

European Wind Energy Competitiveness Report

ETIPWind is supported by the SETIPWind project under Horizon Europe.

About SETIPWind

The SETIPWind project, funded under the Horizon Europe programme, aims to coordinate the European Technology & Innovation Platform on Wind Energy (ETIPWind) and the SET Plan Implementation Working Group on Wind energy (IWG Wind).

ETIPWind was established in 2016 to inform Research & Innovation policy at European and national level.

ETIPWind provides a public platform to wind energy stakeholders to identify common Research & Innovation (R&I) priorities and to foster breakthrough innovations in the sector.

Its recommendations highlight the pivotal role of wind energy in the clean energy transition. They inform policymakers on how to maintain Europe's global leadership in wind energy technology so that wind delivers on the EU's Climate and Energy objectives. As such, the platform is key in supporting the implementation of the Integrated SET-Plan.

ETIPWind activities and publications are free and publicly available. The platform is overseen by a Steering Committee of both industry, research and academia representatives and supported by a forum comprising the industry's Chief Technology Officers.

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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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Executive Summary

- This report looks at several indicators of the European wind industry competitiveness. Unless stated otherwise, “European” refers to the EU+UK in this report.
- The European wind industry has an **annual turnover of €93bn**.
- Wind energy added **€57.2bn to EU + UK GDP** in 2023. €34.5bn of this was a direct contribution from developers, manufacturers and components suppliers. Goods and services from other economic sectors to the wind industry generated an additional €22.7 of indirect economic activity.
- In the EU, **€52.1bn was added to EU GDP**. The direct contribution was €31.9bn and there was an indirect contribution of €20.3 bn.
- The European wind industry generated **€3.4bn** of value added to the European economy in 2023 for each GW of **onshore wind** installed and **€2.8bn** for each new GW of **offshore wind**. That means that on average every new onshore turbine added €15m to the European economy and every new offshore turbine added €27m.
- In 2023 the European wind energy sustained **370,000 jobs**, 350,000 of which were in the EU. The number of people employed in the industry has increased for the second year in a row, after three years of stagnation during the COVID-19 and energy crises in Europe.
- The gross value added per employee, a measure of productivity, from wind energy is higher in many sectors than the EU average value added per employee of many industrial and services in the economy.
- The European wind industry **exports €11bn** of goods and services.
- The wind industry in the EU has increased the **investments in R&I** for the second year in the row. In 2023 the wind industry made investments worth **3.79%** of its contribution to GDP in R&I. The wind industry consistently outperforms the EU average R&I effort.
- The number of patents on wind energy technology registered in Europe has decreased year-on-year since 2011 to historical low levels.
- In 2023 wind energy generation avoided **139 million tons of CO2** in the EU+UK including **119 million tons** avoided in the EU. This would amount to **€11.6bn** in the EU+UK and **€9.9bn** in the EU using the average price of EU emission allowances in 2023 of €83/tCO2.
- Wind energy avoided the equivalent of 95 bcm or **€22bn of fossil fuel imports** to the EU+UK, and 81bcm or **€19bn of fossil fuel imports** in the EU. Whilst more imports were avoided compared to 2022, the monetary savings reduced due to lower overall prices.
- The European wind energy industry paid almost **€10bn of taxes** of which €2.3bn were not linked to corporate taxes and were destined mainly to local governments and communities.
- Wind energy would add **€113bn to GDP by 2030** under the REPowerEU plan. That is almost double the sector’s contribution in 2023.

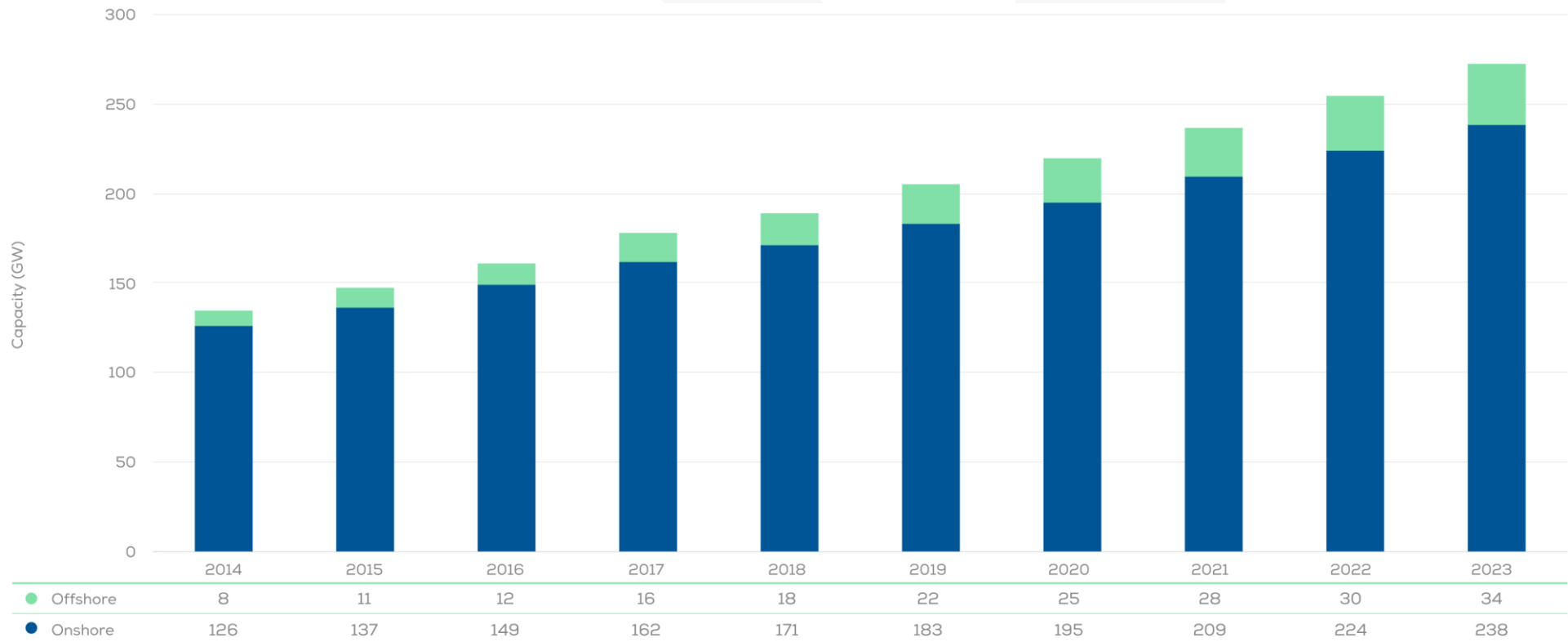
Competitiveness overview and key takeaways

- **The European wind industry has a strong domestic supply chain. €48.9bn or 86% of wind energy payments to suppliers went to European companies.** These payments generated €22.7bn in indirect contributions to Europe's economy of which most in the machinery sector (24%), followed by construction and metals (20%) and electrical equipment (12%).
- **The EU remains a net-exporter of wind energy equipment.** Net-exports by the wind industry totalled €3.1bn a 22% increase compared to 2022. At the same time overall wind energy gross imports reduced also by 22%. More than two thirds of the wind energy imports came from Asia.
- **The EU continues to export more wind turbines than it imports.** Gross exports of wind turbines were €1.4bn. That is double the gross imports. The main markets for EU made wind turbines are the rest of Europe and the Americas.
- **The European wind industry keeps investing in Research & Innovation (R&I).** In 2023 the wind industry invested €1.3bn in R&I. This is equal to 3.8% of the sector's contribution to GDP. The five European wind turbine manufacturers alone would account to almost 66% of the wind industry's R&I effort. However these investments do not necessarily translate into more patents being filed. Indeed we see a steady decrease in European wind patents year on year since 2011.
- Despite similar levels of installations in 2022 **the wind industry's overall contribution to GDP has decreased slightly** compared to last year. This is mainly due to a **normalisation of overall electricity prices**, which were exceptionally high during the energy crises and boosted the GDP contribution of wind farm operators.
- At the same time the GDP contribution of equipment manufacturers has not recovered to pre COVID-19 crisis levels. **European wind turbine and component manufacturers have seen the costs of their raw materials, components, and transportation needs increase significantly the past few years.** But due to the competitive auction system and pressure from non-EU manufacturers, they have not been able to increase their prices at the same rates. This has led to lower overall profits and a reduced contribution to GDP.
- However, **in 2023 revenues and profit margins have seen an upturn for most European wind manufacturers.** Especially those from the onshore segment. This explains why in 2023 the contribution to GDP of onshore wind equipment manufacturers increased compared to 2022, when all OEMs reported lower revenues and negative profit margins.

1. Wind energy installations

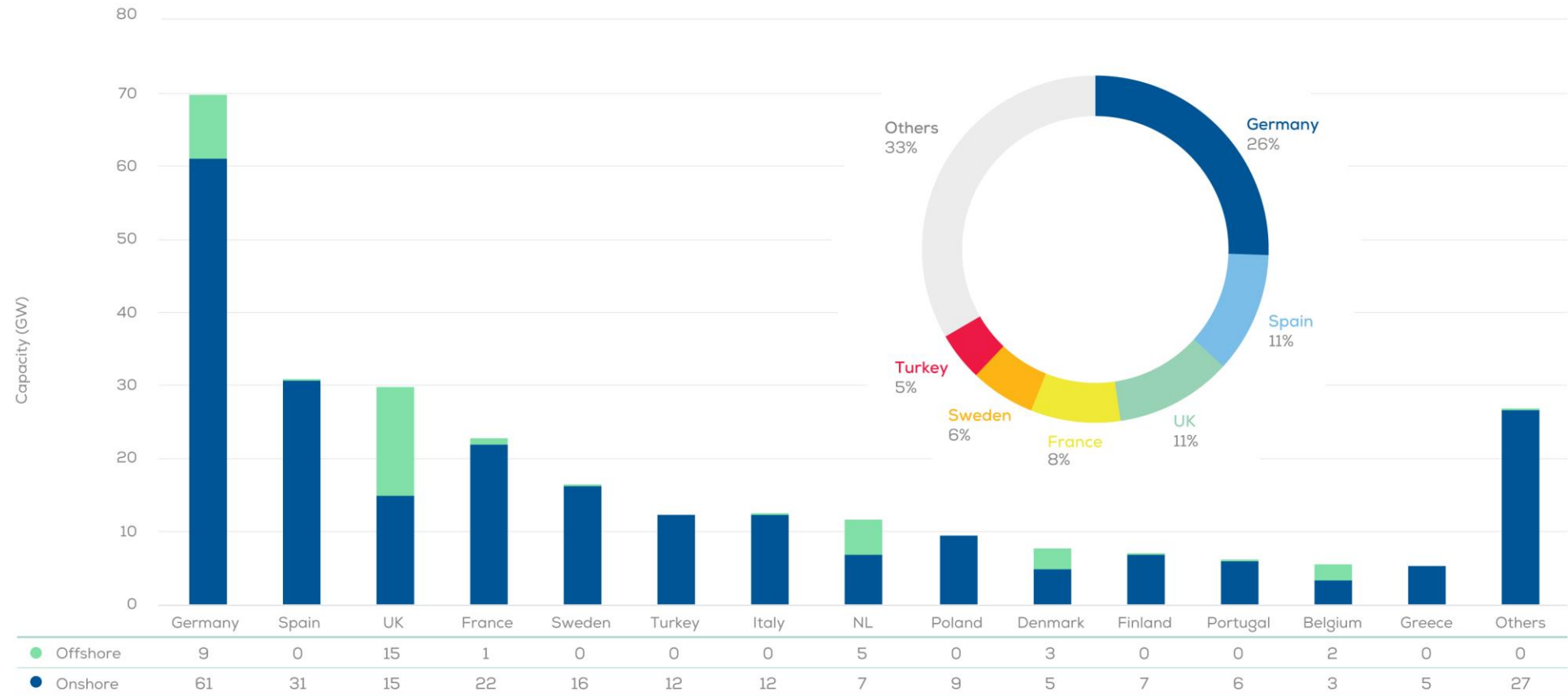
Wind energy installations in Europe

At the end of 2023, Europe has 272 GW of wind power capacity installed. 87% (238 GW) is onshore wind and 13% (34 GW) offshore. The EU has 220 GW of wind power installed capacity with 91% (201 GW) onshore and 9% (19 GW) offshore.



