Institute for Public Policy Research

A SECOND WIND

MAXIMISING THE ECONOMIC OPPORTUNITY FOR UK WIND MANUFACTURING

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SUMMARY

In terms of offshore wind capacity, the UK is second in the world only to China. Yet in the next seven years, the UK must install triple the amount of offshore wind compared to the past 14 years. At current pace, however, the UK will only meet that target in 2048. The fifth Contracts for Difference (CfD) auction fiasco notwithstanding, unresolved issues persist with wind deployment in the UK – such as slow planning and consenting, struggling grid infrastructure, and management and skills shortages.

Moreover, resolving deployment issues won't be enough. Up until this point, the failure to build up domestic wind manufacturing capacity has proved to be an economic missed opportunity. Now the emerging gap between global manufacturing supply and demand risks not only accentuating that missed economic opportunity but also imperils the UK's hopes of advancing towards energy independence, undermining its climate ambitions.

In this report, we argue for a green industrial strategy for the wind sector that should focus on expanding the UK's specialisation in wind manufacturing, to help put the UK on track to energy independence and on course to meet its ambitious climate targets, while reaping the economic opportunity of the green economy.

KEY FINDINGS

- **The global crunch in wind power manufacturing:** While global manufacturing capacity meets current demand for wind turbines, future supply will fall significantly short of demand. To meet global net zero 2030 targets, the world's wind manufacturing annual capacity will have to increase to 350GW (up from the currently planned 120–140GW).
- **China is *the* global wind superpower:** China now accounts for three-fifths of the world's manufacturing capacity in wind nacelles and blades respectively; holds a significant global manufacturing share for nacelle components, and accounts for the overwhelming majority of mining and refining of essential rare earth minerals. The main constructors of the specialised vessels required for deployment of offshore wind are also Chinese. Moreover, Chinese wind turbines are currently between 20 to 40 per cent cheaper than those manufactured in Europe.
- **The UK cannot rely on foreign wind manufacturing capacity:** First, while China's manufacturing potential is higher than current and future domestic demand, it cannot meet the global gap in wind manufacturing capacity. Second, the markets for wind-manufactured components are mainly regional and supply chain shortages will mostly appear in Europe, with bottlenecks already estimated from 2026. And third, current financial fragility among European 'original equipment manufacturers' (OEMs) could impede the expansion of their manufacturing capacity in Europe, let alone in the UK.
- **The UK's weak specialisation in wind manufacturing represents a missed economic opportunity as well as a drag to energy independence and net zero objectives:** If the UK had exploited its huge market for wind installation to the same extent as the three leading European nations in wind manufacturing, it would have generated an additional €21 to €36 billion in production value for wind turbines between 2008 and 2022. However, now the UK – with its relatively weak specialisation in wind manufacturing – stands at risk of increasing

installation costs and scarcity of wind equipment and products, imperilling the UK's march towards energy independence and its climate ambitions. In every major component of the wind supply chain – nacelles, blades, towers, foundations, cables – the UK does not appear among the top three European nations in terms of manufacturing capacity. It only ranks fourth in cables and blades, with two major manufacturing plants. Crucially, the UK does not host any nacelle manufacturing facility or any major player specialised in wind towers.

- **We can and must make in Britain:** To succeed with its wind installation targets aimed at achieving energy independence and climate objectives, the UK needs a significant dose of 'making'. In a scenario of global supply chain shortages and competition from neighbouring countries for scarce wind equipment, foreign dependency will imply unavailability of components or at best bidding for them at higher prices. In the end, this will undermine any deployment strategy that relies on cost-saving through the import of wind equipment. Investing in wind manufacturing instead yields substantial long-term economic benefits, including: higher energy security; spill-over investments from local suppliers; the potential to establish manufacturing facilities in less prosperous areas to address regional imbalances; and the generation of skilled, well-paying jobs. The UK is particularly well-positioned to increase its specialisation in wind manufacturing due to: the existence of related green industries; the prospective size of its wind power market; the possibility of leapfrogging to leading-edge technologies (eg larger turbines, floating systems); its geographical localisation facing the North Sea; and its unique innovation ecosystem.

