Wind energy in Europe: Scenarios for 2030

September 2017

Wind EUROPE

Wind energy in Europe: Scenarios for 2030

September 2017

windeurope.org

WindEurope regularly surveys the wind energy industry to determine the likely level of installations in the future. With this report WindEurope provides updated potential deployment scenarios for wind energy to 2030.

TEXT AND ANALYSIS:
Aloys Nghiem
Iván Pineda

EDITOR:
Pierre Tardieu

DESIGN:
Lin Van de Velde - drukvorm.be

PHOTO COVER:
Florian Martinerie

ACKNOWLEDGMENTS:
Austrian Wind Energy Association - IG Windkraft, Belgian Offshore Platform, EDORA asbl, ODE-Vlaanderen vzw, Bulgarian Wind Energy Association, Czech Wind Energy Association - CzWEA (CSVE), Danish Wind Industry Association - DWIA, Danish Wind Turbine Owners Association, Estonian Wind Power Association - EWPA, Finnish Wind Power Association (Suomen Tuulivoimayhdistys Ry), France Energie Eolienne, German Wind Energy Association - Bundesverband WindEnergie e.V., VDMA Power Systems, Hellenic Wind Energy Association - ELETAEN, Hungarian Wind Energy Industry Association, Irish Wind Energy Association - IWEA, assoRinnovabili, Associazione Nazionale Energia del Vento - ANEV, Latvian Wind Energy Association, Lithuanian Wind Power Association - LWPA, Netherlands Wind Energy Association - NWEA, Polish Wind Energy Association, Associação Portuguesa de Energias Renovaveis - APREN, Romanian Wind Energy Association - RWEA, Asociación Empresarial Eólica - AEE, Spanish Renewable Energy Association - APPA, Swedish Wind Energy Association (Svensk Vindenergi), Renewable UK.

MORE INFORMATION:
policy@windeurope.org
+32 2 213 18 68

CONTENTS

EXECUTIVE SUMMARY 7

INTRODUCTION 11

1. RECENT EU ECONOMIC AND REGULATORY DEVELOPMENTS 12
2. MEMBER STATE DEVELOPMENTS TO 2030 15
3. DESCRIPTION OF THE 2030 WIND ENERGY CAPACITY SCENARIOS 17
4. SCENARIO ANALYSIS 22
5. MACROECONOMIC AND SOCIAL IMPACTS OF THE SCENARIOS 25
6. REGIONAL AND NATIONAL DEVELOPMENTS 27

EXECUTIVE SUMMARY

WindEurope updates its capacity scenarios to 2030 every two years to reflect the latest market and policy developments in the EU. This involves surveying industry experts in every Member State and analysing the potential conditions that would determine the deployment of wind energy, including repowered capacity, in the post-2020 period. This report describes three possible scenarios for wind energy capacity installations in 2030. It also highlights the impact of each scenario and recommends the policy and other measures that are needed to deliver the scenarios and sustain Europe's technological leadership in wind.

According to WindEurope's *Central Scenario*, 323 GW of cumulative wind energy capacity would be installed in the EU by 2030, 253 GW onshore and 70 GW offshore. That would be more than double the capacity installed at the end of 2016 (160 GW). With this capacity, wind energy would produce 888 TWh of electricity, equivalent to 30% of the EU's power demand. In this scenario, the wind energy industry would invest €239 bn by 2030 and provide employment to 569,000 people. The increase in jobs assumes that the EU supply chain remains competitive thanks to a robust market - a doubling of onshore wind capacity and a fivefold increase in offshore wind capacity - and to sustained European leadership in Research and Innovation.

The *Central Scenario* assumes that the EU meets its 27% renewable energy target in 2030 through the adoption of the Clean Energy Package proposals presented by the European Commission in November 2016. It relies on the implementation of a clear Governance for the Energy Union with detailed National Energy and Climate Plans delivering the EU binding targets and effective regional cooperation. It also assumes significant progress in system integration, allowing a higher penetration of wind energy and other renewables as well as sufficient grid infrastructure to meet the EU's 15% interconnection target. In the *Central Scenario*, clear policy commitments on electrification drive demand for renewable power. In addition, the *Central Scenario* assumes onshore wind cost reductions continue and that, as a result of governments providing a visible pipeline of projects between 2020 and 2030, the industry's offshore wind cost reduction objectives to 2025 are met.

According to WindEurope's *High Scenario*, which assumes favourable market and policy conditions including the achievement of a 35% EU renewable energy target, 397 GW of wind energy capacity would be installed in the EU by 2030, 298.5 GW onshore and 99 GW offshore. This would be 23% more capacity than in the *Central Scenario* and two and a half times more capacity than currently installed in the EU. Wind energy would produce 1,129 TWh of electricity, equivalent to 38% of EU's power demand. In this scenario, the wind energy industry would invest €351 bn by 2030, 19% more than in the *Central Scenario*, and it would create 147,000 more jobs, totalling in 716,000 jobs.

In the *Low Scenario*, there would be 256.4 GW of wind capacity in 2030, 207 GW onshore and 49 GW offshore, producing 21.6% of the EU's power demand in 2030. That is 20% less capacity than in the *Central Scenario*. As a consequence the wind energy sector would generate €147 bn investments, 39% lower than in the *Central Scenario*. The wind industry would represent 132,000 fewer jobs than in the *Central Scenario,* with a total of 437,000 jobs.

POLICY RECOMMENDATIONS

- The EU should raise its 2030 renewable energy target to **at least 35%** of final energy demand by 2030 with a clear breakdown per Member State
- Member States should adopt **early National Energy and Climate Action Plans based on a binding template** providing clarity to investors on the post-2020 market volumes including repowering
- The post-2020 Renewable Energy Directive should mandate Member States to set a **schedule for renewable energy support** providing investors at least three years of visibility
- The post-2020 Renewable Energy Directive should set clear design rules for renewable energy support mechanisms, including **technology specific tenders**, to manage the energy transition
- Market design rules should **maintain priority dispatch for existing wind power plants and ensure new wind plants** are dispatched down last and properly compensated in that occurrence
- Member States should **stop capacity payments to polluting power plants** through the adoption of an Emissions Performance Standard of 550 g CO_2/kWh
- EU rules on Guarantees of Origin should **facilitate corporate renewable PPAs and drive renewables-based electrification**