Source: WindEurope

Wind energy installations in Europe by country

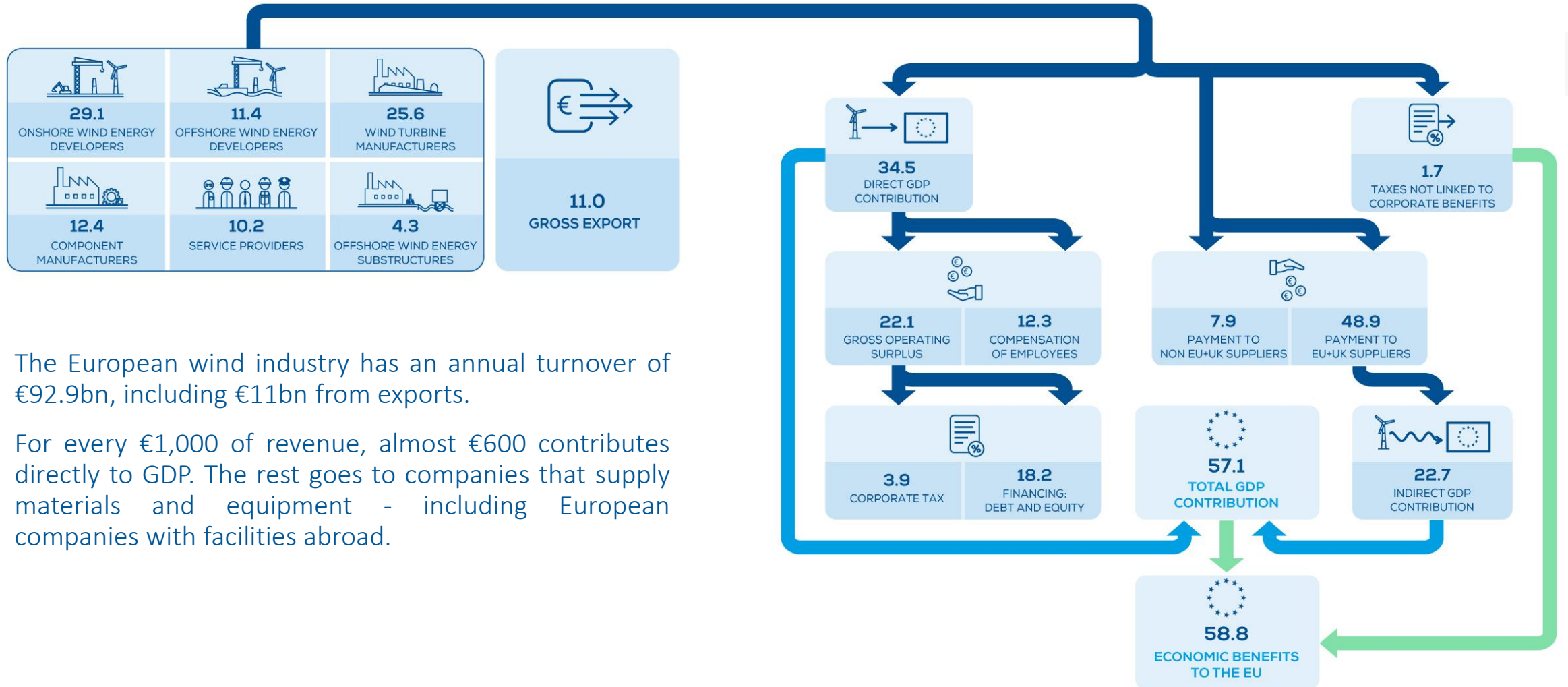


Source: WindEurope

2. Wind energy contribution to GDP

Wind energy contribution to GDP

WIND ENERGY
TOTAL REVENUES (EU + UK) € 92.9 bn



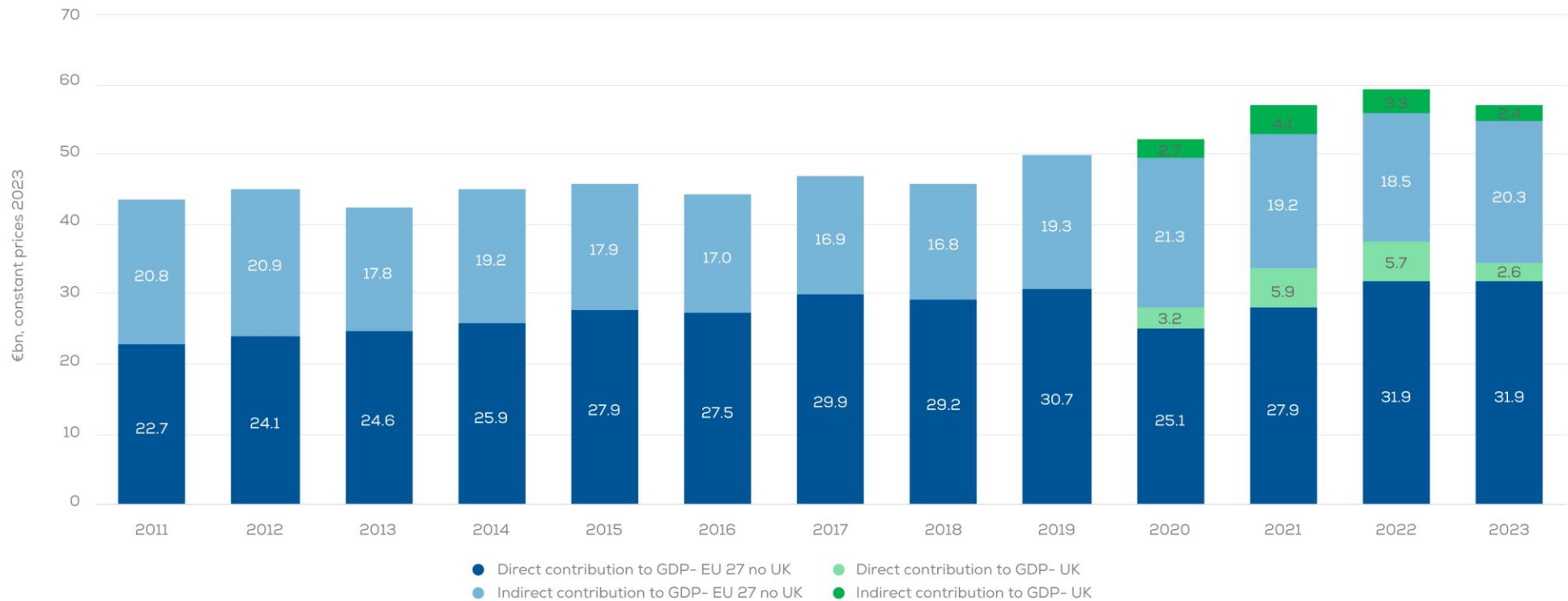
The European wind industry has an annual turnover of €92.9bn, including €11bn from exports.

For every €1,000 of revenue, almost €600 contributes directly to GDP. The rest goes to companies that supply materials and equipment - including European companies with facilities abroad.

Contribution to GDP

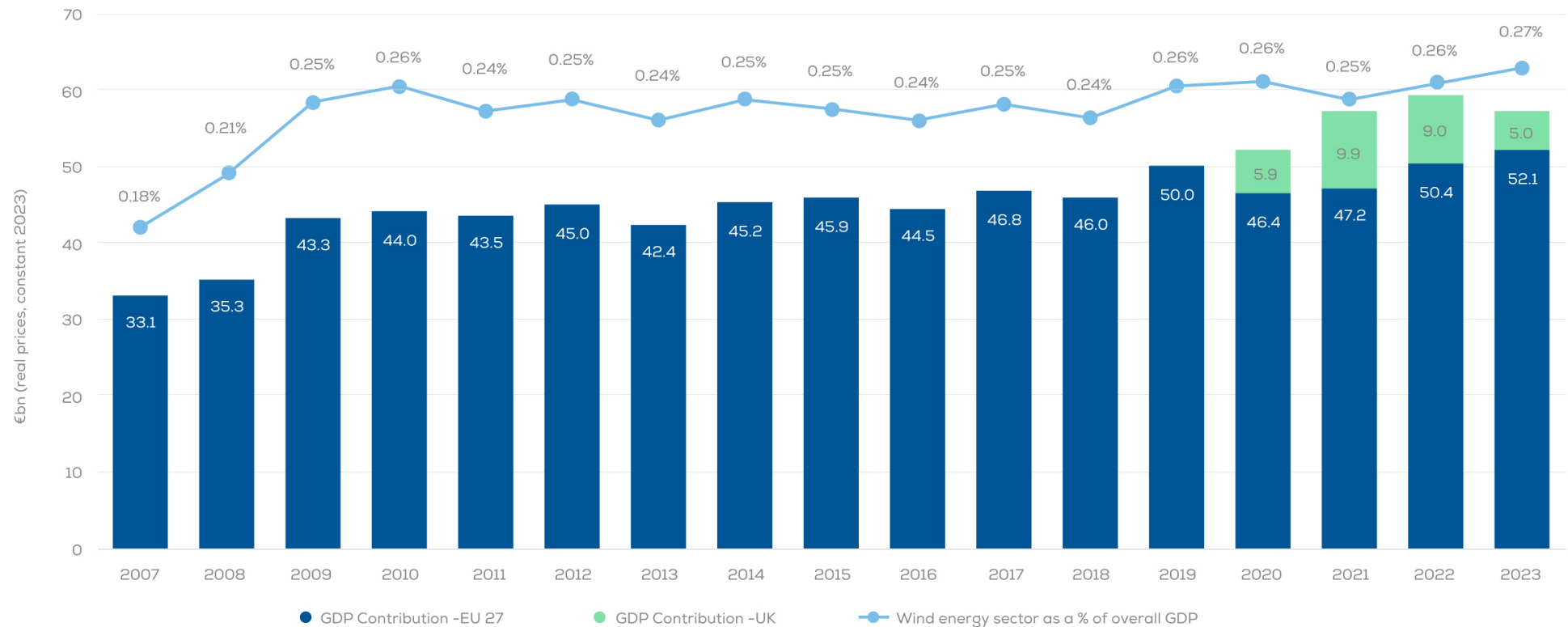
The European wind energy industry and the activities related to it added €57.2bn to EU+UK GDP in 2023. 61% (€34.5bn) of this was a direct contribution from wind energy developers, turbine manufacturers, service providers, and offshore wind energy substructures. Goods and services from other economic sectors to the wind industry generated an additional €22.7bn of indirect economic activity.

In the EU, the wind industry contributed €52.1bn, €31.9bn in direct contributions and €20.3bn in indirect contributions.



Contribution to GDP

The wind industry's impact on the European economy – both direct and indirect – is equivalent to 0.27% of the total value of goods and services produced in the EU.



Source: Deloitte for ETIPWind

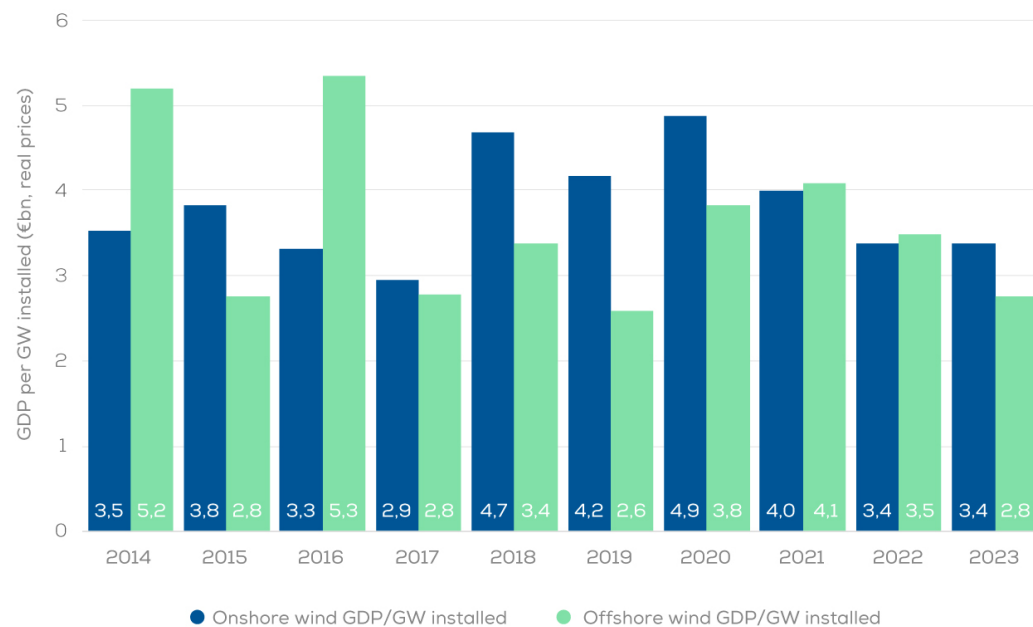
Economic impact per GW installed wind capacity

The European wind industry (EU+UK) generated on average €3.2bn of value added to the European economy for each new GW of wind energy installed in 2023. New onshore wind installations generated €3.4bn per GW installed, unchanged from 2022. Offshore wind contributions dropped to €2.8bn GDP contribution for each new GW installed in Europe.

