Wind energy and economic recovery in Europe

How wind energy will put communities at the heart of the green recovery

WindEurope

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The socio-economic impact evaluation of wind energy on the European Union has been carried out using the SNA93 methodology (System of National Accounts adopted in 1993 by the United Nations Statistical Commission) and Deloitte's approaches, which evaluate the effects of the renewable energy in the economy.

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CONTENTS

FIGURES & TABLES

FIGURES & TABLES


WLL 117T
AB
09
117T
UNITED

EXECUTIVE SUMMARY

Wind energy is an important asset for the European economy. The sector contributes €37bn to the EU's GDP and employs 300,000 people.

Wind energy has been resilient in the COVID-19 crisis. Europe's existing wind farms continued to operate, delivering electricity where it was needed. The industry continued installing new capacity, connecting 5 GW to the grid in the first semester of 2020. It also kept building new turbines in its factories. And it invested €14bn in new projects ready to go ahead. Wind energy therefore can play a significant role in a green economic recovery.

But wind creates additional benefits beyond jobs and value to the economy. It directly benefits communities living near wind farms. It pays €5bn in taxes across Europe every year. In addition to this, wind farms often make direct payments to communities, offer benefits-in-kind, and in many cases communities participate partially in the ownership of the local wind farm.

The EU Green Deal envisages a major expansion of wind energy over the next 30 years, taking it from 15% of Europe's electricity today to around half by 2050. By delivering on this, the EU can significantly boost the contribution of its globally competitive wind industry to the economy, and benefit communities across the continent. But underlying policy measures, in particular on permitting new and repowered wind projects, will be central to that.

BOOSTING THE EUROPEAN ECONOMY

- In 2019 wind energy represented **300,000 jobs in the EU**. 75% of these are in onshore wind and 25% in offshore wind.
- The European wind industry has an **annual turnover of €60bn**. 65% of this adds value to the EU economy. So for every €1,000 of revenues, €650 stay in the EU and contribute to taxes and its GDP. The other €350 go to companies that supply materials and equipment from outside the EU - including European companies with facilities abroad.
- The wind industry today generates **€2.5bn of value added to the EU economy for each new GW of onshore wind installed and €2.1bn for each new GW of offshore wind**[1]. These amounts per GW will continue to 2030 even with expected cost reductions.

CEMENTING GLOBAL TECHNOLOGY LEADERSHIP

- **European wind turbine manufacturers have a 42% share of the global market for wind turbines**. This is up from 33% ten years ago. Of the 10 biggest wind turbine manufacturers in the world, 5 are EU-based.
- European manufacturers' competitive edge depends in large part on their home market. **Europe hosts 31% of all the wind components production facilities, with 30% of the global wind capacity.**
- The global market for wind turbine components is worth €50bn. Europe represents 26%, equivalent to €13bn.
- **Europe should continue the expansion of onshore and offshore wind to keep the strategic parts of the supply chain locally.** That will secure Europe's global leadership and keep delivering value to society.
- The supply chain is ready to deliver. **There are 248 manufacturing sites in Europe**, most of which can ramp up capacity.

BENEFITING COMMUNITIES

- The wind energy industry pays **€5bn in taxes to the EU economy**, including €1bn in local taxes and other payments benefiting communities. **Wind farms pay €2.3/MWh in local taxes** on average.
- Besides taxes, some wind farms also voluntarily offer specific financial benefits to local residents. These include benefits-in-kind, payments into community benefit funds, and communities sharing the ownership of the wind farm.
- **Wind farms are located in rural, often remote, areas with low investment activity**. The benefits created by wind farms are key to these communities which may have been cut off from the faster growing metropolitan areas that have benefitted more from the globalised economy. Investing in wind energy will be therefore key to a just energy transition.
- The wind industry promotes **happy coexistence with other economic and societal interests** such as farming, fishing, biodiversity protection, and military and civil aviation as a necessary condition for the accelerated expansion of wind energy.

1. 2019, real prices

GOVERNMENT POLICY, JOBS AND GROWTH IN WIND

- **Europe's National Energy and Climate Plans (NECPs) add up to 397 GW of wind power by 2030**[2], twice as much as today's 197 GW. This would meet 30% of the EU's power demand in 2030. To deliver this, Europe needs to install 21 GW of new wind capacity every year during the next decade, a 40% increase from the current (pre-COVID-19) 12 GW/year.

- This report envisages two scenarios. In the first scenario Europe delivers the commitments for the expansion of wind energy set out in the NECPs. This is the NECP Scenario.

- **In the NECP Scenario, Europe would employ 450,000 people in wind by 2030**, 250,000 in onshore and 200,000 in offshore wind. This scenario assumes an impeccable delivery of the National Plans.

- **However, the NECPs do not include the policy reforms that are needed for Governments to delivery on their commitments** for the expansion of wind energy. Notably they do not say how Governments are going to simplify their rules and procedures for the permitting of new and repowered wind farms. These rules and procedures are in many cases too complex today to deliver the volumes committed in the NECPs.

- In addition some Governments do not give enough visibility on auctions or fail to provide the revenue stabilisation that will unlock investments in the volumes needed.

- **Without these and other key policy changes, Europe will not deliver on its NECPs for the expansion of wind energy. It would expand wind energy to only 324 GW by 2030.** This would mean installing 14 GW/year. This is what this report calls the Low Scenario.

- **In this Low Scenario, Europe would lose one third of the current onshore wind jobs. And job creation in offshore wind would be cut in half.** Wind energy would employ only 282,000 people in Europe by 2030.

- This report assesses the positive economic impacts of delivering the NECP Scenario and the negative economic consequences of delivering only the Low Scenario.

- As it stands, reaching climate neutrality in Europe would require the impeccably delivery of the National Energy and Climate Plan volumes and installing 50 GW/year from 2030 onwards. The European Commission's Long-Term Decarbonisation Strategy shows that delivering climate neutrality would mean up to 1,200 GW of wind power capacity by 2050.

- An EU commitment to **reduce greenhouse gas emissions by at least 55% by 2030** would put the EU on a more robust trajectory to climate neutrality and maximise medium-term economic benefits. All resulting changes in EU legislation should focus on addressing barriers to the accelerated deployment of renewables.

2. EU-27 + UK

POLICY RECOMMENDATIONS

The European recovery plan will only be as green as the projects it funds and the jobs it creates. It must prioritise investments in new and repowered wind energy projects, help strengthen the wind energy value chain and deploy the right infrastructure: electricity grids and physical infrastructure such as ports which are essential for wind energy installations. Wind energy is ready to deliver: it is cost-competitive, shovel-ready and job-rich.

But getting the most from wind energy will require more than recovery money. For a successful Green Deal and a future-proof EU recovery we call on:

1. National Governments to **simplify permitting rules and procedures** for new and repowered wind projects as well as for on- and offshore grid buildout. And to ensure that permitting authorities have the necessary resources to consent enough wind sites.

2. National Governments to give investors visibility on wind energy volumes to be deployed to 2030 with a **clear schedule of well-designed auctions** allocating stable revenues – Contracts for Difference.

3. The EU and National Governments to prioritise regulation and adapt tax regimes to boost the renewables-based **direct electrification** of transport, heating and industrial processes, and to support renewable hydrogen projects for the decarbonisation of hard-to-abate sectors.

4. The EU's Connecting Europe Facility to help **accelerate the deployment of electricity grids** as required by its Long-Term Decarbonisation agenda.

5. The EU to set up a **masterplan for delivering 450 GW of offshore wind** by 2050, including the buildout of an optimised offshore grid and future-proof Maritime Spatial Planning as part of its Offshore Renewable Energy Strategy.

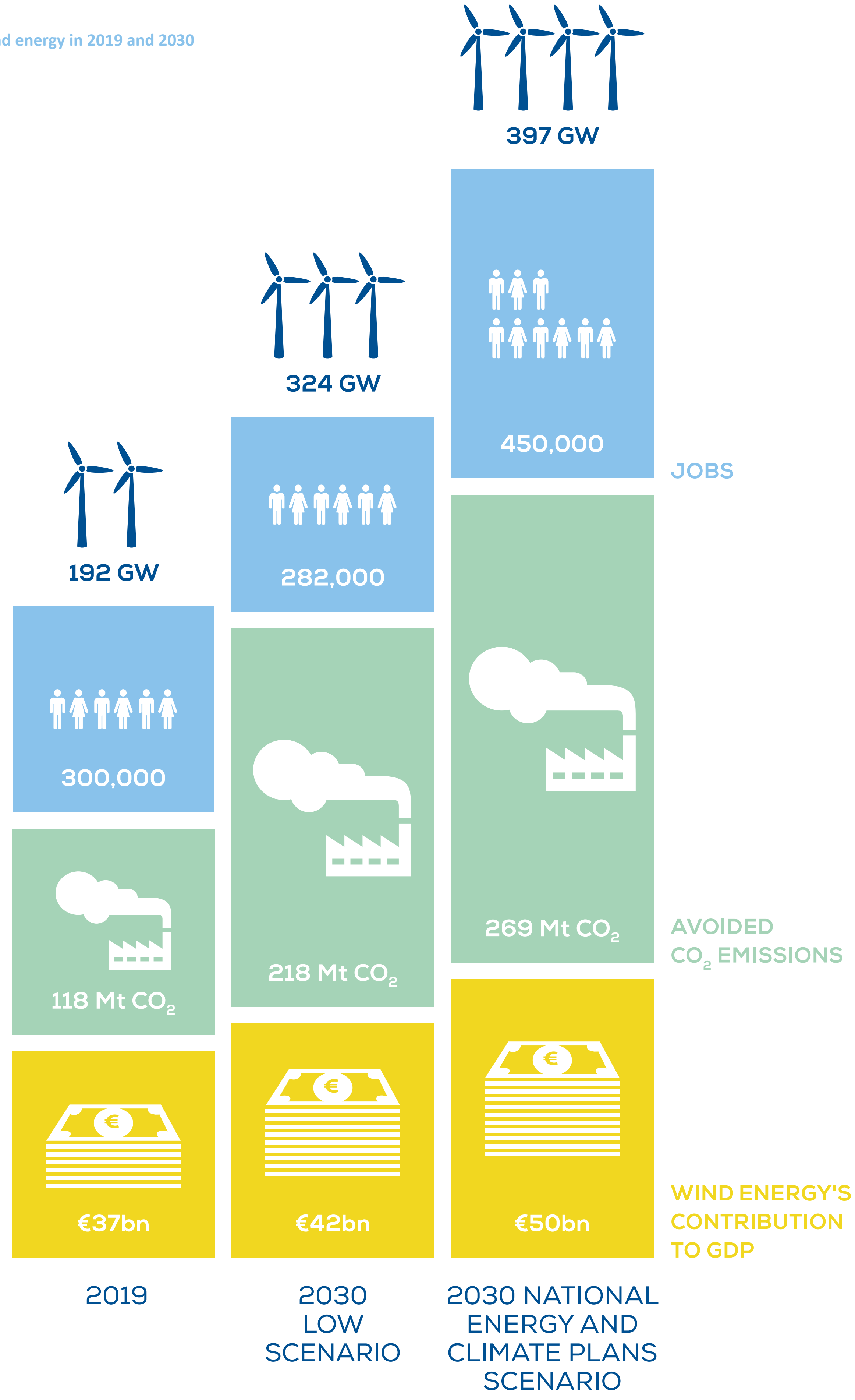
6. The EU to **increase R&D spending** to support incremental improvements in the more mature technologies that will deliver on the European Green Deal – new materials, new component design, and innovative logistics and installation techniques.

7. The EU to adopt **sensible trade policies** ensuring the European wind industry can draw on global supply chains and compete in non-EU markets, including against players with State-backed finance.

8. The EU to deliver on its decarbonisation commitment by setting at least a **55% greenhouse gas emissions reduction** target to 2030 and by raising its renewable energy target accordingly.

FIGURE 1

The benefits of wind energy in 2019 and 2030



Source: Deloitte for WindEurope

1.
INTRODUCTION

On 9 March workers at Lucky Wind in Puglia went to their wind farms to make routine maintenance inspections. That day the Italian Government locked down the country due to COVID-19. The 13 wind farm employees worked throughout the crisis keeping the supply of electricity to the city of Manfredonia. The wind farm operator set up a fund that helped to expand the intensive care unit of Foggia hospital and it supported local charity Caritas with different activities for the needy.

Europe was facing an unprecedented crisis. But through these challenging times the wind continued to blow, and turbines continued to turn, providing electricity to homes, business and vital public services across Europe.

Wind provided electricity to all who needed it during these difficult times. And it will be there to help Europe's recovery after this crisis.

Today almost all of Europe's wind turbine and component factories are open following the easing of restrictions across Europe. Sanitary measures are strengthened within sites to guarantee full compliance with government recommendations. But the industry was hit on its plans for expansion.

Wind energy installations in the first half of the year were severely impacted due to the limited free movement of people and goods across Europe. Installations by the end of 2020 are expected to be 20-30%[3,4] down compared to industry forecasts. This will depend on how quickly activity can ramp up in the most heavily impacted countries – Spain, Italy, France and the UK. And on the disruptions in the global and European supply chains. The supply of components and materials from China is now unaffected after the interruption in February. But other bottlenecks remain (e.g. India). Any continuous restriction to the movement of goods and people is expected to slow activity and to drive up the cost of projects.

3. Bloomberg New Energy Finance - https://about.bnef.com/blog/COVID-19-wreaks-havoc-on-the-wind-industry
4. Wood Mackenzie - https://www.woodmac.com/reports/power-markets-coronavirus-crisis-update-2020-global-wind-market-outlook-downgraded-by-65-396427
5. Euro Area -10.2% on 2019. World Economic Outlook update June 2020. https://www.imf.org/en/Publications/WEO/Issues/2020/06/24/WEOUpdateJune2020

The International Monetary Fund (IMF) forecasts the global economy to shrink by 4.9%[5] and global trade to drop by 11% in 2020. The European Commission's summer 2020 economic forecast expects the EU economy to shrink by 8.7% this year. Some Member States will be hit harder than others, with the forecast contraction ranging from -4.5% in Poland to -11% in Italy and Spain.

The uncertainty over the evolution of the COVID-19 crisis has delayed some final investment decisions. And it might also increase the cost of finance. In the short term, banks will be less willing to lend as they are concerned about liquidity and corporate finance will be more challenging, notably for debt.

In 2021 it will be challenging to make up for the lost ground in wind energy installations this year. The success of the sector will depend on the effectiveness of National and EU Recovery and Resilience Plans.

In July European Heads of State and Government agreed a €1.8 trilion plan: €1.1 trillion in the updated EU Budget for 2021-2017 and a €750bn Recovery Fund to stimulate the EU economy in the wake of the COVID-19 pandemic. Some €390bn will be in grants and €360bn will be in loans. The deal specifies that 30% of the entire package must be spent on climate protection and must contribute to cutting greenhouse gas emissions.

The EU Recovery Strategy creates an unprecedented opportunity for Europe's energy transition. But the recovery will only be as green as the projects and technologies it funds. Investing in wind energy would make this recovery truly green while benefiting European citizens.

The expansion of wind energy would create benefits to Europe as a region, but crucially also to local communities embracing wind as an opportunity. Wind farms are often located in remote rural and coastal areas, where investments are lower and jobs scarcer. The local communities surrounding the projects benefit in many ways, from taxes to benefits-in-kind[6].

This report shows how the wind industry places people at the centre of such a green recovery. It also presents the state-of-play of the European wind industry and its global competitiveness. It demonstrates that the industrial footprint in Europe is ready to expand if there is a strong domestic market and an effective industrial policy.

The report also covers the socio-economic benefits of WindEurope's wind energy deployment scenarios to 2030, based on our analysis of the final National Energy and Climate Plans to 2030. And it shows how wind energy can co-exist with local natural protection and other economic sectors like fishing, agriculture, and aviation.

6. WindEurope, 2020. Wind industry commitments on community engagement. - https://windeurope.org/wp-content/uploads/files/policy/position-papers/20200702-WindEurope-position-paper-wind-industry-commitments-on-community-engagement.pdf

2. WIND ENERGY TODAY AND 2030 SCENARIOS

Today Europe has 197 GW of wind power capacity; 174 GW are onshore wind and 23 GW offshore wind[7]. This represents around 30% of the global onshore wind capacity and 75% of the global offshore wind capacity[8].

In 2019 wind farms in the EU generated an average of 417 TWh of electricity, enough to power 15% of the EU's electricity demand.

Wind power installations have grown by an average 12 GW/year over the last decade. However, this growth in Europe has been uneven, leading to 5 countries having 67% of all installed capacity.

Germany has 30% of the installed capacity followed by Spain and the UK with 13% and 11% respectively. France and Italy are 8% and 5%. Six other countries have more than 5 GW installed and five over 3 GW (Figure 2).

7. EU27 + UK, as of 1 July 2020
8. Global Wind Energy Council – Global Wind Report 2019

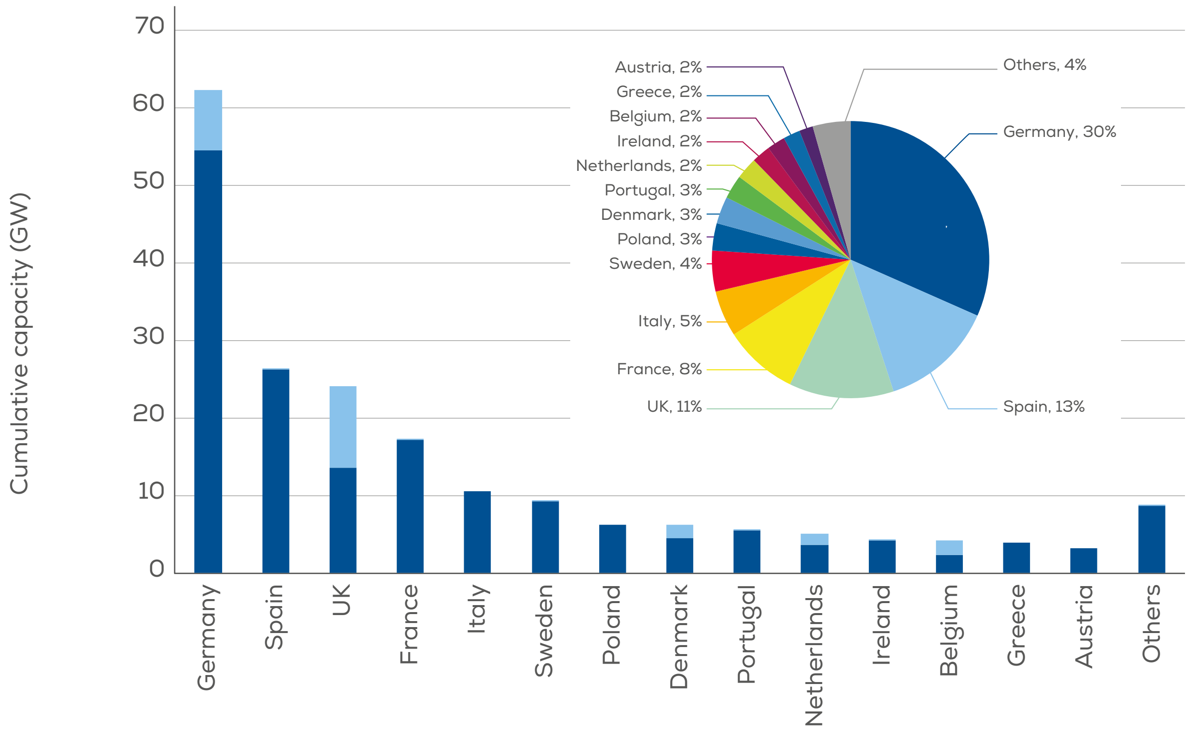
Capacity factors of all of the EU's wind farms are 26% on average, 24% onshore and 38% offshore. These numbers include all operational wind farms at the end of 2019. Newly installed wind turbine models have larger blades and generators with relative lower power ratings, which can reach 30-35% capacity factors onshore and up to 55% offshore.

In the first half of 2020, electricity demand in most European countries dropped by as much as 20% at the peak of the COVID-19 pandemic (mid-March to mid-May). This combined with favourable wind conditions made electricity system operators experience shares of variable renewables that were not expected to occur until some years from now. Wind power plants produced 241 TWh covering 17% of the electricity demand[9]. Throughout this time, the power system showed its resilience and reliability to deliver electricity where it was needed.

COVID-19 also put significant stress on public administrations for permitting and running auctions for renewables. Many governments adapted their plans quickly, providing certainty and flexibility to investors. And where countries have 2020 deadlines for the commissioning of previously auctioned capacity, they are extending these deadlines e.g. Austria, France, Germany, Spain, Poland, Greece and Ireland[10].

FIGURE 2

Cumulative wind power capacity in Europe (EU 27+ UK) as of 1 July 2020



	Germany	Spain	UK	France	Italy	Sweden	Poland	Denmark	Portugal	Netherlands	Ireland	Belgium	Greece	Austria	Others
Offshore	7.7	0.0	10.4	0.0	0.0	0.2	0.0	1.7	0.0	1.3	0.0	1.8	0.0	0.0	0.1
Onshore	54.5	26.2	13.6	17.1	10.5	9.2	6.3	4.5	5.4	3.7	4.2	2.4	3.9	3.2	8.6

Source: WindEurope

9. EU-27 + UK
10. WindEurope 2020. The impact of COVID-19 in European Wind energy.

In the long term, policy ambition and regulatory certainty will be crucial to setting the growth rate of the European wind energy market. Based on different levels of policy ambition and effectiveness of policy implementation, this report presents two different growth paths for wind energy by 2030: one scenario in which Governments deliver their National Energy & Climate Plan (NECP) commitments in full, and another in which they do not.

NECP SCENARIO

If Governments meet the pledges in their 2030 NECPs, wind energy could reach 397 GW in 2030: 286 GW onshore and 111 GW offshore. This is a 64% increase in onshore wind capacity and almost a fivefold increase in offshore.

397 GW of wind energy capacity would produce 953 TWh of electricity, meeting 30% of the EU's power demand. This would contribute to the EU meeting 33% of its final energy demand in 2030, just enough to deliver on the existing EU-wide renewable energy target of 32%, but well below what would be required for the EU to deliver on a 55% GHG reduction target. According to the European Commission impact assessment, that would require between 38-40% renewable energy target in final energy consumption.

As they stand, the policies in the national plans simply will not deliver these volumes of wind energy. Most plans fail to simplify permitting rules and processes holding back wind projects. Certain Governments do not give enough visibility on auctions or fail to provide the revenue stabilisation that will unlock investments in the volumes needed.

To realise this scenario Governments must:

- Install 21 GW/year during the next decade. And from 2030 onwards, Europe would need to install 50 GW/year if it is to reach carbon-neutrality by 2050.
- Design and implement streamlined permitting policies for wind energy and other renewables, including repowering.
- Enshrine policy commitments on electrification in national law and drive demand for renewable power in all easy-to-abate sectors.
- Make wind energy a central pillar in their recovery plans after the COVID-19 pandemic so the economic stimulus takes off in the first two years of the decade and has a rebound effect in the second half of the decade.
- Make significant progress on system integration, including renewables providing balancing and other ancillary services, progress on cybersecurity, interoperability, and hybridisation of power plants and offshore wind farms with interconnectors;
- Strengthen the electricity interconnection infrastructure to allow the increased electrification of the economy;
- Initiate the decarbonisation of the harder-to-abate sectors through the scaling-up of renewable hydrogen;
- Support the supply chain in Europe to continue cost reductions in both onshore and offshore wind while preserving jobs.

LOW SCENARIO

In contrast, if Governments do not implement the policy changes needed to deliver the NECP volumes of wind energy, Europe will have only 324 GW of wind capacity in 2030, 243 GW onshore and 81 GW offshore.

Governments do not address either permitting or administrative procedures quickly enough in the first years of the 2020s. The EU will almost certainly fail to meet the existing 32% renewables target by 2030.

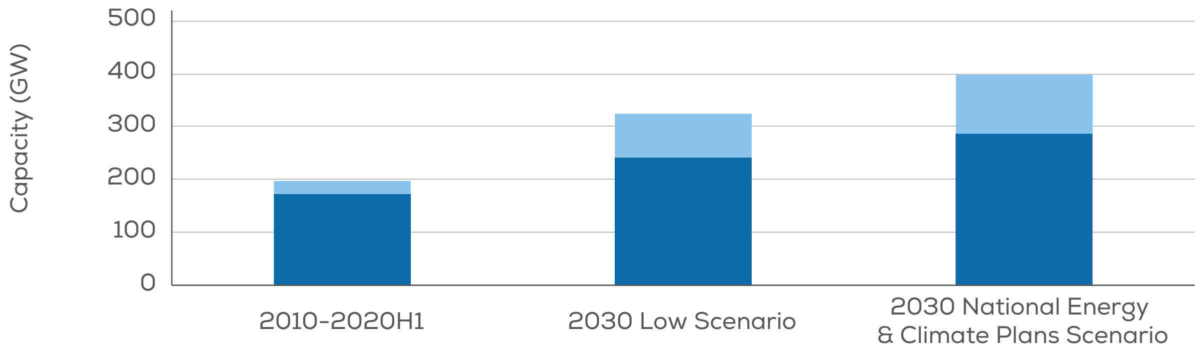
The Low Scenario would be the result of:

- Installing only 14 GW/year during the next decade.
- Governments not addressing neither permitting or administrative procedures fast enough in the first years of the 2020s. The knock-on effects would be a continuation of auctions being either undersubscribed, delayed or cancelled. And final investment decisions (FID) and installations would be postponed or canceled due to the uncertainty of projects being realised.

- Lack of decisive actions to pursue a renewables-based electrification in national policies. Power demand therefore does not grow and the need for replacing existing renewable installations wanes. For wind, this would mean that up to 1/3 of wind power capacity is retired and life extensions are not able to cover the gap. The large-scale deployment of renewable hydrogen does not materialise due to the lack of sufficient renewables to power electrolysers.
- Wind energy and renewables not regarded as strategic sectors in the Government's National Recovery Plans.
- Europe takes 5 (or more years) to recover economically from the COVID-19 pandemic.
- No significant progress being made either in system integration or in electricity interconnections between Member States. Grid congestion issues would continue to slow down new installations;

FIGURE 3

Cumulative wind power capacity in Europe (EU 27+ UK): 2020 to date and possible scenarios to 2030.

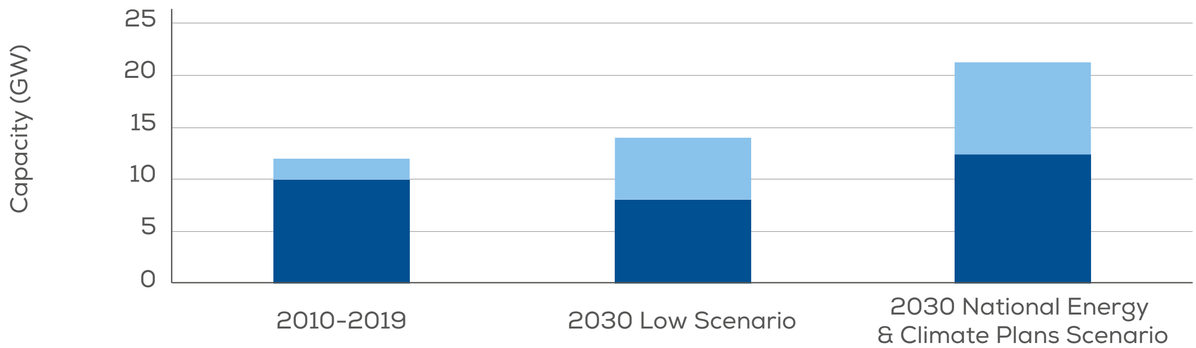


	2010-2020H1	2030 Low Scenario	2030 National Energy & Climate Plans Scenario
Offshore	23	81	111
Onshore	174	243	286
Total	**197**	**324**	**397**

Source: WindEurope

FIGURE 4

Average annual installations to 2030 for Europe (EU 27+ UK)



	2010-2019	2030 Low Scenario	2030 National Energy & Climate Plans Scenario
Offshore	2	6	9
Onshore	10	8	12
Total	**12**	**14**	**21**

Source: WindEurope

TABLE 1

WindEurope 2030 scenarios per country

COUNTRY	2020 H1 [MW]	LOW SCENARIO [MW]	NECP SCENARIO [MW]
Austria	3,166	5,000	6,500
Belgium	4,164	7,500	8,900
Bulgaria	691	691	951
Croatia	739	1,200	1,364
Cyprus	158	158	198
Czechia	337	502	970
Denmark	6,224	10,871	16,603
Estonia	320	890	1,200
Finland	2,284	4,571	5,571
France	17,137	39,877	45,077
Germany	62,178	73,000	89,000
Greece	3,884	5,776	7,070
Hungary	329	300	329
Ireland	4,235	5,525	13,200
Italy	10,796	16,400	19,300
Latvia	72	72	1,100
Lithuania	534	700	1,600
Luxembourg	149	200	322
Malta	-	-	-
Netherlands	5,009	17,603	20,500
Poland	6,222	18,000	22,000
Portugal	5,446	6,025	9,225
Romania	3,029	4,600	5,555
Slovakia	3	3	500
Slovenia	3	3	150
Spain	26,036	48,000	50,333
Sweden	9,374	10,900	12,200
Total EU-27	**172,519**	**278,368**	**339,718**
UK	24,076	45,363	57,070
Total Europe	**196,595**	**323,731**	**396,788**

3.