FIGURE 1

Macro-economic benefits of wind energy under WindEurope's 2030 scenarios

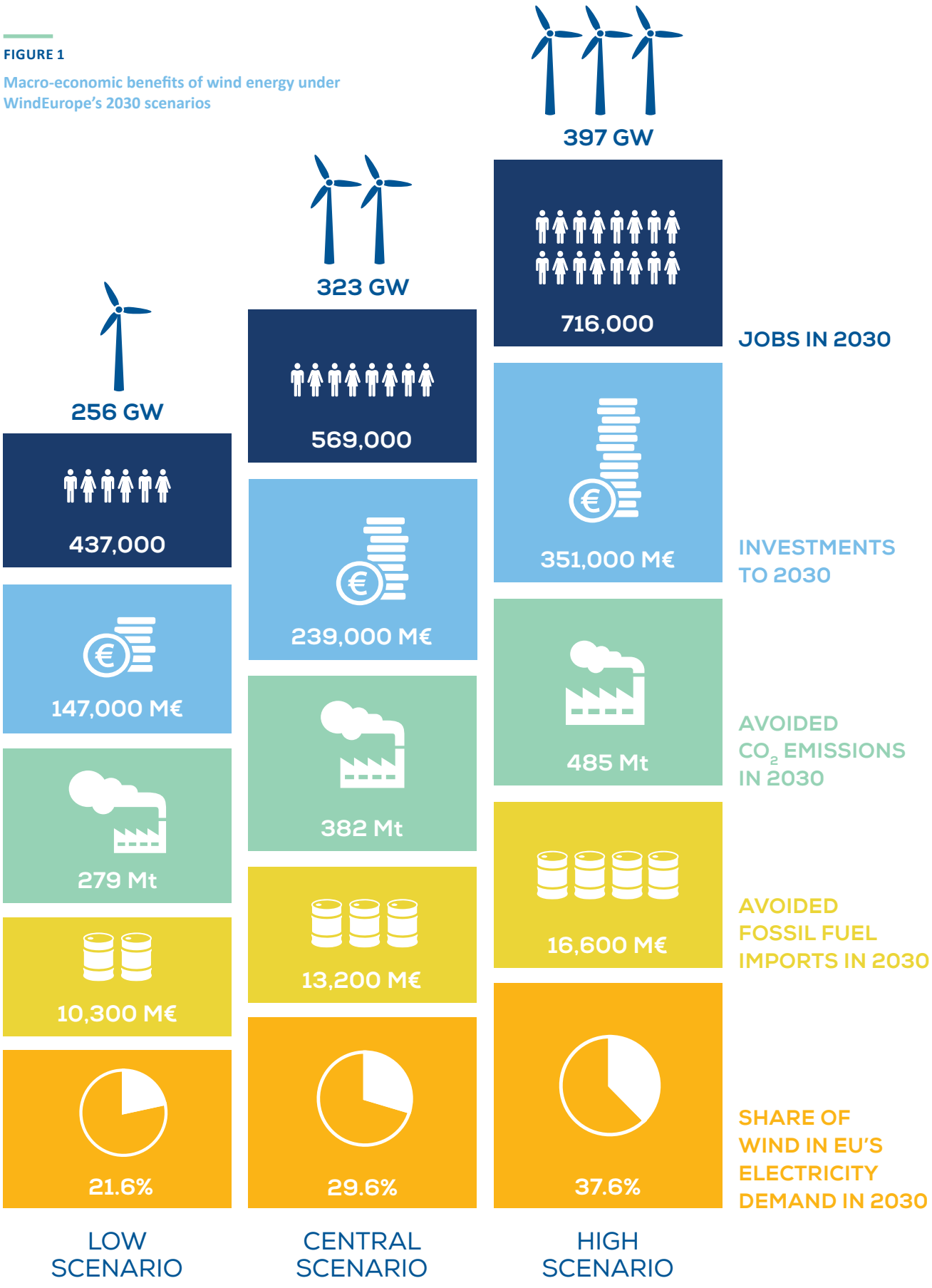


Photo: António Correia

INTRODUCTION

The deployment of wind energy in Europe is a remarkable industrial success for Europe. Between 2006 and 2016, 106 GW of power capacity were installed, supporting 262,000 jobs. In the same period the US installed 71 GW, China 156 GW and the rest of the world 80 GW. 31% of the global installed capacity is in Europe and 46% was manufactured by European companies.

Onshore wind energy is today the cheapest source of new power capacity in many places in Europe. Offshore, auction prices over the last year have exceeded the industry's self-imposed cost reduction targets of €100/MWh with projects delivering bids significantly below that level.

So wind energy could become the leading element of the power system with sustained progress on system integration and the acceleration of electrification. In 2016 wind energy overtook coal in terms of installed capacity, and for the sixth consecutive year wind energy topped investments in new power capacity.

However, the development of wind energy in Europe is more uncertain in the decade after 2020 than it was in the 10 years after it took off from being a niche technology.

European Commission President Jean-Claude Juncker committed in his July 2014 inaugural speech to the European Parliament to making Europe the world's number one in renewables. However, Europe is dealing with increasingly intense competition from mature and emerging markets. This trend was highlighted in the run up to the 2015 Paris Agreement, when more than 70 countries mentioned wind energy in their Intended Nationally Determined Contributions (INDC) as a key mitigation measure against climate change.

In the next 12 to 15 months, EU Member States and the European Parliament are expected to adopt the *Clean Energy for All Europeans* legislative package which will in large part determine the future of renewables in the decade after 2020. With this report WindEurope informs this process by providing updated potential deployment scenarios for wind energy to 2030. The report also highlights the role of wind in delivering the energy transition in Europe, in securing Europe's leadership in renewables and its role in supporting Europe's wider social and economic development.

1. RECENT EU ECONOMIC AND REGULATORY DEVELOPMENTS

Wind energy's potential to 2030 depends to a large extent on climate and energy policies determined at EU-level. In particular, the post-2020 Renewable Energy Directive, the **Governance** of the Energy Union, the European **Market Design** for electricity and the **Emissions Trading System (ETS)** will have a significant bearing on the rate of deployment of wind energy and other renewables at national level.

On 30 November 2016 the European Commission presented the *Clean Energy for All Europeans* legislative package outlining the post-2020 EU regulatory framework for renewable energy, the internal energy market, security of supply and energy efficiency. The package lays out ground rules that will shape the deployment of wind energy until 2030, including a number a measures to secure investments required to meet the EU-wide binding target on renewables.

According to the legislative proposals, the delivery of the target will be monitored by the Commission as part of a new **Governance Framework**. Member States will be required to develop plans, starting in 2021, to deliver the EU's energy and climate objectives. The Commission will be able to trigger measures at EU level to fill the gap If these plans do not add up to the EU's binding target on renewables.

The European Commission proposals include a recast of the 2009 **Renewable Energy Directive**. The post-2020 Directive sets out provisions for renewable energy deployment in the power, heating, cooling and transportation sectors. It sets the 2020 renewable energy targets as the starting point for each Member State's contribution to the EU-wide 2030 binding target. It also deals with the planning, timing, visibility and cross border opening of support mechanisms to renewables in Member States. Finally, the Directive proposes rules for investment protection, streamlining administration and permitting procedures, facilitating repowering and life extension of renewable energy projects and regulating Guarantees of Origin (GOs).

Crucially, *the package* includes proposals for an upgrade of the **Electricity Market Design** to be more flexible and fit for an increasing share of decentralised generation. Under the new rules, renewables would have access to balancing markets and remuneration for services provided (ancillary services). Renewable energy would be traded as close to real time as possible in intraday and balancing markets. Capacity Remuneration Mechanisms (CRMs) would only be allowed after an EU-wide system adequacy assessment and the capacity size would be required to be proportionate to the system adequacy challenge identified. In addition, a new Emissions Performance Standard is proposed as of 2026 to ensure investments in coal are not incentivised via Capacity Remuneration Mechanisms.