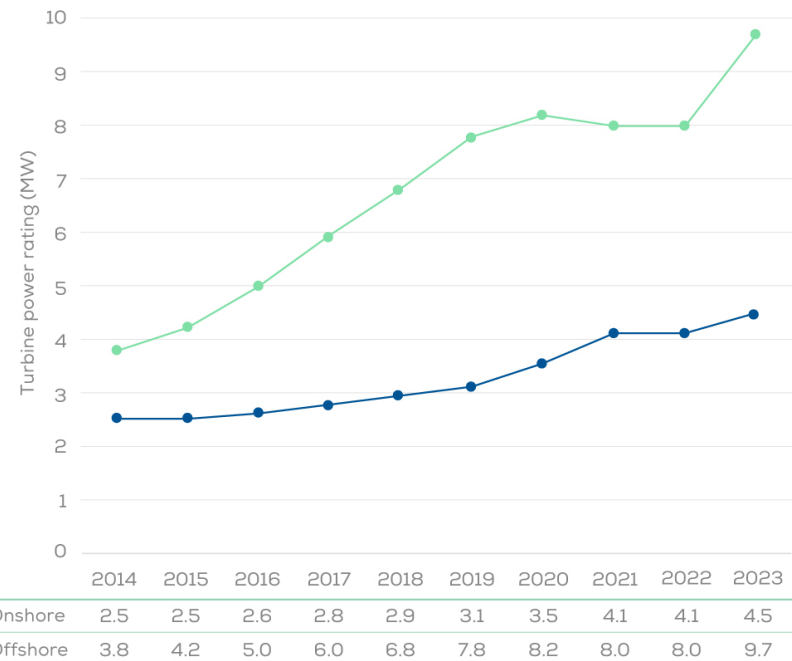
Looking at installations per turbine we can see that installing an onshore wind turbine generated €15m of economic activity on average. Whilst installing an offshore turbine generated €27m of economic activity in Europe.

The annual value added per GW varies depending on the revenues, costs and capacity installed on- and offshore.

The average value added per wind turbine varies depending on the number of turbines installed and their average size every year.



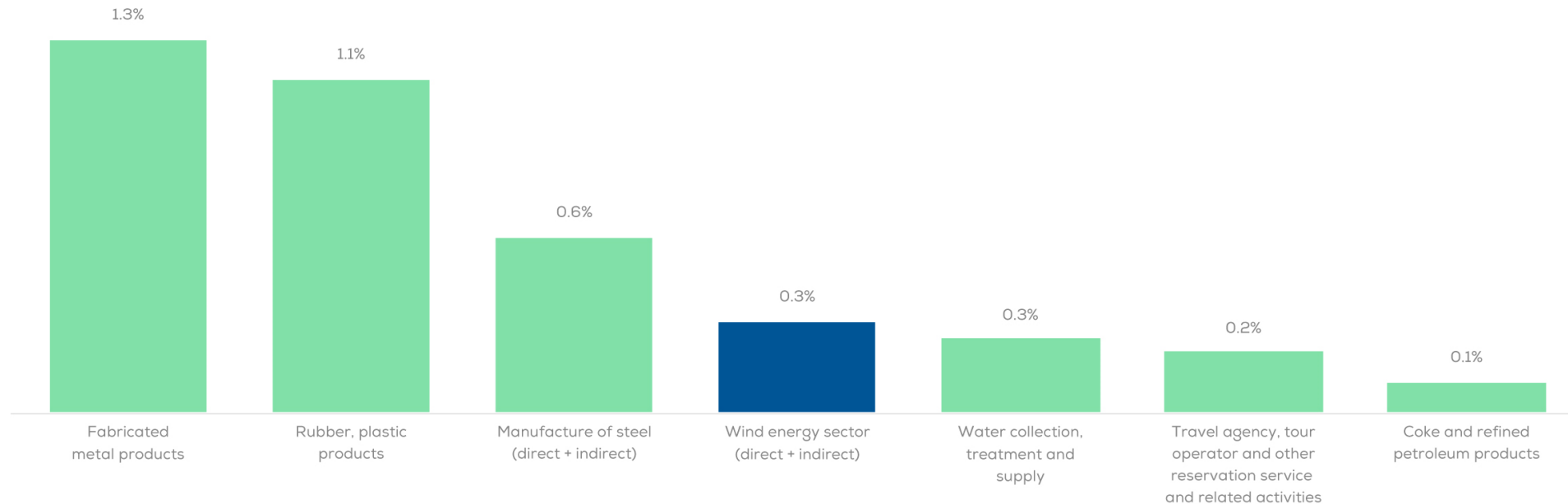
Source: Deloitte for ETIPWind



Source: WindEurope

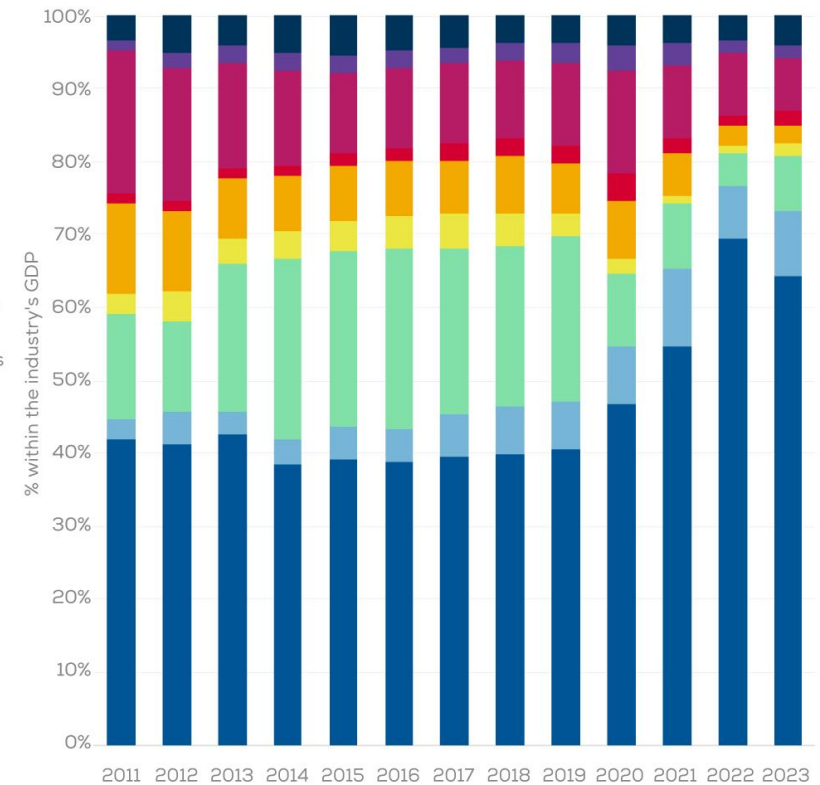
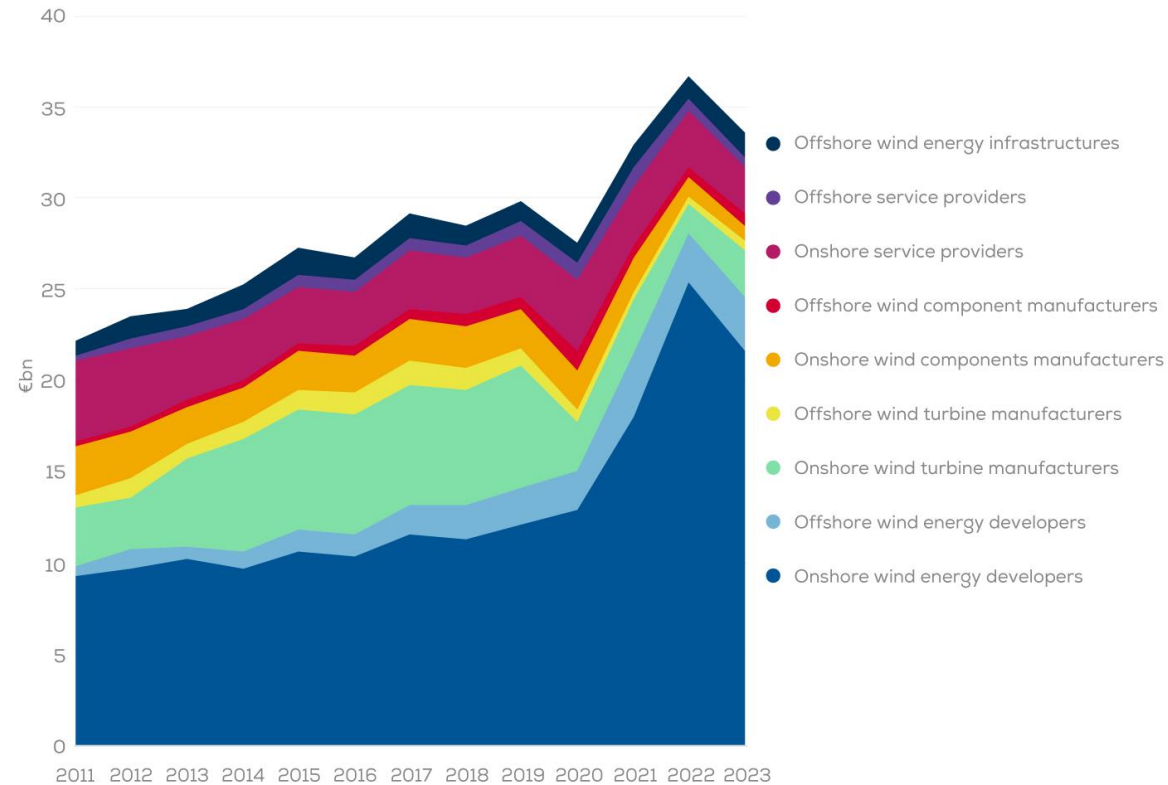
Share of GDP of leading EU economic sectors

The economic contribution of wind energy represents 0.3% of the EU and UK combined GDP. By way of comparison, the manufacturing of steel accounts for 0.6% while the entire supply of rubber and plastic products is 1.1%.