BOOSTING THE EU ECONOMY

3.1. JOBS

In 2019 wind energy was responsible for 300,000 jobs in the EU. The majority of these, 160,000, were direct jobs. Indirect jobs totalled 140,000. We estimate that of the 300,000 jobs in the EU, 75% or around 224,000 jobs are in onshore wind and 25% or around 77,000 in offshore wind.

These figures represent a snapshot in time, based on company financial reports (direct jobs) and derived from job multipliers using macroeconomic data from Eurostat (indirect jobs). They provide information on how many people were employed during a calendar year and allow us to analyse trends across time.

For example, Figure 5 shows that the 160,550 full-time professionals directly employed are up 9% on 2016, the last time WindEurope reported job numbers. This represents 14,000 more jobs over three years. In the same period, wind energy increased 43 GW of installed capacity in Europe, 34 GW onshore and 9 GW offshore.

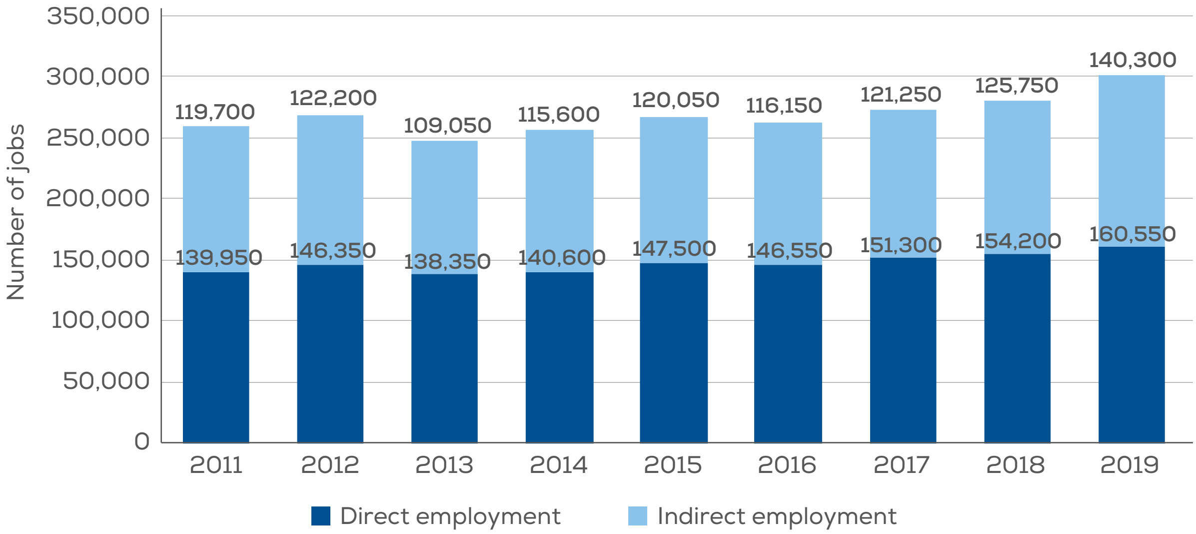
Figure 6 shows that the number of jobs in wind turbine component manufacturers remained almost unchanged between 2016 and 2019 despite the growth in installations in the same period. And jobs in wind turbine manufacturers grew slower than ever before in the same period.

However, annual figures do not tell the full story. Most companies use a project-by-project approach to build wind farms which takes years from planning to entering operation. The most labour-intensive phases are during manufacturing and construction of projects. But wind energy generates employment before, during and after projects are finalised.

Wind energy needs a strong domestic market to keep these jobs in Europe. The 397 GW envisaged in the National Energy and Climate Plans (NECPs) mean wind energy could employ 450,000 people by 2030, 250,000 in onshore and 200,000 in offshore wind. That is 50% more jobs than in 2019. However, without detailed policies to realise these Plans, Europe risks losing the opportunity to create more than half of the potential jobs in offshore wind and losing one third of the current onshore jobs. Wind energy would then employ only 282,000 people in Europe by 2030.

FIGURE 5

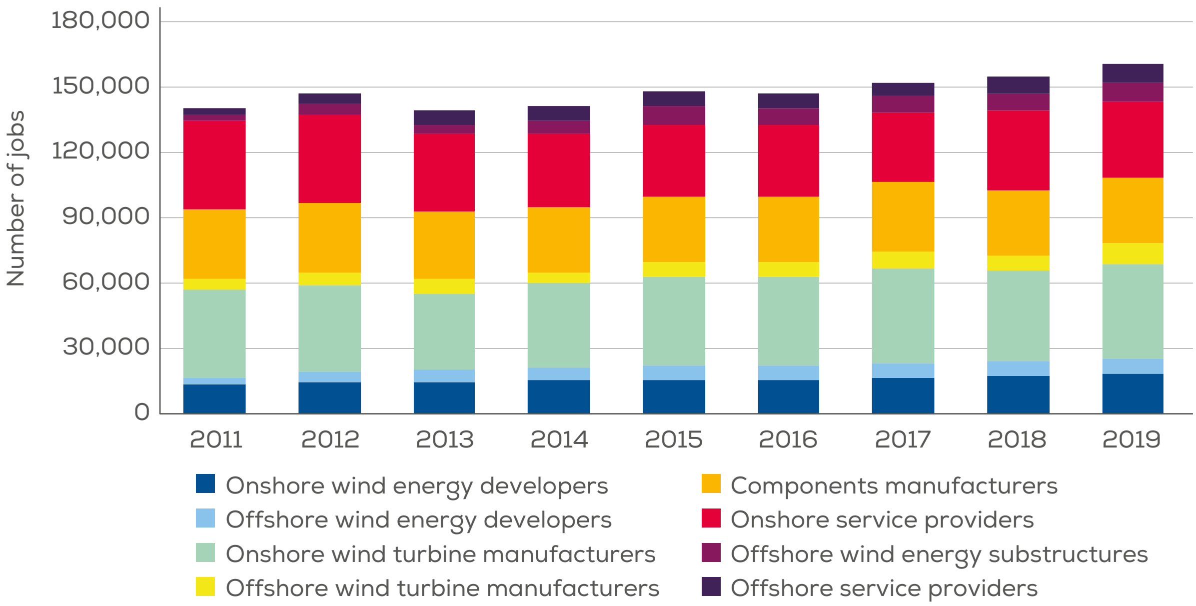
Direct and indirect jobs in the wind energy industry



Source: Deloitte for WindEurope

FIGURE 6

European wind energy direct jobs by sub-sector



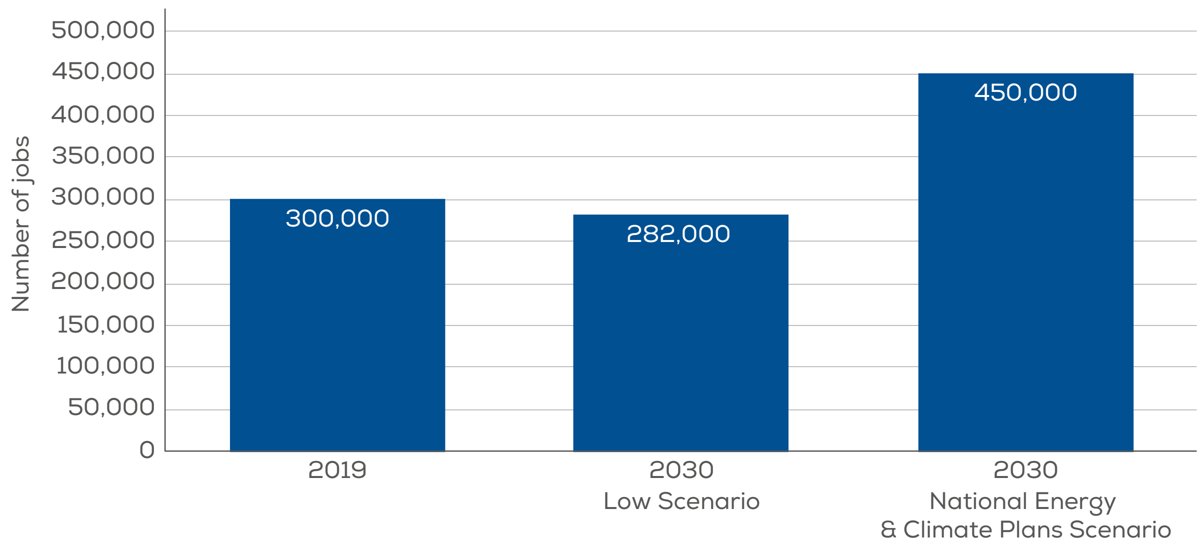
Source: Deloitte for WindEurope

As Europe finetunes plans to restart its economy, investing in wind energy would not only unlock further green jobs, it would also sustain existing ones. Europe would need €422bn to build the wind capacity pledged in the 2030 NECPs, €155bn in onshore wind and €267bn in offshore wind.

Every €1bn invested towards achieving the wind volumes in the NECPs would sustain the current 300,000 jobs and create an additional 165 jobs if spent in onshore wind and 463 jobs if spent in offshore wind. Keeping jobs is a crucial difference between places with a mature industry like Europe and regions at early stages of wind energy deployment where investments predominantly add new jobs. Annex II details our methodology to estimate these figures.

FIGURE 7

Jobs in WindEurope's scenarios to 2030



Source: Deloitte for WindEurope

3.2. CONTRIBUTION TO EU GDP

The wind industry has a turnover close to €60bn/year, 65% of which adds to the EU economy. That means that for every €1,000 of revenues, €650 stay in the EU and contribute to the gross domestic product (GDP). The other €350 go to companies that supply materials and equipment from outside the EU. This includes European companies with facilities abroad as well as non-European companies.

In 2019 the wind energy industry and the activities related to it added €37.2bn to EU GDP. €22.8bn of this was a direct contribution from onshore and offshore wind energy developers, turbine manufacturers, service providers, and offshore wind energy substructures. The deployment of wind energy also requires goods and services from other economic sectors. These sectors generated an additional €14.3bn of indirect economic activity.

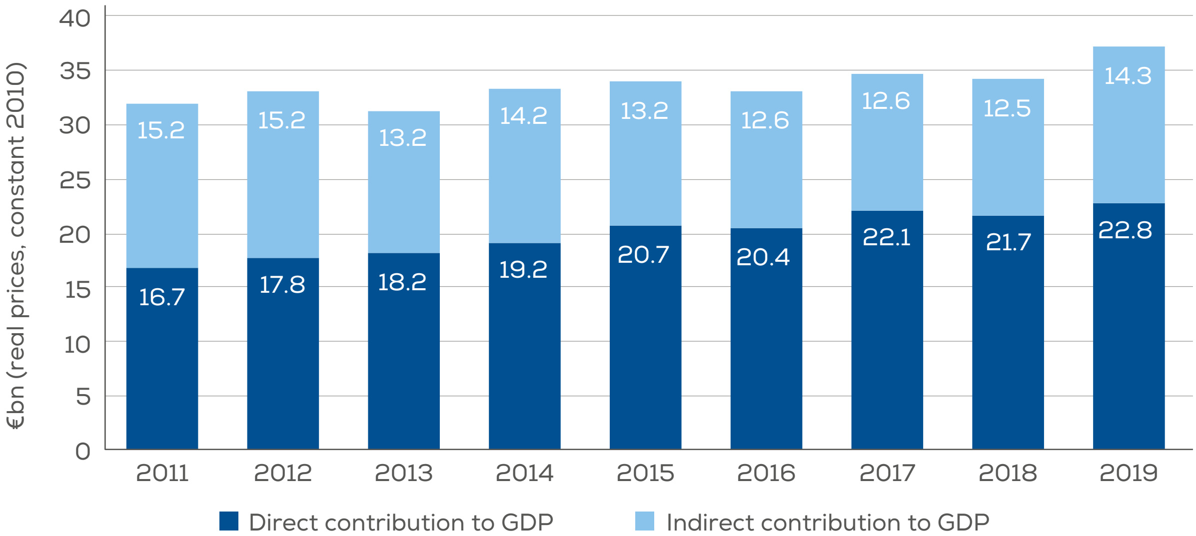
Today the wind industry generates €2.5bn of value added to the EU economy for each new GW of onshore wind installed and €2.1bn for each new GW of offshore wind. That means that every new onshore turbine adds €7m to the EU economy and every new offshore turbine adds €16m[11]. Crucially the onshore wind's value added per GW is slightly higher, mainly because it currently has 3 times as many jobs as offshore wind.

11. Using the average wind turbine sizes of 2.8 MW onshore and 7.8 MW offshore.

The onshore wind supply chain is bigger than the offshore wind supply chain because there is so much more onshore than offshore wind in Europe and we continue to install more onshore than offshore wind each year. The contribution per GW to the economy, from onshore and offshore wind, is expected to continue even with future project cost reductions to 2030.

FIGURE 8

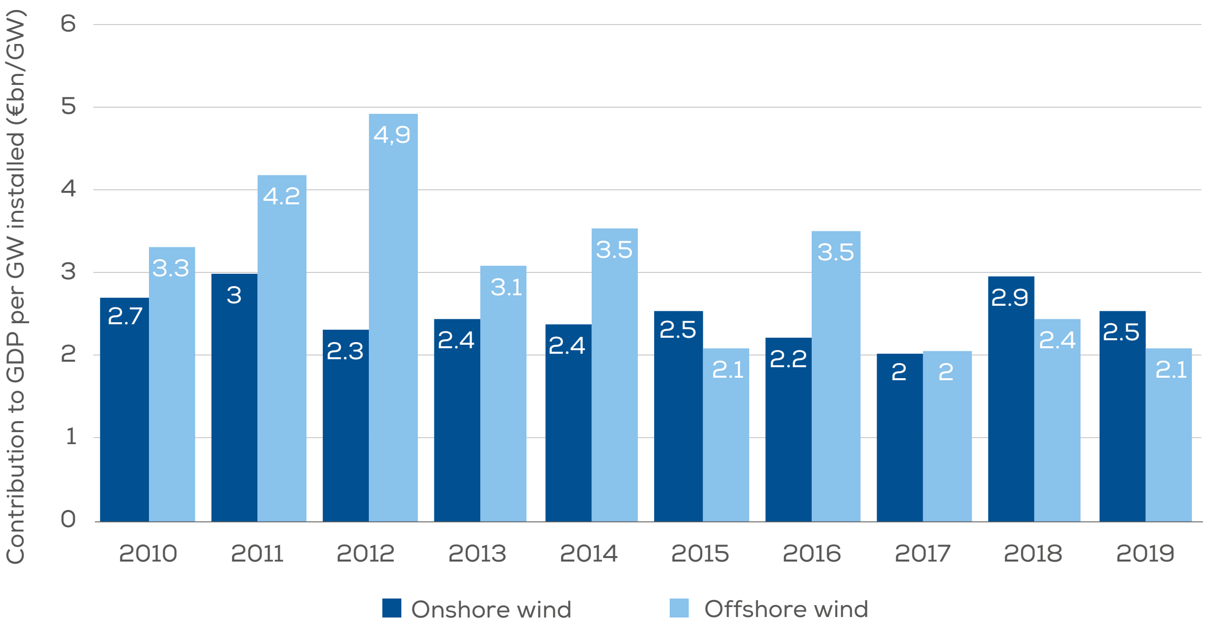
Direct and indirect contribution of wind energy to EU GDP (real prices, constant 2010)



Source: Deloitte for WindEurope

FIGURE 9

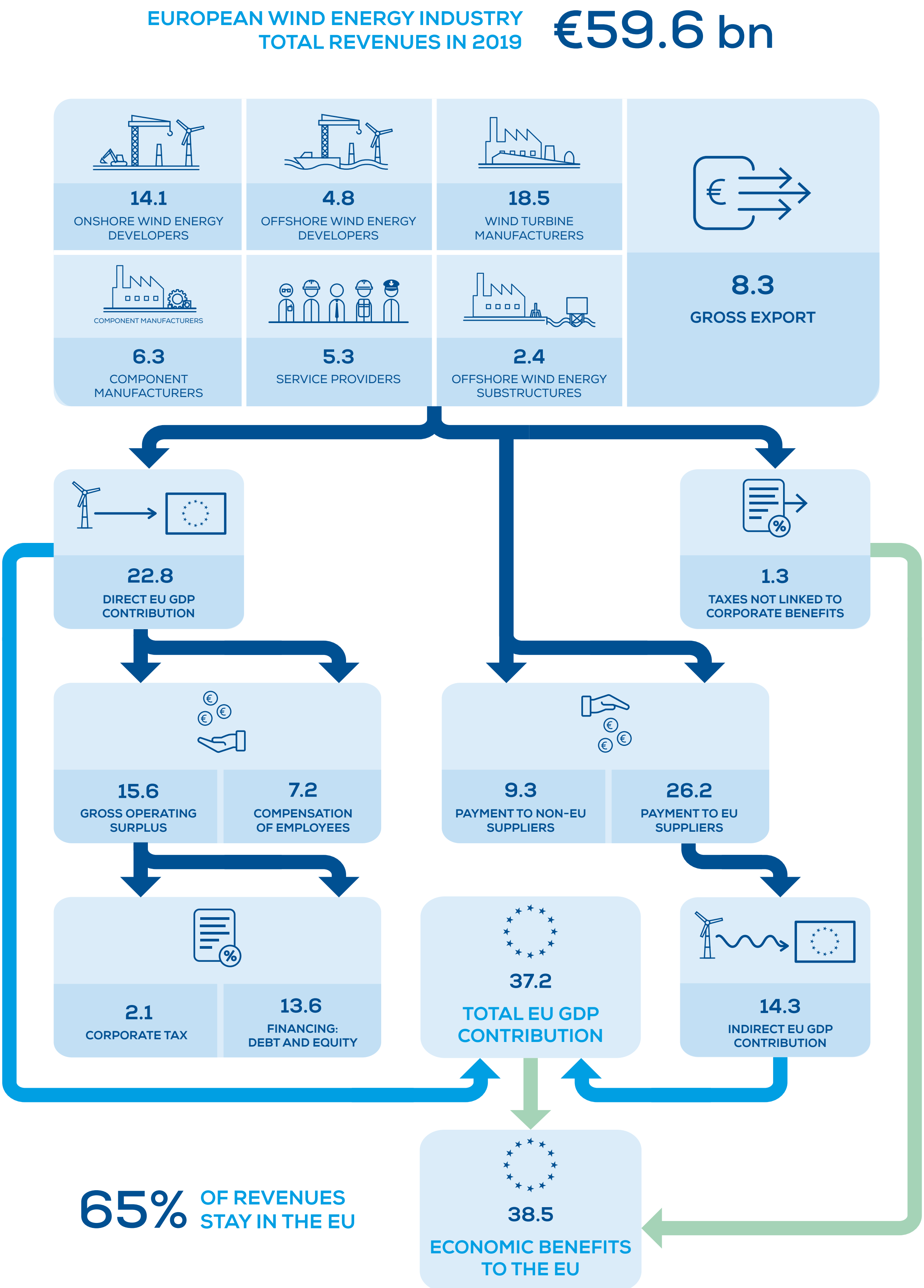
Contribution per GW of wind energy to EU GDP (real prices, constant 2010)



Source: Deloitte for WindEurope

FIGURE 10

Distribution of the EU added value generated by the wind energy industry in 2019 (real prices, constant 2010)



The wind industry's impact on the European economy – both direct and indirect – is equivalent to 0.26% of the total value of goods and services produced in the EU. Though relatively small, wind energy has made important contributions during challenging economic times. But this contribution varies with the level of deployment of new wind power capacity.

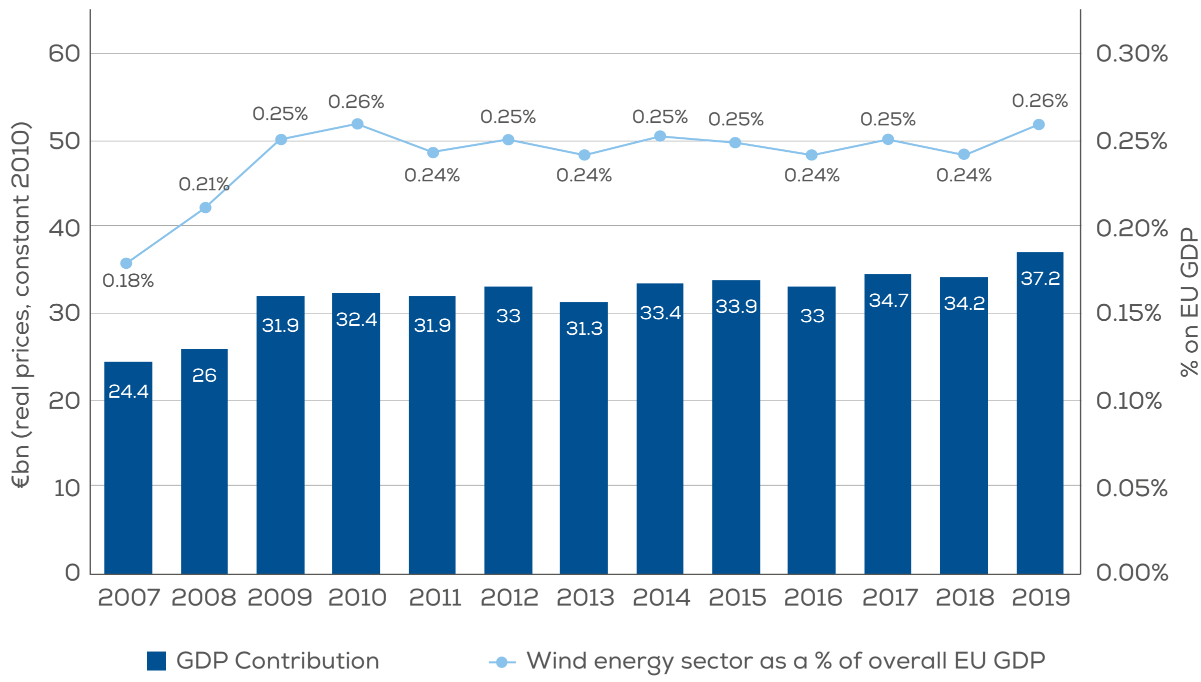
Having a robust European wind energy market in the coming years will underpin a sustained contribution from the sector to EU GDP.

Today the industry's contribution to EU GDP is similar in size to that of entire countries, such as Bulgaria, Croatia, Slovenia or Lithuania. It could grow larger with the right policies.

Also, by way of comparison, the manufacturing of steel accounts for 0.72% of EU GDP[12] while the entire supply of electricity, gas, steam and air conditioning supply is 1.57%.

FIGURE 11

Wind energy sector's share of total EU GDP



Source: Deloitte for WindEurope

12. Oxford Economics for Eurofer. "The Impact of the European Steel Industry on the EU Economy". July 2019.

3.2.1. DIRECT CONTRIBUTION TO EU GDP

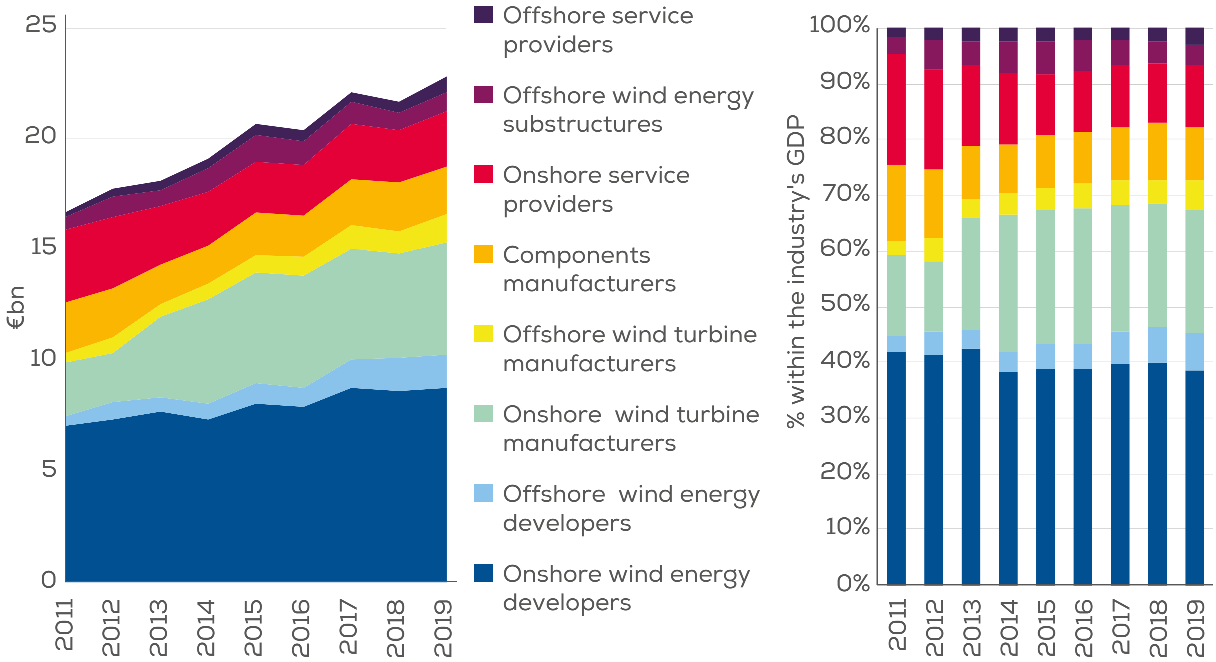
The wind industry's direct contribution to EU GDP varies per sub-sector. Figure 12 shows the evolution of the different sub-sectors' weight within the industry's GDP.

While the weight of offshore wind has increased within the industry, onshore wind still accounts for 80% of the industry's contribution to GDP. Developers and manufacturers have maintained a stable contribution in both on- and offshore wind.

But component manufacturers and service providers have been impacted by the industrialisation of the sector and the development of a global supply chain. In general, there has been a delocalisation of manufacturing of wind components to places outside Europe. The economic activity in these sub-sectors, and therefore their contribution to EU GDP, has not seen the increases that one would expect as a result of more installations.

FIGURE 12

Relative weight of the wind industry's sub-sectors in terms of GDP



Source: Deloitte for WindEurope

€ billions	**Evolution of direct impact of wind energy sector on EU GDP (real prices, constant 2010)**								
Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Onshore wind energy developers	7.0	7.4	7.7	7.3	8.0	7.9	8.8	8.7	8.8
Offshore wind energy developers	0.5	0.8	0.6	0.7	0.9	0.9	1.3	1.4	1.5
Onshore wind turbine manufacturers	2.4	2.2	3.6	4.7	5.0	5.0	5.0	4.8	5.1
Offshore wind turbine manufacturers	0.4	0.7	0.6	0.7	0.8	0.9	1.0	0.9	1.2
Component manufacturers	2.3	2.2	1.7	1.7	2.0	1.9	2.1	2.2	2.2
Onshore service providers	3.3	3.2	2.6	2.5	2.3	2.3	2.5	2.3	2.5
Offshore service providers	0.2	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.7
Offshore wind energy infrastructures	0.5	0.9	0.8	1.0	1.2	1.1	1.0	0.8	0.8
Total	16.7	17.8	18.2	19.2	20.7	20.4	22.1	21.7	22.8

3.2.2. INDIRECT CONTRIBUTION TO EU GDP

The interaction of the wind industry with other sectors adds value to the EU economy. As the industry expands, it demands more specialised products and services. These can be sourced from Europe or from abroad. The sourcing decisions depend on the local demand for wind energy, but policies like local content requirements play a role too. Chapter 4 goes into the sourcing and supply chain aspects.

The total indirect contribution to the EU's economy was €14.3bn in 2019. This accounts for services and products EU companies provided to the wind industry in Europe.

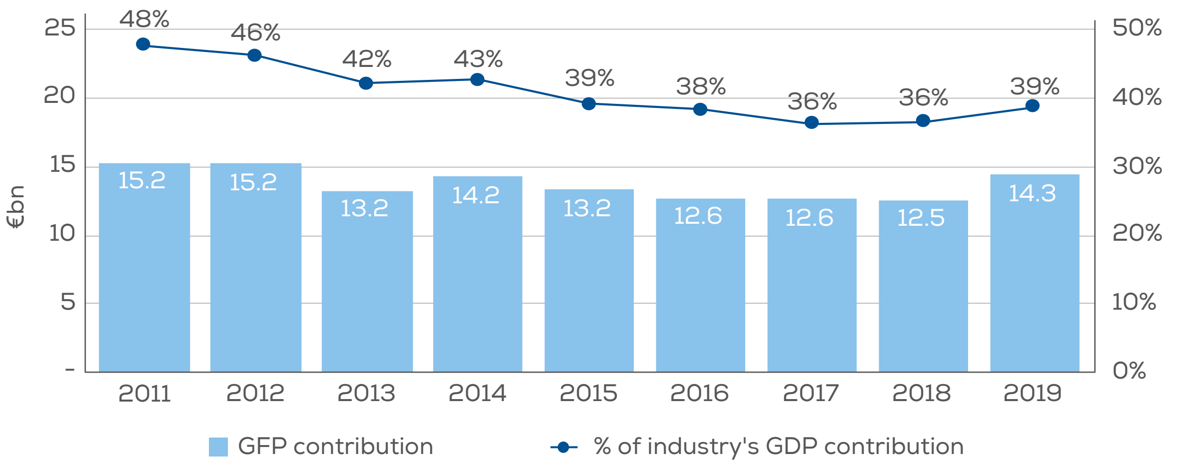
The electrical equipment sector benefits the most from investments in wind energy, with 21% of the total indirect contribution to the economy from wind, or €3bn in 2019. Every €1,000 spent in wind energy generates €50 in the electrical equipment sector.