KEY RECOMMENDATIONS

The UK needs a comprehensive green industrial strategy for the wind sector, bringing together deployment targets and the enabling expansion in wind manufacturing. IPPR has set out a series of coordinated industrial policies for the wind sector, with a focus on three policy priorities:

1. **On the purchasing side, fixing the current demand problem**, by securing a consistent commitment to long-term, **regular contracts for difference with developers, combined with non-price criteria such as local content requirements**.
2. **On the production side, supporting businesses to expand UK production capacity across the entire wind manufacturing supply chain**, particularly in wind turbines (nacelles, towers, blades) and essential components for offshore wind farms (cables, foundations).
3. **On the economic conditions, upgrade infrastructure capacity of ports and naval vessels for offshore wind installation.** Retrofitting ports and securing installation vessels are the prerequisites for large-size offshore wind manufacturing sites.

Collaboration between public entities and private businesses is vital. Public financing institutions such as the UK Infrastructure Bank, the British Business Bank and IPPR's proposed National Investment Fund could also play a pivotal role in jointly financing projects related to infrastructure renovation, establishment of new manufacturing facilities, and growth of small and medium-sized suppliers. A state-owned energy company, like the Labour party's proposed GB Energy, could be a linchpin, operating a national fleet of installation vessels and promoting joint ventures with private developers.

1.
THE UK WIND SECTOR AT A CROSSROADS

In terms of capacity, the UK is a global wind energy superpower. It ranks sixth in the world in terms of total wind energy capacity installed.[1] In offshore wind it is second only to China (IRENA 2023), accounting for over a fifth (22 per cent) of offshore wind energy installed capacity worldwide.

Within the UK, 30.1GW of installed wind power capacity secured 28.7 per cent of national electricity generation in 2023 (DESNZ 2024b). Official targets for wind energy deployment make it a vital component for achieving the full decarbonisation of electricity generation in the UK by 2035 (CCC 2023).

The UK government has a highly ambitious target of installing 50GW of offshore wind power (of which 5GW floating) by 2030. This equates to installing in seven years[2] three times as much offshore wind power capacity as was installed in the UK over the 14 years from 2009 to 2022.

Furthermore, the Labour party is committed to proposals that are even more ambitious (Labour Party 2023). Labour has pledged a 55GW target in offshore wind and a 35GW objective in onshore wind (an additional 41GW in offshore and 20GW in onshore wind installation relative to the current situation).

1.1. THE UK URGENTLY NEEDS TO ACCELERATE WIND DEPLOYMENT TO MEET ITS TARGETS

However, the UK is set to fall well short of even its current target of 50GW for offshore wind (see figure 1.1). Based on its rate of deployment in recent years – 1.4GW per year in the period 2018–22 – the UK will not reach its target until 2048 (The Crown Estate 2022).[3]

1 Figures reported here refer to the year 2022.

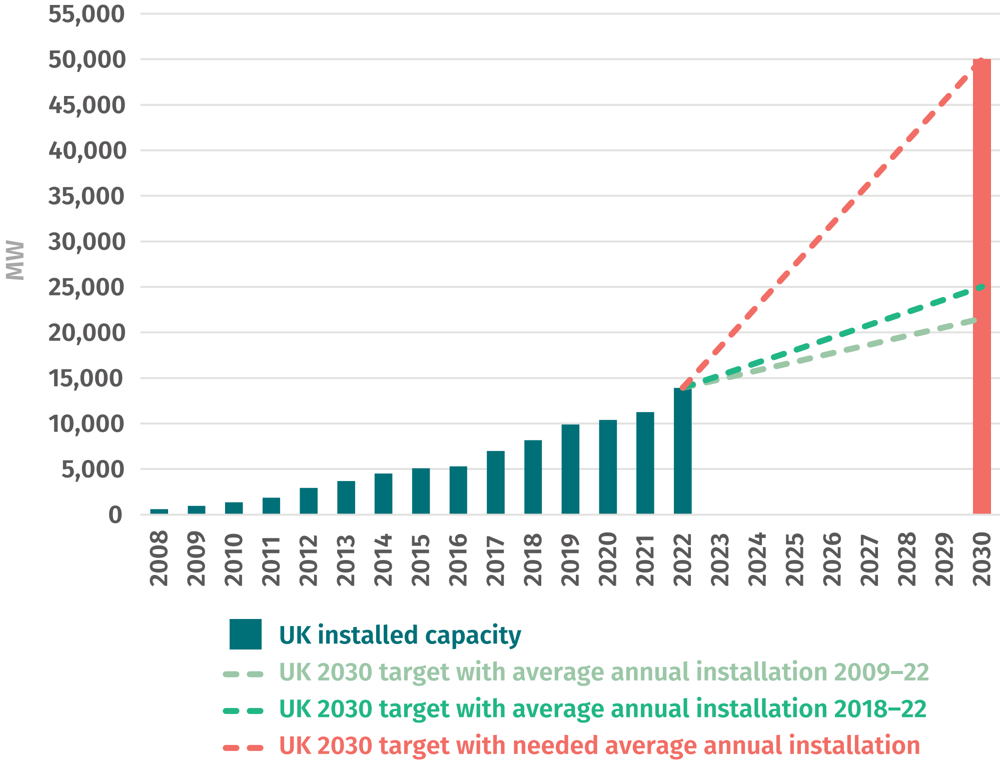
2 Including the year 2024.