Source: Deloitte for ETIPWind

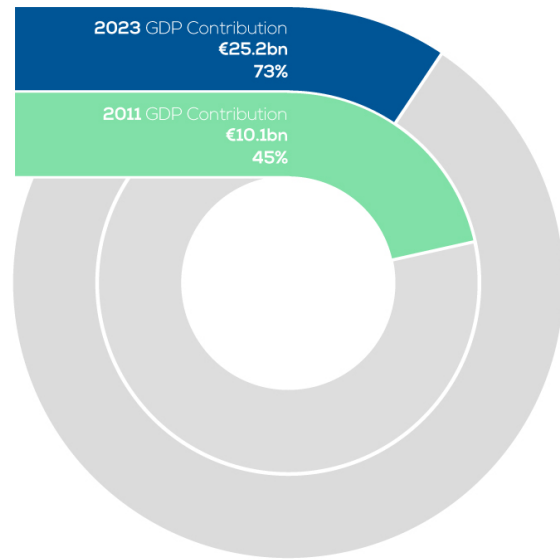
Subsector's share in the direct contribution to GDP



Source: Deloitte for ETIPWind

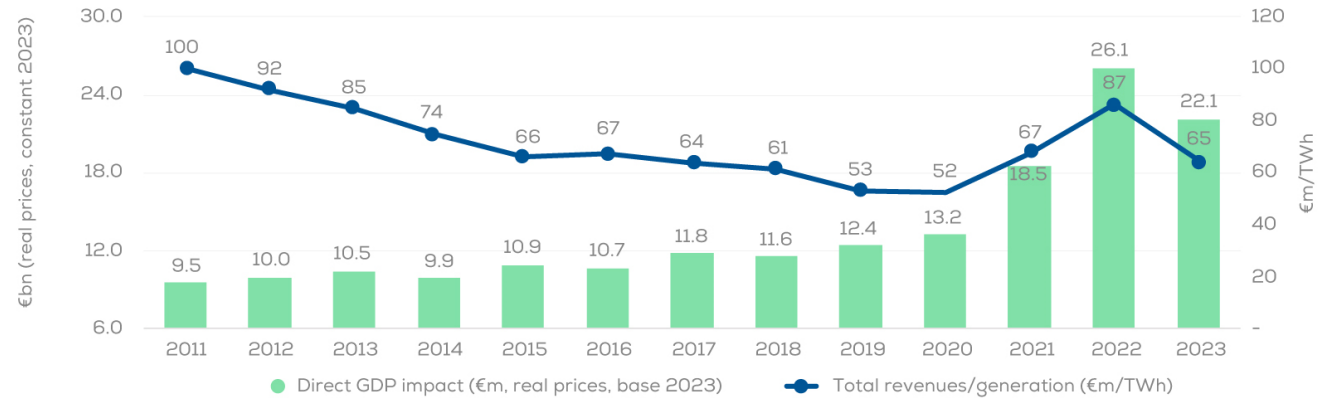
Wind energy developers' direct contribution to GDP

Contribution of wind energy developers' to GDP and total revenues per TWh of energy generated.

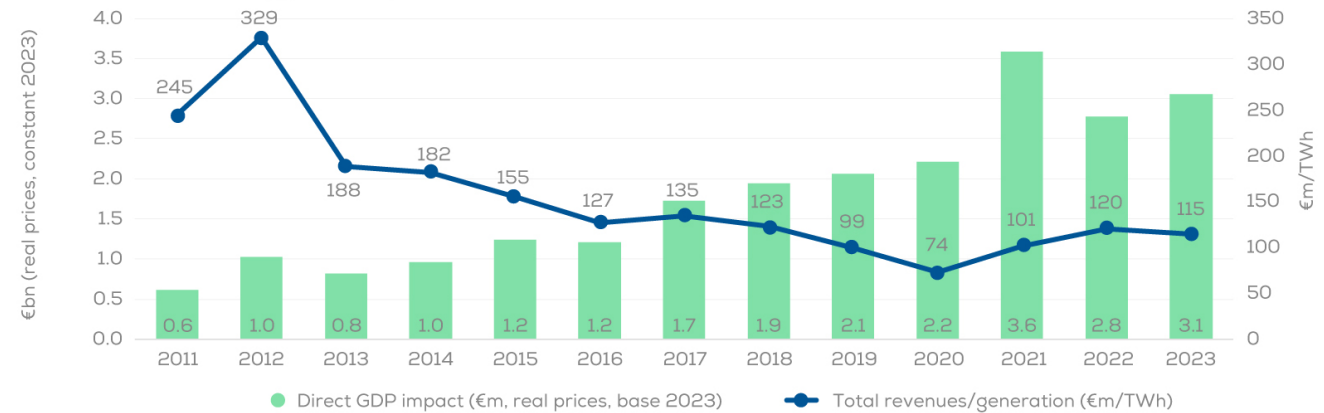


Source: Deloitte for ETIPWind

Onshore wind energy developers

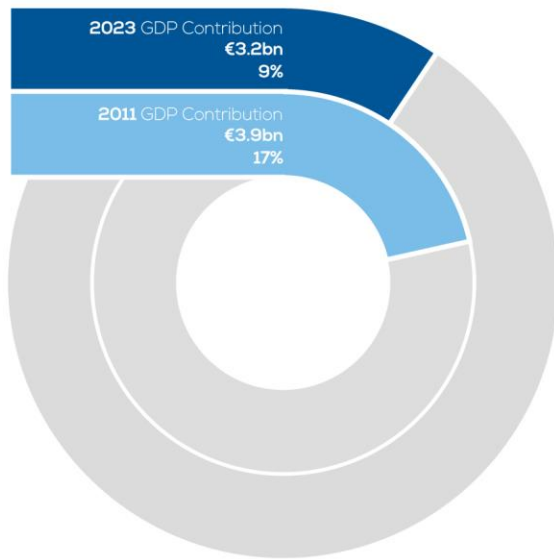


Offshore wind energy developers

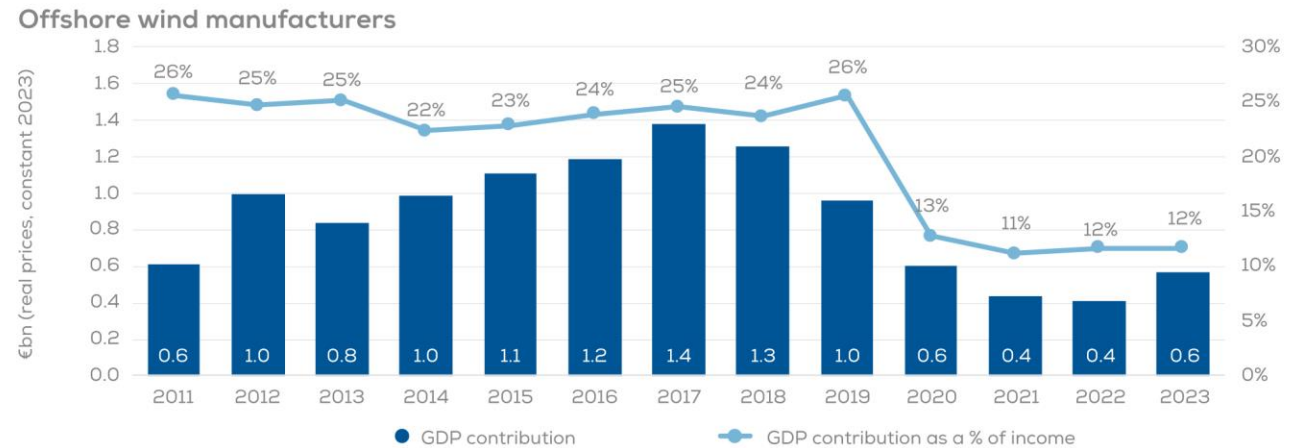
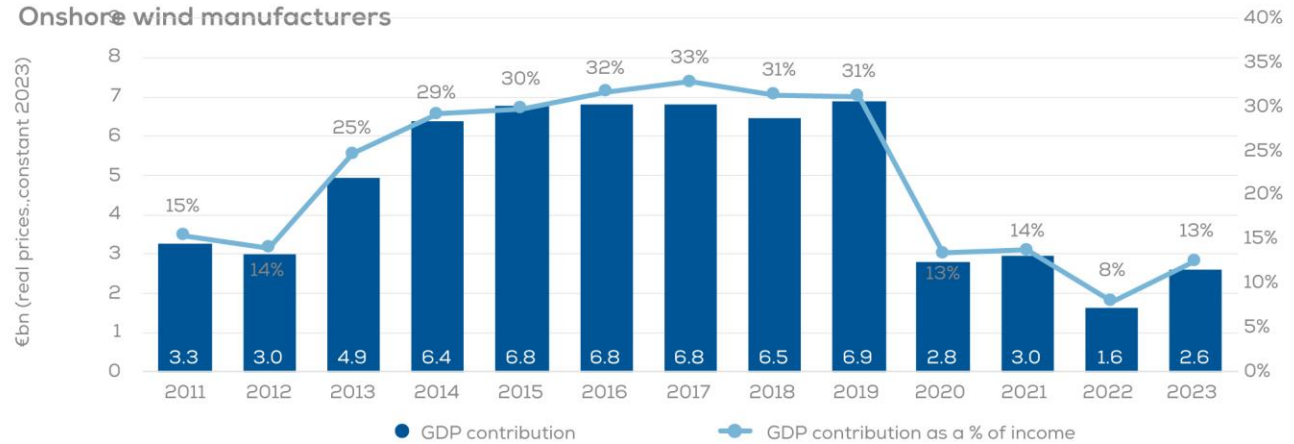


Wind energy manufacturers' direct contribution to GDP

Manufacturers' contribution as a percentage of sub-sector income (real prices, constant 2023).

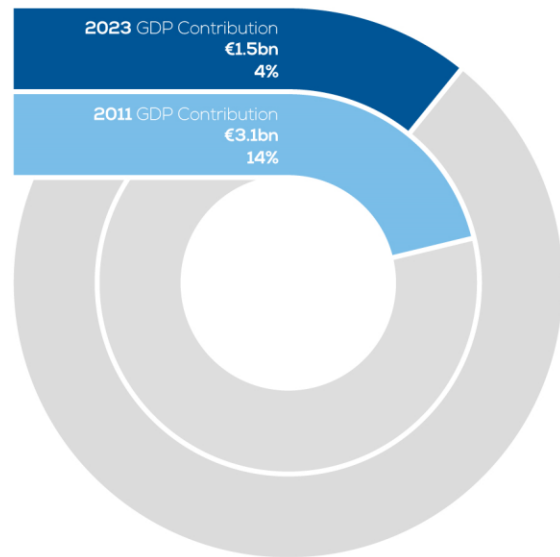


Source: Deloitte for ETIPWind



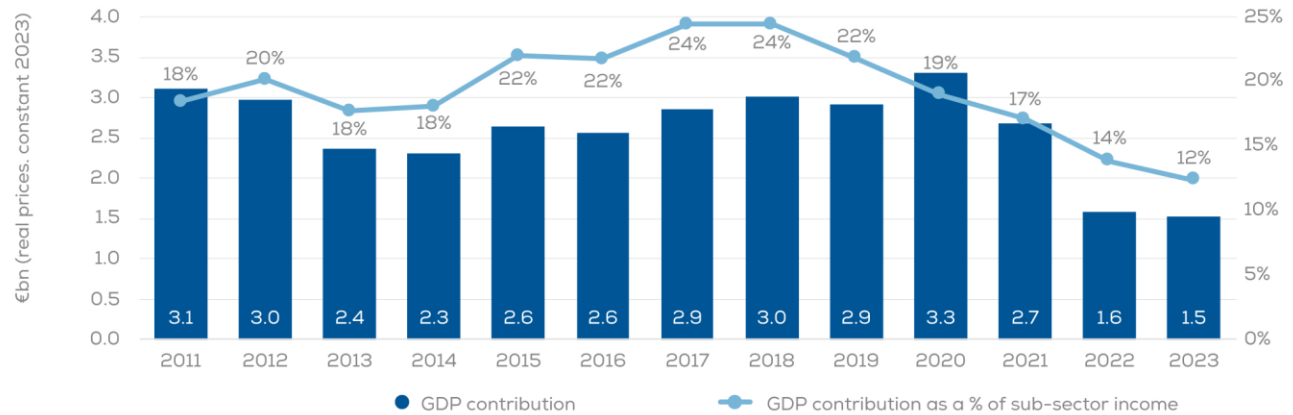
Wind energy component manufacturers' direct contribution to GDP

Component Manufacturers' contribution as a percentage of sub-sector income (real prices, constant 2023).