The European Parliament and the Council of the European Union have engaged in the co-decision process based on these proposals with a final adoption of the package expected for the end of 2018.

Negotiations on the *Clean Energy package* as a whole, and on specific provisions, such as maintaining priority dispatch for existing assets and protecting investors from retroactive changes in national legislation, will determine whether European leaders provide the right investment conditions for achieving the common EU energy strategy. Long-term visibility and stable regulatory frameworks, therefore, remain crucial for wind energy deployment post-2020. **Today, only 8 out 28 Member States have renewable energy plans post 2020[1].** The Emissions Trading System (ETS), is still not expected to provide the market signals needed to shift investments from polluting power generation into renewable energy. This would require a root and branch reform to align with the EU's climate ambitions.

On the macro-economic side, the slow recovery in Europe has also impacted the long-term plans and decisions of investors in wind energy. Since 2015, Europe has been overshadowed by **record-high investments for renewables in competing markets.** China overtook the EU in wind energy installations two years ago. The extension of the production and investment tax credits (PTC and ITC) in the United States up to 2020 sets the stage for a surge in wind turbine orders and permitting requests. Similarly, auctions across African countries and Latin America have provided strong incentives for European manufacturers and project developers to look abroad.

The conditions of historic low oil prices throughout 2015 and 2016 and the oversupply of shale gas from the US had knock-on effects in the European energy markets. Whilst renewables generated around 30% of electricity during these two years, **coal power plants still represented over 25% of European power generation.** The resulting overcapacity contributed to depressed wholesale power prices.

In spite of interest rates trending close to zero across the EU, the cost of capital rose in markets which experienced abrupt regulatory changes. Greece, Bulgaria, Romania, Poland and Spain top the charts in the EU with 9-12% cost of capital to invest in renewables[2]. This has led to **exacerbated concentration in markets such as Germany and the UK.**

Europe's leadership in wind energy is the result of a clearly defined regulatory framework, which was introduced in the early 2000s. This was decisive in fostering national policies and attracting investment. Driven by supportive frameworks, the wind energy sector became a mainstream industry. However, as current trends show, **the market for wind energy in Europe is slowing down compared to the rest of the world.**

Sustaining Europe's leadership in wind energy will require ambitious deployment based on a **binding renewable energy target of at least 35% with a clear national breakdown.** In parallel, the energy market should be more flexible thanks to cross-border integration; demand response and storage. This market design reform should include a fair regime for grid access and balancing responsibility and it should ensure the system makes the most of interconnectors and smart grids.

1. Germany, France, Finland, Netherlands, Sweden, Ireland, Lithuania and Portugal
2. Diacore Project, 2016

TABLE 1

WindEurope's recommendations for the Clean Energy Package

RECOMMENDATION	RATIONALE
1. Early adoption of the National Plans (Art. 3 & 9 Governance Regulation)	Only 8 out of 28 Member States have clear pledges on renewables beyond 2020. This prevents timely investment decisions and the cost-effective fulfilment of the 2030 renewable energy target.
2. Maintain priority dispatch for existing wind power plants and introduce clear curtailment rules (Art. 5, 11 & 12 Electricity Regulation)	Priority dispatch and balancing exemptions should be maintained for existing assets to avoid retroactive changes and maintain investor confidence, To minimise wind power curtailment, operators should introduce rules that ensure wind plants are dispatched down last and properly compensated in that occurrence.
3. Stop investment support to polluting assets (Art. 23 Electricity Regulation)	The Emissions Performance Standard of 550 gr CO_2/kWh as part of the design criteria for Capacity Remuneration Mechanisms will be critical to addressing the structural overcapacity of inefficient and polluting power plants.
4. Enhance system flexibility (Art. 16 Renewable Energy Directive)	The national energy and climate plans should include an indication of a) the roll-out of clean flexibility options like demand response and storage, b) the enhancement of thermal generators' flexibility, and c) the limitation of must-run practices when conventional generators keep generating at a minimum level when not needed.
5. Include a schedule for renewable energy support providing at least 3 years of visibility to investors (Art. 15 Renewable Energy Directive)	This visibility on timing, capacity and budget is key for industrial planning. It will significantly help reduce the short-term costs of the energy transition.
6. Introduce clear design rules for renewable energy support mechanisms (Art. 4 Renewable Energy Directive)	Legislation must include general principles for the design of national renewable energy support mechanisms In particular, Member States must have the flexibility to run technology-specific auctions to properly plan their energy transition. .
7. Clarify the grandfathering clause protecting existing assets from retroactive changes (Art. 6 Renewable Energy Directive)	The rule of law principle underpinning investor protection is key in keeping investments in the EU. The rights conferred to renewable energy assets should remain intact through the lifetime of the projects.
8. Facilitate repowering (Art. 17 Renewable Energy Directive & Template for National Plans)	Over half of Europe's wind capacity will reach the end of its normal operational life during the next decade. In addition to deploying new renewable energy assets, Member States must have a plan for how to deal with these assets and facilitate investment in repowering.
9. Include a national breakdown of the binding renewable energy target (New article in Renewable Energy Directive)	A breakdown is necessary to ensure the fair share towards the collective EU target and tools for Member States to justify new renewables investments domestically.
10. Ensure that rules on Guarantees of Origin facilitate Corporate Renewable PPAs and drive renewables-based electrification (Art. 19 Renewable Energy Directive)	Renewable energy producers must retain control of their Guarantees of Origin to market green power effectively. This is critical to the development of Corporate Renewable PPAs and has broader implications for the uptake of renewable electricity in Heating and Transport.

2.
MEMBER STATE DEVELOPMENTS TO 2030

The 2017 European Commission report on renewable energy progress to 2020 shows that while vast majority of EU countries are on track to reaching their 2020 binding targets for renewable energy, most countries will have to sustain their efforts to meet these targets. France, Ireland, the Netherlands and Luxembourg are likely to miss their targets. Hungary and Poland also risk missing their targets as they have put significant obstacles in the way of additional renewable energy deployment. Spain, which until last year was set to miss its target, has held three renewable energy auctions since 2016 but will face a challenge in deploying the necessary capacity in the remaining interval following a four year market standstill.

The transition to auctions for the allocation of renewable energy capacity as per the EU State Aid guidelines has represented a unique challenge for the industry across Member States, undermining the build-out to 2020. Whilst in some countries investments have halted, others have seen unforeseen developments such as community projects dominating auctions.

Overcapacity of inflexible and carbon intensive assets still puts pressure on the wholesale power prices, undermining the case for new renewable energy investments.

In addition, investors lack long term visibility, with only 8 out of 28 Member States having policies in place for the deployment of renewable energy post-2020.

The aforementioned developments will continue to impact the deployment of wind energy capacity in the decade after 2020. In addition, other sources of uncertainty are:

- The degree of implementation of the opening of auctions across-borders. The recast Renewable Energy Directive proposes a mandatory 10% opening of renewable energy auctions to projects in neighbouring countries in the period 2021-2025 and 15% in the period 2026-2030. The appetite for such projects from developers and investors has yet to manifest itself. The development of properly functioning cross-border power markets will be a key enabler for cross-border auctions.