The second largest beneficiary is the machinery and equipment sector, with 15% of the indirect contribution to the EU economy from wind, equivalent to €2bn. Basic metals and construction follow with 14% and 13%, or €2bn each and €1.8bn respectively in 2019.

Overall, for every €1,000 of revenue in the wind energy sector, there is €241 worth of economic activity generated in other industrial sectors. Figure 14 shows the indirect value of wind energy to different sectors of the economy.

FIGURE 13

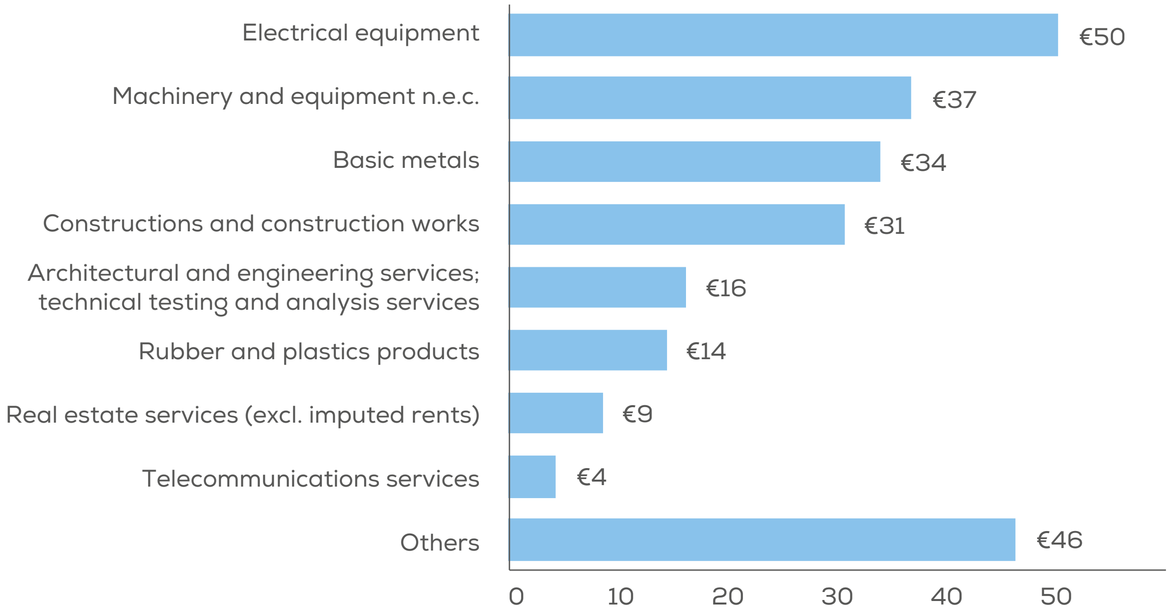
Indirect impact of the EU wind energy industry (in real prices and % of industry's GDP)



Source: Deloitte for WindEurope

FIGURE 14

Indirect value added to the economy by the wind industry in 2019: impact of €1,000 on the rest of the economy



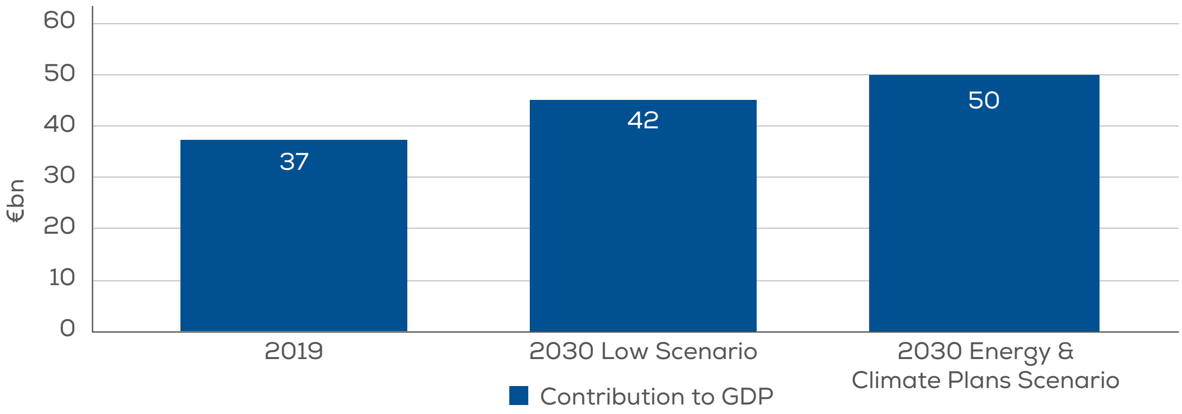
Source: Deloitte for WindEurope

Under the NECP Scenario, the 397 GW of wind power installed would produce a GDP contribution of €50bn in 2030, a 34% increase on 2019. With this deployment of wind energy, the sector's weight within the economy could also rise from 0.26% in 2016 to 0.88% in 2030.

In contrast, in the Low Scenario for 2030, wind power installations would be only 324 GW which would yield €42bn contribution to EU GDP. This means that not acting on the detailed policies needed to realise the NECPs would cost the EU economy €8bn in 2030 alone.

FIGURE 15

Wind energy industry's contribution to EU GDP in WindEurope's 2030 Scenarios



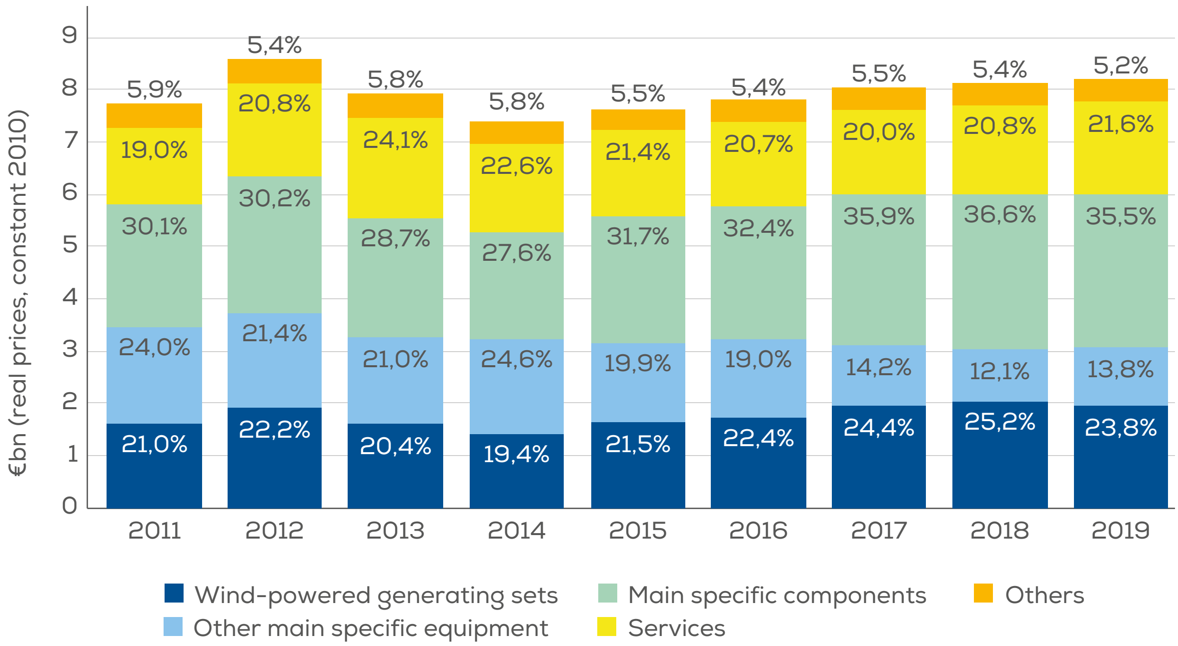
Source: Deloitte for WindEurope

3.3. EXPORTS

The wind energy industry is responsible for €8bn/year of exports in goods and services. Wind turbine manufacturers and component manufacturers are the largest exporters representing 73% of the annual industry's exports. But despite decades of experience and high-quality products, Europe's annual exports seem to have reached their peak.

FIGURE 16

EU wind industry exports in absolute terms and their weight within the sector (in constant prices 2010 and percentage)[13]



Source: Deloitte for WindEurope

Exports of wind turbine components made in Europe have stagnated despite the growth of wind energy projects globally. 2019 exports were only a 1% increase on 2018, 7% more than five years ago (2015) and merely 6% more than 9 years ago (2011). Wind energy capacity outside Europe has grown 10% between 2018 and 2019, 50% since 2015 and 175% since 2011.

These figures suggest that the share of European content in the installed wind power capacity outside Europe has declined. However, while these figures do not account for the substantial number of products and services sold by European-owned companies and subsidiaries located outside of the EU, they illustrate the point of having less wind "made in Europe" abroad.

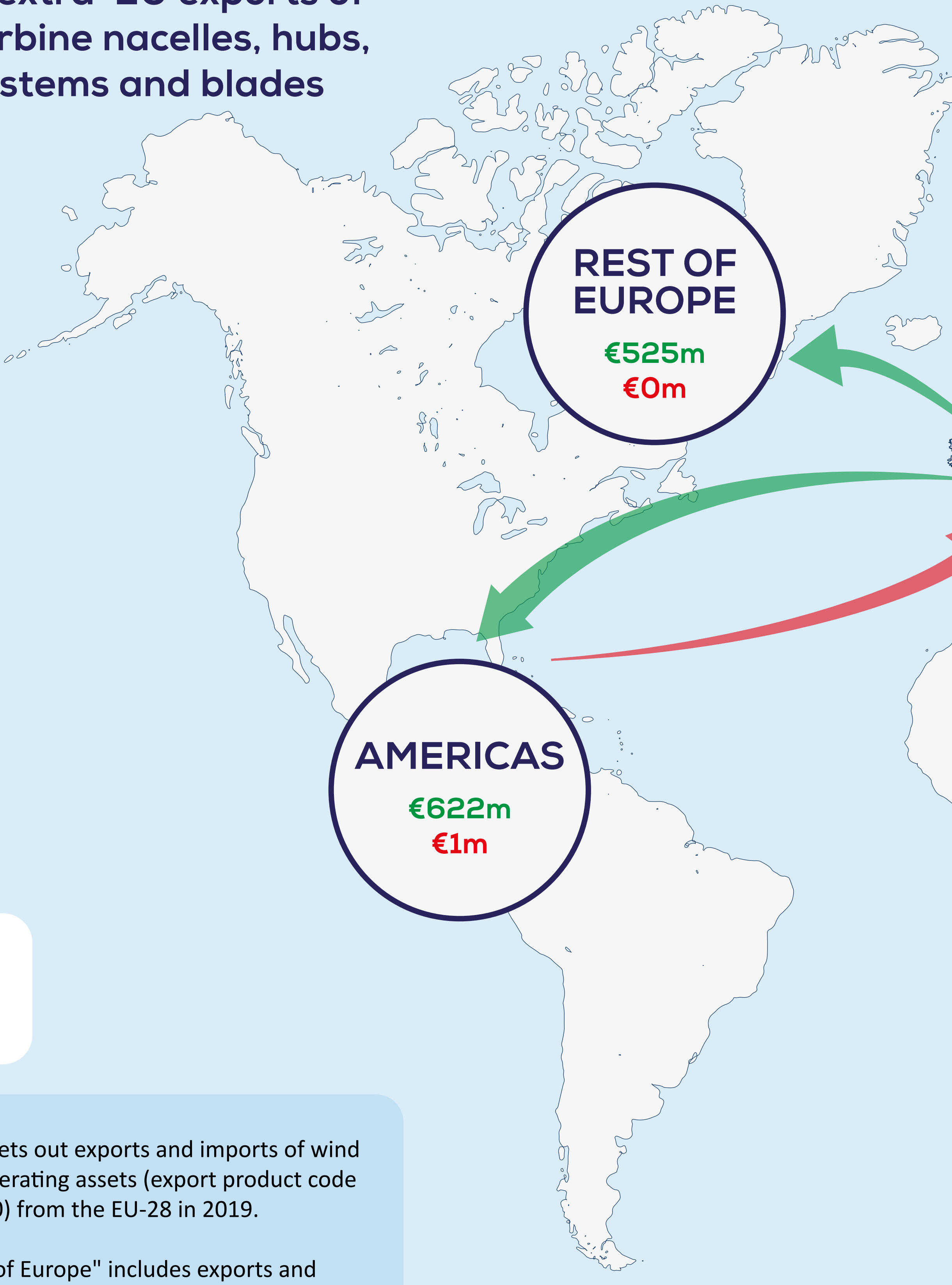
Local content requirements and other supply chain constraints have played a role. But most importantly, larger and more predictable volumes of projects elsewhere have attracted companies to set up manufacturing facilities abroad. Even if tapping into the largest wind energy emerging markets is reserved for a few, many of these locations offer better manufacturing costs to serve the European market.

Indeed, while Europe continues to be a net exporter of assembled wind turbine nacelles, hubs, pitch systems and blades (wind-powered generating sets), the components and materials inside these are mostly coming from outside Europe.

13. "Others" include electricity exports to non-EU countries.

FIGURE 17

Map of extra-EU exports of wind turbine nacelles, hubs, pitch systems and blades

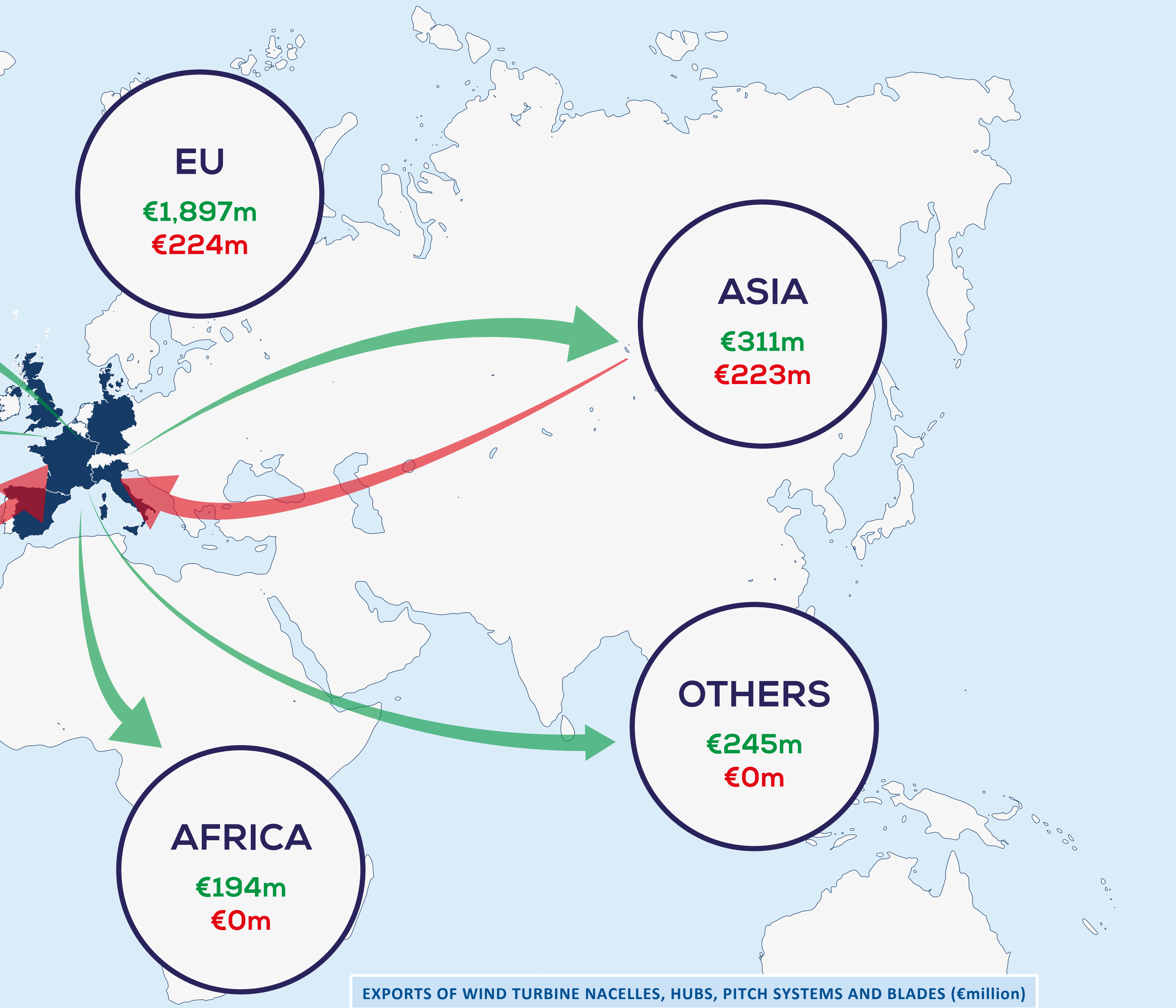


Export
Import
(mEur)

This map sets out exports and imports of wind power generating assets (export product code 8502 31 00) from the EU-28 in 2019.

The "Rest of Europe" includes exports and imports of EU wind power generating assets in European countries outside the EU.

"Others" includes Oceania.



EXPORTS OF WIND TURBINE NACELLES, HUBS, PITCH SYSTEMS AND BLADES (€million)

		TO						
		Africa	Americas	Asia	Others	Rest of Europe	Extra-EU	Intra-EU
FROM	Germany	2	135	219	42	319	718	1,323
	Denmark	86	99	58	0	163	405	135
	Spain	105	380	2	5	13	506	235
	France	0	2	0	0	0	3	271
	Italy	0	0	1	0	0	1	46
	UK	0	0	1	0	0	1	196
	Other countries	1	4	32	197	29	263	1,905
	Total	**194**	**622**	**311**	**245**	**525**	**1,897**	**4,111**

4.

THE INDUSTRIAL FOOTPRINT OF WIND ENERGY IN EUROPE

The wind industry is ready to deliver a green recovery in Europe. There are 248 manufacturing sites for wind turbine components in Europe, none of which are operating at their designed production capacity. Likewise, suppliers delivering balance of plant equipment (cables, subsea foundations, substations, etc.) and other service providers (engineering, construction, vessels) can gear up swiftly.

But the economic slowdown, issues on permitting, and the cost pressures resulting from auctions, are all serious obstacles. There is already a decrease of wind industry activity in the EU. At least 97 manufacturing sites have shut down since 2010 (see Annex III). Consequently, the number of jobs the industry delivered was slower than what it should have been (see section 3.1). The industry wants to – and can – reverse this trend, with the right policy signals.

The EU places wind and renewables at the core of achieving climate-neutrality and economic recovery. But it is not clear where it wants these technologies to come from. The supply chain is at risk of losing out if policymakers do not make it a strategic sector with clear industrial policies that maintain its competitiveness. Non-European companies are benefiting from targeted generous support, State-backed financing, or larger volumes of projects at home.

The EU can do something about that by boosting the domestic market of wind energy, using the EU recovery plan to invest in wind projects, in innovative technologies and in the associated infrastructure like power grids, storage systems, ports facilities and renewable hydrogen facilities. And enshrining detailed policies to deliver the European Green Deal.

Europe is a leader in wind energy. If Europe falls behind in competitiveness, it won't enjoy the benefits of that leadership. This chapter explores what these competitive advantages are, and how policymakers can maintain and leverage them for the benefit of people in Europe.

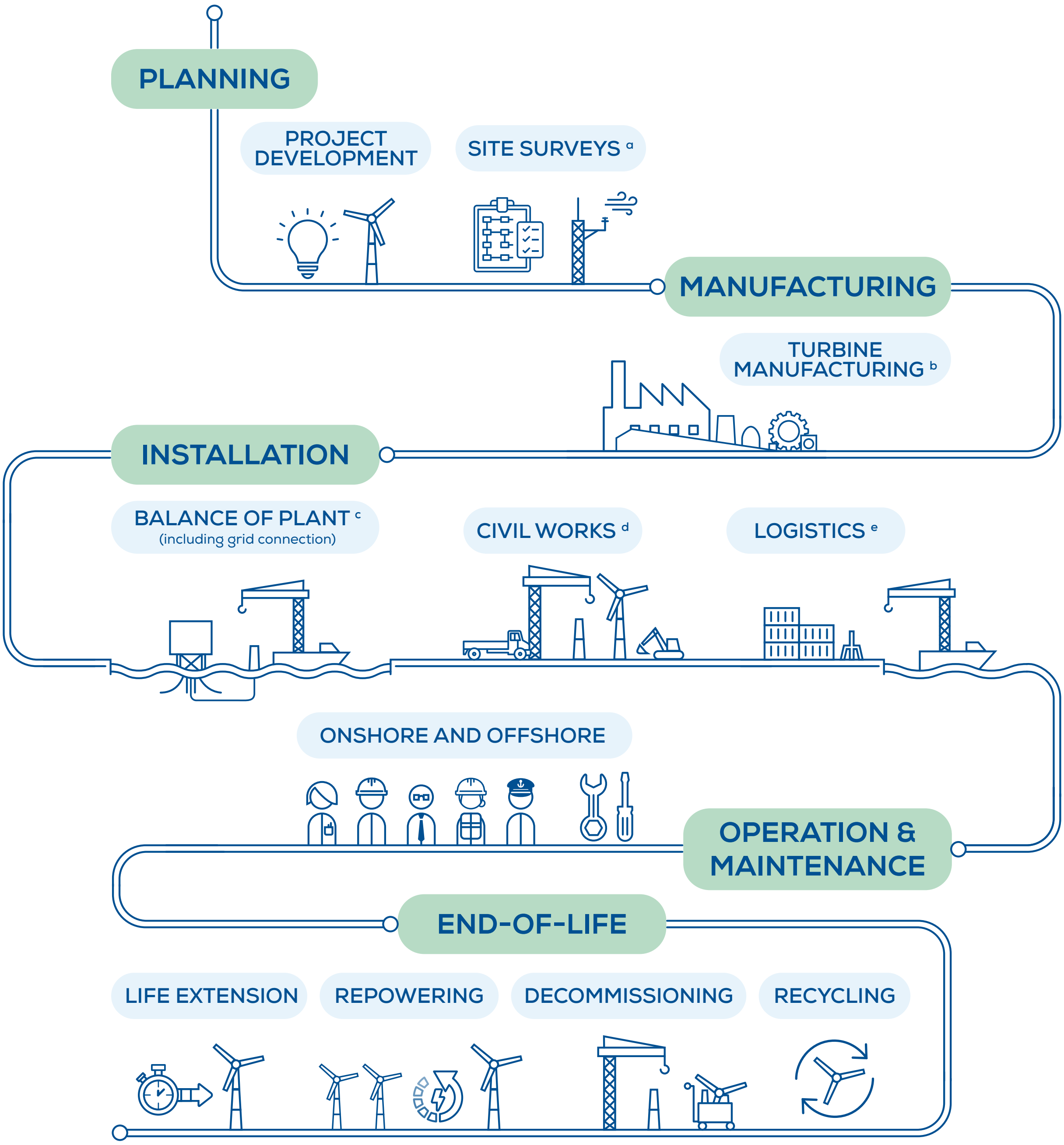
4.1. WHAT KIND OF COMPANIES COMPRISE THE SUPPLY CHAIN OF WIND ENERGY?

The supply chain of the wind energy industry can be analysed according to the life cycle of the power plant: Planning, manufacturing, installation, operation & maintenance, and end-of-life.

The following sections focus on the manufacturing of wind turbines and their components as the core of Europe's technological leadership.

FIGURE 18

Supply chain of the wind energy industry



a. Resource assessments, environmental impact, landscape, archaeological and unexploded ordnance (UXO) assessments.
b. Hub, pitch, blades, nacelle, gearbox, bearings, forgings, castings, generator, converter and tower.
c. Onshore foundations, intra-array cabling, substation, offshore foundation, subsea export cabling, converter, and transformer stations.
d. Onshore and offshore foundations.
e. Ports, warehouses, road transportation and vessels.

4.2. WIND TURBINE MANUFACTURERS

There are 10 manufacturing companies covering 88% of the demand of wind turbines globally. Five of these companies are headquartered in the EU: Vestas, Siemens Gamesa Renewable Energy, Enercon, Nordex SE, and GE Renewable Energy[14]. In addition, Europe is home of two of the top five offshore wind turbine manufacturers, MHI Vestas and Siemens Gamesa Renewable Energy.

The number of manufacturers has decreased in the last ten years, partly due to price pressures from auctions, and partly due to the uncertainty of volumes in key markets, notably in Spain and Germany.

China represents the biggest source of global competition for the European wind industry, having four of the global top ten wind turbine manufacturers. Chinese manufacturers have benefited from the remarkable expansion of wind energy in China in the last 5 years, driven by strong government support schemes. Chinese manufacturers control more than 90% of their home market.

On the other hand, European wind turbine manufacturers are globally diversified and lead in most markets. They command 85% of the European market, including Russia and the Caspian region, 66% in North America, and 67% in Latin America. Overall, European wind turbine manufacturers have 42% of the market share globally, up from 33% ten years ago[15].

Chinese manufacturers could take a growing share of non-EU markets as government support is reduced domestically. Chinese developers, working together with manufacturers, benefit from state-backed finance from institutions like the China Development Bank and the Asian Infrastructure Investment Bank to gain market share in key growth regions like Central Asia. That allows them to access low cost finance, which would become a determining factor to secure projects abroad.

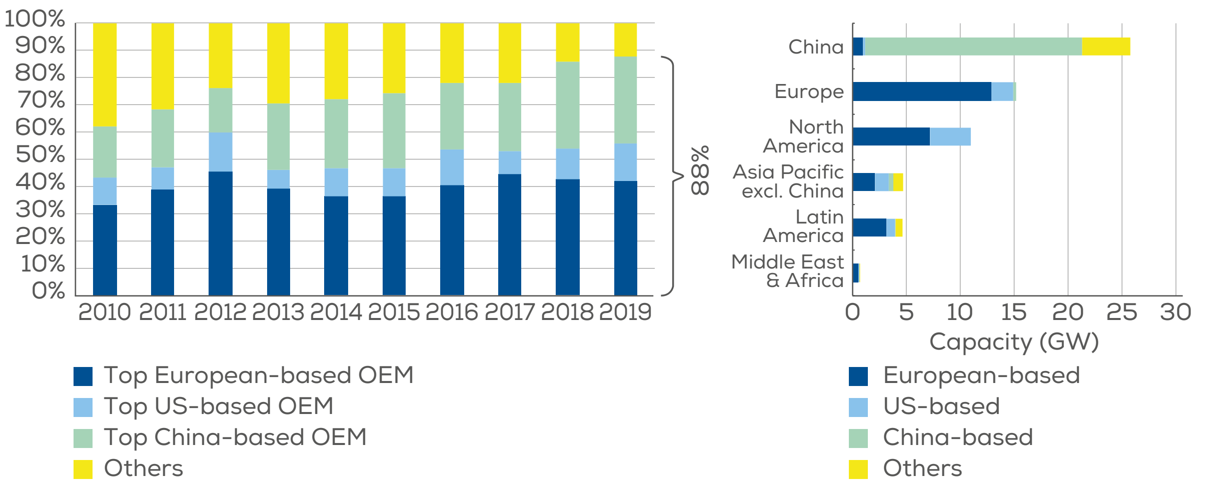
For the moment European manufacturers retain their competitive edge thanks to their technological leadership, geographical diversification, service capabilities, broad product portfolios covering different wind regimes (speeds), and broader energy market offering. Beyond supplying high-quality equipment, they can take on project management, EPC (engineering, procurement, and construction) and even post-construction energy aggregation and trading.

So far utilities and investors are comfortable with the turbine technology and service offered by European OEMs but this is not something that we can take for granted in the future.

European wind companies create value for customers beyond the manufacturing, assembly, and supply of equipment. This characteristic allows them not only to gain in the market share globally, but also to deliver significant opportunities for domestic value creation.

FIGURE 19

Annual share of global wind energy installations and 2019 installed capacity by region and turbine manufacturer origin



Source: Wood Mackenzie for WindEurope

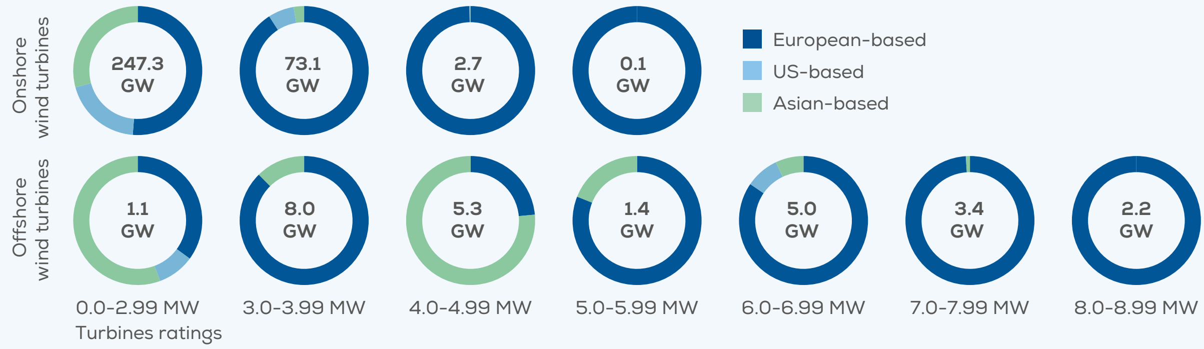
14. Although GE onshore wind is headquartered in the U.S. it belongs to GE Renewable Energy Business Unit, which is headquartered in Paris. GE offshore wind is headquartered in Nantes, France. In all charts displayed in the report, onshore wind installations in Europe by GE are therefore shown as from a US-based company.
15. Market share of capacity installed worldwide each year per wind turbine manufacturer. European manufacturers' geographical allocation is based on where their headquarters are based. Includes on- and offshore wind capacity.