Source: Deloitte for ETIPWind

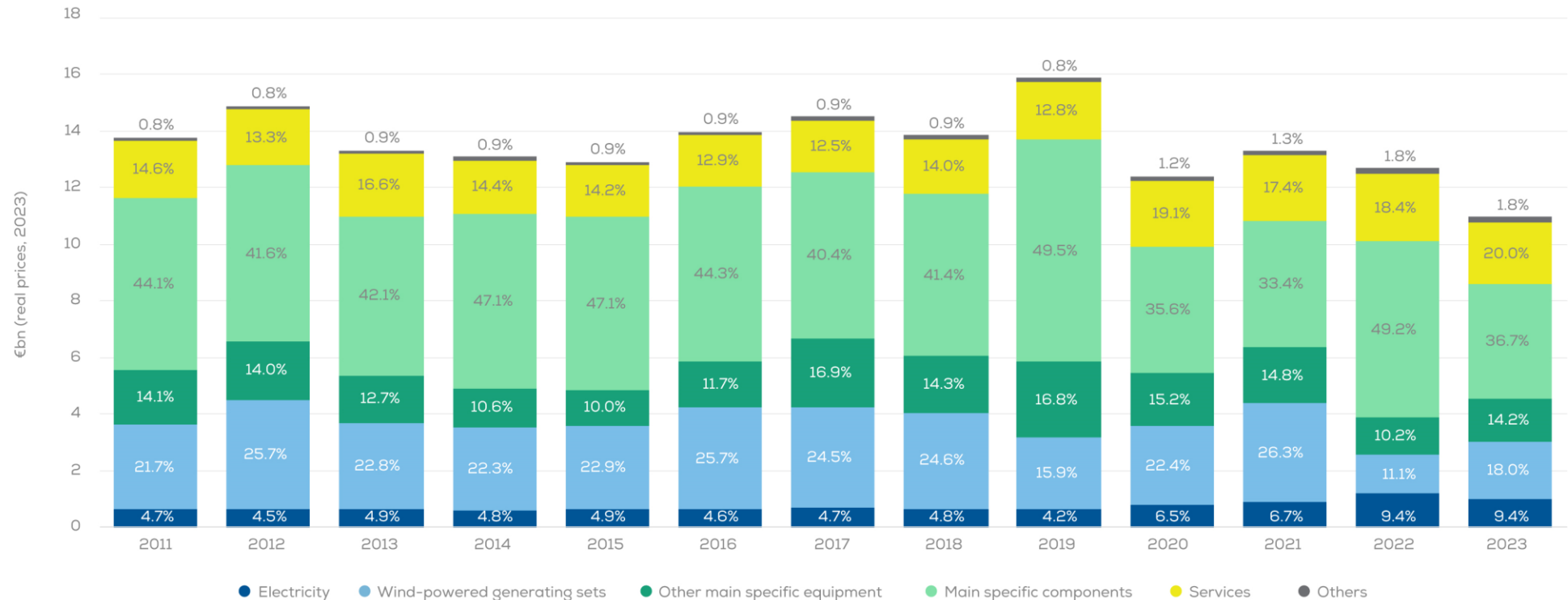
On- and offshore component manufacturers (excl. offshore wind substructures)



3. Trade Balance

European wind energy industry gross exports

The European wind industry exports €11bn of goods and services. Wind energy turbine nacelles and generators, including or not blades, accounted for 20% of gross exports in 2023*. While other various components accounted for around 50.9% (hubs, rotor, pitch systems, blades, towers, foundations for offshore wind, etc.).



Source: Deloitte for ETIPWind

* For Wind-powered generating sets, the TARIC code 8502310090-Wind-powered generating sets has been considered. This code is the only one which can be categorized as wind power equipment with certainty. The information has been obtained from the European Commission, EU Trade Helpdesk. For other main specific equipment and Main specific components, the information has been estimated based on questionnaires and interviews with mail companies in the wind energy sector. For Services, the information has been estimated based on questionnaires and interviews with these companies. For Electricity, the information has been obtained from Eurostat.

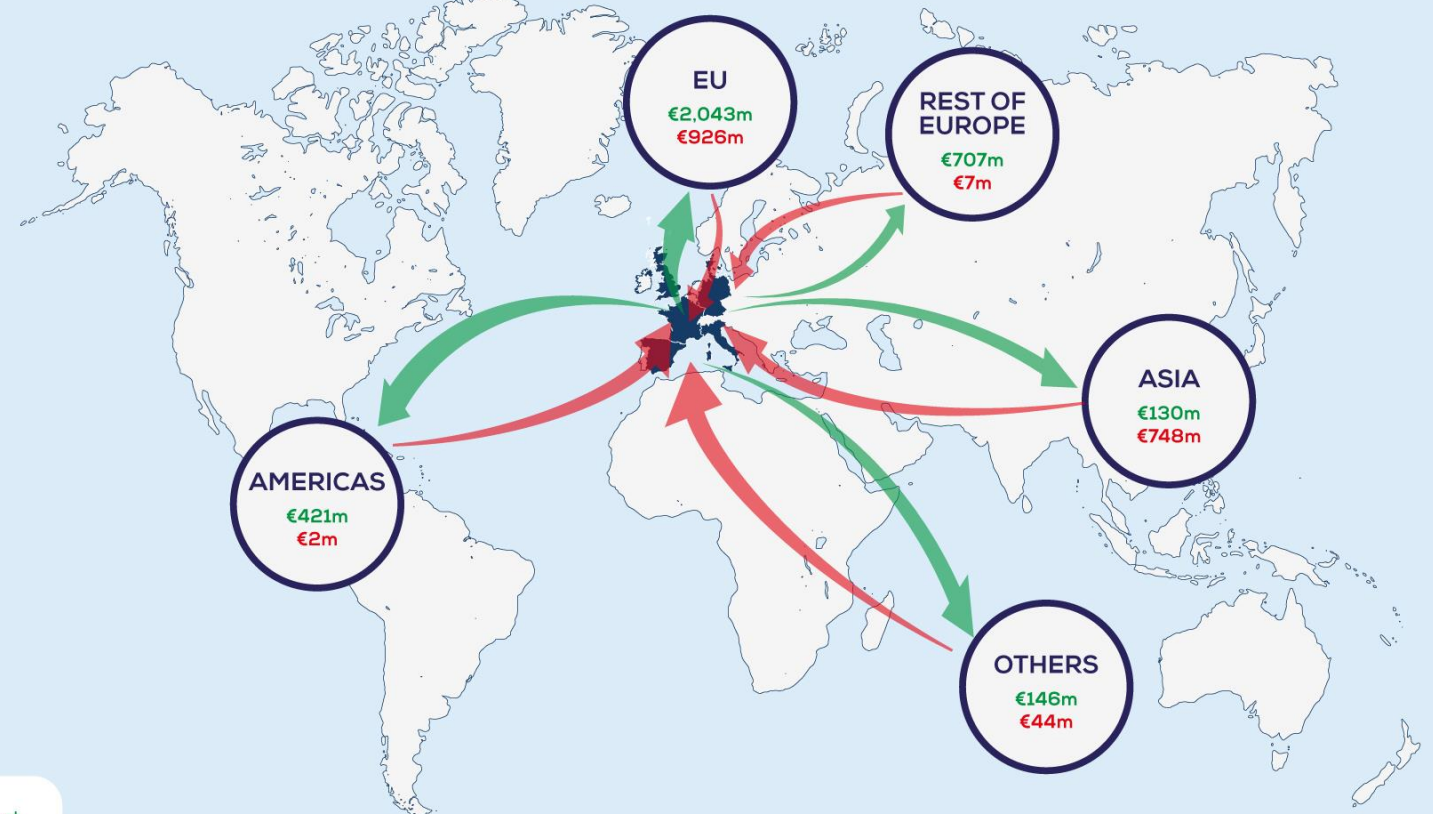
Wind turbine generator exports and imports in 2022

The European wind industry exports a variety of assembled equipment and individual components globally.

Fully assembled wind turbines, generators, with or without their rotor blades accounted for €1.4bn of EU exports in 2022. (Additional €2bn were traded within the EU).

The same year the EU imported €801m of these assemblies from outside the EU.

Wind turbine generators (real prices, real 2023)



This map sets out exports and imports of 'wind power generating sets' (export product NACE code 8502 31 00) from the EU-28 in 2022.

The "Rest of Europe" includes exports and imports of EU wind power generating assets in European countries outside the EU27.

"Others" include Africa and Oceania

■ Export
■ Import
(mEur)