- Varying legislation on spatial planning across Member States. In some countries, set back distances, noise limits or wind turbine interference regulations with civil aviation and military radars are tightening (Poland, France, the UK, Sweden and Baltic countries).

- The interpretation that Member States give to the EU environmental guidelines when licensing areas for renewable energy projects. More specifically, the assessment of cumulative environmental impacts and the protection of birds, bats and sea mammals.

- The amount of repowering and life extension of assets in mature wind energy markets. Around 50% of the current cumulative installed capacity will reach the end of its operational life by 2030 in the EU. The uptake of a repowering market will be determined by the implementation of fast-track administrative procedures. High levels of repowering will be key to the delivery of WindEurope's *Central Scenario*.

- The rate of build out and reinforcement of onshore grids to host an increasing capacity of wind energy, on- and offshore, whilst minimising curtailment.

- The uptake of offshore wind in the Baltic Sea.

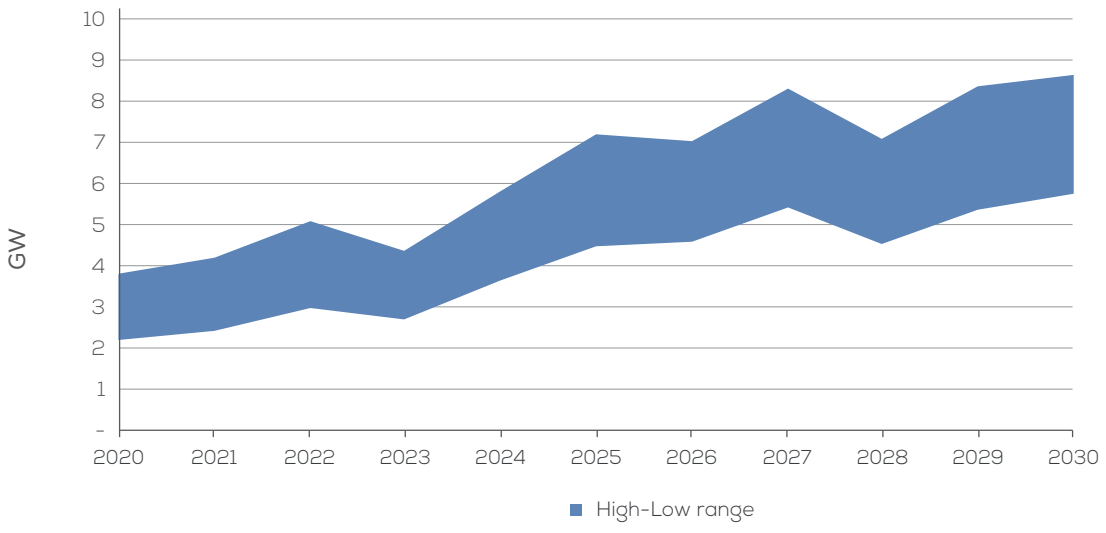
- The rate of progress of regional cooperation in Member States, particularly, but not exclusively, in offshore wind: in June 2016, 10 Member States signed a Memorandum of Understanding (MoU) for energy cooperation in offshore energy. Whilst the work programme set out in the political declaration was ambitious, including maritime spatial planning, support frameworks, offshore grid development and technical standards, progress has been slow in delivering tangible results. One year later, three signatory governments (Germany, Belgium and Denmark) reaffirmed their commitment to supporting significant amounts of offshore wind in their countries but two of these countries still need to reflect this in their national energy plans.

REPOWERING VOLUMES TO 2030

Considering a lifetime between 20 and 25 years, 40 to 80 GW of the installed onshore wind capacity in the EU could reach end-of life by 2030. The potential annual repowering volumes should grow significantly to reach the 4-7 GW/year range by 2025. This volume represents more than half of the annual onshore market, but will be highly dependent on the implementation of fast-track administrative procedures and Member States properly factoring repowering volumes as part of the National Energy and Climate Action Plans.

FIGURE 2

Annual repowering potential to 2030



3. DESCRIPTION OF THE 2030 WIND ENERGY CAPACITY SCENARIOS

WindEurope makes its projections on installed capacity figures with a bottom-up approach, collecting data at country level. This exercise consists in discussions with experts from all the relevant national wind energy associations as well as with industrial stakeholders including turbine manufacturers and wind project developers.

CENTRAL SCENARIO

In WindEurope's *Central Scenario*, a clear 2030 governance structure with reporting mechanisms on Member States' progress to 2030 is implemented, and effective regional cooperation mechanisms are established. Member States implement detailed National Energy and Climate Plans in line with the EU's binding targets. The Renewable Energy Directive is implemented as proposed by the European Commission, and national policies for wind energy are streamlined, including repowering. As a result, the EU achieves a 27% renewable energy target.

Significant progress on system integration allows for higher penetration of wind energy and other renewables, and power interconnection infrastructure is strengthened to allow the EU to reach the 15% interconnection target. Wind energy provides balancing and other ancillary services in all Member States. Policy commitments on electrification drive demand for renewable power.

Onshore wind cost reductions keep apace. Offshore wind cost reduction objectives in 2025 (€80/MWh across all sea basins and distance from shore) are met and governments have a visible pipeline of projects to 2030.

LOW SCENARIO

No binding templates are agreed for National Energy and Climate Plans leading to weak governance, a challenging implementation of the post-2020 Renewable Energy Directive and failure to deliver the EU-wide 27% renewable energy target.

Persistent overcapacity continues to 2030. The new market design is not able to guarantee increased renewable energy penetration, and system costs are therefore not reduced.

No significant progress is made in electricity interconnections between Member States. Grid congestion issues continue to slow down new installations. The offshore wind energy pipeline of projects is below 4 GW/year, and cost reductions do not materialise.

Unfavourable national policies for permitting and planning in high-potential markets persist, resulting in the slowdown of new and repowered installations.

HIGH SCENARIO

The EU-wide RES target for 2030 is increased to 35%. Binding templates for National Energy and Climate Plans are adopted, leading to an efficient governance system and full implementation of the recast Renewable Energy Directive.

The EU-wide power transmission network is further developed beyond the European Commission's 15% target.

Both the new market design and a reformed ETS contribute to the phasing out of inefficient and uneconomical fossil fuels power plants and pave the way for a sustained development of renewable energy.

With a deployment rate of 7 GW/year, the offshore wind industry becomes fully competitive with new fossil fuel generation.

Favourable national policies for permitting and planning are in place, resulting in the acceleration of new and repowered installations.

Europe accelerates electrification of heating, cooling and transport, bolstering demand for renewable power.