3 Calculations are based on 13.8GW of offshore wind connected at the end of 2022, subtracted from the 50GW target and divided by the rate of installation from 2018–22.

FIGURE 1.1

The UK is off track to meet its 2030 targets for offshore wind

Offshore wind deployment rate trajectories compared to trajectory required to meet net zero targets



Source: Author's analysis of DESNZ figures

In fact, despite the need for acceleration, offshore wind deployment slowed down in 2023. While 2.7GW of offshore wind were installed in 2022, the year 2023 has recorded only around 800MW of additional capacity (DESNZ 2024b).

The acceleration in deployment required for onshore wind is even more drastic. Despite being the eighth largest installer of onshore wind in the world[4] (IRENA 2023), installation in the UK has slowed following the government's de facto ban on onshore wind in 2015.[5] Even though the de facto ban on developments has been lifted,[6] many industry figures have suggested that planning requirements are still largely prohibitive to further investment (Horton 2023). Nevertheless, potential for onshore wind installation remains high, with industry associations such as Renewable UK (2021a) making recommendations for a 30GW UK target by 2030 (compared to the 15.3GW level at the end of 2023).

4 That ranking refers to the year 2015. Since then, the UK has slipped behind Brazil, and in 2023 it is likely to be overtaken by Sweden.

5 The UK installed 5.6GW of onshore wind between 2016 and 2022, of which 75 per cent was in the first three years.

6 As announced to parliament on 5 September 2023 by the secretary of state for Levelling Up, Housing and Communities, and the minister for Intergovernmental Relations. See: https://questions-statements.parliament.uk/written-statements/detail/2023-09-05/hcws1005

1.2. CHALLENGES FACING WIND DEPLOYMENT IN THE UK

Despite the success of its wind installation programme over the past 15 years, the UK is encountering various challenges in wind energy deployment. As the number and complexity of offshore wind projects rapidly increase to meet installation targets, longstanding constraints (see below) on deployment will only worsen unless they are resolved.