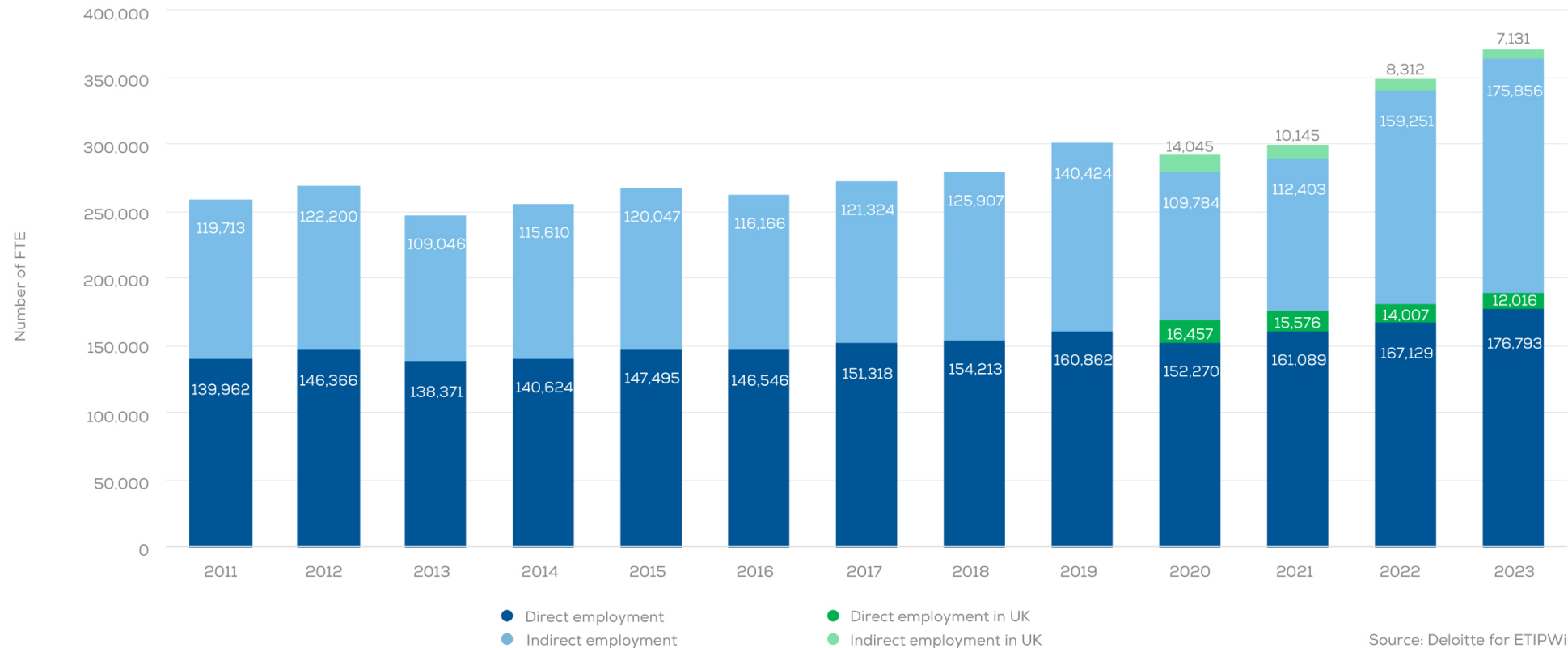
Source: Deloitte for ETIPWind

4. Jobs

The European wind energy

Jobs in the wind energy industry

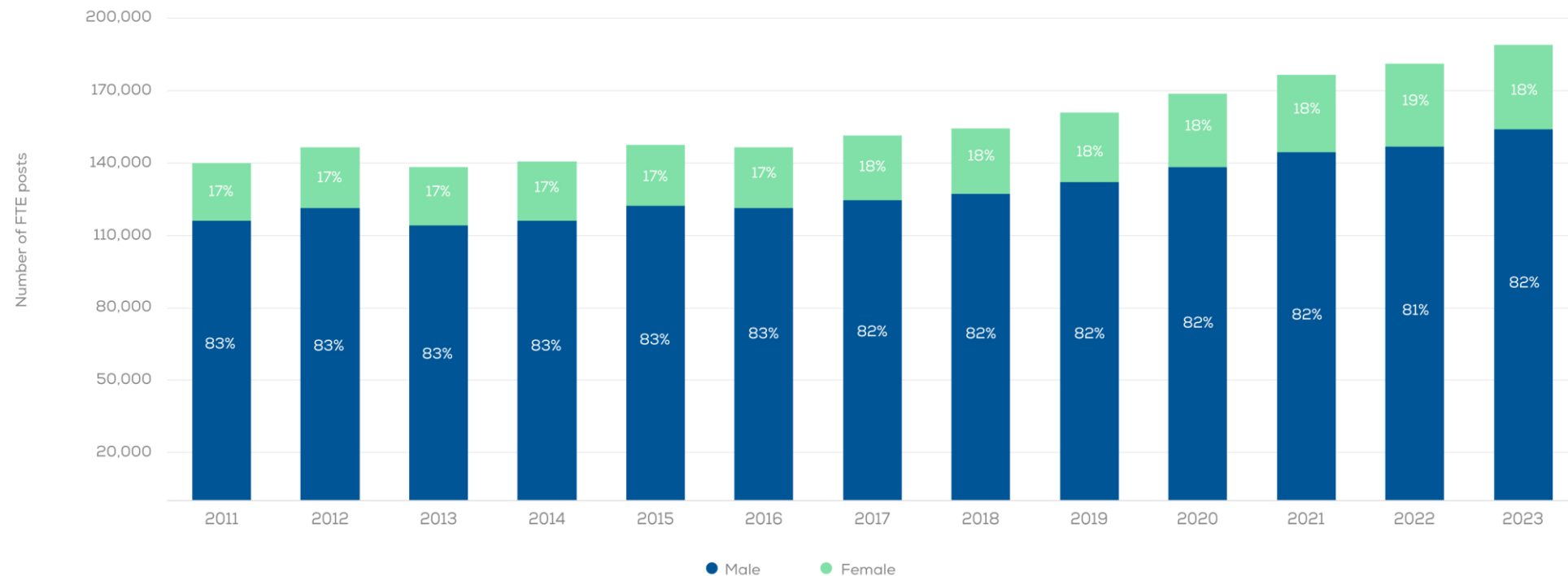
In 2023 wind energy sustained 370,000 jobs in the EU+UK including 350,000 coming from the EU. The number of people has increased in recent years after three years of stabilisation (2019-2021 stable since 2019) in light of economic recovery after the COVID-19 pandemic and energy crisis.



Source: Deloitte for ETIPWind

Gender in the jobs in wind energy in Europe

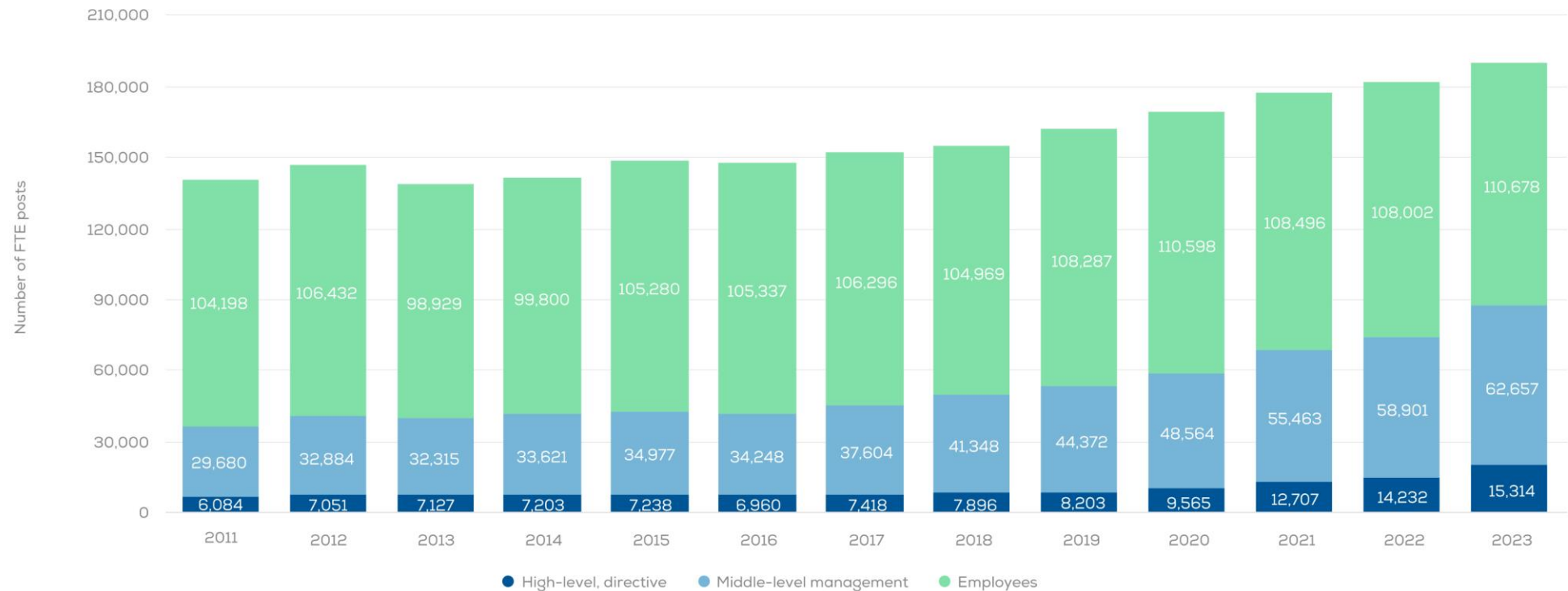
82% of workers directly employed in the European wind industry are men. The number of women working in the wind industry has remained stable at 18% since 2017.



Source: Deloitte for ETIPWind

Distribution of jobs per function in wind energy

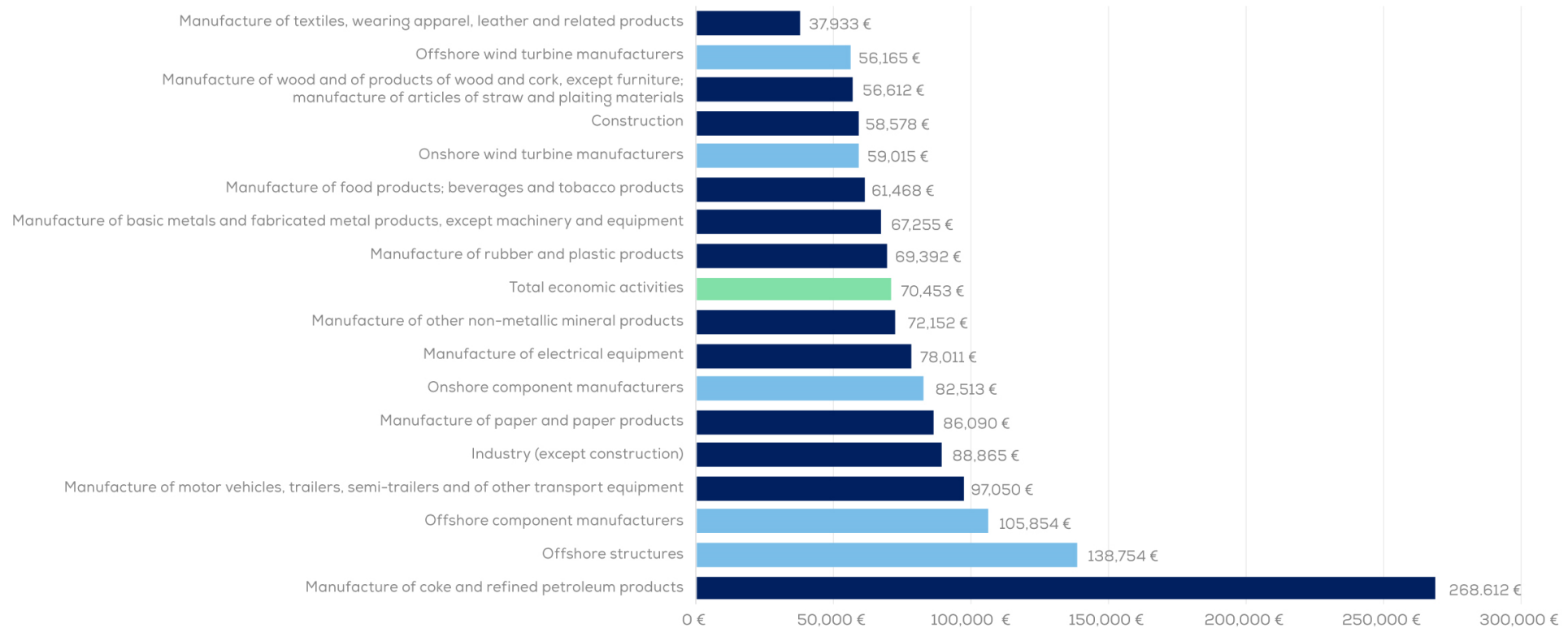
Technical, commercial and administrative employees represent 54% of the workforce in the European wind industry while 36% are in management roles and 10% in executive or directive functions.



Source: Deloitte for ETIPWind

Productivity of wind energy manufacturing and other sectors

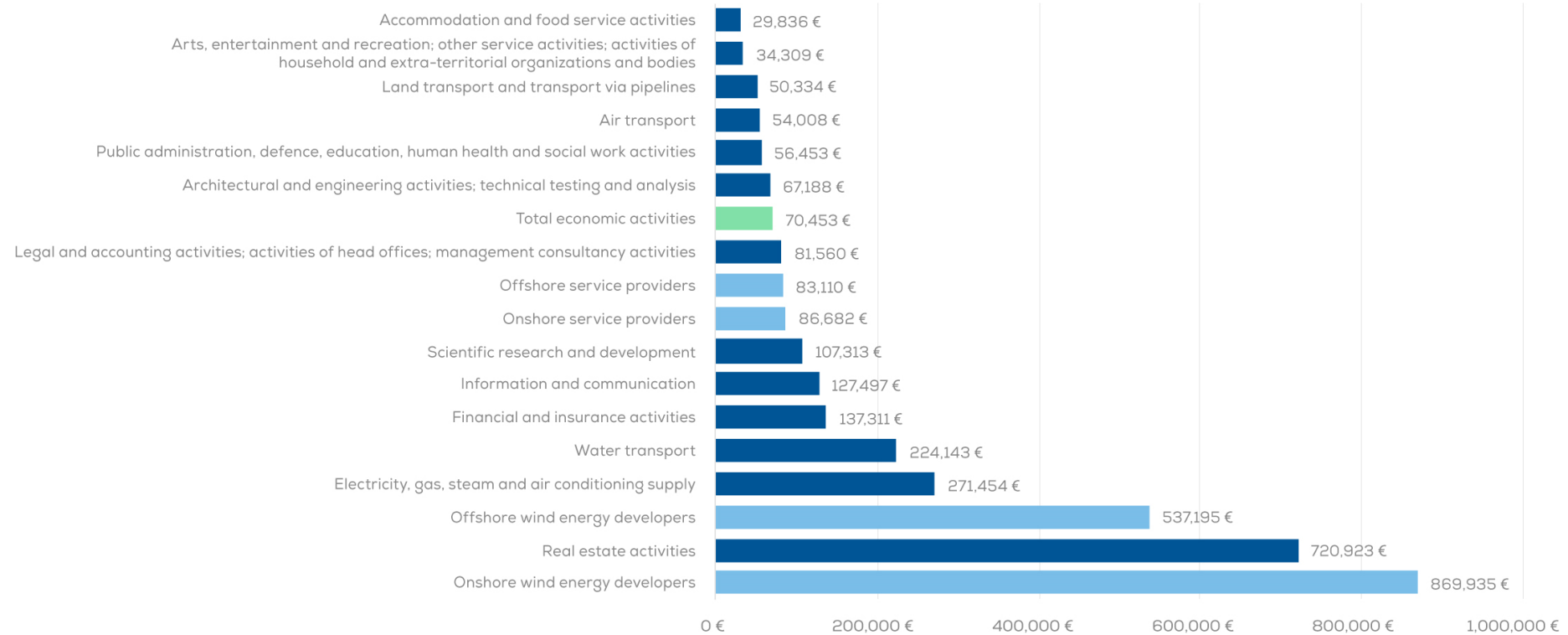
In 2023 the gross value added per employee of many industrial activities in the wind energy sector was higher than in many sectors of the EU economy. For example, offshore component manufacturers and substructures add between 50% and 100% more value to the economy per employee compared to the EU average of industrial sectors. In contrast, the gross value added by employees of wind turbine manufacturers was lower than the EU average.