INSTALLED CAPACITY BY **2030**

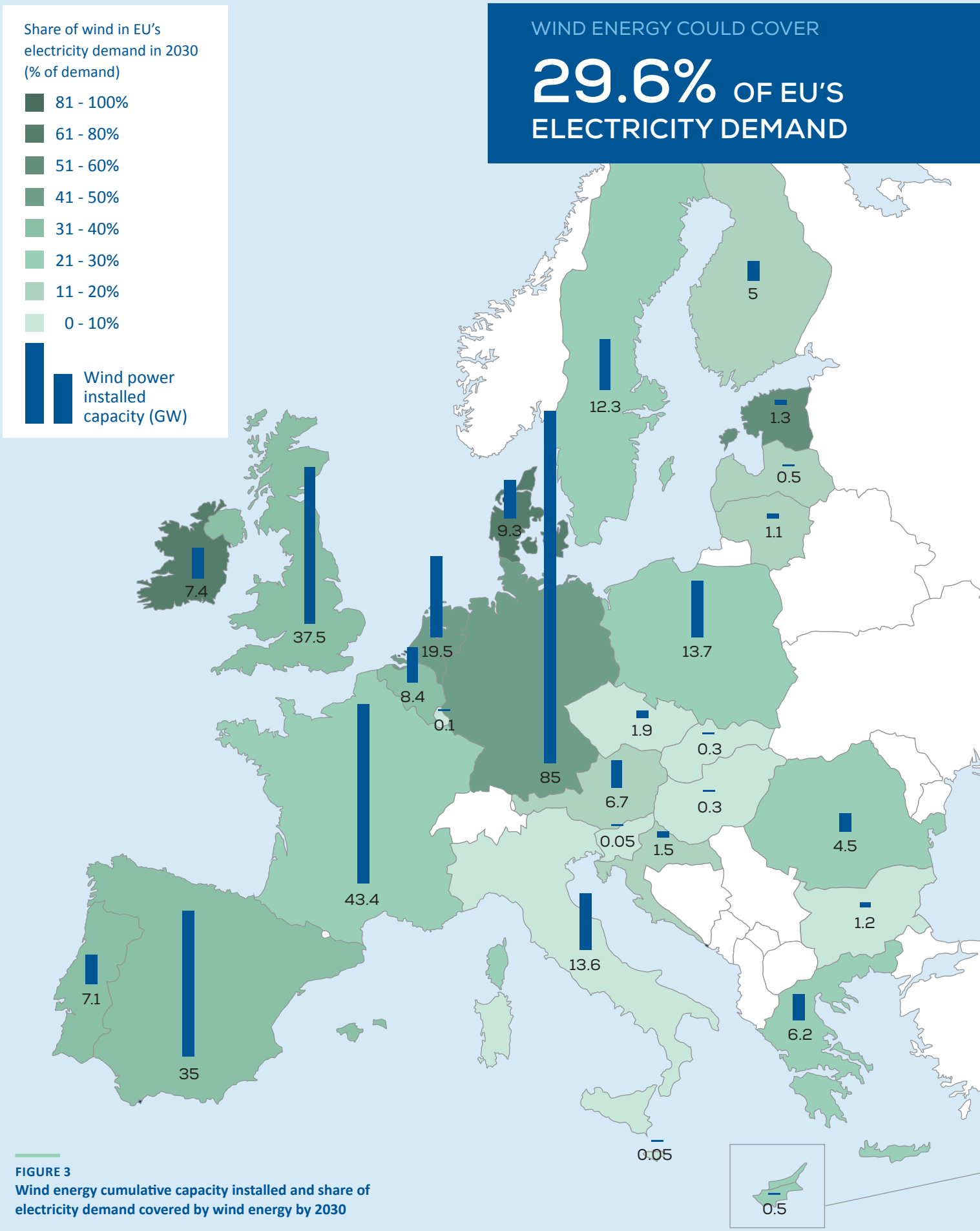


FIGURE 3
Wind energy cumulative capacity installed and share of electricity demand covered by wind energy by 2030

TABLE 2

Onshore wind power cumulative capacity to 2030

	LOW	CENTRAL	HIGH
Germany	60,000	70,000	71,000
France	31,320	36,360	41,400
Spain	30,000	35,000	40,000
United Kingdom	13,000	15,000	20,000
Italy	10,700	13,600	16,700
Sweden	9,000	12,000	13,000
Poland	7,000	10,500	12,000
Netherlands	8,000	8,000	15,000
Portugal	6,750	7,000	7,250
Austria	5,000	6,700	8,000
Greece	3,400	6,200	7,000
Ireland	5,000	5,600	6,700
Denmark	3,650	5,000	6,500
Finland	3,000	5,000	10,000
Romania	3,025	4,500	6,000
Belgium	3,400	4,400	4,400
Bulgaria	691	1,200	3,000
Lithuania	750	1,100	1,500
Czech Republic	1,450	1,900	2,450
Estonia	600	744	1,000
Cyprus	158	483	600
Hungary	300	300	1,500
Luxembourg	100	100	200
Malta	50	50	100
Slovenia	3	50	100
Slovakia	3	300	500
Croatia	500	1,500	2,000
Latvia	63	500	648
TOTAL EU-28	**206,913**	**253,087**	**298,548**
Switzerland	300	600	1,200
Turkey	16,000	24,000	28,000
Norway	4,000	10,000	11,000
TOTAL EUROPE	**227,213**	**287,687**	**337,748**

TABLE 3

Offshore wind power cumulative capacity to 2030

	LOW	CENTRAL	HIGH
United Kingdom	18,000	22,500	30,000
Germany	14,000	15,000	20,000
Netherlands	4,500	11,500	18,500
France	4,300	7,000	11,100
Denmark	3,400	4,300	6,130
Belgium	1,600	4,000	4,000
Poland	2,200	3,200	6,000
Ireland	1,200	1,800	2,000
Estonia	-	600	1,200
Sweden	300	300	800
Portugal	-	150	175
Italy	-	-	650
TOTAL	**49,500**	**70,200**	**98,930**

TABLE 4

Installed capacity, power generation and percentage of EU electricity demand met

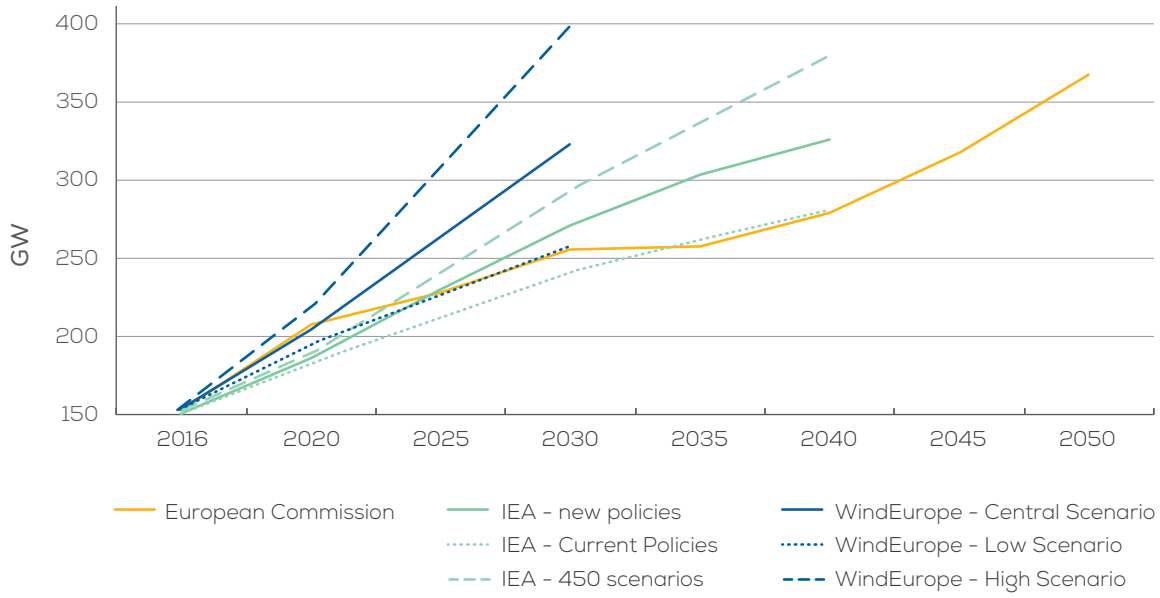
	INSTALLATIONS (GW)			GENERATION (TWh)			EU ELECTRICITY DEMAND MET BY WIND ENERGY (%)		
	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL
CENTRAL SCENARIO	253	70	323	599	290	888	19.9%	9.9%	29.6%
HIGH SCENARIO	299	99	397	706	422	1129	23.5%	13.9%	37.6%
LOW SCENARIO	207	49	256	453	195	648	15.1%	6.5%	21.6%

