-21	Business As Usual	2030	Yes
Turkmenistan	0	2015	2030	N/A
Ukraine	-40	1990	2030	Yes
USA	-26 to -28	2005	2025	No
Uruguay	N/A	1990	2030	N/A
Vanuatu	N/A	N/A	2030	N/A
Vietnam	-12.5 to -25	Business As Usual	2021-30	Yes
Zambia	-25 or -35	Business As Usual	2030	Maybe
Zimbabwe	-33	Business As Usual	2030	Yes

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About EWEA

The European Wind Energy Association (EWEA) is the voice of the wind industry, actively promoting wind power in Europe and worldwide. It has over 600 members, active in over 50 countries, including wind turbine manufacturers with a leading share of the world wind power market, plus component suppliers, research institutes, national wind and renewables associations, developers, contractors, electricity providers, finance and insurance companies, and consultants. This combined strength makes EWEA the world's largest and most powerful wind energy network.

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