Source: Deloitte for ETIPWind

Productivity of wind energy services and other services

The gross value added per employee of services in the wind energy sector was higher than the EU average of service sectors. For example, wind energy developers generate significantly higher gross value added per employee than information and communication or the accommodation and food service activities (tourism).

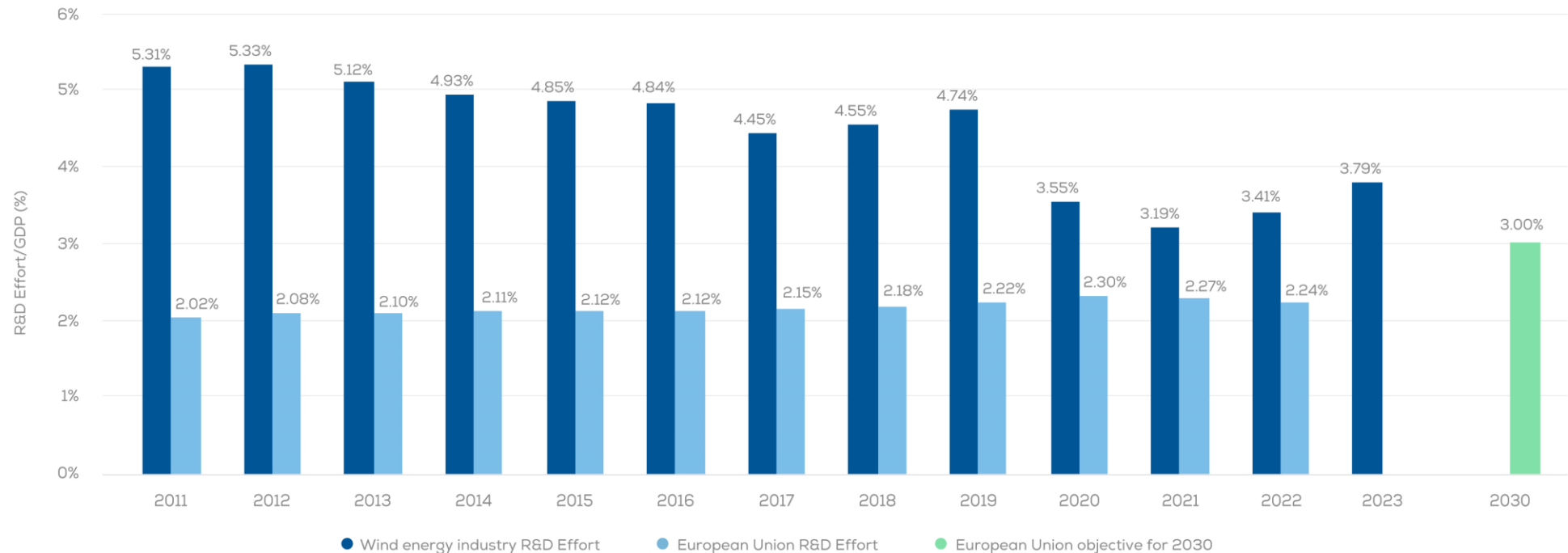


Source: Deloitte for ETIPWind

5. Research & Innovation

Research & Innovation (R&I) investments

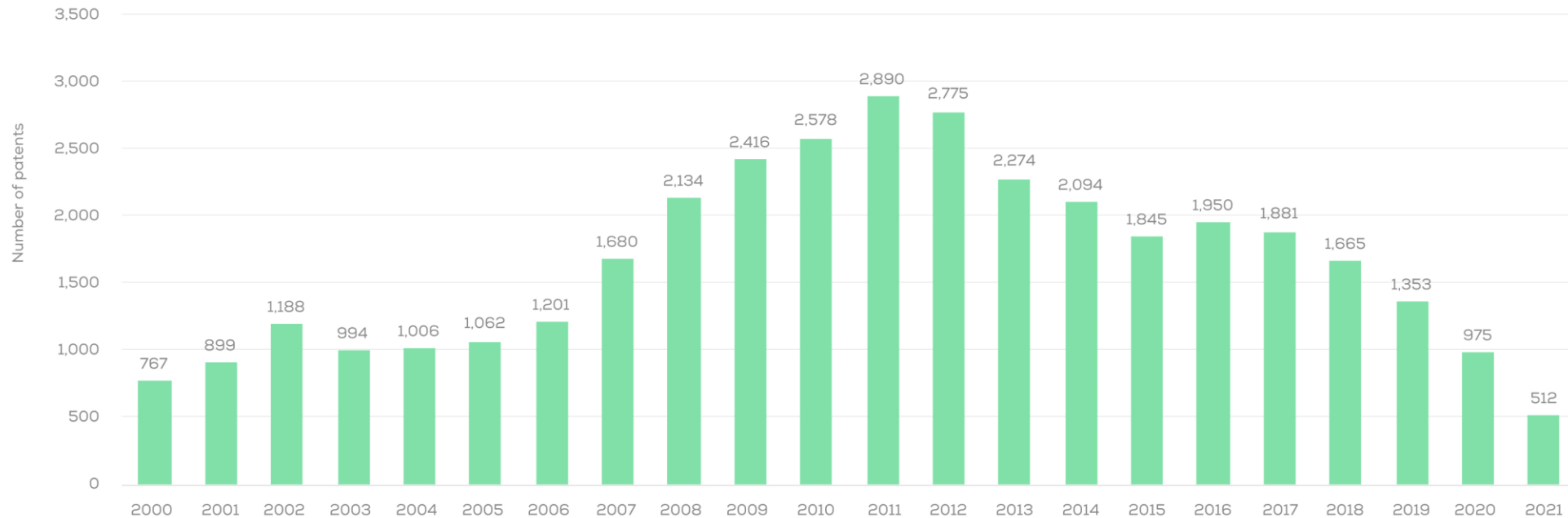
The wind industry investments in R&I as a proportion of GDP have increased for the second year in a row. In 2023 the EU wind industry invested the equivalent of 3.8% of its GDP contribution in R&I activities. This would amount to an annual R&D expenditure of €2bn. Whilst the relative R&I effort of the wind industry is still lower than ten years ago, the industry remains to outperform the EU average.



Source: Deloitte for ETIPWind

Patents

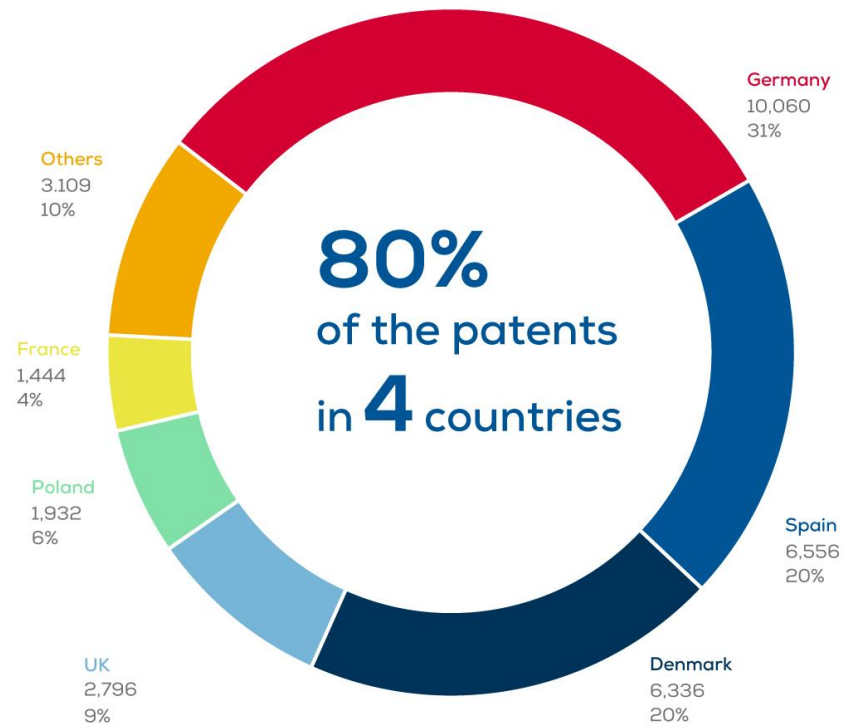
The number of patents on wind energy technology registered in Europe has significantly decreased year-on-year since 2011 to historical low levels. Only 512 patents were logged in Europe in 2021. Due to delays in patent offices this number may still increase over the next years. There is no representative data yet for patent applications in 2022.



Source: Deloitte for ETIPWind

Patents

Historically, 80% of patents originate from 4 countries: Germany, Denmark, Spain and the UK. Together they hold 25,748 patents on wind energy and related technologies.