FIGURE 20

How do the competitive advantages of wind turbine manufacturers create value for Europe?

TECHNOLOGY LEADERSHIP

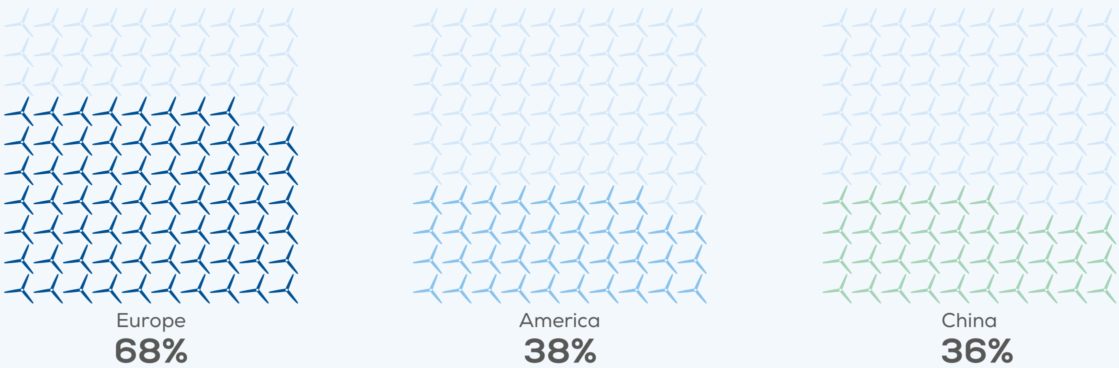
Turbine rating and platforms modularisation – European Original Equipment Manufacturers (OEM) have more and bigger turbine model portfolios.



Source: Wood Mackenzie for WindEurope

Blade technology is a key competitive advantage. A slight increase in blade length significantly reduces the levelised cost of energy (LCOE), much more than an increase on the capacity rating of the generator. European OEMs are more likely to have in-house blade manufacturing which enables improved processes and innovation.

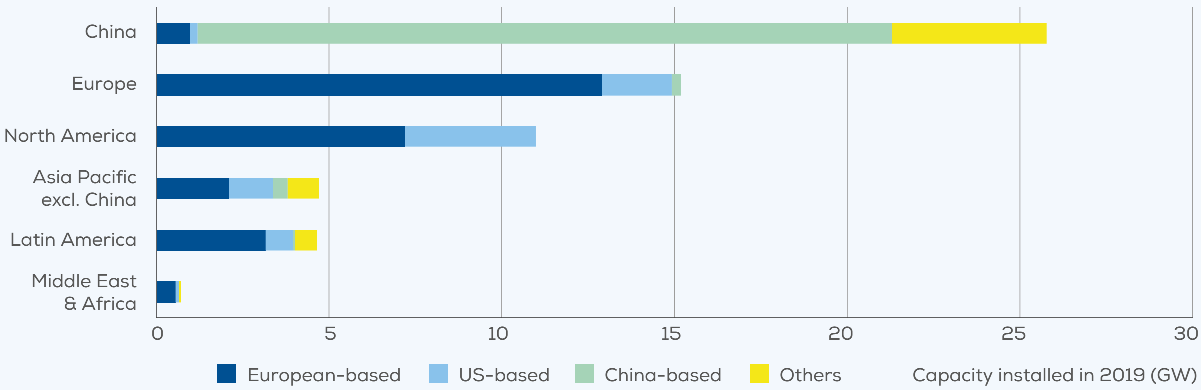
Share of blade production capacity owned by OEMs, per region



Source: Wood Mackenzie for WindEurope

GEOGRAPHICAL DIVERSIFICATION

Geographical diversification has been a strategy used by European companies as market conditions for wind swinging from boom to boost in different regions.

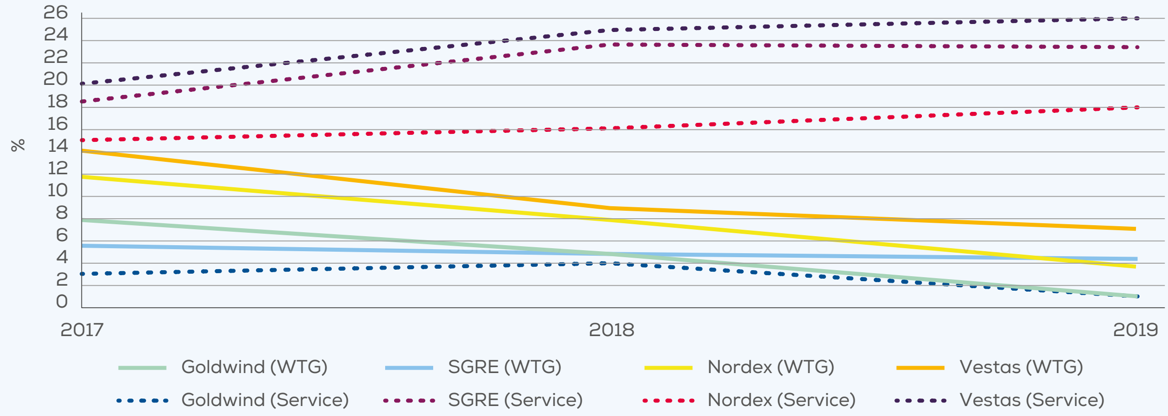


Source: Wood Mackenzie for WindEurope

SERVICE OFFERING

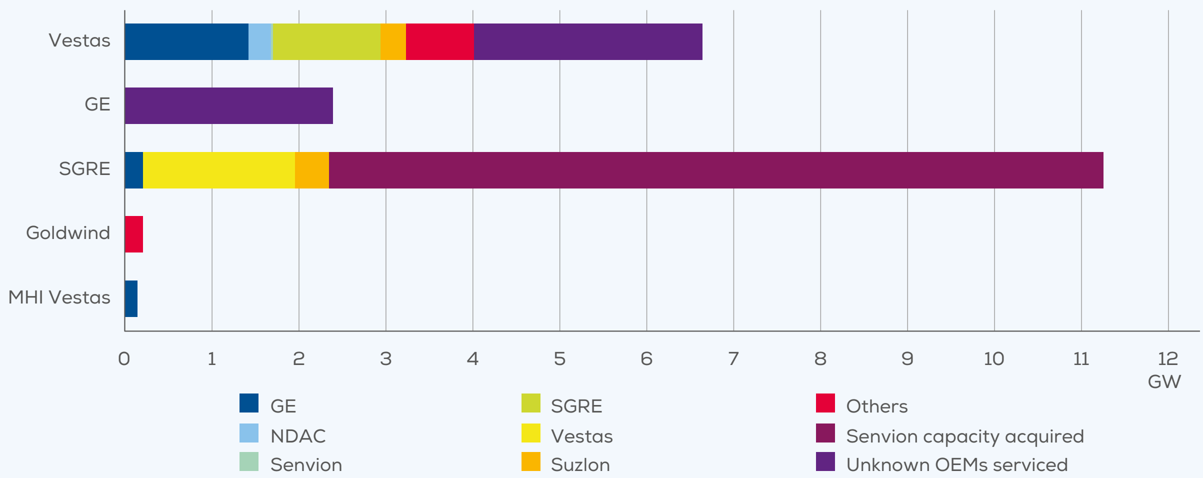
Service offering is a significant advantage in mature markets. Services margin is high (first chart), wind turbine orders include more operation & maintenance (O&M) contracts in Europe, and European wind turbine manufacturers have more multi-brand service contracts than others.

EBIT margin development by business segments



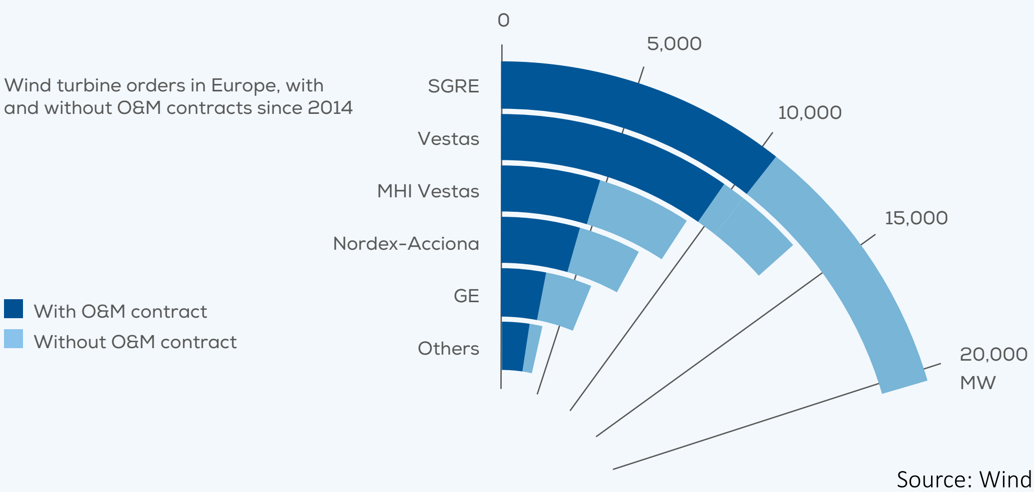
Source: Wood Mackenzie for WindEurope

Multi-brand servicing - Identified global volume under multi-vendor O&M



Source: Wood Mackenzie for WindEurope

Wind turbine orders in Europe, with and without O&M contracts since 2014



Source: WindEurope

4.3. WIND TURBINE COMPONENTS: A €50bn MARKET

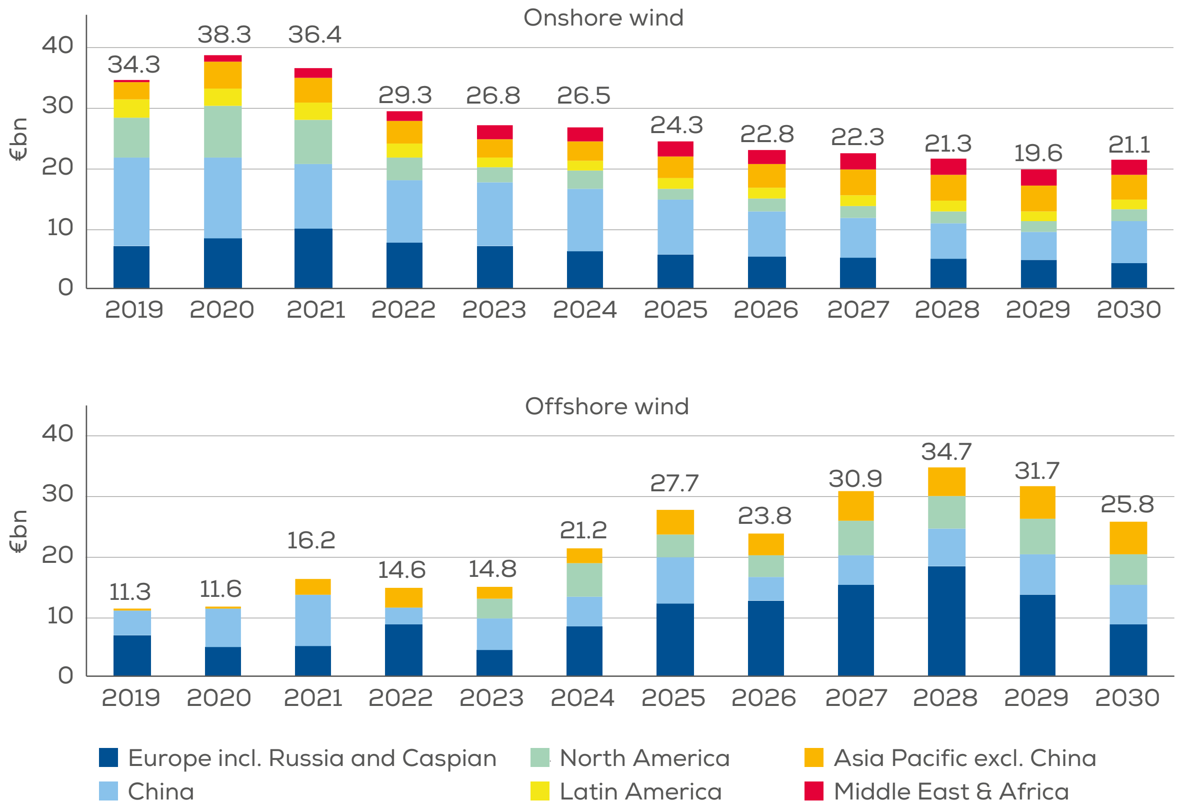
The global market for wind turbine components in 2020 is worth €50bn, €38bn onshore and €12bn offshore (Figure 21). Towers, rotor blades and gearboxes are the components with the highest market value totalling 50-55% of the market globally. The competition to supply these components is fierce.

European companies are still well-placed to manufacture these components but have considerably reduced their production capacity, as shown in the following pages (Figure 28). The share of annual installations in a region is a good proxy of the share of the market value for wind components. The more installations a region has, the higher the market value it drives. But cost reductions have an impact on the market value of components as cost pressures drive manufacturing to more competitive regions.

Europe drives the demand of around 26% of the global market value of wind turbine components in 2020. It was 30% in 2019, with a quarter of the annual global installations[16]. China drove 41% of the demand with 45% of the installations. It is uncertain what the share of installations of each region will be in 2020 due to the impacts of COVID-19.

FIGURE 21

Global wind turbine component market value, 2019-2030

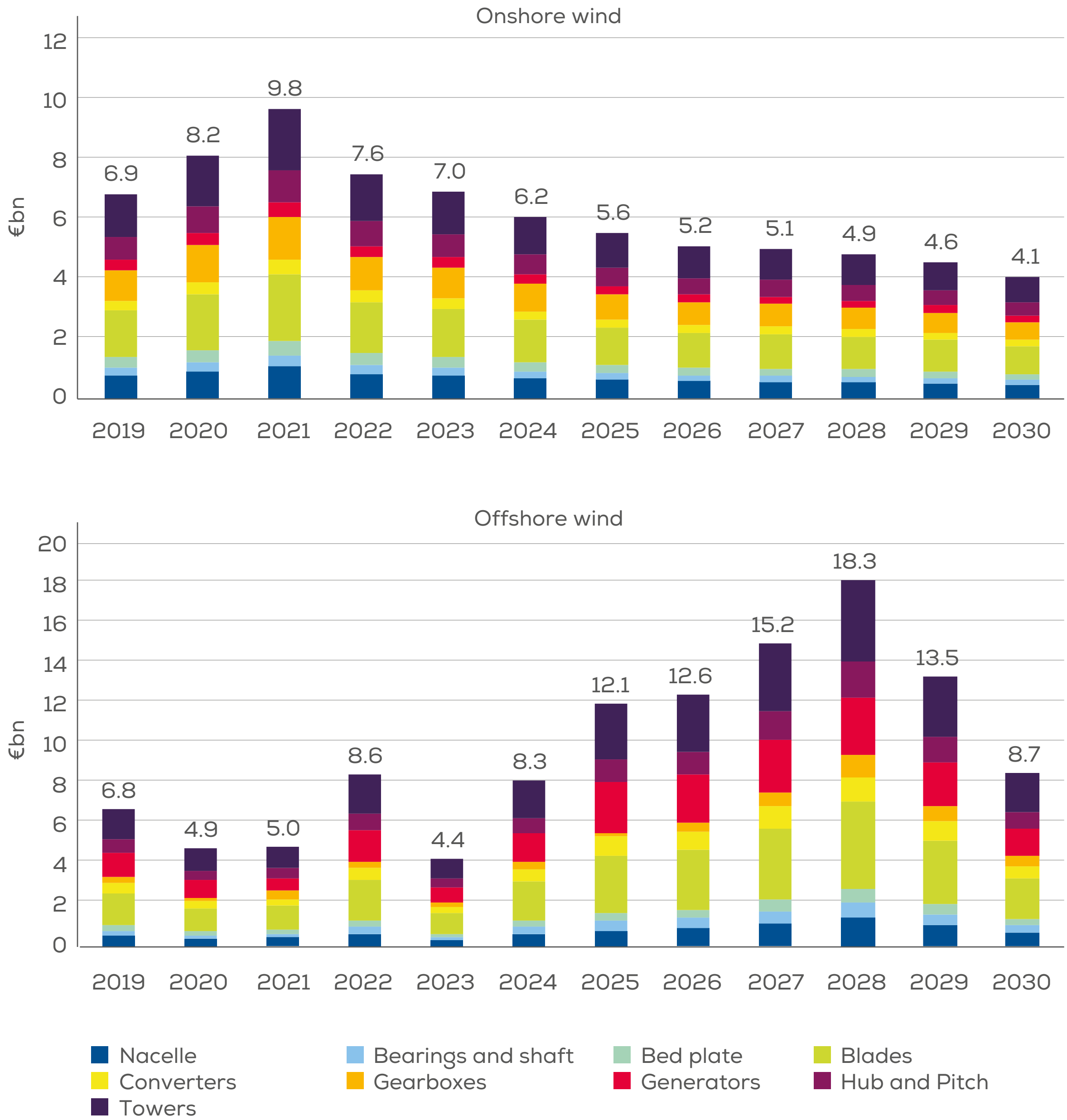


Source: Wood Mackenzie for WindEurope

16. GWEC market status report 2019, March 2020

FIGURE 22

European wind turbine component market value, 2019-2030



Source: Wood Mackenzie for WindEurope

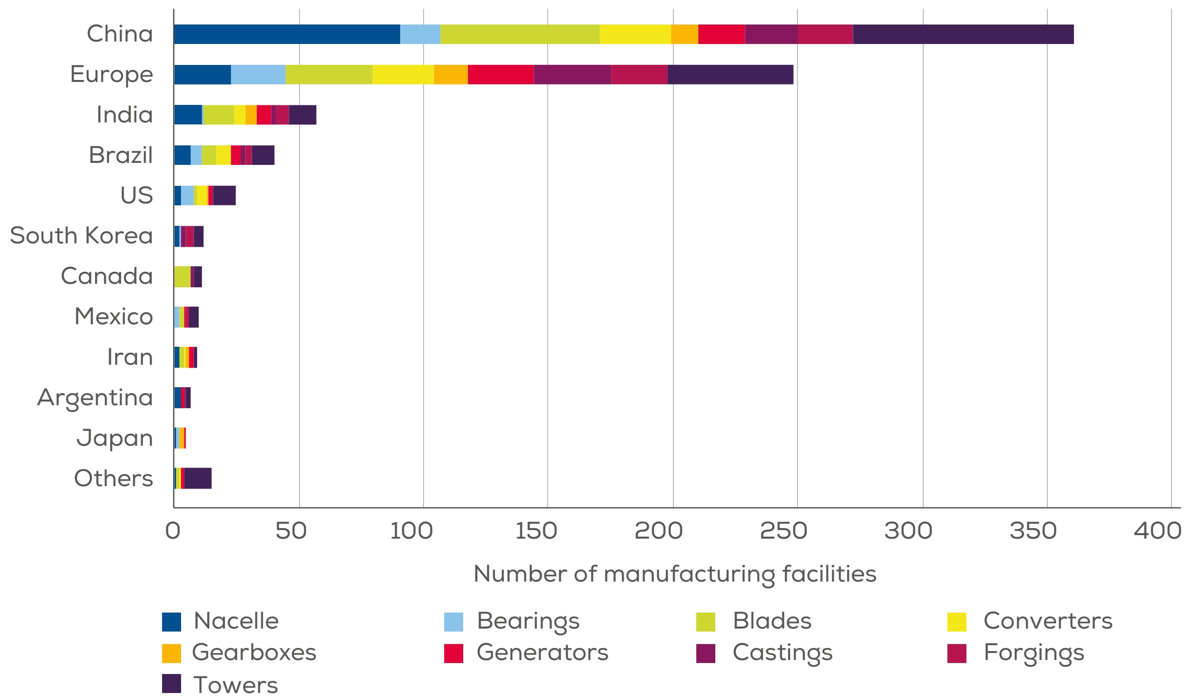
4.4. WHERE ARE WIND COMPONENTS MANUFACTURED?

There are close to 800 operating manufacturing sites for wind turbine components globally. Europe and China host 31% and 45% of facilities respectively. North America (US, Canada and Mexico) is home to only 4.5% of global wind component factories. Together with Brazil (5%) and India (7%), all these regions are home of 92% to wind component manufacturing facilities.

While wind energy relies on a global supply chain, the location of the factories mirrors the importance of the local markets. China hosts about 45% of the facilities, with around 33% of the global cumulative capacity. Europe hosts 31% of the production facilities, with 30% of the global cumulative capacity. Both regions are net exporters. North America, in contrast, hosts just 4.5% of the facilities with a cumulative capacity of almost 20%. Latin America is a growing market (6% of installations in 2019) which has managed to attract an important manufacturing base, mostly due to Brazil's local content requirements. Brazil alone hosts 5% of the facilities.

FIGURE 23

Global operational manufacturing facilities of wind energy components in 2019

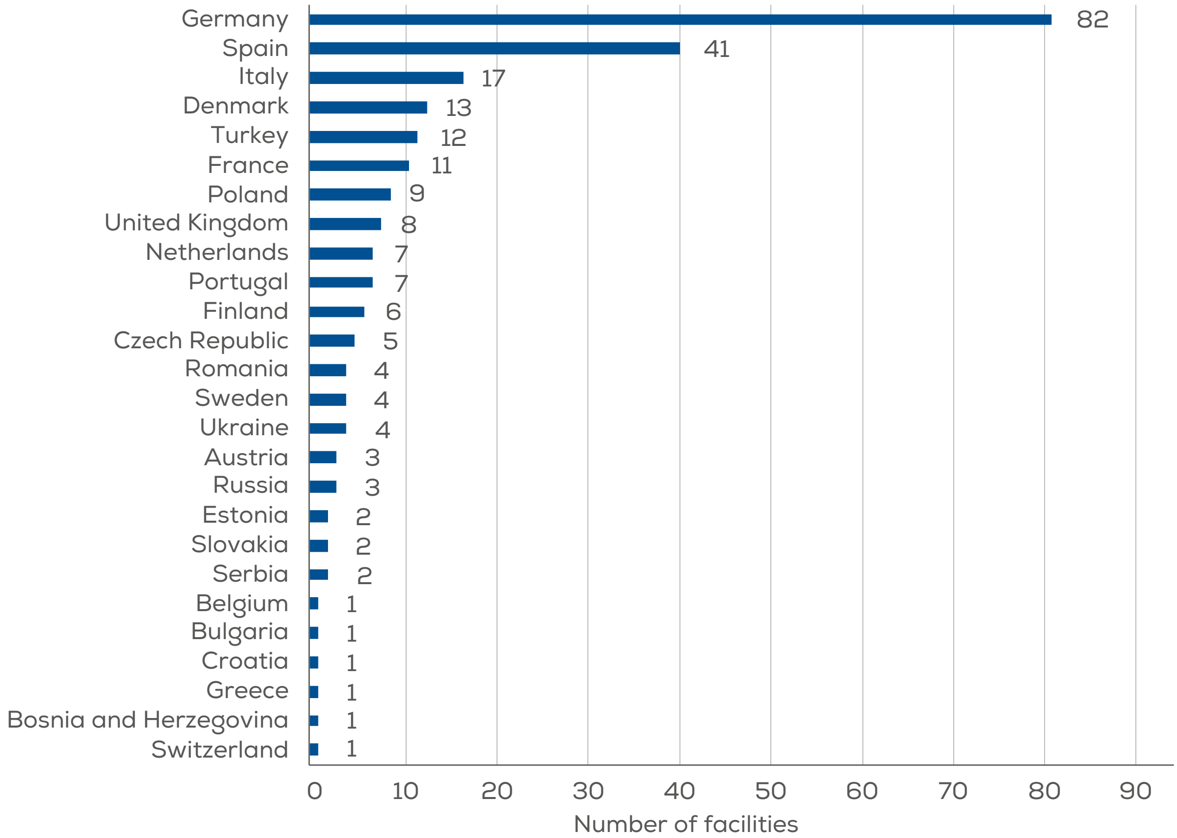


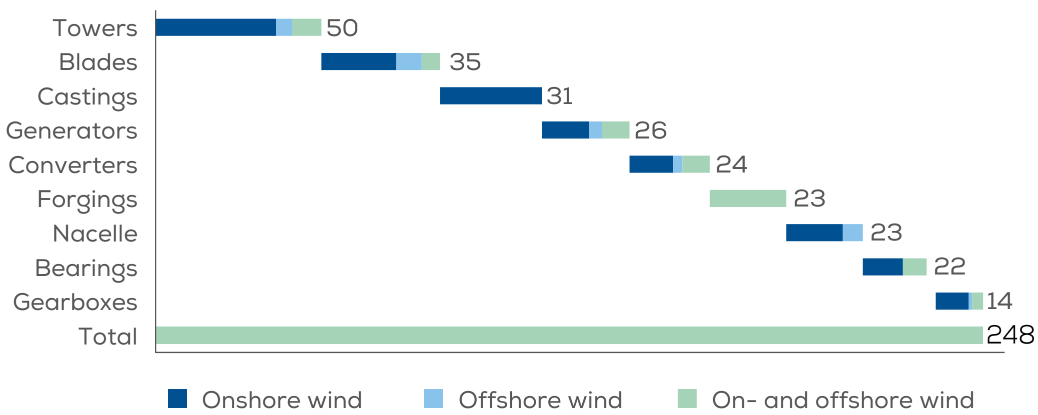
Source: Wood Mackenzie for WindEurope

Germany, Spain, France, Italy, and Denmark remain the leading producers of strategic wind turbine components in Europe. Germany for example, commands most of the nacelle, blades, gearboxes, castings, converters, and bearings factories in Europe.

FIGURE 24

European operational facilities by country and number of facilities by component





Wood Mackenzie for WindEurope, WindEurope (lower chart)

The strong position of European wind energy companies around the globe secures a competitive supply of wind energy components for European projects while keeping strategic sites locally.

Europe has the largest share of OEM-owned facilities for blade production totaling 68%. This compares to less than 40% in other regions. The contrast is even higher in converters, where Europe's share is 40% while the US and China have around half of that amount each (see figure 25).

Components such as gearboxes, casting, forging and bearings are predominantly outsourced from either large conglomerates or specialised companies.

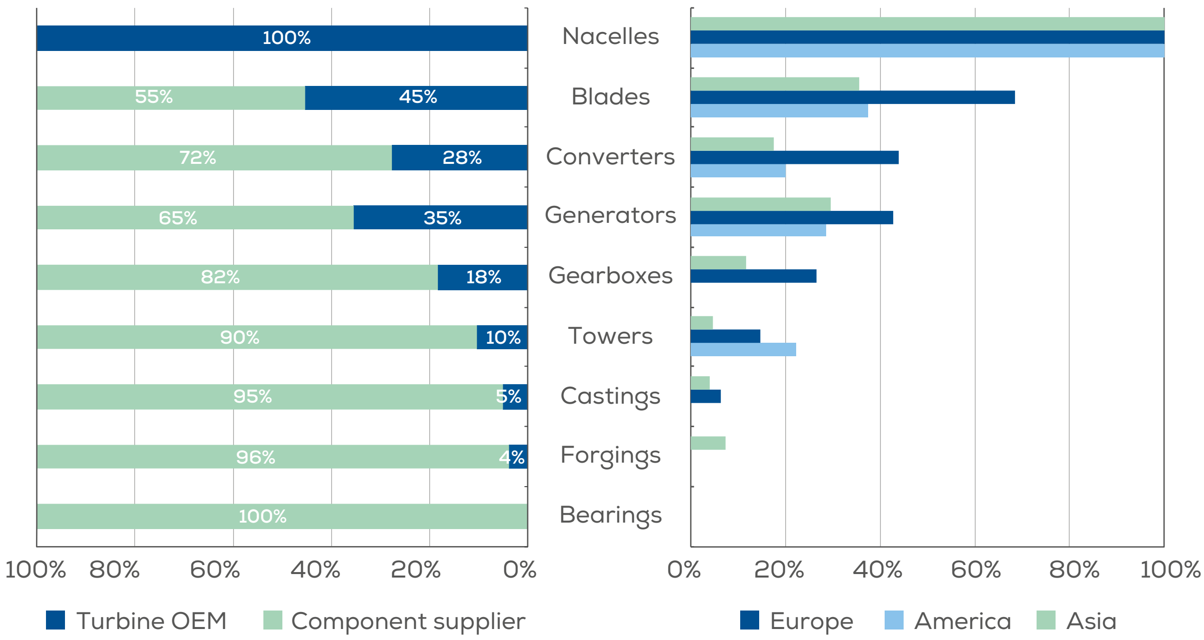
Towers, due to their nature (very heavy and relatively low complexity) are the component most widely spread in terms of manufacturing footprint, globally.

Raw and processed materials used in wind turbines are also sourced from around the world. China supplies about half of raw materials, like iron ore for steel making, and rare earths like dysprosium and neodymium, which are used in the permanent magnets in the generators of turbines without a gearbox. But China's role decreases significantly as transformation processes add value along the supply chain, which takes place mainly in Europe[17].

Global supply chains are therefore a key characteristic of wind energy. They allow companies to source materials and components at competitive costs so that the European wind industry continues to reduce costs, which brings down consumer energy bills, and keeps exporting competitive technology vis-à-vis Chinese manufacturers.