- **Long-term uncertainty related to Contracts for Difference (CfD) auctions.** The recent failure of the fifth CfD auction round to contract any offshore wind projects has put a serious dent in industry confidence (Renewable UK 2023). While the ceiling price has been raised for the sixth round (Wind Europe 2024), a long-term schedule for CfDs is required to restore developer confidence with early warnings over adjustments to the ceiling price.
- **Planning and consenting issues.** Deployment timelines could be reduced from 10 years to between five and six years. Without these reforms the government is unlikely to meet its target of deploying 50GW by 2030 by around 10GW (Pick 2023).
- **Inadequacy of port infrastructure.** The timeline for investing in port infrastructure does not synchronise well with wind deployment. Upgrading port infrastructure and developing manufacturing facilities can take three to four years. By contrast, wind developers who win CfD contracts will often want short-term leases that only last long enough to deploy their projects. The win/lose nature of the contracts also means developers tend not to work with ports until they have secured a CfD, at which point they tend to gravitate towards ports that already have appropriate infrastructure (Pick 2023).
- **Electric grid capacity and management.** The electricity grid requires significant physical upgrades and better management. This is challenging in the current environment where Ofgem has a responsibility to minimise the impact of new investment on consumer bills, while private ownership of the grid requires a substantial rate of return for shareholders (Pick 2023). Ofgem needs to take a longer-term view on the impact of upgrading networks on energy bills, while also taking a stricter approach to permissible profits within RIIO regulations.[7] On grid management, queues for grid connections have been a bottleneck for developers for many years (Winser 2023), with speculative projects offered grid connections that then don't progress, while more concrete projects are left waiting.
- **Difficulty of attracting the right skills in the right quantities.** As IPPR has previously highlighted, there are also more fundamental issues across the UK skills system as a whole (see Emden and Murphy 2019; Emden et al 2020). These include:
  - **Lack of funding for adult retraining and apprenticeships.** By 2024/25, spending on adult education and apprenticeships will have fallen by 25 per cent compared to 2010/11 (Sibieta et al 2022).
  - **Length of retraining.** Outside certain specific skills in oil and gas, retraining can be prohibitively time-consuming and/or costly, particularly for workers hired as contractors who would have to shoulder the cost themselves.
- **Lack of pipeline for skills.** Certain roles such as electrical engineers are in short supply, meaning there is high competition between many sectors but little incentive to do in-house training in case the worker then moves to another company. Training for many of these high-skilled roles can take a long time. Without a clear pipeline from higher education institutions, the industry is facing a lag between supply and demand of skilled workers.

7 RIIO (Revenue = Incentives + Innovation + Outputs) is a model of price controls through which Ofgem sets prices for electricity network companies in the UK.

1.3. A GREEN INDUSTRIAL STRATEGY FOCUSED ON WIND MANUFACTURING IS KEY TO DELIVERING ON THE UK'S WIND INSTALLATION TARGETS

Addressing those deployment challenges is a necessary condition for the UK to achieve its 2030 wind power installation targets. But it won't be sufficient.

In a world of upcoming global shortages for wind equipment and competition from China, deepening and diversifying a domestic wind manufacturing supply chain is essential to any deployment strategy, as our analysis shows in chapter 2. The UK's relatively weak specialisation in wind manufacturing – documented in chapter 3 – translates into a structural dependency on imported wind products. But as we set out in chapter 4, this is neither a sustainable nor a cost-effective strategy. The UK should build its strategic future comparative advantages in wind manufacturing from its currently existing competitive strengths. This will require the coordination of policy measures under a comprehensive 'green' industrial strategy for the wind sector – recognising the inextricable interdependency between wind energy deployment and wind manufacturing capacity.

IPPR's green industrial strategy for the wind sector is outlined in chapter 5, together with some key policy recommendations resulting from processing the most relevant analyses and data as well as from interviews held with various stakeholders over the past months, including experts from industry associations, executives of wind manufacturing companies and trade union representatives.

2.
WIND MANUFACTURING IN THE GLOBAL COMPETITION TO NET ZERO

2.1. THE UPCOMING GLOBAL WIND MANUFACTURING SHORTAGE

The wind power sector has expanded significantly since the turn of the century. While in 2001 global installed capacity was only 24GW, by several estimates it has surpassed 1,000GW in 2023 (IEA 2024; GWEC 2024).

The upsurge in installation capacity was made possible by a corresponding increase in the manufacturing capacity of wind turbines and other components of wind farms. New global wind manufacturers have emerged, others have further consolidated their market shares. Great technological leaps have been achieved, among them the mastering of offshore wind installation technologies and a three-times increase in the rotor diameter – from an average of 50 metres for onshore turbines in 2000 (Statista 2023) to the record[8] level of 252 metres achieved in 2023 by Goldwind commercialising its new 16MW wind turbine. This is more than four times the size of the first 3.6MW Siemens turbines installed at the Burbo Bank offshore wind farm in 2007.

Yet recent additions of manufacturing capacity and engineering progress remain insufficient. While current global manufacturing meets existing demand for wind turbines, future demand compatible with a 2030 net zero emissions scenario[9] will fall short of announced capacity projections (IEA 2023a) and calls for an expansion in global manufacturing supply.