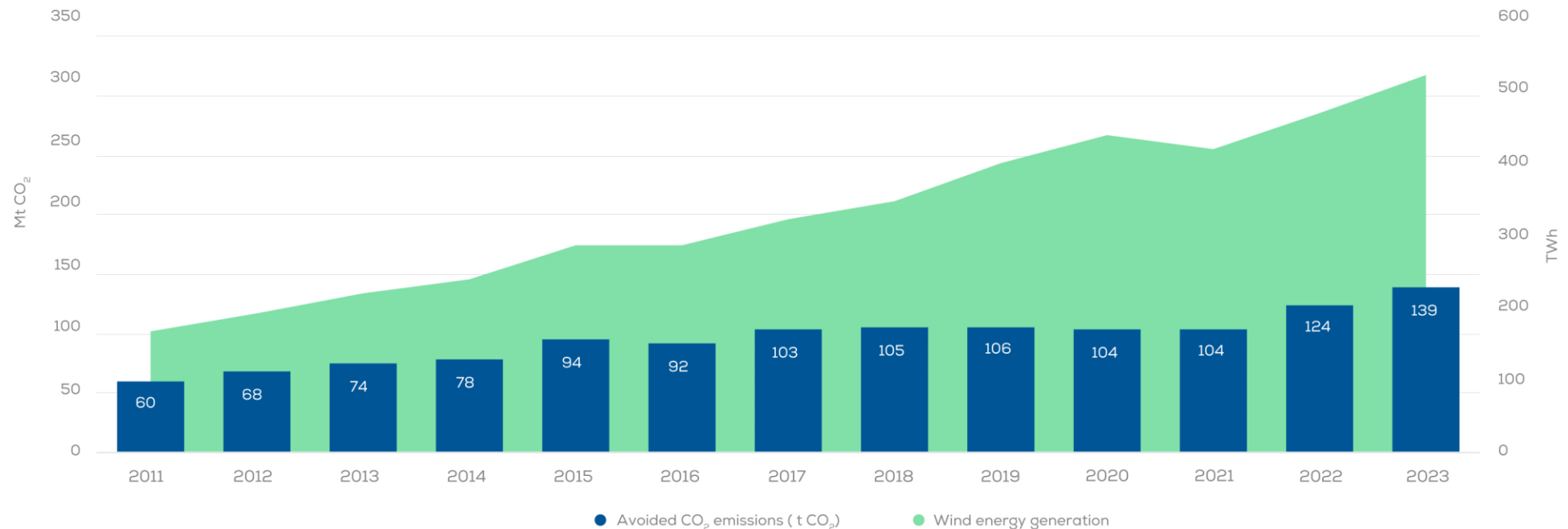


Source: Deloitte for ETIPWind

6. Energy & Climate savings

Avoided CO₂ emissions

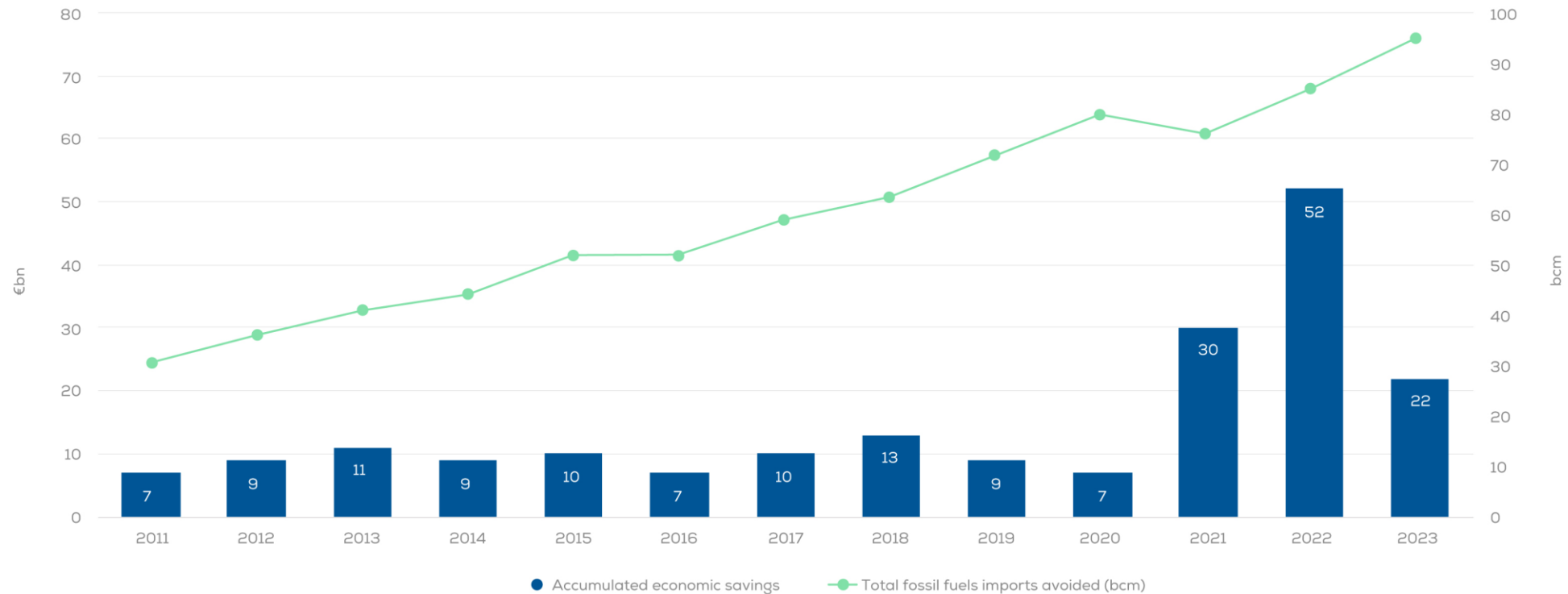
In 2023 wind energy generation avoided 139 million tons of CO₂ emissions in the EU+UK including 119 tons in the EU. This would amount to €11.6bn in the EU+UK and €9.9bn in the EU using the average price of EU emission allowances in 2023 of €83.24/tCO₂.



Source: Deloitte for ETIPWind

Avoided fossil fuel imports due to wind energy generation

In 2023 wind energy avoided the equivalent of 95bcm in fossil fuel imports to the EU+UK and 81bcm to the EU. This was 13% (EU+UK) more than in 2022 even if the total value of the imports avoided dropped to €22bn, down from €52bn in 2022. In the EU avoided imports were €19bn down from €44bn in 2022.

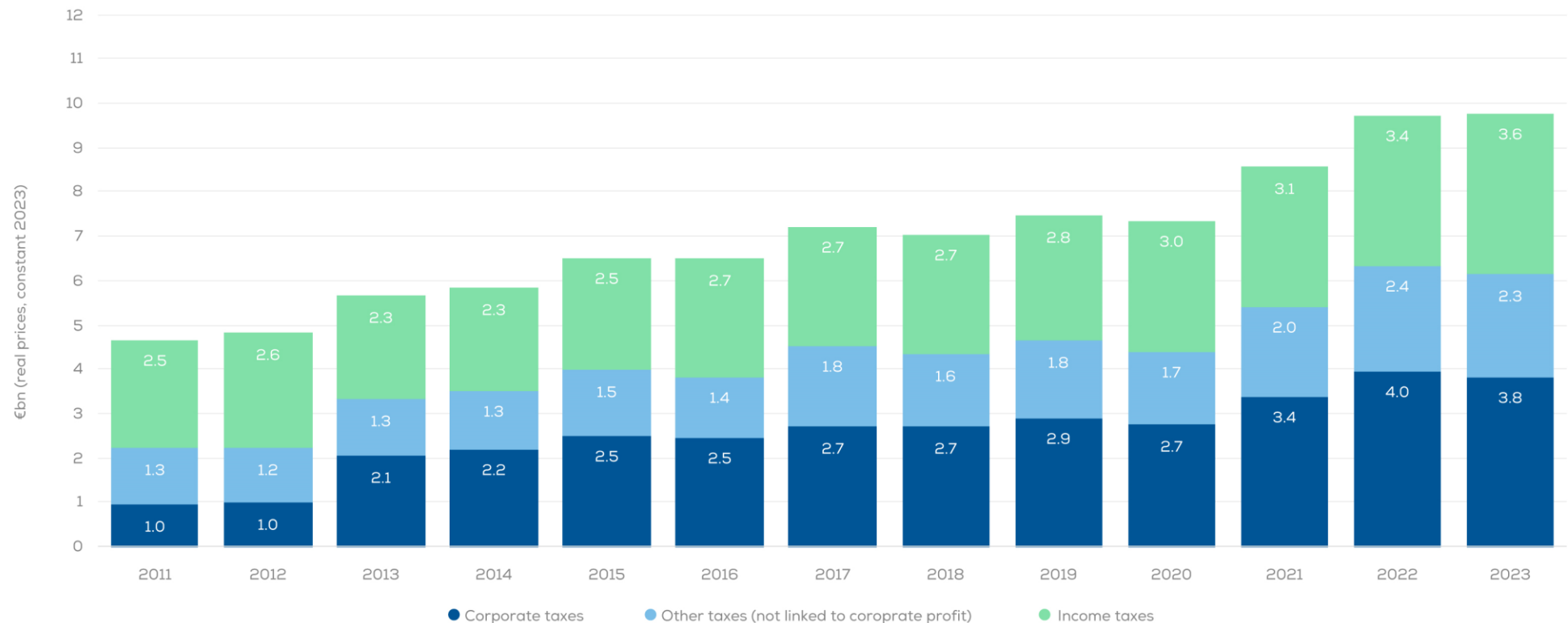


Source: Deloitte for ETIPWind

7. Taxes

Taxes paid by the European wind energy industry

In 2023 the European wind energy industry paid almost €10bn of taxes of which €2.3bn were not linked to corporate taxes and were destined mainly to local governments and communities. This includes taxes on the value of the electricity production, taxes focused on real state, environmental taxes, and contributions to local development.



Source: Deloitte for ETIPWind

Annex

Annex: EU Wind Energy sector direct contribution to GDP from 2011 to 2023 in current and real prices

EU-27 + UK (thousand million €)	2011		2012		2013			2014			2015			2016			2017			2018			2019			2020			2021			2022			2023			
	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	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	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	58.4	43.5	61.0	4.6%	46.2	56.5	-7.4%	43.6	59.8	5.8%	47.0	62.9	5.1%	50.3	59.0	-6.1%	47.9	60.4	2.3%	49.7	62.2	2.9%	52.2	64.9	4.4%	55.7	75.1	15.7%	65.6	80.7	7.5%	72.6	88.5	9.7%	83.8	87.6	-1.0%	87.6
Net exports	7.2	5.4	7.8	8.2%	5.9	6.2	-20.2%	4.8	6.0	-4.1%	4.7	5.2	-13.4%	4.1	5.7	10.2%	4.6	6.4	11.2%	5.2	5.0	-21.7%	4.2	5.1	2.7%	4.4	2.0	-61.7%	1.7	2.9	47.9%	2.6	2.6	-11.6%	2.4	3.1	21.7%	3.1
Gross exports	13.8	10.3	14.9	8.1%	11.3	13.3	-10.5%	10.3	13.1	-1.8%	10.3	12.9	-1.3%	10.3	14.0	8.2%	11.3	14.5	3.8%	11.9	13.8	-4.6%	11.6	15.9	14.6%	13.6	12.4	-21.7%	10.8	13.3	7.3%	12.0	12.7	-4.7%	12.0	11.0	-13.5%	11.0
Imports	6.5	4.9	7.1	8.0%	5.3	7.1	0.3%	5.5	7.1	0.2%	5.6	7.7	9.0%	6.2	8.3	6.9%	6.7	8.2	-1.3%	6.7	8.9	8.7%	7.4	10.8	21.3%	9.2	10.5	-2.8%	9.1	10.4	-0.3%	9.4	10.1	-2.8%	9.6	7.9	-22.4%	7.9
Intermediate inputs demand	42.9	32.0	44.7	4.3%	33.8	38.1	-14.7%	29.4	39.8	4.5%	31.3	40.1	0.7%	32.1	37.3	-7.0%	30.2	36.9	-1.0%	30.4	37.9	2.8%	31.9	39.4	3.7%	33.8	48.7	23.8%	42.6	49.8	2.1%	44.8	53.4	7.3%	50.6	56.2	5.3%	56.2
Demand	22.7	16.9	24.1	6.2%	18.3	24.6	1.9%	19.0	25.9	5.4%	20.4	27.9	7.7%	22.3	27.5	-1.7%	22.3	29.9	8.7%	24.6	29.2	-2.2%	24.5	30.7	5.0%	26.3	28.3	-7.7%	24.7	33.8	19.5%	30.4	37.6	11.2%	35.6	34.5	-8.4%	34.5
Total revenue	72.0	53.7	75.9	5.4%	57.4	69.8	-8.0%	53.8	72.9	4.4%	57.2	75.8	4.0%	60.6	73.0	-3.6%	59.2	75.0	2.7%	61.7	76.0	1.4%	63.8	77.3	1.6%	66.3	83.1	7.6%	72.6	88.3	6.3%	79.5	95.4	8.0%	90.4	92.9	-2.6%	92.9
Total expenditures	49.3	36.7	51.8	5.1%	39.2	45.2	-12.7%	34.9	46.9	3.8%	36.9	47.8	1.9%	38.3	45.6	-4.8%	36.9	45.1	-1.0%	37.1	46.8	3.8%	39.3	46.6	-0.5%	40.0	54.8	17.6%	47.9	54.5	-0.6%	49.1	57.8	6.0%	54.7	58.5	1.2%	58.5
Production or value added approach	22.7	16.9	24.1	6.2%	18.3	24.6	1.9%	19.0	25.9	5.4%	20.4	27.9	7.7%	22.3	27.5	-1.7%	22.3	29.9	8.7%	24.6	29.2	-2.2%	24.5	30.7	5.0%	26.3	28.3	-7.7%	24.7	33.8	19.5%	30.4	37.6	11.2%	35.6	34.5	-8.4%	34.5
Compensation of employees	8.6	6.4	9.1	4.9%	6.9	8.2	-10.2%	6.3	8.1	-1.0%	6.3	8.8	9.4%	7.1	9.3	5.1%	7.5	9.4	1.0%	7.7	9.4	0.5%	7.9	9.8	3.9%	8.4	10.3	5.3%	9.0	11.0	6.6%	9.9	11.8	7.5%	11.2	12.3	4.4%	12.3
Gross operating surplus	14.1	10.5	15.1	7.0%	11.4	16.4	9.2%	12.7	17.9	8.5%	14.0	19.1	6.9%	15.3	18.2	-4.8%	14.7	20.5	12.7%	16.9	19.8	-3.4%	16.6	20.9	5.5%	17.9	18.0	-13.8%	15.7	22.8	26.9%	20.5	25.8	13.1%	24.4	22.1	-14.3%	22.1
Income	22.7	16.9	24.1	6.2%	18.3	24.6	1.9%	19.0	25.9	5.4%	20.4	27.9	7.7%	22.3	27.5	-1.7%	22.3	29.9	8.7%	24.6	29.2	-2.2%	24.5	30.7	5.0%	26.3	28.3	-7.7%	24.7	33.8	19.5%	30.4	37.6	11.2%	35.6	34.5	-8.4%	34.5