FIGURE 25

Share of production facilities by company type and share of OEM-owned facilities by region



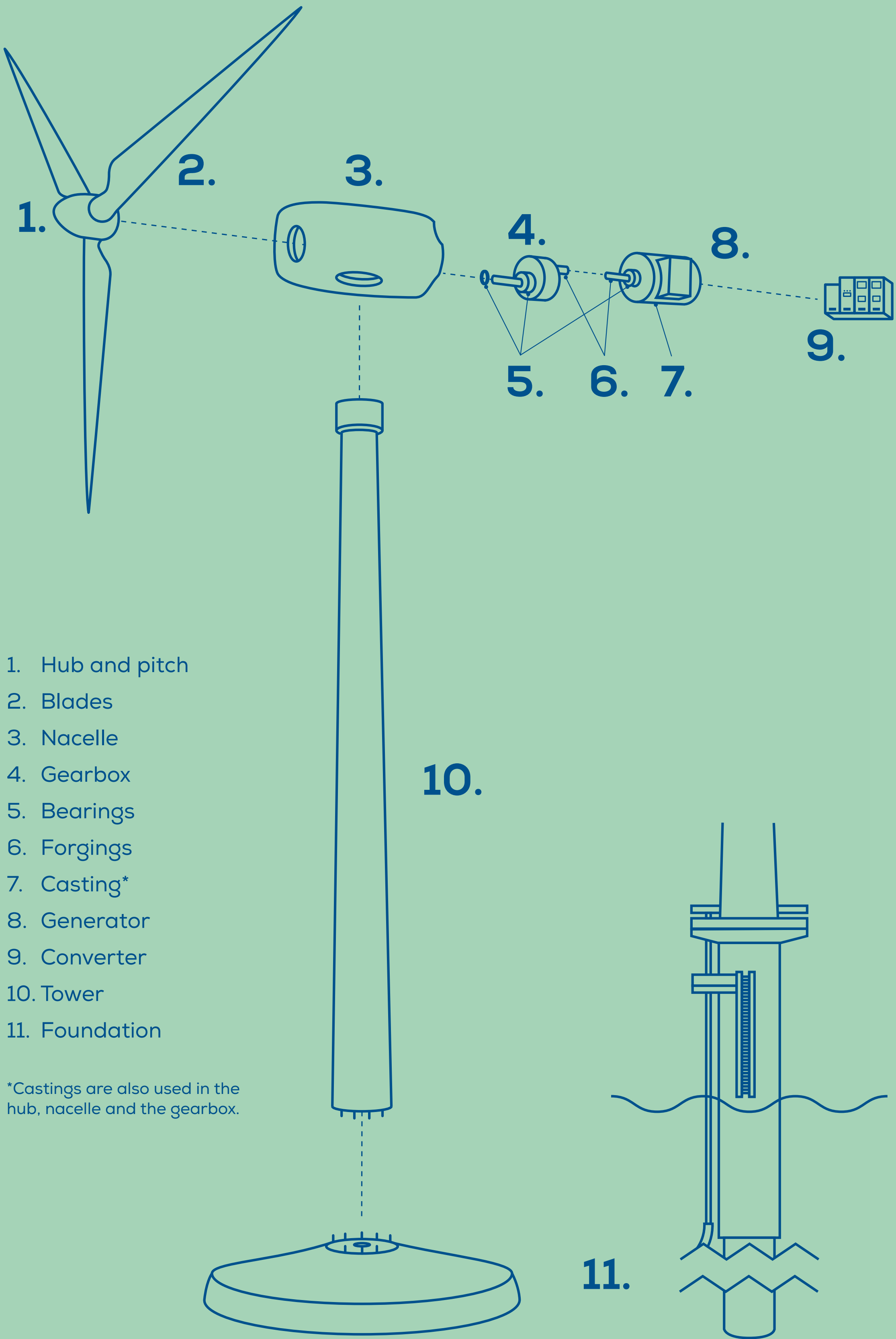
Source: Wood Mackenzie for WindEurope

17. European Commission, 2020. Critical raw materials for strategic technologies and sectors.


© Vattenfall

FIGURE 26

Main wind turbine components



1. Hub and pitch
2. Blades
3. Nacelle
4. Gearbox
5. Bearings
6. Forgings
7. Casting*
8. Generator
9. Converter
10. Tower
11. Foundation

*Castings are also used in the hub, nacelle and the gearbox.

FIGURE 27

Snapshot of operating wind turbine component manufacturing facilities in Europe*

AUSTRIA

Generators	1
Towers	1

BELGIUM

Gearboxes	1

BULGARIA

Converters	1

CROATIA

Towers	1

CZECH REPUBLIC

Gearboxes	1
Forgings	3
Towers	1

DENMARK

Blades	4
Nacelles	4
Converters	2
Towers	3

ESTONIA

Generators	1
Converters	1

FINLAND

Gearboxes	1
Generators	2
Converters	3

FRANCE

Blades	1
Nacelles	1
Forgings	2
Generators	4
Towers	1

GERMANY

Blades	1
Nacelles	8
Gearboxes	7
Forgings	4
Castings	16
Generators	8
Converters	7
Towers	13

GREECE

Towers	1

ITALY

Blades	1
Forgings	6
Castings	3
Converters	2
Towers	3

NETHERLANDS

Nacelles	3
Generators	2
Converters	2

POLAND

Blades	3
Forgings	1
Castings	2
Converters	1
Towers	2

PORTUGAL

Blades	2
Nacelles	1
Generators	1
Towers	3

ROMANIA

Forgings	1
Generators	1

SLOVAKIA

Castings	1

SPAIN

Blades	6
Nacelles	3
Gearboxes	3
Forgings	4
Castings	5
Generators	3
Converters	3
Towers	11

SWEDEN

Forgings	1
Castings	1
Towers	1

BOSNIA AND HERZEGOVINA

Generators	1

RUSSIA

Blades	3
Nacelles	3
Towers	3

SERBIA

Generators	1
Converters	1

SWITZERLAND

Converters	1

TURKEY

Blades	4
Castings	2
Towers	6

UKRAINE

Nacelles	1
Forgings	1
Castings	1
Towers	1

UNITED KINGDOM

Blades	3
Nacelles	1
Gearboxes	1
Generators	1
Towers	1

* Foundations not included

Source: Wood Mackenzie for WindEurope

In the last 10 years the wind energy industry experienced a strong consolidation of suppliers and frequent changes in market dynamics. In Europe a number of small suppliers exited the market or were acquired. In parallel, large OEMs and suppliers expanded operations.

Emerging markets and local content requirements resulted in more factories outside well-established OEM home markets[18]. This contributed to the rise in the number of facilities starting up. With the exceptions of 2015, the industry added more facilities than it shut down. But the trend has changed again in 2019 (see Figure 29).

The market expansion of wind energy in European markets has seen boom-and-bust cycles. After seeing a significant boost of industrial activity in early years, policy changes forced factories to shut down, relocate or become idle. This was particularly bad in Spain where support to the sector was fully halted in 2013 and where more than 25 factories had to shut down.

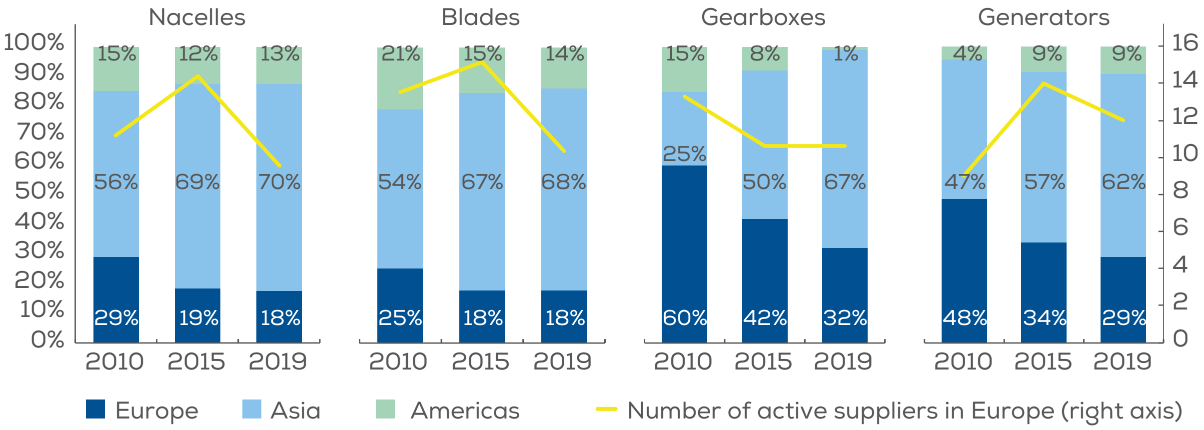
The result is that in the last decade the manufacturing footprint of the European supply chain shrank. Industry consolidation through mergers and acquisitions led to redundant component designs and production lines, also bringing down the total number of facilities, albeit with higher production capacity. And other markets offered higher prospects for growth and investments. The delocalisation of factories resulted in lower shares of production capacity for Europe.

For example, Europe had 13 nacelle assembly suppliers with 29% of the global production capacity in 2010. By 2015 it had 17 suppliers and only 19% of the production capacity. Today there are 12 suppliers with practically the same share (18%) of a larger market. 1/3 of recent additions in production capacity has been for offshore wind. Blade manufacturing experienced a very similar evolution to nacelles. And the production of gearboxes and generators shifted markedly outside Europe too. While the region used to host 60% and 48% of the global production capacity of these components in 2010, today it only has 32% of gearbox production capacity and 29% of generators. However, as these factories serve other industries, the viability of those factories is less sensitive to the dynamics in the wind sector.

China has attracted most of the production capacity for key wind turbine components from Europe. India particularly has increased its global share of gearbox manufacturing capacity, from less than 2% in 2010 to 10% today.

FIGURE 28

Regional production capacity of selected wind components and number of active suppliers in Europe

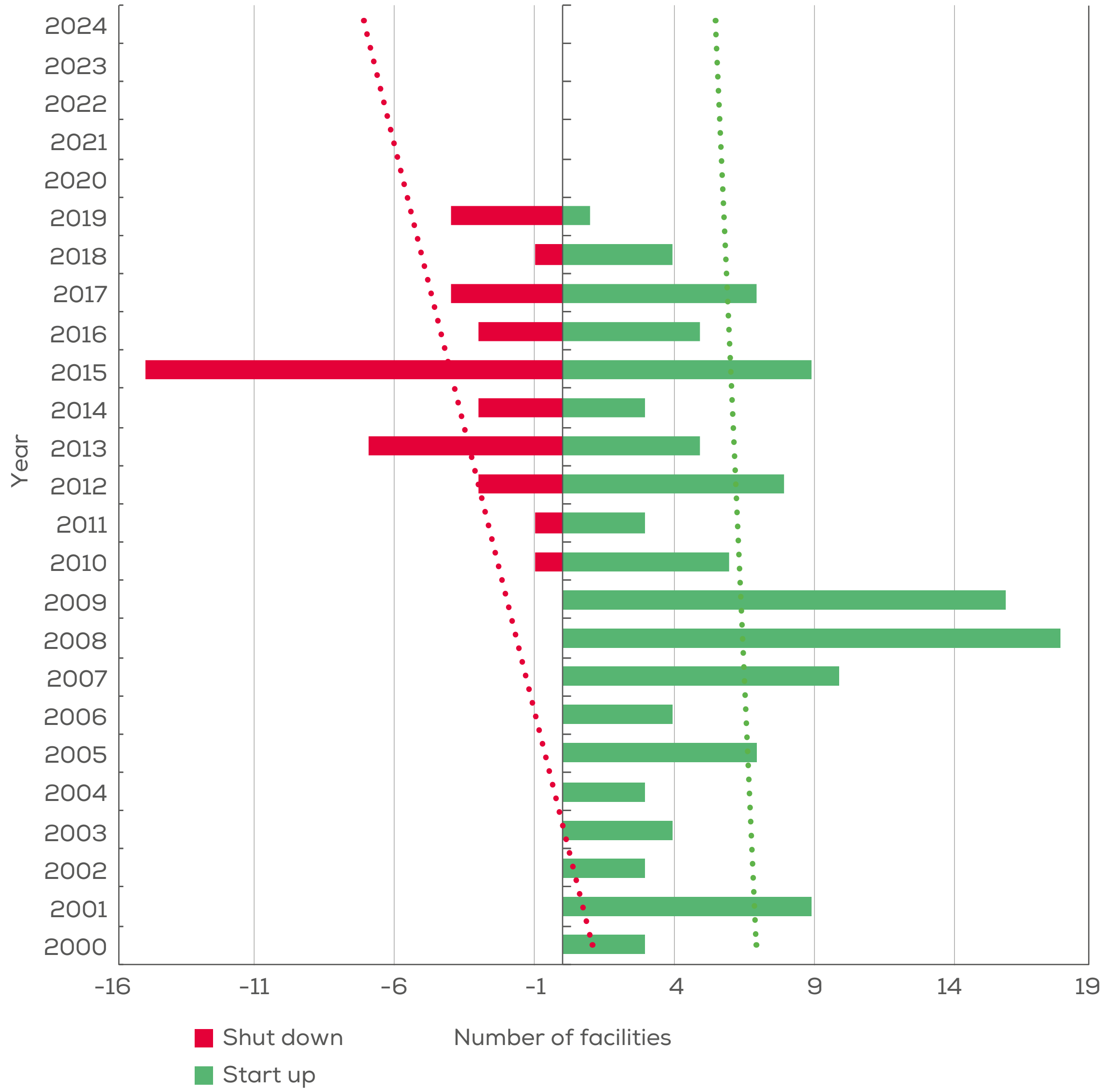


Source: Wood Mackenzie for WindEurope

18. Emerging markets: Poland, Romania, Bulgaria. Local content requirement: Turkey, Russia, UK, France

FIGURE 29

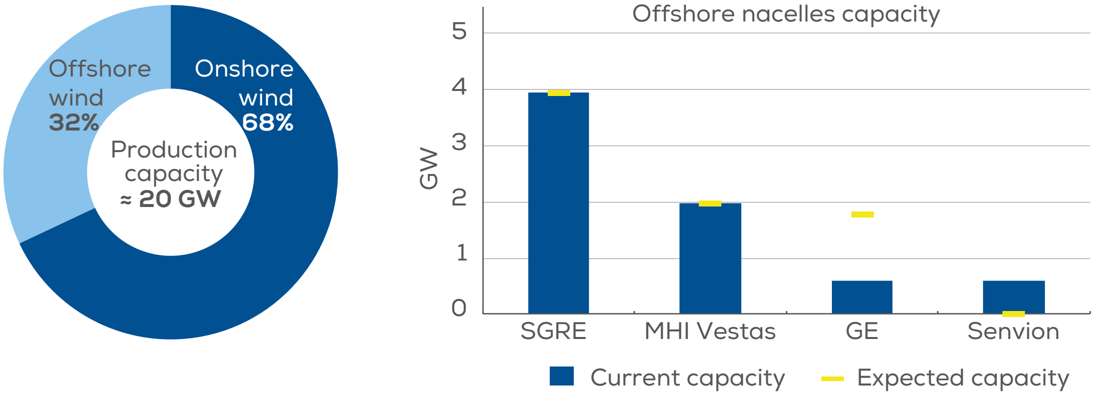
Illustrative post-2000 European wind turbine component manufacturing footprint evolution (number of facilities)



Source: Wood Mackenzie for WindEurope

FIGURE 30

Production capacity of wind nacelles in Europe



Source: Wood Mackenzie for WindEurope

Offshore wind makes up 32% of nacelle assembly production capacity today (Figure 30, left). Europe has 8 GW of nacelle production capacity (Figure 30, right), 2.5 times as much as current annual installations, but less than half of what Europe will need after 2030. Most of the excess capacity is to serve the US market in the short- to medium-term.

As the size of turbines and their components are rapidly growing, the dynamics in the industry are changing. While some components were merely scaled-up to meet demand at the beginning, the manufacturing of purpose-made turbines for offshore conditions meant that suppliers had to restructure capabilities and logistics to offer solutions to the growing sector.

The logistical challenges related to the size and weight of components mean that facilities near a port location provide a clear advantage. For example, direct drive generators can weigh 80-100 tonnes (for a 10 MW turbine) against 30 tonnes for a geared drive generator. Manufacturing these components close to the port and avoiding road transport reduces the logistical costs. There are several examples of such facilities: SGRE nacelle factory in Cuxhaven and their blade factory in the Hull port; LM Wind Power blade factory in Cherbourg and GE Renewable nacelle factory Saint-Nazaire, France; and MHI Vestas' factories at Lindoe port Odense on Fyn (nacelles) and Isle of Wight (blades).

4.5. WHERE COULD THE WIND INDUSTRY EXPAND IN EUROPE?

In the next five years, the global wind component market is expected to grow 8% to €54bn in 2025.

In Europe, however, the market for onshore wind components is expected to decrease 19% to 2025 even at annual installation rates that result in achieving the 2030 NECP wind volumes. Reversing this trend and capturing a larger share of value from wind components would depend on the strength of the domestic market.

In contrast, Europe has the highest growth potential in the offshore wind turbine component market. To 2025 it is expected to be worth €12bn, a 16% compound annual growth rate (CAGR) over 5 years. This is mainly driven by the higher local content of offshore wind turbines due to their size and weight.

Focusing on the highest value, most strategic parts of the supply chain would keep Europe's global leadership and keep delivering value to society.

First, for Europe to continue cost reductions in wind energy, its supply chain should remain diversified.

Second, Europe should target those components where innovation would yield the best economic outcome.

And third, by tapping new manufacturing locations in Central, South and Eastern Europe, the industry could generate jobs and industrial activity in regions where traditionally fossil fuels have done it in the past.

For example, wind turbine blades will remain as a key component, making up 24% of the wind turbine supply cost over the foreseeable future. The onshore wind turbine blades market will stand at around €6bn/year globally.

In contrast, as turbines grow, requiring less units for equal or higher capacity, the market for steel towers will reduce by 22% in the next 5 years, from €7.2bn to €5.6bn. Despite this decreasing market value, opportunities for opening new factories for concrete towers will exist, as evidenced by the recent announcement from Nordex SE on the opening of a new manufacturing facility for these components in Spain[19].

Offshore wind supply chain development will continue to be more local where projects take place. Particularly for heavy components like generators[20] and almost all the balance of plant parts (foundations, transition pieces, cables, etc). The emergence of large commercial floating offshore wind projects is an opportunity to produce components more locally. Europe cannot afford to miss this opportunity.

European suppliers of substructures, particularly monopiles, are expected to continue dominating with 80% of the foundations installed to 2025. Suppliers will continue to innovate to cater for projects in deeper waters (up to 60m), leaner designs, and innovative transition pieces.

Another area in which European suppliers will continue having a strong position in the market is subsea cables. The same goes for services provided by European marine contractors. Major consolidation has taken place in the marine installation business. But new vessels are bound to enter the market to cater for the next generation of turbines.

Vessel innovation will be crucial for both installation and O&M activities. Suppliers of the latter will enhance their capabilities to cater for a wider spectrum of projects and better leverage project scale.

Europe will see not only new technology, but also new business strategies. Installers are looking to offer more services covering engineering, procurement, construction and installation (EPCI) to expand on their value proposition and competitiveness.

On the technology side, onshore turbine sizes could get to 7-8 MW in the next decade. The solutions for logistics to transport and install blades need to emerge in the next 3-5 years to be ready for projects in the second half of 2020.

Expanding from new build to repowering will become an important differentiator in mature markets for European companies. OEM's strategy on multi-brand service would be an important advantage to tap into repowering and life-extension opportunities.

Recycling of wind turbine blades could become the next big business opportunity. However, the value of the market is uncertain as exact volumes are not clear. Margins dealing with waste are low and factories need to be located close to large volumes.

19. https://www.nordex-online.com/en/2020/06/nordex-se-nordex-group-to-build-factory-for-concrete-towers-in-spain/
20. However, direct drive designs in offshore wind, which do not require a gearbox, are expected to decrease the market opportunity for gearboxes.

5.
BENEFITS TO COMMUNITIES

Wind energy creates value beyond jobs and its industrial activities. It directly benefits communities hosting projects. Wind farms are often located in rural, remote, or deprived areas with low investment activity. The benefits created by wind farms are key to these communities, which may have been cut off from the faster-growing metropolitan areas that have done far better from the globalised economy. A prime example are coal regions moving away from mining activities or other heavy processing of fossil fuels.

Wind farms make significant contributions to the local economy through taxes and payments associated with land management. In many places these payments represent an important part of the local municipality's revenues. Taxes then finance new infrastructure or upgrades to the existing one, as well as social programmes for education, health care, or recreational activities. All this contributes to social welfare and economic development at local level. This is why 75-80% of Europeans want more wind today[21].

Some wind farms also voluntarily offer specific financial benefits to local residents, or make use of different community benefit models to cement their community engagement. These include benefits-in-kind, community benefit funds, and community investments through shares in the wind farm.

This chapter describes the following wind energy benefits for local communities:

- Local, regional taxes and land management taxes;
- Community benefit funds;
- Benefits-in-kind;
- Community participation through shares (community ownership);
- Participation in municipality programmes to support community engagement.

Benefits to communities are always tailor-made. A blanket policy for all projects or a single model approach to benefit communities is less productive and creates less cohesive relations between the wind project developers and locals[22]. For this reason, this chapter exemplifies the community benefits of wind through specific case studies.

21. Based on opinion polls:
Suisse Eole: https://www.suisse-eole.ch/de/windenergie/akzeptanz/
France: Harris Interractive, Octobre 2018 https://fee.asso.fr/wp-content/uploads/2018/10/rapport-harris-les-franccca7ais-et-lenergie-eolienne-france-energie-eolienne1.pdf
Germany: Fachagentur Windenergie an Land & forsa Oct. 2019 “Roughly half of respondents said they already lived near wind turbines. Of those, a large majority (78%) said they approved of the installations.” https://www.cleanenergywire.org/news/large-majority-germans-support-wind-power-rollout-survey#:~:text=A%20stable%20majority%20of%20people,(Fachagentur%20Windenergie%20an%20Land).&text=Roughly%20half%20of%20respondents%20said%20they%20already%20lived%20near%20wind%20turbines.
22. Scottish Guidance on good practice principles for community benefits from offshore renewable energy developments, Produced by Local Energy Scotland on behalf of The Scottish Government, SC164 Energy Saving Trust, Revised September 2015, https://www.localenergy.scot/goodpractice

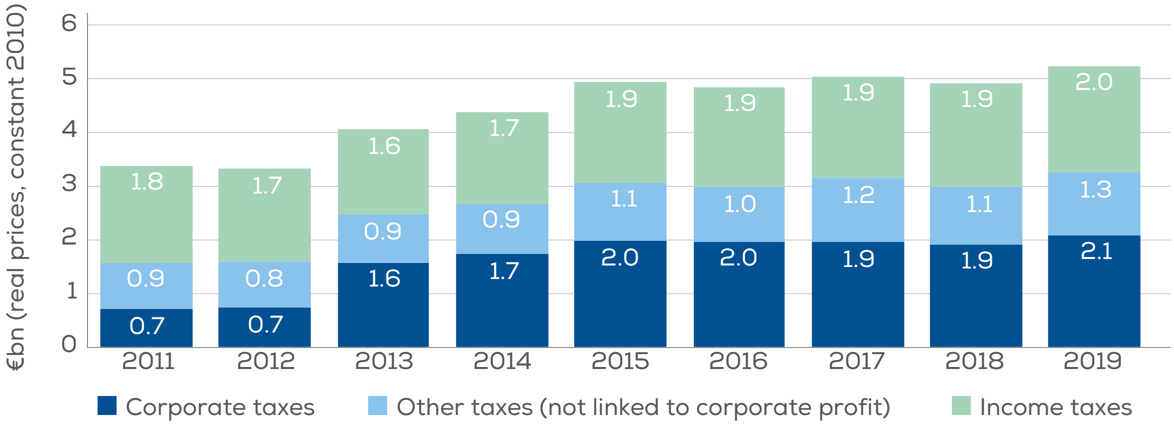
5.1. TAXES

The wind energy industry paid €5.2bn in taxes in 2019, of which €1bn were not linked to corporate profits and were mostly destined to local governments and communities[23].

The total taxes paid by wind energy have increased 52% since 2011.

FIGURE 31

Taxes paid by the EU wind energy industry (real prices, constant 2010)



Source: Deloitte for WindEurope

Local taxes are levied upon different criteria, under different names, and may change over time. As such it is difficult to detail each of them everywhere. But the following examples provide general information to demonstrate the importance they have across Europe:

- In Galicia, in 2019 local municipalities collected €27.8 million of revenue from the 3.4 GW installed in the region. 46% of this was taxes on wind farms[24]. For some municipalities these taxes represent 90% of their revenues.
- In France wind energy contributed €1.2 million of taxes in 2019. Local communities are largely the main beneficiary of this income[25].
- In Greece, the 3% local tax on the turnover of wind farms is split between municipalities (which get 1.7%), local electricity consumers (1%), and the rest goes to the Green Fund (0.3%). In 2019, the tax collected €19.8 million.
- In Ireland, wind farms currently pay €42.5 million directly to the local councils/municipalities in local taxes, which is around 2.6% of all taxes they collect[26]. In addition, municipalities collect a property tax.
- In Romania, the average local taxes paid in 2019, is €2,450/MW plus €15/MW on land taxes[27].
- In Poland, through the real estate taxes, the wind energy sector is paying around €45 million yearly.

In addition, there is the corporate rate income tax which brings around €23 million per year and the personal income tax of the landowners leasing their land to the wind farm owners (an amount equivalent to €8m per year)[28].

These taxes are then invested in various social programmes and initiatives supporting the social welfare of vulnerable groups, health campaigns, community actions, procurement of goods and services, educational campaigns and infrastructure upgrades. Each municipality or region discloses different details on the way taxes collected from wind farms are used.

23. This includes: Tax on the value of the electricity production, tax focused on real state, environmental taxes, and "contributions to local development".
24. Observatorio Eolico de Galicia 2019. http://economiaecoloxica.webs.uvigo.gal/docs/publicacions/informe_oega_2019.pdf
25. Évaluation et analyse de la contribution des énergies renouvelables à l'économie de la France et de ses territoires, Report, SER and EY, June 2020, https://www.syndicat-energies-renouvelables.fr/wp-content/uploads/basedoc/synthese-ser-ey-contribution-des-enr_290120.pdf
26. But this tax will vary depending on the local authority. In five counties the income from wind farms makes up 10% or more of their total commercial rates income: Offaly (10%), Cavan (14%), Roscommon (14%), Tipperary (15%) and Leitrim (22%).
27. Romanian Wind Energy Association, based on interviews.
28. Polish Wind Energy Association based on their database.

The case studies below illustrate how taxes are used at local level.

VALUE CREATION IN LOCAL COMMUNITIES THROUGH TAXES: SOCIAL IMPACT MANAGEMENT

CASE STUDY

© Acciona Energy

ACCIONA

VARIOUS PROJECTS

OPERATIONAL

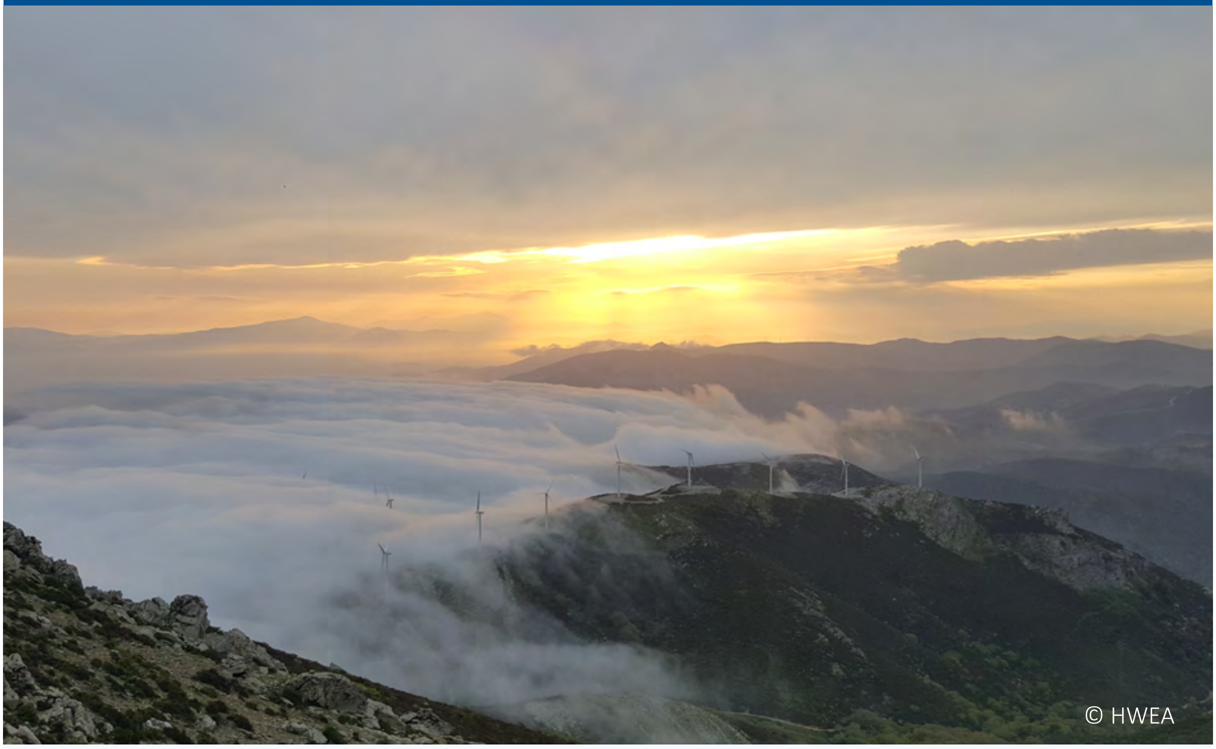
SPAIN

Since 2015, all energy facilities developed by Acciona follow a Social Impact Management (SIM) process in order to guarantee local engagement and create added value from projects to society. In 2019, SIM reached 124 projects in 27 different countries. The social contribution to communities totals more than €12.5 million. In Spain alone, between 2018 to 2019, Acciona contributed €21.6 million at local level and €19.4 million at regional level. €14.8 million was paid for land rent. The cost of land fees varies depending on the area and the company: for wind, the average is €4,400/MW. The joint contribution of local and regional tax contributions for renewable electricity projects, together with land management, represented an average of €9,630/MW or €4.3/MWh. The budget is used to support infrastructure improvements, social welfare of vulnerable groups, voluntary activities, health campaigns, community actions, volunteering activities, procurement of goods and services, educational campaigns and other information and volunteering initiatives.

https://www.acciona.com/sustainability/society/social-impact/

ACTIVATING LOCAL ECONOMY THROUGH TAXES

CASE STUDY



ALL THE WIND FARMS IN SOUTH EVIA ISLAND

218.7 MW

OPERATING BETWEEN 1998-2017

GREECE

Construction and operation of the wind farm projects in South Evia Island between 1998 to 2017 contributed to a total benefit of €82 million. The wind farms brought several benefits to the local community, including :

- 62 direct permanent locally-based jobs;
- €16.5 million in total benefit from operation;
- €27.7 million total benefit from the special 3% turnover tax; and
- €44.4 million total benefit from construction.