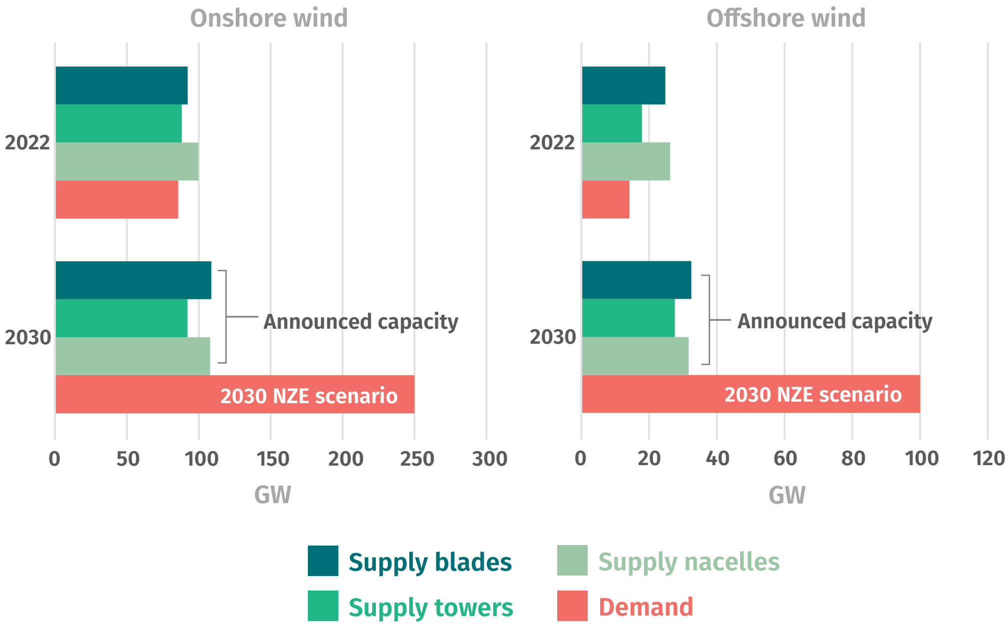
8 The Chinese SOE CSSC Haizhuang is about to unveil its new 18MW prototype with a rotor diameter of 260 metres.

9 In the net zero emissions scenario (NZE) elaborated by the International Energy Agency (IEA 2021), wind power generation will need to reach 3,101GW of global capacity – with this source of electricity generation reaching 21 per cent of the total by 2030, up from 9 per cent in 2020.

FIGURE 2.1

Net zero targets require a global expansion of wind manufacturing

Global demand and supply for onshore (left) and offshore (right) wind manufacturing equipment in 2022 and 2030 (NZE scenario and current expected capacity)



Source: Authors' analysis of IEA 2023a

To attain global net zero emission objectives by 2030, the world's wind manufacturing annual supply will have to reach 350GW (up from the currently planned 120–140GW), of which 250GW is onshore and 100GW is offshore (figure 2.1).

2.2 WIND MANUFACTURING CAPACITY IS STRONGLY CONCENTRATED IN CHINA

Europe was the birthplace of the modern wind manufacturing industry, clustered around Denmark, Germany and Spain, with a supply chain spread across the continent (see sections 3.1 and 3.2). Today it still enjoys a solid and technologically advanced manufacturing base, between two and three times larger than in the US.

However, in the past 15 years, China has emerged as the global leader in wind manufacturing, now accounting for 57 and 62 per cent of the world's manufacturing capacity in wind nacelles and blades respectively[10] (figure 2.2). It also holds a significant global manufacturing share for nacelle components, specifically 65 per cent for generators and 75 per cent for gearboxes (GWEC 2023a). Finally, China accounts for 68 per cent of mining and 90 per cent of refining of rare earth minerals (such as dysprosium and neodymium) which are essential for the permanent magnet generators used in wind turbines (IEA 2023b).