4. SCENARIO ANALYSIS

WindEurope's *Central Scenario* is higher than two of the most referenced energy scenarios: the IEA New Policies Scenarios and the European Commission's most updated Trends to 2050 Reference Scenario, released in the summer of 2016.

FIGURE 4

Comparison of different scenarios for cumulative wind power capacity in the EU



WINDEUROPE'S CENTRAL SCENARIO

According to WindEurope's *Central Scenario*, there would be 323 GW of cumulative capacity by 2030: 70 GW offshore and 253 GW onshore. This means significantly more capacity than both the European Commission (+78 GW) and the IEA New Policies (+52 GW) scenarios. The levels foreseen in WindEurope's 2030 *Central Scenario* are only reached in 2040 in the IEA New Policies scenario and in 2045 in the European Commission Reference scenario.

These differences can be attributed to Western Europe, where WindEurope foresees much higher wind power installations. More specifically, in countries such as Germany, France, Spain or the Netherlands, WindEurope believes that the wind energy market will be more robust than the IEA or the European Commission.

In addition, WindEurope foresees a more positive outlook for offshore wind, due notably to the recent series of tenders resulting in record low prices. Cost reduction in offshore wind will be a key driver that will push offshore wind far beyond the European Commission and the IEA's expectations.

WINDEUROPE'S LOW AND HIGH SCENARIOS

WindEurope's *Low Scenario* is in line with the European Commission's Reference scenario and between IEA's Current Policies (low) and New Policies (central) scenarios. This scenario shows how the wind industry sector could perform in case of unfavourable policies at European and Member State levels. In this scenario, wind energy would be able to cover 22% of the EU's electricity demand.

Finally, WindEurope's *High Scenario* is the most optimistic of all scenarios, and would provide respectively 47% and 55% more cumulative installations to the IEA's New Policies and the European Commission's Reference scenarios. This would be enough to cover 38% of the EU's electricity demand.

IEA SCENARIOS

The 2016 version of the *IEA new policies* scenario takes as its starting point all the policies and targets already in place in all EU member states. It also measures the impact of each country's climate pledges enshrined in the Paris Agreement on new renewable energy installations. It assumes that today's ambitions are going to drive investments in the energy sector. All of this results in 271 GW of cumulative wind energy capacity installed by 2030 in the European Union, an increase of 76% compared to 2016 but 52 GW less than WindEurope's *Central Scenario*.

The *IEA 450 scenario*, also called the decarbonisation scenario, has the objective of limiting the average global temperature increase in 2100 to 2 degrees Celsius above pre-industrial levels. This results in 292 GW of cumulative wind energy capacity installed by 2030 in the European Union.

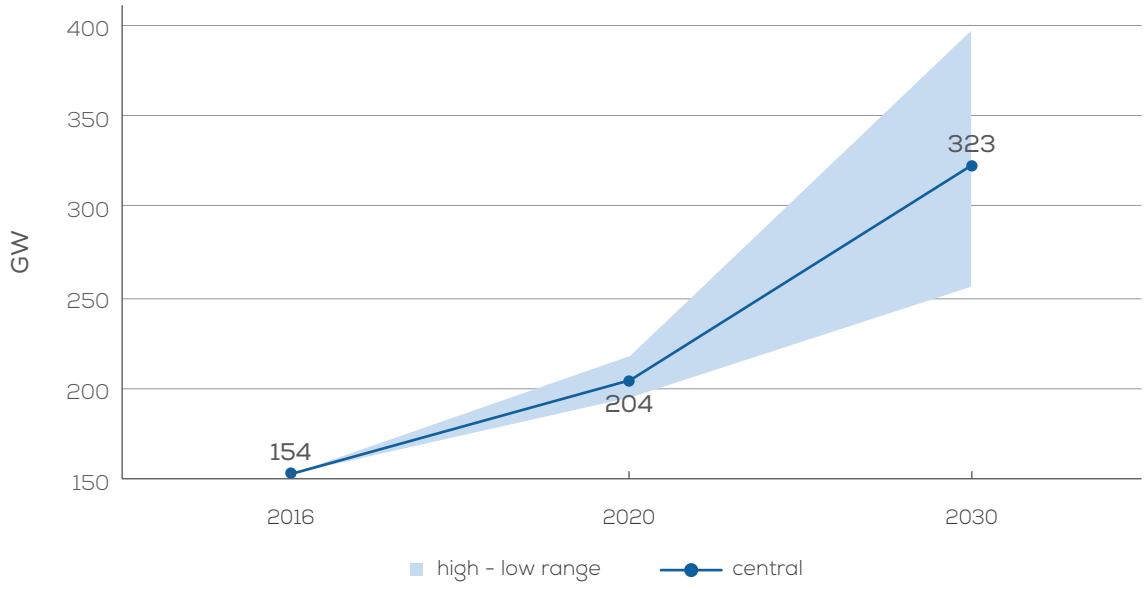
THE EU REFERENCE SCENARIO 2016

The European Commission Reference 2016 scenario assumes that the EU's legally binding greenhouse gas emissions and renewables targets to 2020 are met. It is a projection based on policies agreed before December 2014, not a forecast including evolving policies. It also assumes a constant decrease in CO_2 emissions as well as strong reduction in final energy demand due to successful energy efficiency policies. In this scenario, the EU economy recovers with the EU's GDP reaching €15 trillion. This results in 255.4 GW of cumulative wind energy capacity installed by 2030, a number which is equivalent to WindEurope's *Low Scenario*.

Photo: Todd Klassy

5.
MACROECONOMIC AND SOCIAL IMPACTS OF THE SCENARIOS

FIGURE 5
WindEurope 2020 and 2030 scenarios



WindEurope's *Central Scenario* of 323 GW would generate investment of €263 bn by 2030. The industry could provide 569,000 jobs by 2030. The increase in jobs assumes that the EU supply chain remains competitive thanks to a robust market - a doubling of onshore wind capacity and a fivefold increase in offshore wind capacity - and to sustained European leadership in Research and Innovation. Wind energy would save 382 million tCO_2 emissions and €13 bn in fossil fuel imports to the EU in 2030.