These funds have been used to support many local projects including financial aid to firefighters of Taminaio and Stira, implementation of emergency flood defense projects, repair the rural hospital of Katsaronio, buying medical equipment for the rural hospital of Almiropotamos and a series of infrastructure projects.

https://eletaen.gr/wp-content/uploads/2018/09/2018-06-25-wf-local-benefits-in-s-evia-greece.pdf

HIGH CONTRIBUTION TO PROPERTY TAXES

CASE STUDY

WIND FARMS IN THE KALAJOKI MUNICIPALITY, SEVERAL WIND FARM OPERATORS (WPD, TUULIWATTI OY)

VARIOUS PROJECTS

OPERATIONAL

FINLAND

The municipality of Kalajoki is Finland's biggest wind power municipality with a total of 64 turbines from different operators. Wind farm operators pay a property tax of €30,000 per onshore turbine each year (3 times higher than offshore turbines). The municipality of Kalajoki received over €1.75 million last year for the different wind farms that are located on its territory. This was approximately 30% of all property taxes the municipality received.

https://www.wpd.de/
https://hyotytuuli.fi/en/tuulipuistot/jokela-windfarm/

TAX CUTS AT LOCAL LEVEL AND SHARED INCOME

CASE STUDY

ENEL GREEN POWER, SA TURRINA MANNA WIND PARK, TULA I AND II

84 MW

OPERATING SINCE 2010

ITALY

The Sa Turrina Manna Wind Park pays 2% of its gross revenue to the Tula municipality. Authorities consulted its inhabitants on how this income should be used to benefit the community. This resulted in municipal tax reductions for 1,600 households, including the elimination of the personal income and real estate taxes. The municipality also invested in family-friendly policies and education. A total of €400,000 was invested in education (i.e. grants for all level students, funding environmental and sport activities within schools), in support to families (birth incentives), housing tax rebates (i.e. abolition of the tax on the first house from 2012), waste tax discounts (i.e. €50 discount to each family paying this tax), public facilities and infrastructure (i.e. renovation of public sport facilities and sidewalks and cycling paths), and energy efficiency (i.e. renovation of schools and public buildings).

https://renewablesnow.com/news/enel-green-power-adds-60-mw-to-sardinia-wind-farm-45373/

5.2. COMMUNITY BENEFIT FUNDS

Besides taxes, wind farms can offer voluntary financial advantages to nearby residents or make use of different benefit models to strengthen community engagement. These initiatives depend on the local and regional context and the developer's resources and possibilities.

One way of doing so is to establish community benefit funds, which offer opportunities for locals to access financial resources generated by the development of wind farms. Different models of community funds exist, either administered by developers, local authorities or communities. These are established in consultation with communities and are available to residents and organisations neighbouring on- and offshore wind farms within a given distance from the project. Funds might be used for small-scale, one-off investments (for example a school gardening project, a biking lane, or the purchase of equipment), or for larger renovation projects (for example, repairing a memorial, or local infrastructure upgrades), education and training activities, energy efficiency programmes, or other initiatives for the benefit of the community.

Recently many developers have launched special COVID-19 emergency response community funds to help vulnerable members of the community. These provide necessary support for residents who may need temporary or more long-term support during the pandemic for services like food banks, shopping services, and other financial services.

The following case studies show some of the existing community funds and the way they are used by local communities.

COMMUNITY BENEFIT FUND ENCOURAGES LOCAL BUSINESS

CASE STUDY

PEN Y CYMOEDD WIND FARM, VATTENFALL

VARIOUS PROJECTS

OPERATIONAL

UK

The Pen y Cymoedd community benefit fund has an annual budget of £1.8 million until 2043. It has funded numerous initiatives in the surrounding communities. For example, Treorchy, a former mining town in the South Wales Valleys, applied to the Pen y Cymoedd Community Fund for close to £25,000 towards their "Visit Treorchy" initiative. This initiative has helped to create the vision needed to unite vibrant businesses and over 50 community groups, to encourage local people and visitors alike to come and explore the town.

Also, the Community COVID-19 Emergency Funding was recently set up to help organisations facing short term cashflow issues or risk of closure due to financial difficulties arising as a direct result of COVID-19. It prioritises applications from key anchor organisations that deliver services, products and support related to pandemic. It also considers applications from any organisation at risk of closure. Awards may be in the form of a grant or interest-free loan or a mix of the two, depending on individual circumstances.

The developer of Pen y Cymoedd wind farm, Vattenfall, invests more than £2.5 million annually into local communities hosting wind farm projects in the UK. This funds community benefit packages that support capital works, skills, training, education programmes and sponsorship. Vattenfall also offers shared ownership.

https://group.vattenfall.com/uk/what-we-do/our-projects/investing-in-local-communities
https://penycymoeddcic.cymru/community-covid-19-emergency-funding-2/

OFFSHORE WIND TURBINE APPRENTICE TECHNICIAN PROGRAMME

CASE STUDY

© MHI Vestas Offshore Wind

MHI VESTAS OFFSHORE WIND

2,173 MW

OPERATING SINCE 2020

UK

MHI Vestas is setting up an apprenticeship programme to train future offshore wind turbine technicians in the UK. The programme is run in collaboration with the North East Scotland College (NESCOL) and will have a duration of 3 years. NESCOL offers excellent facilities and have a strong heritage of delivering highly skilled individuals ready for the workplace. Initially students will be based at the college campus in Fraserburgh, leading onto a year of offshore experience, either on one of MHI Vestas' flagship 'Walk to Work' vessels, or commuting daily on a modern crew transfer vessel (CTV) to an offshore wind farm. The final qualification will encompass the multi-skilled electro/mechanical mix needed to continue the expansion of offshore wind in Europe. In the first year of the programme MHI Vestas will offer the paid internship to 8 students. Candidates from all backgrounds are welcomed to apply to the programme as MHI Vestas aspires to have an equal mix of male and female students.

https://mhivestasoffshore.com/

COMMUNITY BENEFIT FUNDS SUPPORTS EDUCATION AND TRAINING OF LOCALS

CASE STUDY

© EDF Renewables

BURNHEAD MOSS WIND FARM, CORRIEMOILLIE WIND FARM AND LONGPARK WIND FARM COMMUNITY FUNDS, EDF RENEWABLES

26 MW, 47.5 MW AND 38 MW

OPERATING SINCE 2015, 2017 AND 2009

UK

The Burnhead Moss Education and Training Fund has been used to fund the studies for two engineering apprentices at Forth Valley College (FVC). Another local resident has received financial support towards her travel to college, materials and equipment while she's studying early education and childcare. £26,000 is invested annually to support local people with vocational education and training.

The Corriemoillie Education and Training Fund totals £48,450 per year that supports local people with education and training or apprenticeship opportunities and contributes to creating job opportunities in the local area. It is ring-fenced to help individuals, small businesses and third sector organisations receive funding for the cost of materials, travel and equipment required to complete training and education courses.

The Longpark Wind Farm Community Benefit Fund totals £56,000 per year and was opened in 2010. At the start of the Covid-19 pandemic, the Stow Community Council received funding from the EDF Longpark Wind Farm Community Benefit Fund. The awarded grant of £7,500 is used to support community-led Covid-19 related responses. The funding has also allowed for a home-made soup service to be set up, buying local produce and decomposable and environmentally-friendly tubs to provide households with nutritional soups. The Action Group is working in partnership with Fountainhall's Resilience team, local Community Councils and the Scottish Borders Council to ensure residents continue to be supported through a variety of community initiatives.

https://www.edf-re.uk/local-community/community-benefits#economy

COMMUNITY BENEFIT FUNDS WITH TARGETED ACTIONS TO SUPPORT LOCAL COMMUNITIES DURING COVID-19

CASE STUDY

FALCK RENEWABLES

VARIOUS PROJECTS

OPERATIONAL

EU/ UK, SWEDEN, NORWAY AND FRANCE

Falck Renewables S.p.A. launched an international supporting program to alleviate the impact of the Covid-19 pandemic with targeted actions in the local communities and territories where it operates. The program – for a total value of €740,000 – will help local communities around Falck Renewables wind & solar plants in the UK, Italy, France, Spain, and the US where the epidemic is having a significant negative impact.

In the UK, the company donated to the community benefit trusts connected to each one of its 12 wind farms, located in Scotland, England, and Wales.

In Italy, the support is oriented to assisting 9 municipalities around 8 Falck Renewables' assets in Sardinia, Apulia, Calabria, and Sicily. Funds will be used mainly to locally support Civil Protection, social services, hospitals & emergency services, to install air purifiers in schools, and to contribute to the "Food Bank for Families" initiative. Falck Renewables also supported two medical researches on Covid-19 carried out by the University of Milan.

In France, the contribution has been addressed to the 15 municipalities where Falck Renewables operates its 9 wind farms, located in the Bretagne, Centre-Val de Loire, Grand-Est, Hauts-de-France, Nouvelle-Aquitaine and Pays de la Loire regions. The funds will contribute to the ongoing actions implemented by the municipalities and are aimed at supporting the local population and economy and containing the spread of the virus.

In Spain, Falck Renewables is committed to supporting the municipalities around its two wind farms, in Castilla y León and in Aragón regions. In particular, the assistance will be used to protect the most vulnerable groups by supporting the purchase of sanitary equipment.

http://community.falckrenewables.eu/2020/08/28/launch-of-cefn-croes-wind-farm-community-trust-covid-19-hardship-fund/
http://community.falckrenewables.eu/2020/05/19/covid-19-emergency-how-we-support-our-local-communities-in-the-uk/
http://community.falckrenewables.eu/2020/04/15/covid19-falck-renewables-response-to-assist-local-communities-2/
https://www.falckrenewables.com/en/media/documents-detail/covid-19-emergency-falck-renewables-launches-international-supporting-program-areas-where-it-operates

VALUE CREATION IN LOCAL COMMUNITIES THROUGH LOCAL COMMUNITY BENEFIT FUND : THE RAMPION OFFSHORE COMMUNITY BENEFIT FUND

CASE STUDY

© RWE Renewables

RWE RENEWABLES GMBH

400 MW

OPERATING SINCE 2018

UK

Since the construction phase, the Rampion Community Fund has made support available to local communities in the area. It is designed to help funding local projects, particularly those with links to the environment and ecology, climate change and energy, as well as those that work to improve community facilities. Rampion intends to play an active and supporting role and be of benefit to the local communities in which it works and impacts. Rampion has contributed £4 million to the Sussex Community Foundation. It provides special support for local businesses, educational outreaches to schools and youth organisations, high-quality training and sponsorship for charity organisations, community groups and non-profit organisations. A visitor centre was established to house exhibitions and interactive displays to inform about wind energy and discover the whole Rampion story. The Funds are managed by the local partners, as they know best what projects create most value for the region.

https://www.rampionoffshore.com/community/benefit-fund/

5.3. BENEFITS-IN-KIND

Benefits-in-kind are another way in which wind farms tailor support to the needs of the local community. These are voluntary initiatives for in-kind works and other local initiatives. Benefits could be a one-off funding or investments linked to cultural, educational, recreational and health related initiatives. Benefits can also fund environmental awareness initiatives, infrastructure upgrades, or boost sectors of the local economy (e.g. tourism). Benefits depend greatly on local communities' needs and possibilities, and whether benefits come from an onshore or offshore project.

LOCAL ELECTRICITY DISCOUNT SCHEME

CASE STUDY


© Jason Bickley

THE RES GROUP (RENEWABLE ENERGY SYSTEMS)

VARIOUS PROJECTS

OPERATIONAL

UK

In 2012 developer RES launched its first Local Electricity Discount Scheme (LEDS) as part of the community benefits package for a wind farm in Carmarthenshire, UK. Through the discount scheme, qualifying properties close to a wind farm are eligible for a minimum discount of £100 per year of their electricity bill.

The LEDS benefit is available to private residences, local businesses and public buildings like schools, libraries, and hospitals. Participation in the scheme is voluntary and is not linked to any electricity supplier or tariff. As of 2013, RES offers LEDS in all its new wind farm projects of 5 MW or more.

www.res-leds.com

LOCAL ENVIRONMENT RESTORATION

CASE STUDY


© EDF Renewables

DORENELL WIND FARM, EDF RENEWABLES

177 MW

OPERATING SINCE 2019

UK

The Dorenell Wind Farm Visitor Centre opened in September 2019, together with the Ranger Service, creating 2 full time jobs. The Rangers deliver events and environmental education at the Visitor Centre. As part of the Dorenell Wind Farm Habitat Management Plan, Blanket Bog Restoration is taking place, with 3,200 dams being installed to block historic drainage ditches. This will re-wet the bog and encourage active peat forming vegetation over an area equivalent to that affected by the wind farm.

A Nature Awareness and Climate Action programme has been developed for primary schools. The aim is to inspire children's enthusiasm about the natural world before exploring how we can take action to protect it including renewable energy and bog restoration for carbon capture.

https://www.edf-re.uk/local-community/community-benefits#economy

5.4. INITIATIVES FOR COMMUNITY ENGAGEMENT BY MUNICIPALITIES

LABEL FOR FAIR WIND

Some municipalities and regions in Europe have started to produce guidelines for good community engagement and initiate voluntary labels. In the German region of Thuringia, the Service Unit Wind Energy under the state-owned Thuringian Energy and GreenTech Agency (ThEGA) has set up a catalogue of five guidelines that need to be followed by wind farm developers who want to use the label for fair wind energy in Thuringia. This label is the first of its kind in Germany. The Service Unit Wind Energy was set up in 2015 and provides comprehensive, neutral, and free advisory and technical assistance services for citizens, municipalities and developers in the field of wind energy. The creation of the service unit as well as guidelines and the label in Thuringia were inspired by the example of a similar service unit established in the administrative district of Steinfurt (federal state of North-Rhine Westphalia) back in 2011.

The service unit started to award the 'Fair Wind energy label' in 2015, a certificate for wind energy project developers that commit themselves to certain transparency, procedural and financial participation standards. The label "Partner for Fair Wind Energy" was introduced in parallel to the comprehensive support and advisory services provided by the Service Unit to address and overcome existing barriers concerning non-transparent planning procedures and uneven distribution of costs and benefits of wind energy.

The award of the label is based on voluntary agreements between the Service Unit and project developers. Since 2015, 50 project developers have been awarded the label.

TERRITORIES OF POSITIVE ENERGY

Another municipal initiative is the creation of positive energy territories 'Territoires à énergie positive' in France. The initiative aims to ensure all the energy needs of a locality are reduced to a minimum and supplied by renewable energy following three principles: energy sobriety, energy efficiency and renewable energy.

TERRITORIES OF POSITIVE ENERGY

CASE STUDY

LANDES DE LAVERNAT WIND FARM, ENGIE

8 MW

OPERATING SINCE 2018

FRANCE

First contacts with the local authority concerning the project were made in 2007. Consultations with local residents, farmers and property/landowners followed in 2008 and 2009. These were undertaken as part of the spatial planning decision-making (i.e. defining the "Zone de Développment Eolien"). During the planning application phase, drop-in information sessions were organised in the town hall describing the project, its potential impacts and the mitigation measures put in place. Construction started in 2017 and the wind farm became operational in 2018. In Spring 2019, Engie and the commune co-organised visits to the wind farm which attracted hundreds of people. Since then, the wind farm has become a local symbol to the point of featuring on the commune's logo. Lavernat has also joined the "Territoires à énergie positive" initiative, becoming the first village in Sarthe to do so. The initiative aims to ensure all the energy needs of a locality are reduced to a minimum and supplied by renewable energy following three principles: energy sobriety, energy efficiency and renewable energy. Investigations for the expansion of the wind farm started in 2020.

https://www.engie-green.fr/app/uploads/2018/10/lavernat-ENGIE-A4-eolien-2018_DEF.pdf
http://www.territoires-energie-positive.fr/

5.5. COMMUNITY OWNERSHIP

Local communities can also benefit from owning shares of a wind farm. There are different models for community ownership. Much like other benefits, community ownership represents an opportunity for rural communities to profit directly from the presence of wind farms in their areas. The profits from the electricity generated by the wind farms are distributed among participants of the community ownership scheme.

The following example showcases a repowering project co-owned by local citizens, farmers and other locals.

SHARED OWNERSHIP WITH LOCAL COMMUNITY CASE STUDY

© RWE Renewables

RWE RENEWABLES GMBH

67 MW

OPERATIONAL

GERMANY

Community participation and shared ownership proved to be a valuable measure to increase public acceptance. The city of Bedburg (49%) and RWE Renewables (51%) collaborated to build the Königshovener Höhe wind farm on a renaturalised area of the Garzweiler open-cast mine. The project also brings stimulus to a region affected by energy transitions. It has a total capacity of 67 MW, and each of the Senvion windmills is 200 metres high. The wind park serves 58,000 households and amounts to an investment of €110 million.

https://www.group.rwe/unser-portfolio-leistungen/betriebsstandorte-finden/onshore-windpark-koenigshovener-hoehe

SHARED OWNERSHIP – REPOWERING

CASE STUDY

© Vestas Rabobank Windpark Zeewolde

ZEEWOLDE WIND FARM

336.7 MW

TO BE OPERATIONAL END 2021

NETHERLANDS

The Zeewolde Wind Farm is a repowered project with 220 old wind turbines being replaced by 91 new and more powerful ones. This will result in almost three times more electricity generation. The first old wind turbine was dismantled in June 2020.

With the exception of 8 wind turbines that are owned by Raedthuys and Eneco, the Zeewolde Wind Farm is developed by farmers, wind turbine owners and citizens of the rural area of Zeewolde. Local citizens in the communities surounding Zeewolde Wind Farm will be able to invest in the wind farm.

The developer Windpark Zeewolde B.V. will issue bond loans at the end of the construction phase, planned for the end of 2021. €12 million will be available. It concerns a long-term loan with expected interest rates of 6%. Citizens can participate with a minimum amount of €500. Citizens of Zeewolde, Almere and members of the renewable energy cooperative 'de Nieuwe Molenaars' will be given priority. In case the €12 million is not reached, all citizens living in areas adjacent areas can also subscribe.

https://windparkzeewolde.nl/
https://windenergie-magazine.nl/local-residents-can-invest-in-zeewolde-wind-farm/
https://steelguru.com/power/vestas-rabobank-and-windpark-zeewolde-partner-up-to-build-netherland-s-largest-onshore-wind-project/560690

5.6. JUST TRANSITION

The European Green Deal puts great emphasis on the need for an inclusive transition that leaves nobody behind. This is particularly the case in the so-called Coal Regions in Transition, which are exiting conventional generation and will be reorienting towards renewables.

Coal regions have clear incentives to look at wind power as their future electricity source. Onshore wind will be a big chunk of any newly installed capacity because of its low costs: it is the most competitive form of new energy generation today in most of Europe. Bloomberg New Energy Finance estimates that the EU's most coal-intensive economies (Poland, Czechia, Romania and Bulgaria) could reach a 47% share of renewables in 2030, easily outpacing the 31% they cumulatively pledge in their National Energy and Climate Plans.

The energy transition is already taking shape in these regions. In Margonin, Poland, the biggest wind farm of the country contributes 25% of the municipal budget which is used for the development of local infrastructure. On the Greek island of Evia, wind energy projects have contributed €82m to the local economy. From operation alone, the wind farms contribute €3.9m each year and the project has created 62 direct permanent jobs.

And the wind industry already works on skills development that create long-term value for local communities. Initiatives across coal regions for the retention of local employment already exist. In both Poland and Romania there are plans for re-skilling projects for coal miners to gain skills necessary in the wind energy sector.

Pilot project Valea Jiului, Romania: In Romania, the wind industry has the ambition to contribute to a just energy transition and proposes a professional training and reconversion project for people in the coal dependent regions, such as Valea Jiului. Building on the 8 year experience of the Monsson – RESS (Renewable Energy School of Skills) training center in Constanta, The Romanian Wind Energy Association (RWEA), along with its member companies such as Monsson and CEZ Group in Romania through Distributie Energie Oltenia, and also other companies within the Group plan to access the funding available under the Just Transition Fund for developing a professional Academy (for reconversion) in Valea Jiului. During the project's implementation period (10 years), the project aims to reconvert up to 800 renewable and energy distribution technicians annually, for up to 8,000. They will be then employed in the wind and renewables sectors.

The technical and professional abilities of the mining sector technicians are easily transferrable towards renewable energy and energy distribution, while the certifications awarded following the training and reconversion courses will allow them to be employed in installing, operation and maintenance of RES projects and energy distribution grids with attractive salary packages. This will allow short- and long-term job security and restore confidence. This model can be replicated in other European areas.

Pilot Project City of Bytom, Poland: In Poland, the wind industry actively supports and participates in measures to improve the situation of regions that may be adversely affected by the effects of the energy transition, such as Silesia. The Polish Wind Industry Association (PWEA) put in place a pilot project to mitigate the consequences of the energy transition and retrain employees working in industries affected by it. It thus proposes a project to retrain employees in coal-dependent sectors for the purposes of the wind and energy sectors.

Like the Romanian project, the Polish will use the technical and professional abilities of the mining sector specialists in the renewables (RES) and energy distribution sectors. The certificates granted after training sessions will enable employment in installation, operation and maintenance of RES projects and energy distribution networks in Poland and worldwide.

PWEA, the Vulcan Training Center and the City of Bytom preliminarily agreed on the construction of a practice and training center fully equipped in an area currently occupied by the shutdown Upper Silesian Narrow-Gauge Railway Repair Shop in Bytom.

They are often mentioned as a perfect illustration of how the EU funds could be used to support the transition.

6. HAPPY CO-EXISTENCE

Like the community benefits in the previous chapter, the approach towards happy co-existence between wind farms and its surroundings is tailor-made. There are many good examples of how this is achieved (for example, on the involvement of fishing communities in siting decisions for offshore wind farms, the alternative employment opportunities offered by developers, or the compensation schemes if disruptions to local activities occur during construction of wind farms).

This chapter describes how wind farms can co-exist with government activities like defence; civil society initiatives, such as nature conservation and biodiversity protection; and other economic sectors, such as fishing and agricultural activities.

6.1. DEFENCE, MILITARY AND CIVIL AVIATION

Governments may restrict the deployment of wind farms in certain areas used for military activities, like surveillance, training and R&D. The wind industry strives for a collaborative approach with the different defence authorities – covering air, sea and land – so that restrictions are well communicated, properly understood, and mitigation solutions jointly discussed and agreed.

The constructive dialogue between military authorities and wind farm developers has meant that wind turbines can now be built and operated in areas previously thought impossible. This has freed up large areas for developing onshore wind farms in France and the UK. The Swiss air force has also taken interest in building bridges to the wind industry. And there are ongoing discussions about synergies between offshore wind farms and the navy in Belgium, the Netherlands and Sweden, for example on how to share communications infrastructure and other assets to monitor criminal activities at sea.

In particular, the improved understanding on the interactions between wind turbines and military radars and aircraft has yielded significant improvements for their coexistence. There are now technologies available in the market that help authorities to clearly differentiate signals produced by wind turbines from those by aircraft.

All these developments have required strong political involvement and oversight in order to ensure a productive dialogue. In the medium- to long-term this could be applied not only on a project-by-project basis but on a larger national, and potentially international, strategic basis.

6.2. NATURE CONSERVATION AND RESTORATION

Wind energy not only contributes to the conservation of biodiversity through the decarbonisation of the electricity supply, there is also evidence that wind farms can act as local nature conservation areas, and indirectly promote restoration of habitats and ecosystems[29].

Indeed, at the local level, wind energy can have positive effects on biodiversity and offers an opportunity to practice ecological restoration. Offshore wind farms, for example, are quickly populated by sea life once they enter operation[30].

Strategic environmental assessments and environmental impact assessments are effective ways for managing the happy co-existence of wind farms, wildlife and the environment. Developers use these assessments as the basis to actively work out methods to adapt their wind farm designs to minimise their impacts, and to find synergies with the environment. This is always done in close dialogue with authorities and stakeholders.

The appropriate siting and design of wind farms is the most important factor to enable nature protection in areas chosen for wind energy development. These can even be inside or adjacent to the so-called Natura 2000 areas (special protected areas, special conservation areas, sites of community interest), provided that all suitable impact assessments are done in line with European and national legislation.

The wind energy industry can also contribute to wildlife protection thanks to the body of knowledge it has created over years of project development. Not only do developers perform environmental assessments in the pre-construction phase of projects, they also execute research and development (R&D) during and post-construction. This R&D spending is in addition to the cost of the mandatory environmental impact assessments (EIA) and any potential costs associated with environmental monitoring programmes.

29. WindEurope, 2017. Mainstreaming energy and climate policies into nature conservation
30. https://www.ecori.org/renewable-energy/2020/7/8/offshore-wind-can-change-habitats-for-the-better

ONSHORE

Appropriately sited and well-designed onshore wind farms can happily co-exist with wildlife. For example, during the environmental impact assessment process for the Beinn an Tuirc wind farm in Scotland, a golden eagle territory was identified close by. This led to the relocation of the wind farm further south and the development of a habitat management plan (HMP). The HMP covered 1,670 ha and involved the restoration of habitats to provide an alternative foraging area away from the main wind farm site. Results of the monitoring work carried out between 1997 and 2014 showed that eagles have neither collided with the wind turbines nor have they been displaced due to disturbance[31].

A regional framework was developed for the Burgenland Region of Austria, which identified suitable areas for wind farms in consultation with stakeholders. The region is one of the most important bird areas in Austria and has a high wind energy potential. Within 10 years, 900 MW of wind power was installed. Meanwhile, both the sea eagle and the imperial eagle, which were extinct in the whole of Austria, have returned to the region and the bustard population has grown from 60 to 500[32].

OFFSHORE

Offshore wind farm developers can take extra measures to enhance the positive effects of wind farms on biodiversity. They can increase the ecological conditions of the seabed through solutions such as benthic-friendly scour protection systems or artificial substrata. These actively help to promote healthy and diverse marine ecosystems. For example, developers can add artificial reef substructures in soft sediments, between wind turbines and scour protections, or introduce species compatible with the local ecosystems[33].

The co-location of offshore wind farms and aquaculture has shown many benefits. Flat oyster restoration projects in the Dutch North Sea have improved the seabed conditions, increased water quality through filtration and boosted local ecosystem services, including food production. Oyster farming is enhanced by the fact that no seabed-disturbing activities are carried out inside wind farm areas. This is why the Netherlands is targeting oyster restoration projects within its current and planned offshore wind farms[34].

6.3. FARMING

Farmers traditionally used windmills for generations to pump water and mill grain. Now farmers turn to wind turbines to generate electricity on their farmland.

Wind turbines provide a stable source of income to farmers through money earned from leasing their land to wind energy companies. This can help protect farmers from fluctuations in commodity prices or poor crop yields resulting from droughts or floods. Farmers can also choose to reinvest in their business by purchasing new equipment or making other improvements.

No other form of power generation has less impact on the land in which it is installed. Conventional sources have important environmental impacts due to mining and contamination of adjacent waters. Other renewables require more surface for power generation, making it more challenging to combine them with agricultural activities.

The main advantage of wind energy is that farmers can continue to work on most of their land. Other benefits include:

- After the turbines and related infrastructure are installed, farming can continue nearly right to the base of the turbine;
- A typical wind farm leaves 98% of the land undisturbed, meaning it's free for other uses like farming and ranching;
- Often the construction process will include creating new roads or updating existing roads, which can improve operations;
- If crops are damaged during construction, wind developers will typically reimburse the landowner for the lost revenue[35].