The *Low Scenario* has 20% less capacity than the *Central Scenario* in 2030. As a consequence, the amount of investment would be reduced to €147 bn. The industry would generate 132,000 fewer jobs and would save 103 million tCO_2 less than in the *Central Scenario*. Likewise, there would be a drop of 22% in savings on the imports of fossil fuels to the EU.

However, the realisation of the *High Scenario* would mean 23% more wind power capacity in 2030, which would yield 47% more investments, amounting to €351 bn. The industry would be able to create 147,000 more jobs for a total of 716,000. Wind energy would save 103 million tCO_2 more than in the *Central Scenario* for a total of 485 million tCO_2. Finally, it would avoid 26% more fossil fuel imports for a total of €17 bn.

TABLE 5

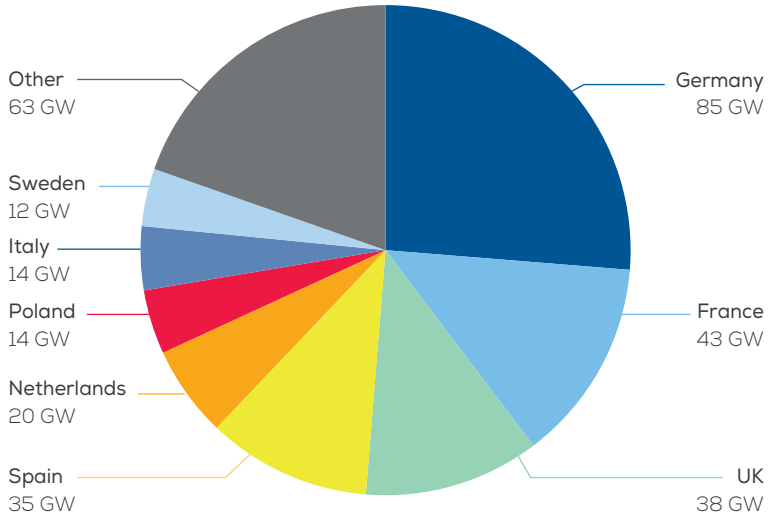
Macro-economic and social impacts of the scenarios

	LOW SCENARIO	CENTRAL SCENARIO	HIGH SCENARIO
Installed capacity [GW]	256	323	397
Investments [M€]	147,000	239,000	351,000
Jobs	437,000	569,000	716,000
CO_2 emissions savings [$MtCO_2$]	279	382	485
Avoided fossil fuel imports [M€]	10,300	13,200	16,600

6. REGIONAL AND NATIONAL DEVELOPMENTS

FIGURE 6

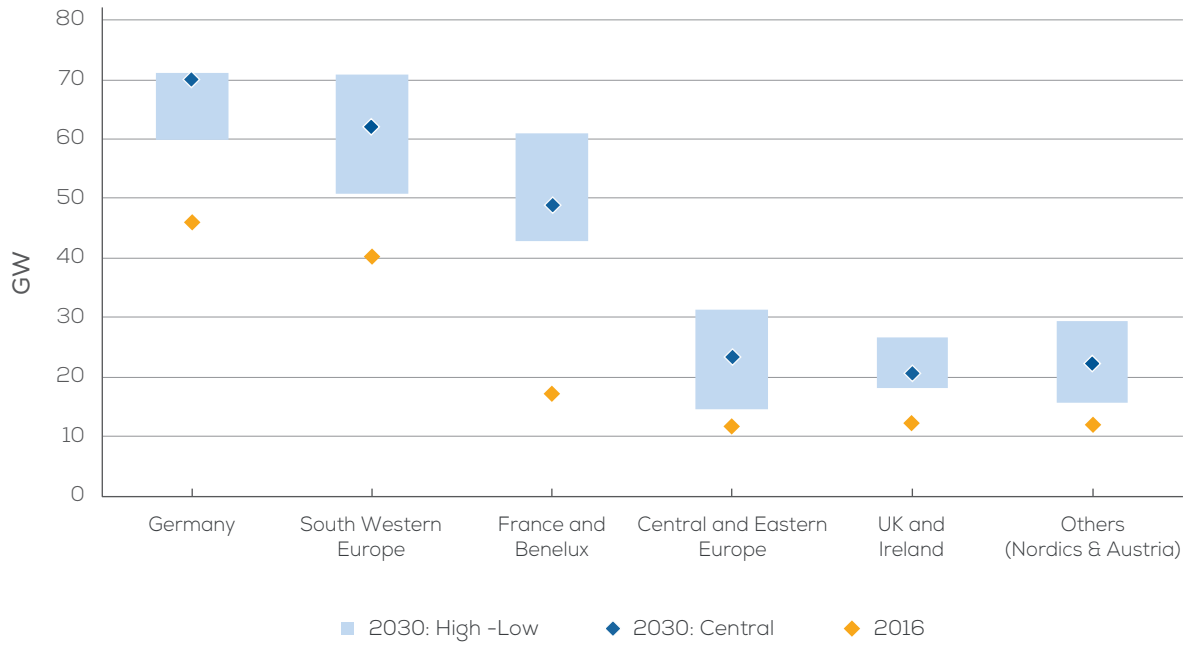
2030 wind energy installed capacity by country according to Central Scenario in the EU (GW)



With 85 GW and more than a quarter of Europe's cumulative capacity, Germany would be the country with the largest wind energy fleet in the *Central Scenario*. France would follow with 43 GW, close to half of the German installations. The UK would be the third country in wind installations with 37.5 GW, 60% of which would be offshore. These three countries would account for more than half of the EU's total installations. Outside of the EU, Turkey (28 GW) and Norway (11 GW) would also constitute significant wind energy fleets.

FIGURE 7

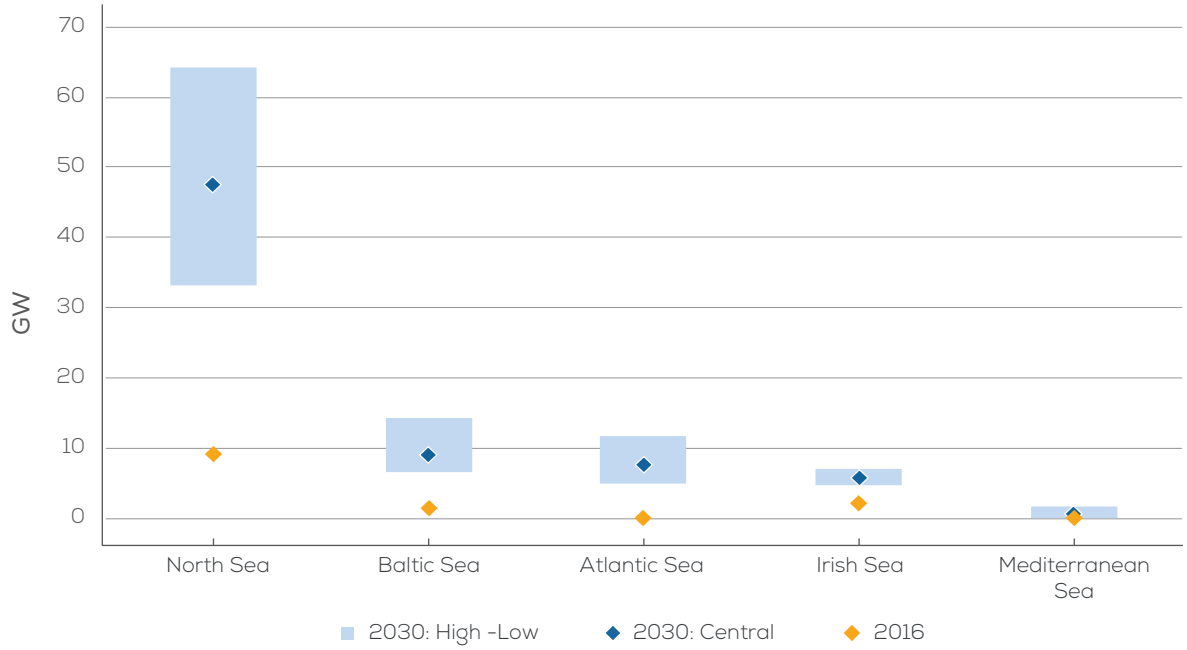
2016 and 2030 offshore wind installations per region