31. WindEurope, 2017. Mainstreaming energy and climate policies into nature conservation
32. WindEurope, 2019. Wind Energy and Birds.
33. Bureau Waardenburg. 2020. Options for biodiversity enhancement in offshore wind farms. Knowledge base for the implementation of the Rich North Sea Programme. Bureau Waardenburg Rapportnr. 19-0153, Culemborg.
34. Didderen et al. 2019. Pilot to actively restore native oyster reefs in the North Sea – Comprehensive report to share lessons learned in 2018. https://www.ark.eu/sites/default/files/media/Schelpdierbanken/Report_Borkumse_Stenen.pdf
35. American Wind Energy Association. Available online at https://www.awea.org/wind-101/benefits-of-wind/wind-in-my-community/agriculture [accessed 17 July 2020].

6.4. FISHERIES

Offshore wind can co-exist and develop synergies with other economic activities at sea. The fishing sector is crucial for offshore wind deployment and for Europe to achieve its commitment to become carbon-neutral through the Green Deal. The constructive dialogue between the wind industry and fishermen is key to finding solutions so that communities continue to develop their activities under the best possible conditions when a wind farm is developed.

Fishing plays a crucial role in employment and economic activity in several EU regions. In some European coastal communities, the fishing sector accounts for as many as half the local jobs[36]. Once in operation offshore wind farms enable fish stocks to replenish as a result of banning seabed-disturbing activities. This is very positive not only for the environment but also for local fishermen. Fishing communities only stand to gain when fish stocks are in good health.

However, this means that only certain types of fishing can take place within and nearby the wind farms. Currently this is only allowed in some countries and under important safety considerations. Wind farm owners and authorities have had to adapt security and safety protocols to enable this.

The most serious risk affecting fishermen when accessing areas where submarine cables exist, is to snag their gear or anchors on a cable. Submarine cables are initially buried on installation. However, they may become exposed due to both current and seabed erosion. A fishing vessel and its crew could be endangered if unintentionally attempting to lift a cable from the seabed.

To reduce the risk of accidents, law infringements and/or collision, it is very important to communicate clearly detailed natural charts and navigation routes, cables and related assets as well as exclusion areas (temporary or permanent) and security zones. Developers and fishermen must commit to sharing data that can help to reduce such risk. Fishing plotters can download all the information on submarine cables around the UK and Northern Europe from the KIS-ORCA website[37].

Wind farms may also offer the possibility of alternative employment to fishermen, who can help with safety patrols, and in some cases offer other services to developers depending on the size and condition of their vessels. Indeed, fishermen's experience could be a valuable skill to support offshore wind, especially during construction and surveys. In order to maximise these opportunities early, close dialogue between developers, authorities and communities is paramount.

Examples of such initiatives include the West of Morecambe Fisheries Fund and the Thanet Fishermen's Association fuel company. An innovative approach is the case of employment of local fishermen (those who can count on appropriate vessels) in wind farm-related work such as Guard Boat or Stand-by Boat as well as bird and mammal watch for environmental monitoring. This has proved effective especially when fishing quotas were exhausted.

Sea Source is a co-operative owned by the fishermen of Kilkeel, in Northern Ireland. It is a membership organisation offering marine services and offshore asset management expertise. It is powered by a collective of experienced and knowledgeable fishermen with a deep understanding of the shared marine environment. Their services include guard vessels, asset protection, marine observation and data collection. Sea Source offshore profits are fed back into the co-operative, which in turn make their way directly into the fishing communities.

Last, in finding the best possible solutions, developers may offer compensation schemes if disruption to local activities occurs during construction of wind farms, even if this is not foreseen in legislation[38]. In general, when a wind farm is under construction, fishing activities in the immediate area are restricted for safety reasons. Once the wind farm is operational, fishing can resume according to national regulations.

36. European Commission, 2020. Facts and figures on the common fisheries policy. https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/pcp_en.pdf
37. www.KIS-ORCA.eu.
38. This includes economic losses due to new navigation rules, habitat displacement or disruption of fishing activities (during surveys, construction, or operation of the wind farm). The Crown Estate introduced the concept of disruption settlements and Fisheries Community Funds, adopting a case-by-case approach.

ANNEX I

BUILDING THE WINDEUROPE SCENARIOS

The previous WindEurope scenarios to 2030 were published in 2017. There have been significant regulatory changes at EU and national level. This is a summary of the recent events that have shaped the context of our long-term scenarios.

Regulatory developments at EU level

In 2018 Europe set a target of at least 32% renewable energy by 2030 and upgraded its energy market rules as part of the Clean Energy Package. The comprehensive set of policies to drive the energy transition included Member States working out detailed National Energy and Climate Plans (NECPs) to deliver the collectively agreed 2030 target.

Following the June 2019 European Parliament elections, European Commission President Ursula von der Leyen committed to making the EU climate neutral by 2050. To reach this objective the Commission launched the European Green Deal as a new growth strategy for Europe. This is a set of new initiatives and rules for accelerating the decarbonisation across the economy.

The Green Deal envisages raising climate and energy targets for 2030. This autumn the EU will decide on it. The European Green Deal also brought new strategies on industrial policy, energy sector integration and offshore renewables.

All these policies are expected to guide Member States' ambitions to deploy more wind in their countries.

Regulatory developments in Member States

In 2018 the share of renewables in gross final energy consumption reached 18%. This is the last official indication of whether Europe will meet its 20% renewables target by 2020. 12 Member States had already reached a share equal to or above their national 2020 binding targets: Bulgaria, Czechia, Denmark, Estonia, Greece, Croatia, Italy, Latvia, Lithuania, Cyprus, Finland and Sweden. But some countries will most certainly miss their targets: France, Slovenia, and Ireland. The COVID-19 pandemic, combined with mild temperatures and strong winter storms, led to rising generation from wind farms amid a lower energy consumption. That could help countries such as Germany, Belgium and Poland to reach their 2020 targets, as well as the EU.

The NECPs delivered to the European Commission at the end of 2019 will get the EU to a renewable energy share of 33% by 2030. But despite countries pledging to expand renewables and wind energy, the NECPs lack the policy measures that will deliver these pledges. In developing WindEurope's capacity scenarios we have taken into consideration the impacts this would have for wind installations.

Many national governments increased their commitments on offshore wind in their NECPs on back of dramatic cost reductions. France is now planning to tender 1 GW a year up to 2024. The Netherlands has raised their 2030 offshore wind target to 11.5 GW. Poland, Ireland and Lithuania made new commitments too. The UK government has ambitions for up to 40 GW by 2030. In total there are 111 GW of offshore wind in Governments ambitions by 2030, reflected in our NECP scenario.

However, some of the positive developments in onshore wind auctions do not seem to reflect improved policies to 2030. In 2019 Poland held Europe's largest ever onshore wind auction, awarding 2.2 GW at €39-55/MWh. Denmark, Greece and Lithuania all had successful auctions. Permitting is the biggest issue. This impacts auction results severely. In Germany undersubscribed onshore wind auctions are becoming the new norm as five out of six auctions were undersubscribed in 2019. And in 2020 there are undersubscribed auctions both in Germany and Italy.

Permitting is becoming more complex and more expensive all-around Europe. Permits are an issue because of many applications and increasing numbers of appeals and legal complaints. In Germany the rate of new project permits has dropped significantly and the proposed 1,000m setback distance rule was not helpful for both new and repowered wind farms. The Government has dropped the proposal and after months of negotiations the German federal government will allow states an 'opt-in' procedure to decide themselves whether to introduce this minimum distance between new wind projects and the nearest settlement.

Setback distance is also being reviewed in Poland where there have been announcements to liberalise the process of creating onshore wind farms. Among the topics of liberalisation will be the "10H-rule", which was established as a minimum distance between wind turbines and buildings and protected areas. Wind turbines were forbidden to be built closer than 10 times the turbine height from buildings.

Germany is building around 80% fewer wind farms than it used to. This is badly affecting the German wind turbine manufacturing industry, which has lost thousands of jobs in the last 2 years.

There are positive developments in Sweden, Spain and Norway as well as in other European countries. Together, these have compensated for the low installations in Germany and helped the wind sector to see a growth in installations in 2019 compared to 2018.

Another challenge for wind installations in the long-term is the ageing wind fleet in Europe, especially the onshore wind fleet. In 2019 there was less than 200 MW of decommissioned projects in Europe, but that figure is set to grow significantly this decade as more turbines reach their theoretical end of operational life (20 years). By 2023 around 22 GW of wind energy capacity will reach the end of its theoretical operational life. Most of this capacity will get a lifetime extension. Around 2 GW will be repowered delivering 4-5 GW of capacity. And another 2 GW will be fully decommissioned. The wind industry would like to repower more, but government policy and regulation either don't allow for it or make it unattractive.

ANNEX II

AII.1 JOBS

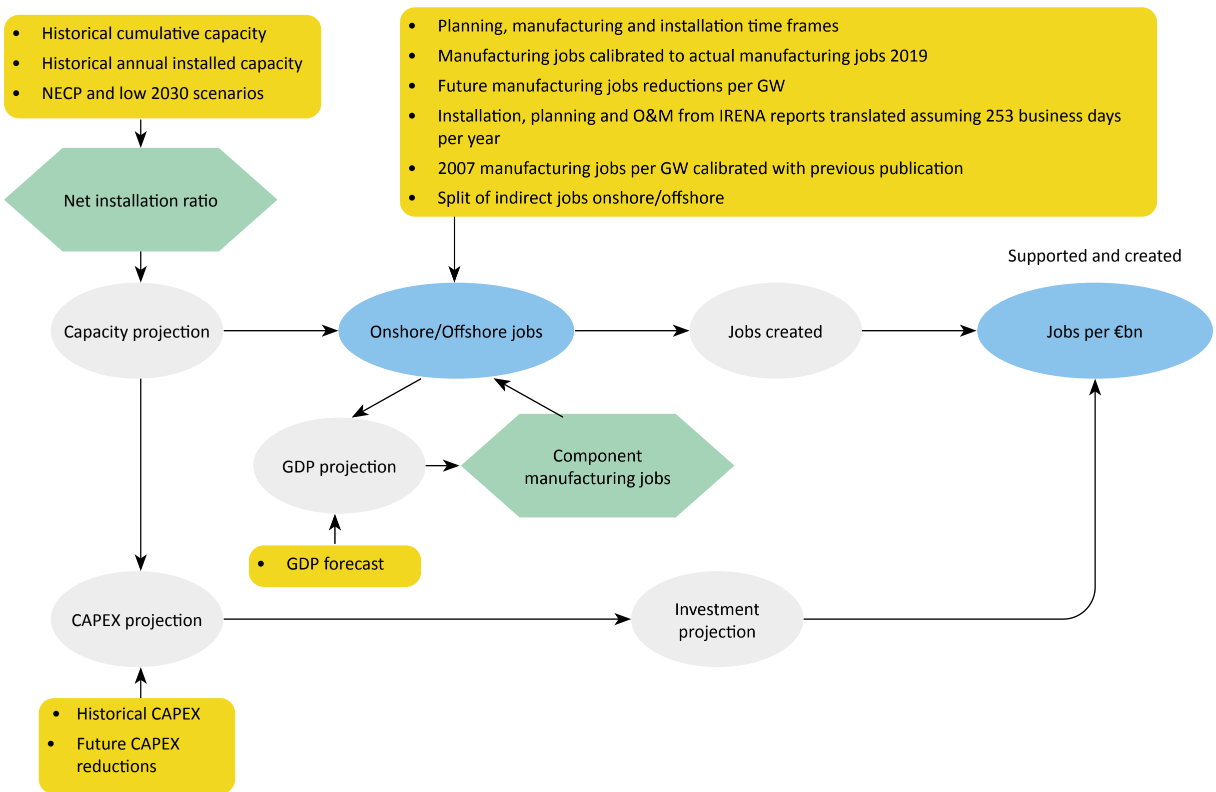
We estimate jobs based with a combination of bottom-up data collection from companies and a top-down model. All calculations use Full Time Equivalent employees (FTE). One job is equivalent to one FTE working 253 days over one year.

Collecting staff numbers directly from companies allow us to the estimate the direct and indirect employment of wind energy in Europe. This split is helpful to present the macro-economic impact of the industry. However, it also poses the challenge of clearly identifying jobs in each subsector, on- and offshore. Many companies are active in both, but do not report the split of their staff in that way.

To estimate the split between onshore and offshore wind based on the annual direct and indirect jobs, we built a model using the International Renewable Energy Agency (IRENA) estimates on job creation in wind energy[39,40]. We updated IRENA's assumptions on the duration of projects, capacity installed, turbine size, and CAPEX. We used the model also to estimate jobs/GW and to forecast job creation with future investments. Figure AII.1 shows a graphic representation of inputs and outputs of the model.

FIGURE AII.1a

WindEurope model to estimate jobs

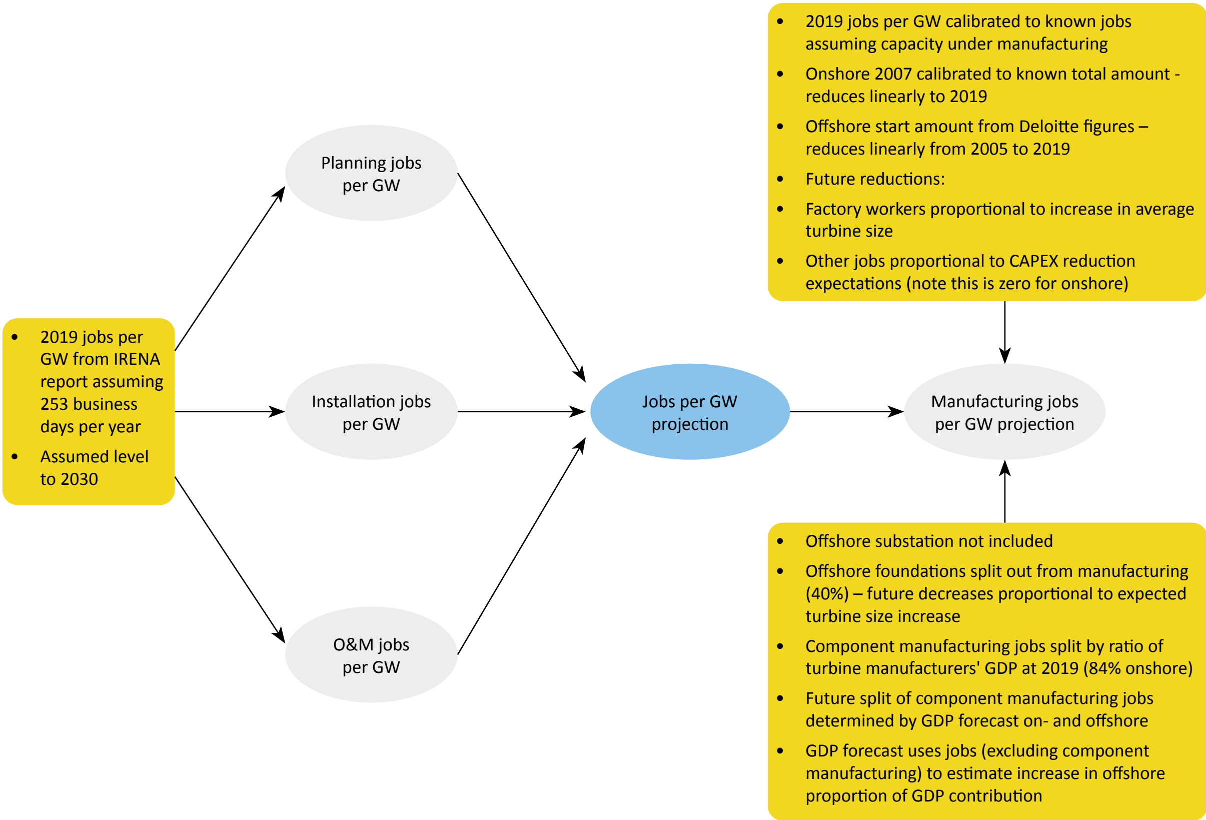


Source: WindEurope

39. IRENA (2017), Renewable energy benefits: Leveraging local capacity for onshore wind.
40. IRENA (2018), Renewable energy benefits: Leveraging local capacity for offshore wind.

FIGURE AII.1b

WindEurope model to estimate jobs per GW



Source: WindEurope

First, there are 30,402 jobs producing turbine components in Europe (Table AII.1, year 2019). These companies supply their products to both on- and offshore wind turbine manufacturers. For example, gearboxes, generators or converters. We use the ratio onshore to offshore of the contribution to the EU GDP of wind turbine manufacturers to allocate these jobs accordingly to onshore or offshore wind.

Second, there are just over 140,000 indirect jobs in wind energy. We allocated them QBIS study estimates to derive a ratio of direct-to-indirect jobs for offshore wind and then calculate the onshore jobs accordingly[41].

Adding these two steps to the clearly identifiable direct jobs (turbine manufacturers, developers, offshore foundations, and services) shows that Europe had 224,000 jobs in onshore wind and 77,000 in offshore wind in 2019.

41. QBIS, 2020. Socio-economic impact study of offshore wind.

TABLE AII.1

Onshore and offshore jobs per function

	JOBS IN THE WIND INDUSTRY								
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Onshore wind energy developers	13,096	13,745	14,417	14,943	15,181	15,585	16,544	17,343	18,065
Offshore wind energy developers	3,186	5,219	5,103	5,578	6,350	6,239	6,402	6,374	6,715
Onshore wind turbine manufacturers	40,831	39,796	35,635	38,874	40,868	40,950	43,567	41,633	43,607
Offshore wind turbine manufacturers	4,329	5,647	6,365	5,133	6,882	6,628	7,801	6,953	9,079
Components manufacturers	31,884	32,185	30,535	29,916	30,215	30,177	31,686	30,101	30,402
Onshore service providers	40,539	39,888	35,935	33,852	32,432	32,633	31,702	36,271	35,240
Offshore service providers	3,051	4,592	5,972	6,448	7,152	6,684	6,010	7,962	9,550
Offshore wind energy substructures	3,045	5,295	4,410	5,880	8,415	7,650	7,606	7,577	7,898
Direct jobs	139,962	146,367	138,372	140,624	147,495	146,545	151,319	154,213	160,556
Indirect jobs	119,713	122,200	109,046	115,610	120,047	116,166	121,247	125,744	140,293
Total jobs	**259,674**	**268,567**	**247,419**	**256,234**	**267,542**	**262,711**	**272,566**	**279,958**	**300,850**

Model outputs	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Onshore wind jobs	181,124	189,689	201,830	201,194	205,335	212,405	214,762	215,296	224,023
Offshore wind jobs	28,260	34,560	43,769	45,690	53,642	52,380	61,487	67,153	77,356
Total jobs	**209,383**	**224,249**	**245,599**	**246,884**	**258,977**	**264,785**	**276,250**	**282,449**	**301,379**

Model output match versus annual figures	80%	83%	99%	96%	97%	101%	101%	101%	100%

Source: Deloitte data and WindEurope own elaboration

Third, to estimate how many jobs are needed per unit of capacity installed (e.g. GW), it requires identifying the jobs per function in a project: planning, manufacturing, installation, operation, and maintenance. This provides valuable information on the type of jobs used during a wind energy project. And implicitly on the period these jobs enter or exit the project life cycle. This means not all jobs are created immediately when investments are made. Job are spread over the project duration, even many years before investment decisions are made.

We estimate wind energy projects in Europe require 6,073 FTEs/GW in onshore wind and 5,677 FTEs/GW in offshore wind. Onshore wind uses 204 FTEs in planning, 3,723 FTEs in manufacturing, and 1,935 FTEs in installation per GW. It employs a further 211 FTEs/GW per year in O&M. Offshore wind requires 188 FTEs in planning, 2,049 FTEs in wind turbine manufacturing, 1,366 FTEs in foundations manufacturing, and 1,875 FTEs in installation per GW. It employs a further 198 FTEs/GW per year in O&M. All these are direct jobs only. Adding the indirect jobs results in 11,105 FTEs/GW and 11,457 FTEs/GW in offshore wind.

For comparison, IRENA direct job estimates that onshore wind globally employs on average 4,858 FTE/GW in project planning, manufacturing and installation. Once in operation it employs a further 205 FTE/year in operation and maintenance (O&M) activities[42]. Offshore wind employs 12,674 FTE/GW/year plus 209 jobs/year in O&M[43].

IRENA's reports includes the estimation of the total job creation along the whole wind energy value chain. For this reason, those services which are imported from outside the European Union would also be included in IRENA's figures. However, we are not sure about the convenience of comparing WindEurope's numbers and IRENA's numbers in a to-be-published document.

IRENA's numbers can be different because of different reasons:

a. Different geographic range: the WindEurope estimation is for Europe, while IRENA's numbers are worldwide ranged.
b. Differences in the activities which are considered to make the wind energy value chain: some activities which were considered to make part of the wind energy value chain in the IRENA report may not be treated as such by WindEurope (or may be considered as indirect jobs).

IRENA estimated the total job creation along the whole wind energy value chain. This includes those jobs of imported services. That means not only local jobs. Also, not all activities or labor intensity can be directly transfered to the European context.

It is also important to note that all figures per GW represent the human resources needed for a new project, likely without pre-existing installations, and possibly in a region kick-starting wind energy. This means the next GW installed will not create another (new) 4,858 FTEs/year in onshore and 12,674 FTEs/year for offshore. Therefore, converting these FTEs into number of jobs and multiplying these times the capacity (in GW) of several projects across the years leads to large differences against annual jobs reported by companies.

TABLE AII.2

Onshore and offshore jobs per GW and per function

	DIRECT JOBS PER FUNCTION						INDIRECT JOBS
Jobs / GW	Total (2019)	Planning	Manu-facturing	Foundations (offshore only)	Installation	Operation and maintenance	
Jobs supported in onshore wind sector	11,105	204	3,723	-	1,935	211	5,032
Jobs supported in offshore wind sector	11,457	188	2,049	1,366	1,875	198	5,780

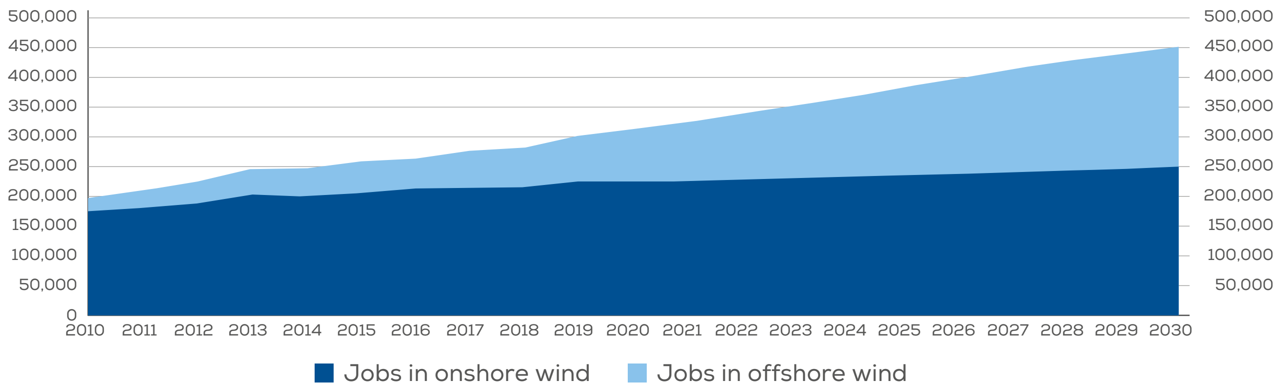
Source: WindEurope

We forecast jobs to 2030 using the jobs allowing for efficiency improvements, cost reductions, and expected turbine sizes. Table AII.2 shows the jobs forecast on- and offshore per function in 2030.

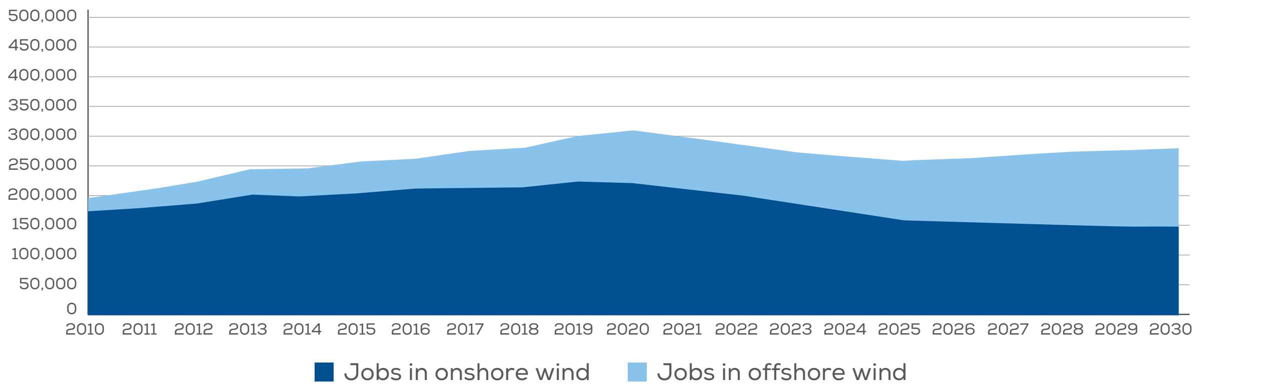
42. IRENA (2017), Ibid
43. IRENA (2018), Ibid

FIGURE AII.2

Onshore and offshore jobs forecast in 2030 in the NECP (top) and Low (bottom) Scenarios



NECP SCENARIO	Total in 2030	Planning	Manu-facturing	Foundations (offshore only)	Installation	Operation & maintenance	Estimated direct jobs	Estimated indirect jobs
Jobs supported in onshore wind sector	250,000	8,000	59,000	-	11,000	58,000	136,000	113,000
Jobs supported in offshore wind sector	200,000	11,000	39,000	9,000	25,000	20,000	104,000	97,000
Total jobs in wind energy	450,000	19,000	98,000	9,000	36,000	78,000	240,000	210,000



LOW SCENARIO	Total in 2030	Planning	Manu-facturing	Foundations (offshore only)	Installation	Operation & maintenance	Estimated direct jobs	Estimated indirect jobs
Jobs supported in onshore wind sector	150,000	3,000	24,000	-	5,000	50,000	82,000	68,000
Jobs supported in offshore wind sector	132,000	7,000	25,000	5,000	16,000	15,000	68,000	64,000
Total jobs in wind energy	282,000	10,000	49,000	5,000	21,000	65,000	150,000	132,000

Source: WindEurope

The investment forecast to reach the capacity installed in our scenarios is shown in Figure AII.3.

The difference between the number of jobs in 2030 and 2019 divided by the total amount of investment needed to 2030 gives an indication of the number of new jobs created in the economy. This means that investments would not only add jobs, but crucially sustain existing employment levels.

TABLE AII.3

Onshore and offshore investment and job creation forecast in 2030, NECP Scenario

	ONSHORE WIND			
	CAPEX (€m/MW)	Annual installations (GW)	Total Jobs (direct+ indirect)	Annual Investment (€bn)
2019	1.26	11.7	224,023	13.07
2020	1.25	11.7	224,910	14.62
2021	1.24	11.7	226,405	14.51
2022	1.23	11.7	228,180	14.40
2023	1.22	11.7	230,191	14.30
2024	1.21	11.7	232,403	14.19
2025	1.20	11.7	234,788	14.08
2026	1.19	11.7	237,416	13.98
2027	1.18	11.7	240,118	13.87
2028	1.17	11.8	242,982	13.76
2029	1.16	11.8	246,216	13.70
2030	1.16	11.8	249,541	13.64

Capacity 2020-2030 (GW)	**129.10**
Job difference 2030 vs 2019	**25,518**
Cumulative investments 2020-2030 (€bn)	**155**
Jobs / €bn invested	**165**

	OFFSHORE WIND			
	CAPEX (€m/MW)	Annual installations (GW)	Total Jobs (direct+ indirect)	Annual Investment (€bn)
2019	3.22	3.7	77,356	5.96
2020	2.66	4.4	87,865	16.65
2021	2.60	5.2	98,974	18.15
2022	2.56	5.9	110,621	19.76
2023	2.54	6.6	122,761	21.43
2024	2.52	7.4	135,350	23.16
2025	2.51	8.1	148,352	24.92
2026	2.51	8.8	160,577	26.70
2027	2.50	9.5	173,244	28.50
2028	2.50	10.3	185,579	29.39
2029	2.50	11.0	193,496	29.38
2030	2.50	11.7	201,101	29.38

Capacity 2020-2030 (GW)	**88.96**
Job difference 2030 vs 2019	**123,746**
Cumulative investments 2020-2030 (€bn)	**267**
Jobs / €bn invested	**463**

Source: WindEurope

AII.2 CONTRIBUTION TO GDP

METHODOLOGY

WindEurope commissioned Deloitte to update the macro-economic indicators of the wind energy industry in Europe from the report "Local Impact, Global Leadership" published in November 2017 .

Due to updates in the information provided by the International Monetary Fund (October 2019) specifically for the gross domestic product deflator, some figures have changed slightly compared to the ones published in 2017[44].

Deloitte used the following data sources:

- Annual statements of the relevant companies in the sector and its sub-sectors: onshore wind energy developers, offshore wind energy developers, onshore wind turbine manufacturers, offshore wind turbine manufacturers, components manufacturers, services providers and offshore wind energy infrastructures.
- Questionnaires and interviews with relevant EU stakeholders in the wind industry.
- Publicly available information from reputed entities, including:
  - Eurostat
  - WindEurope
  - The International Energy Agency
  - The International Monetary Fund
  - European Union Member States foreign trade statistical bodies
  - The Wind Energy Barometer from EurObserver
  - The BP Statistical Review of World Energy
  - Patent Offices from different European Union countries.