Central And Eastern Europe, which is composed by all the countries that joined the European Union after 2004, would represent a small proportion of the European installed capacity with 27 GW isntalled. This corresponds to only slightly more than half of the total installed capacity in Germany at the end of 2016.

FIGURE 8

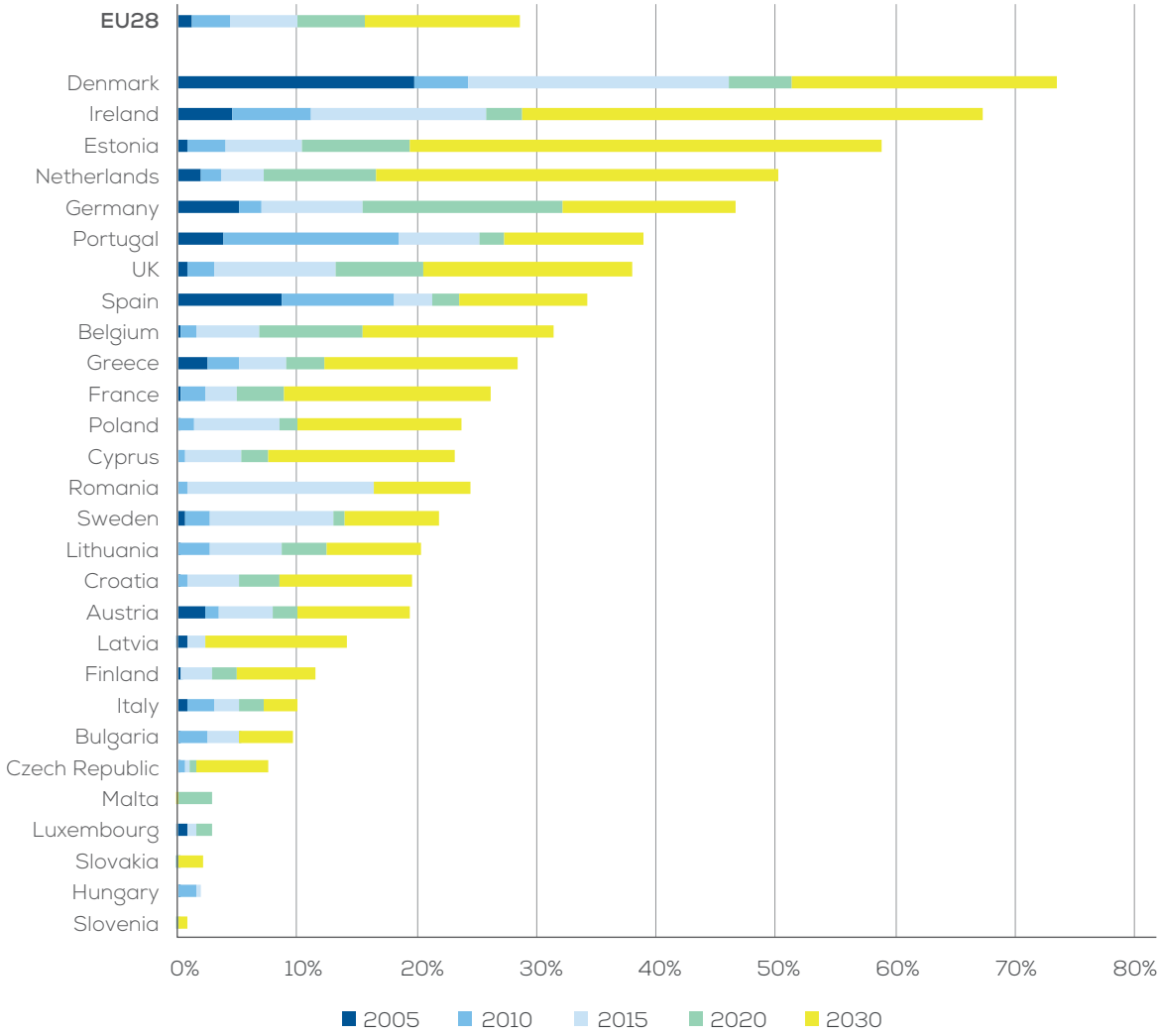
2016 and 2030 offshore wind installations per sea basin



The North Sea will see the majority of offshore wind installations by 2030 with almost 48 GW installed in 2030 in the *Central Scenario*. This represents more than five times the capacity installed in the North Sea at the end of 2016. The Baltic Sea, where 1.5 GW of offshore wind is grid-connected today, will represent the second largest basin for offshore wind with potentially 9 GW installed by 2030. This capacity represents permitted projects in Poland, Estonia, Germany, Denmark and Sweden as well as government ambitions to 2030. The Atlantic Sea, where there is almost no capacity today, will reach close to 8 GW thanks to installations both in France, in the UK and, to a lesser extent, in Portugal. The UK will also install the majority of the capacity in the Irish Sea, which will total close to 6 GW. The Mediterranean Sea will see installations from both Italy and France and could reach 0.5 GW.

FIGURE 9

Share of wind energy in the EU-28 according to WindEurope's *Central Scenario*



In the *Central Scenario*, the EU would be able to power close to 30% of its electricity. Denmark would remain the country with the highest share of wind energy in its power mix followed by Ireland and Estonia. Germany, the UK, Spain and France would power respectively 47%, 38%, 34% and 26% of their electricity demand with wind energy.

WindEurope is the voice of the wind industry, actively promoting wind power in Europe and worldwide. It has over 450 members with headquarters in more than 40 countries, including the leading wind turbine manufacturers, component suppliers, research institutes, national wind energy associations, developers, contractors, electricity providers, financial institutions, insurance companies and consultants. This combined strength makes WindEurope Europe's largest and most powerful wind energy network.

Rue d'Arlon 80, 1040 Brussels, Belgium
T +32 2 213 1811 · **F** +32 2 213 1890
windeurope.org