DIRECT CONTRIBUTION TO GDP

To calculate the wind energy sector's contribution to EU GDP, Deloitte used three equivalent approaches – recognised by the European System of National and Regional Accounts (ESNRA)[45]: expenditure, added value and income.

The wind energy sector is made up of companies that carry out a wide range of different activities integrated in the value chain of the industry. Therefore, the sector was divided into seven sub-sectors:

- Onshore wind energy developers
- Offshore wind energy developers
- Onshore wind turbine manufacturers
- Offshore wind turbine manufacturers
- Component manufacturers
- Service providers
- Offshore wind turbine substructures

Over 400 EU companies active in wind energy were identified and their financial statements analysed for the period between 2016 and 2019.

The value added and income approaches were used to estimate the sector's contribution to GDP, using the information companies disclosed in their financial statements. Additional information, such as tax balance and R&D expenditure, was gathered by surveying wind industry players. Combining these two data sets, it was possible to calculate the total direct impact on GDP.

INDIRECT CONTRIBUTION TO GDP

The different sub-sectors of the wind energy industry purchase from, and provide services to, other sectors of the economy. This has an indirect impact on GDP.

This impact is quantified using input-output models from the EU[46]. However, these tables do not consider the wind energy sector as a separate industry. It was, therefore, necessary to add the information of this sector to the evaluation scheme. To do this the information was completed with sectoral data collected directly from relevant industry players.

Based on this input-output table, income multipliers containing information on the wind energy sector's impact on the rest of the economy were calculated. For full details of the methodology, please refer to Annex II.

44. WindEurope, 2017. Local impact, global leadership. The impact of wind energy on Jobs and the EU economy.
45. Definitions as given by Eurostat: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/National_accounts_%E2%80%93_GDP
46. An input-output model is a quantitative economic technique that captures the correlations between different branches of an economy or among branches of different and even competing economies.

CALCULATING THE WIND ENERGY SECTOR'S DIRECT CONTRIBUTION TO GDP

Three equivalent approaches, recognised by the European System of National and Regional Accounts (ESNRA), can be used to calculate an economic sector's contribution to GDP:

EXPENDITURE APPROACH

GDP is defined as what individuals spend on final consumption, plus what the government spends on final consumption, plus gross capital formation, plus exports and minus imports. In the system of national accounts, only households, non-profit institutions serving households (NPISH)[47] and governments have final consumption, whereas corporations have intermediate consumption.

Private final consumption expenditure is defined as expenditure on goods and services for the direct satisfaction of individual needs, whereas government consumption expenditure includes goods and services produced by the government, as well as the purchase of goods and services by the government to supply households as social transfers in kind.

Gross capital formation is the sum of gross fixed capital formation and the change in inventories (stocks). The external balance is the difference between exports and imports of goods and services. Depending on the size of exports and imports, it can be positive (a surplus) or negative (a deficit).

VALUE ADDED APPROACH

The gross value added of various sectors, plus taxes, minus subsidies on products. The output of the economy is measured using gross value added. Gross value added is defined is the value of all newly generated goods and services minus the value of all goods and services consumed in their creation; the depreciation of fixed assets is not included. When calculating value added, output is valued at basic prices and intermediate consumption at purchasers' prices. Taxes minus subsidies on products have to be added to value added to obtain GDP at market prices.

INCOME APPROACH

Includes salaries and other money spent on employees, net taxes on production and imports, gross operating surplus and mixed income. The income approach shows how GDP is distributed between different participants in the production process, as the total of:

- compensation of employees: the total remuneration, in cash or in kind, payable by an employer to an employee in return for work done by the latter during the accounting period; the compensation of employees is broken down into: wages (in cash and in kind); employers' social contributions (actual social contributions and imputed social contributions);

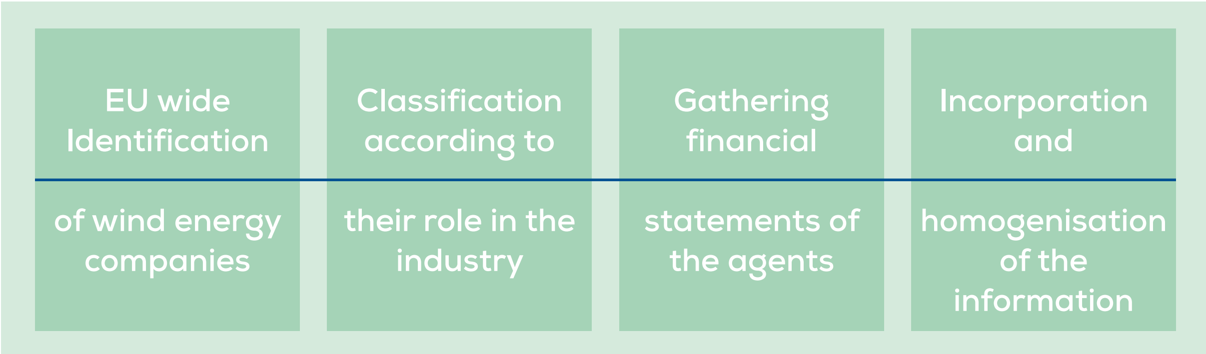
- gross operating surplus: the surplus (or deficit) on production activities before account has been taken of the interest, rents or charges paid or received for the use of assets.

The wind energy sector is made up of companies that carry out a wide range of different activities integrated in the value chain of the industry.

47. Eurostat definition: non-profit institutions are not mainly financed or controlled by governments and they provide goods or services to households for free or at prices that are not economically significant. Examples include churches and religious societies, sports and other clubs, trade unions and political parties.

FIGURE AII.3

Information collection for the value added and income approaches



Source: Deloitte for WindEurope

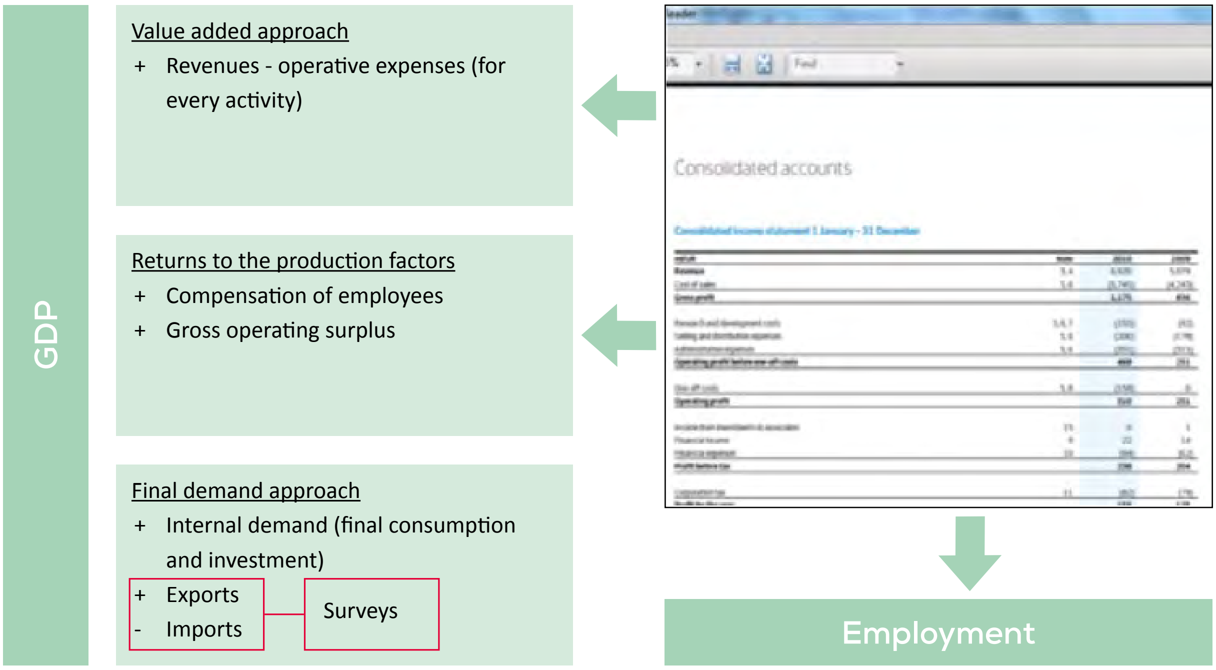
Over 400 companies active in wind energy were identified and their financial statements analysed for the period between 2016 and 2019.

The financial statements gathered include information that allows the sector's contribution to GDP to be estimated using two of the three methods this report is based on: the value-added approach and the income method. The information collected from a survey of over 400 EU wind energy players was extrapolated to the total size of the sector.

The calculation based on the Expenditure Approach requires an estimate of the sector exports and imports: this estimation has been carried out based on the information available in the financial statements about export and imports, the public statistics and an EU sector survey.

FIGURE AII.4

Estimation of direct GDP contribution using three ENSRA recognised methodologies



Source: Deloitte for WindEurope

CALCULATING THE WIND ENERGY SECTOR'S INDIRECT CONTRIBUTION TO GDP

The input-output analysis is a quantitative economic technique that shows the interdependencies between different branches of a national economy or between branches of different, even competing economies.

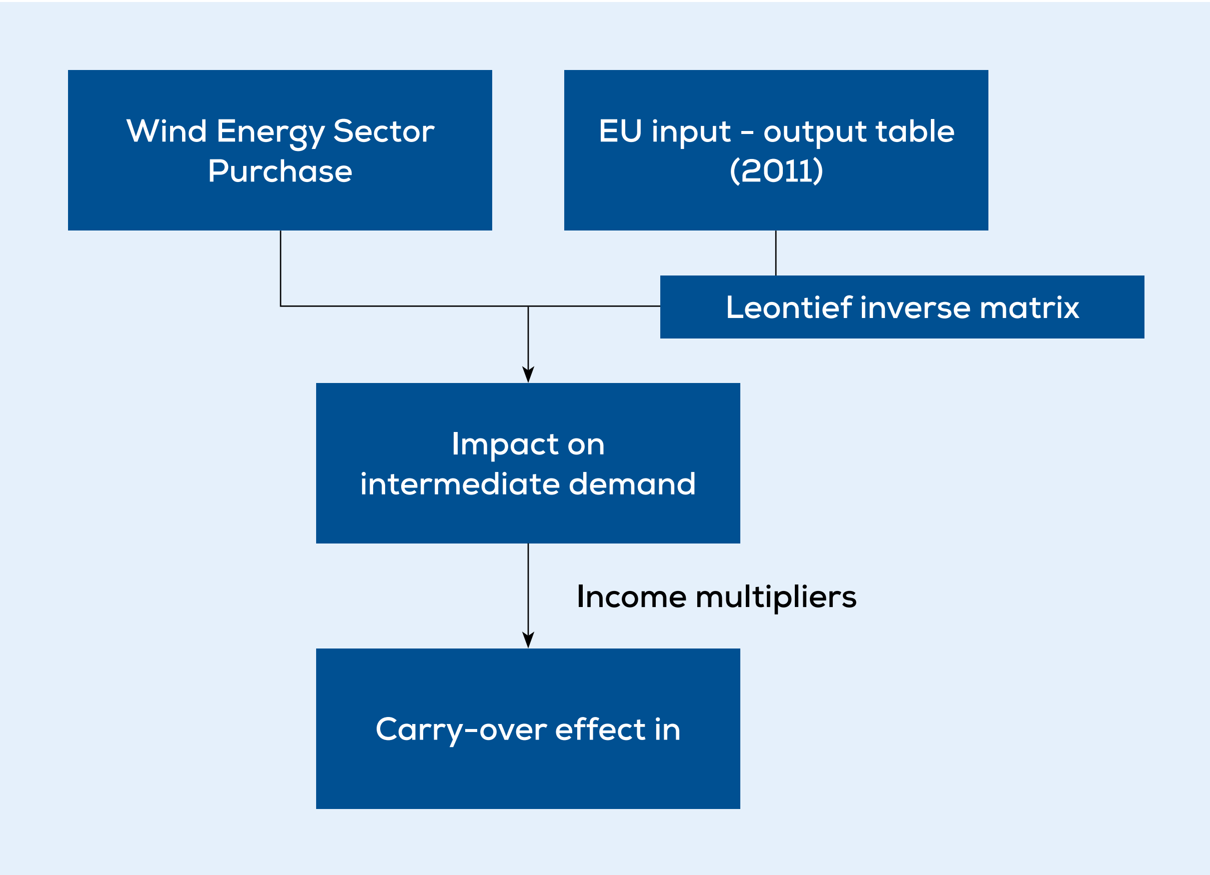
The different sub-sectors of the wind industry require products and services from other sectors. Therefore, the sector has an additional economic impact on other economic sectors that can be evaluated from input-output tables.

The input-output tables show all the production and distribution that takes place in the different sectors of the economy. The indirect effects of an industry on other sectors of the economy can be quantified from the matrix of technical coefficients and the Leontief inverse matrix.

Currently, the European account tables do not break the wind sector into sub-sectors, so it is necessary to evaluate the interrelationships with other economic sectors separately. In order to achieve this, a questionnaire was prepared and completed by industry players on the supply structure of the different subsectors of the industry.

Therefore, based on the latest tables published and the information gathered via the questionnaires, a new type of table was built containing the broken-down sub-sectors identified by the wind energy sector.

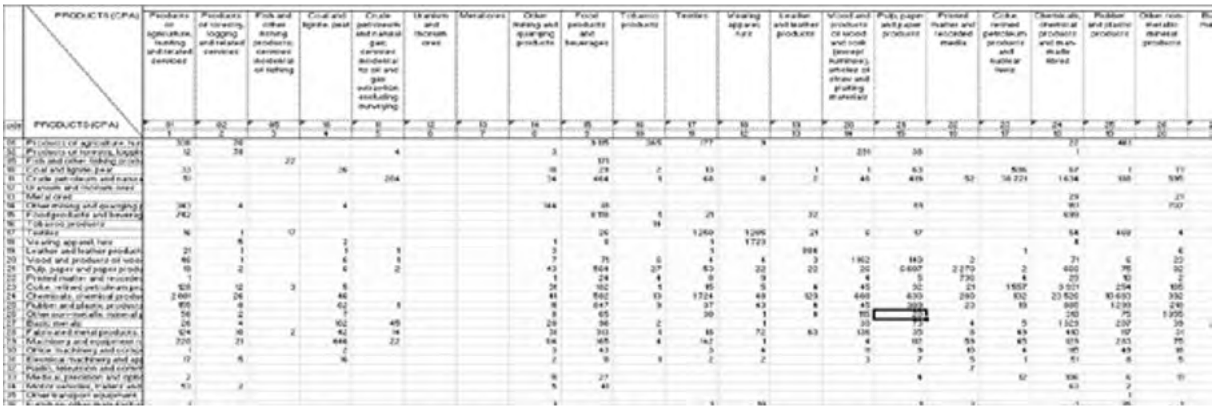
FIGURE AII.5
Outline of the analytical methodology used



Source: Deloitte for WindEurope

FIGURE AII.6

Symmetric input-output table for domestic output at basic prices



Source: Deloitte for WindEurope

HOW TO CALCULATE THE INDIRECT IMPACT ON GDP:

1. Obtained the latest EU Input-Output tables from Eurostat and access the "Symmetric Input-Output Table for domestic output at basic prices".

2. Questionnaires were developed to incorporate the breakdown of the wind sector. The intermediate consumption flows between the sub-sectors (developers, developers, turbine manufacturers, component manufacturers and services) and other economic activities were then quantified.

3. Questionnaires were completed by industry players.

4. Based on the information collected via the questionnaires, transactions between the wind energy sector and the other economic sectors were introduced into the matrix.
   a. A technical coefficients matrix was drawn up. This measures the relative importance of each industry in the total production of another sub-sector.
   b. A Leontief inverse matrix was drawn up. This measures the indirect impact of a sector on another economic activity through the multiplier effect that a sector has on the intermediate production of another.
   c. Income multipliers were calculated. These measure the existing relation between gross added value (contribution to GDP) and total production. This set of indicators, multiplied by the intermediate production, quantifies the indirect impact that an increase of €1 in the wind energy sector's contribution to the EU's GDP has on the GDP of the rest of the economy.

5. The indirect impact of wind energy sector was estimated by multiplying the expenses in goods and services by the multipliers of each economic activity.

TABLE AII.4

Income multipliers for wind energy sector

SECTOR	INCOME MULTIPLIER
Electrical equipment	0.191471
Machinery and equipment n.e.c.	0.322923
Basic metals	0.187523
Fabricated metal products, except machinery and equipment	0.375961
Construction and construction works	0.393430
Architectural and engineering services: technical testing and analysis services	0.486455
Rubber and plastic products	0.327128
Land transport services and transport services via pipelines	0.452475
Telecommunications services	0.443387
Real estate services (excl imputed rents)	0.669686
Chemical products	0.241181
Postal and courier services	0.550841
Scientific research and development services	0.458944
Other professional, scientific and technical services	0.501808

Source: Deloitte for WindEurope

TABLE AII.5

Wind energy industry's contribution in real and current prices calculated based on three different approaches (in €bn): a) demand approach; b) value added approach; c) income approach

EU 27+ UK	2011		2012			2013			2014			2015		
	Constant prices	Current prices	Constant prices	% Y-o-Y change	Current prices	Constant prices	% Y-o-Y change	Current prices	Constant prices	% Y-o-Y change	Current prices	Constant prices	% Y-o-Y change	Current prices
Internal final demand	45.1	45.6	47.3	5%	48.5	43.4	-8%	45.4	46.2	6%	49.2	48.1	4%	52.1
Net exports	2.5	2.6	3.2	27%	3.3	2.4	-25%	2.5	1.8	-23%	2.0	1.7	-7%	1.9
Gross exports	7.8	7.9	8.7	11%	8.9	8.0	-8%	8.3	7.4	-7%	7.9	7.7	3%	8.3
Imports	5.3	5.3	5.4	4%	5.6	5.6	2%	5.8	5.6	0%	6.0	6.0	7%	6.5
Intermediate inputs demand	30.9	31.2	32.7	6%	33.5	27.7	-15%	29.0	28.9	4%	30.8	29.1	1%	31.5
Demand	16.7	16.9	17.8	6.3%	18.2	18.2	2.0%	19.0	19.2	5.6%	20.4	20.7	8.0%	22.4
Total revenue	53.1	53.6	56.0	5%	57.4	51.5	-8%	53.9	53.9	5%	57.4	56.2	4%	60.9
Total expenditures	36.3	36.7	38.2	5%	39.2	33.4	-13%	34.9	34.7	4%	37.0	35.5	2%	38.5
Production or value added approach	16.7	16.9	17.8	6.3%	18.2	18.2	2.0%	19.0	19.2	5.6%	20.4	20.7	8.0%	22.4
Compensation of employees	6.3	6.3	6.6	5%	6.8	5.9	-11%	6.2	5.9	0%	6.3	6.4	9%	6.9
Gross operating surplus	10.5	10.6	11.2	6.9%	11.5	12.3	9.5%	12.8	13.3	8.4%	14.2	14.3	7.8%	15.5
Income	16.7	16.9	17.8	6.3%	18.2	18.2	2.0%	19.0	19.2	5.6%	20.4	20.7	8.0%	22.4

EU 27+ UK	2016			2017			2018			2019		
	Constant prices	% Y-o-Y change	Current prices	Constant prices	% Y-o-Y change	Current prices	Constant prices	% Y-o-Y change	Current prices	Constant prices	% Y-o-Y change	Current prices
Internal final demand	45.3	-6%	49.7	46.2	0.0	51.2	47.0	0.0	52.9	51.4	0.1	59.1
Net exports	1.9	13%	2.1	2.2	0.1	2.4	1.8	-0.2	2.0	0.7	-0.6	0.8
Gross exports	7.9	2%	8.6	8.1	0.0	9.0	8.2	0.0	9.2	8.3	0.0	9.5
Imports	5.9	-1%	6.5	5.9	0.0	6.5	6.4	0.1	7.2	7.6	0.2	8.7
Intermediate inputs demand	26.9	-8%	29.5	26.3	0.0	29.1	27.1	0.0	30.5	29.2	0.1	33.7
Demand	20.4	-1.5%	22.4	22.1	8.6%	24.5	21.7	-1.8%	24.5	22.8	5.0%	26.3
Total revenue	54.3	-3%	59.5	55.6	0.0	61.6	56.6	0.0	63.6	59.6	0.1	68.6
Total expenditures	33.9	-5%	37.2	33.4	0.0	37.0	34.8	0.0	39.2	36.8	0.1	42.3
Production or value added approach	20.4	-1.5%	22.4	22.1	8.6%	24.5	21.7	-1.8%	24.5	22.8	5.0%	26.3
Compensation of employees	6.7	5%	7.4	6.8	0.0	7.5	6.9	0.0	7.7	7.2	0.0	8.3
Gross operating surplus	13.7	-4.5%	15.0	15.4	12.4%	17.0	14.9	-3.4%	16.7	15.6	5.1%	18.0
Income	20.4	-1.5%	22.4	22.1	8.6%	24.5	21.7	-1.8%	24.5	22.8	5.0%	26.3

Source: Deloitte for WindEurope

ANNUAL CONTRIBUTION TO GDP PER GW

WindEurope estimated the contribution to the annual GDP per GW using annual installations and allocating the indirect contribution to on- and offshore wind using their ratio of direct contribution to GDP.

This indicator is a proxy and does not capture completely that some sub-sectors contribute to the economy from the cumulative installations which generate electricity rather than the annual installations. These include developers and O&M service providers. In addition, turbine and component manufacturers' revenue (and contribution to the economy) depends on the sales of turbines they manufacture, which are installed in the future, not the year of the annual installations we see.

EXPORTS

Deloitte estimates exports of wind energy based on data extracted from Eurostat and from questionnaires and interviews with companies. The TARIC code[48] 8502310090, "Wind-powered generating sets" is the only code which can be directly attributed to wind power equipment with certainty. This information has been obtained from the European Commission, EU Trade Helpdesk. We showed intra-EU and extra-EU exports for this code only in figure 17.

Deloitte added two other equipment categories of exports: Other main specific equipment and Main specific components. The contribution to the sector's GDP from exports of these two were estimated based on information collected from the questionnaires and complemented with ICEX (the official Spanish Foreign Trade Bureau) data . More than 60 companies replied to these questionnaires. All the exports from these codes are extra-EU.

Deloitte also included exports of electricity from the EU to non-EU countries, the information has been obtained from Eurostat and was classified under "other exports".

Deloitte updated its methodology to estimate exports from the one used in the report "Local Impact Global Leadership published in 2017". The differences between the method and the previous one applied methodology are 2.7% in 2017, 3.2% in 2018 and 1.04% in 2019.

TABLE AII.6

Exports categories considered in WindEurope analysis[49]

CN CODE	CN DESCRIPTION	Category in WindEurope analysis
7308 20 00	Towers & lattice masts	Main specific components
8501 64 00	Electric motors and generators (excluding generating sets):- AC generator (alterntors): Of an output	Main specific equipment
8502 31	Wind-powered generator sets	Wind-powered genereted sets
8412 90 80	Parts of engines	Main specific components
850300	Parts suitable for use solely or principally with the ma-chines of heading 8501 or 8502	Main specific equipment

Source: Deloitte for WindEurope

48. TARIC, the integrated Tariff of the European Union, https://ec.europa.eu/taxation_customs/business/calculation-customs-duties/what-is-common-customs-tariff/taric_en
49. The CN Code is the Combined Nomenclature is the eight-digit coding system serving the EU's common customs tariff and provides statistics for trade inside the EU and between the EU and the rest of the world. https://trade.ec.europa.eu/tradehelp/eu-product-classification-system

ANNEX III

METHODOLOGY FOR OEM MARKET SHARES

Wood Mackenzie's recognition criteria to determine global, regional and country market shares, which allow for the normalisation of the varied data sets provided by turbine OEMs, are as follows:

- Wood Mackenzie bases its analysis on grid connected capacity;
- Wood Mackenzie employs the following data collection methods to ensure accuracy and to independently verify data provided by turbine OEMs;
- Track and monitor global wind power plant development in proprietary project databases;
  - Independently confirm and verify project commissioning with grid operators, developers, and trade associations;
  - Track reported turbine delivery and turbine commissioning activity from all turbine suppliers, with follow up verification with respective turbine OEMs when available;
- Wood Mackenzie improves data quality continuously and may adjust figures retroactively resulting in discrepancies with prior reports.

Near-term market share forecasts are established with:

- Turbine OEM MW floor set by identified turbine sales backlog (firm orders and framework agreements) within the chosen market;
- Wood Mackenzie's every effort to validate the timing of project COD associated with the mentioned turbine order backlog;
- Asset owner project pipelines without an assigned turbine OEM are examined against established strategic client/supplier relationships and serve to fill gaps between identified turbine OEM sales backlogs and a country's total market outlook;
- Persistence method is applied where historical market share development trends shape near-term market share forecasts.

Long-term turbine OEM market share forecasts are positively influenced by

- Existence of local supply chain, which increases OEM competitive positioning through lower landed costs and diminished foreign exchange risks
  - Strength of supply chain positioning is especially critical in local content markets like Brazil and South Africa;
- Turbine OEM deployment of world class turbine technology, as defined by capacity factor or AEP, with portfolio breadth that correctly address local climatic conditions;
- Pre-existing track record within a country, which is further bolstered by an existing wind services presence.

TABLE AIII.1

Snapshot of manufacturing facilities in Europe[50]

	NACELLES			BLADES		
COUNTRY	OPERATING	IDLE	SHUT DOWN	OPERATING	IDLE	SHUT DOWN
Austria			1			
Belgium						
Bulgaria						
Croatia						
Czech Republic						
Denmark	4		2	4		1
Estonia						
Finland			1			
France	1			1		
Germany	8	1	7	1		3
Greece						
Italy			1	1		
Netherlands	3		1			
Poland				3		
Portugal	1			2		
Romania						
Slovakia						
Spain	3	1	1	6		6
Sweden						
Bosnia and Herzegovina						
Russia	1			1		
Serbia						
Switzerland						
Turkey				4		1
Ukraine	1					
United Kingdom	1			3		
Ireland						
Malta						
Norway						
TOTAL	23	2	23	35		11

50. This information is subject to change. Some facilities may not be disclosed publicly

	TOWERS			GEARBOXES		
COUNTRY	OPERATING	IDLE	SHUT DOWN	OPERATING	IDLE	SHUT DOWN
Austria	1					
Belgium				1		
Bulgaria						
Croatia	1					
Czech Republic	1			1		
Denmark	3		6			
Estonia						
Finland				1		
France	1					
Germany	13	1	6	7	1	3
Greece	1		2			
Italy	3		3			
Netherlands						
Poland	2		1			
Portugal	3		3			
Romania						
Slovakia						
Spain	11		9	3		
Sweden	1		2			
Bosnia and Herzegovina						
Russia	1					
Serbia						
Switzerland						
Turkey	6		3			
Ukraine	1		1			
United Kingdom	1	1	2	1		
Ireland						
Malta						
Norway						
TOTAL	5	2	38	14	1	3

	CONVERTERS			CASTINGS		
COUNTRY	OPERATING	IDLE	SHUT DOWN	OPERATING	IDLE	SHUT DOWN
Austria						
Belgium						
Bulgaria	1					
Croatia						
Czech Republic					1	
Denmark	2					
Estonia	1					
Finland	3					1
France					1	
Germany	7		1	16		4
Greece						
Italy	2			3		
Netherlands	2					
Poland	1			2		
Portugal						
Romania						
Slovakia				1		
Spain	3			5		6
Sweden				1		1
Bosnia and Herzegovina						
Russia						
Serbia	1					
Switzerland	1					
Turkey				2		1
Ukraine				1		
United Kingdom			1			
Ireland						
Malta						
Norway						2
TOTAL	24		2	31	2	15

	FORGINGS			BEARINGS		
COUNTRY	OPERATING	IDLE	SHUT DOWN	OPERATING	IDLE	SHUT DOWN
Austria					1	
Belgium						
Bulgaria						
Croatia						
Czech Republic	3			1		
Denmark						
Estonia						
Finland						
France	2			2		
Germany	4	1		9		
Greece						
Italy	6		2	2		
Netherlands						
Poland	1					
Portugal						
Romania	1			2		
Slovakia				1		
Spain	4	1		3		
Sweden	1			1		
Bosnia and Herzegovina						
Russia						
Serbia						
Switzerland						
Turkey						
Ukraine	1					
United Kingdom				1		
Ireland						
Malta						
Norway						
TOTAL	23	2	2	22	1	0

	TOTAL		
COUNTRY	OPERATING	IDLE	SHUT DOWN
Austria	2	1	2
Belgium	1		
Bulgaria	1		
Croatia	1		
Czech Republic	6	1	1
Denmark	13		9
Estonia	2		
Finland	6		3
France	11	1	
Germany	82	4	24
Greece	1		2
Italy	17		6
Netherlands	7		1
Poland	9		1
Portugal	7		3
Romania	4		
Slovakia	2		
Spain	41	2	31
Sweden	4		3
Bosnia and Herzegovina	1		
Russia	3		
Serbia	2		
Switzerland	1		
Turkey	12		5
Ukraine	4		1
United Kingdom	8	1	3
Ireland			
Malta			
Norway			2
TOTAL	248	10	97

WindEurope is the voice of the wind industry, actively promoting wind power in Europe and worldwide. It has over 400 members with headquarters in more than 35 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.

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