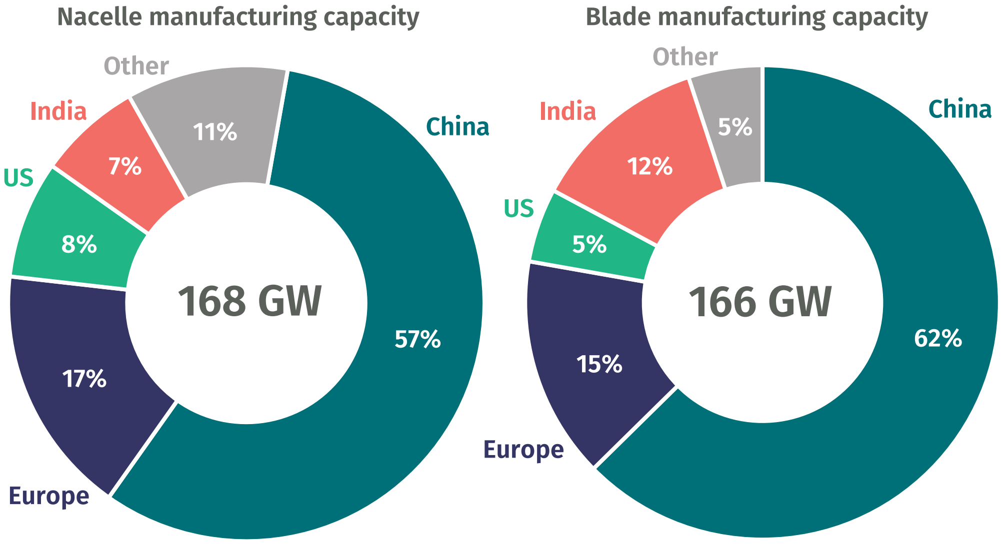
Moreover, in the expanding offshore wind sector, deployment is critically dependent on the availability of jack-up and heavy-lift vessels (WTIVs). European operators operate a consistent fleet, but they will soon face a shortage of vessels capable of installing the newest more efficient turbines, larger than 10MW. The main constructors of these specialised vessels are also Chinese – COSCO, CIMC Raffles and China Merchants Heavy Industry have won the majority of WTIVs orders placed in recent years by European vessels operators (GWEC 2023b).

10 Global manufacturing capacity of wind nacelles and blades is estimated to be around 168GW and 166GW in 2022 (Rystad Energy 2023).

FIGURE 2.2

Global wind manufacturing capacity is largely concentrated in China

Global nacelle (left) and blade (right) manufacturing capacity by geographical area in 2022



Source: Authors' analysis of Rystad Energy 2023

Note: Manufacturing capacity does not represent actual production, but only potential production.

The substantial concentration of global manufacturing capacity in China can be attributed in part to the consistent increase in installed capacity, as indicated in table 2.1. – from 10 per cent of global installed capacity in 2008 (12GW) to 40.3 per cent in 2022 (365GW).

TABLE 2.1

China's total wind power installed capacity and global share in the years 2008 and 2022

	Total 2008 (MW)	Onshore 2022 (MW)	Offshore 2022 (MW)	Total 2022 (MW)
China	12,024	333,998	31,442	365,440
Global	120,297	841,898	64,320	906,218
China's share	10.0%	39.7%	48.9%	40.3%

Source: Authors' calculations based on figures from various GWEC Global Wind Reports

In 2022, 99.9 per cent[11] of China's 48.8GW installations (57 per cent of the world's total) was commissioned to Chinese-based wind manufacturing companies (BloombergNEF 2023). China's manufacturing potential is higher than current and future domestic demand for wind power installation, but it won't be enough to cover the upcoming global supply gap.

11 In 2021, Chinese companies covered around 98 per cent of the 55.8GW total installed capacity (BloombergNEF 2022).

Forecasts from the International Energy Agency (IEA 2023a) suggest that China's global manufacturing share will notably rise across all supply chain segments, especially in offshore wind. According to analysis from the Global Wind Energy Council (GWEC 2023a), 64 out of the 74 newly announced global wind turbine nacelle assembly facilities are projected for China, in contrast to just three in the US and one in Europe. This implies that supply chain shortages in wind manufacturing will be mostly appearing in Europe and in the US – and much earlier, with potential bottlenecks already estimated from 2026 (GWEC 2023c).

2.3. CHALLENGES FOR EUROPEAN WIND MANUFACTURERS

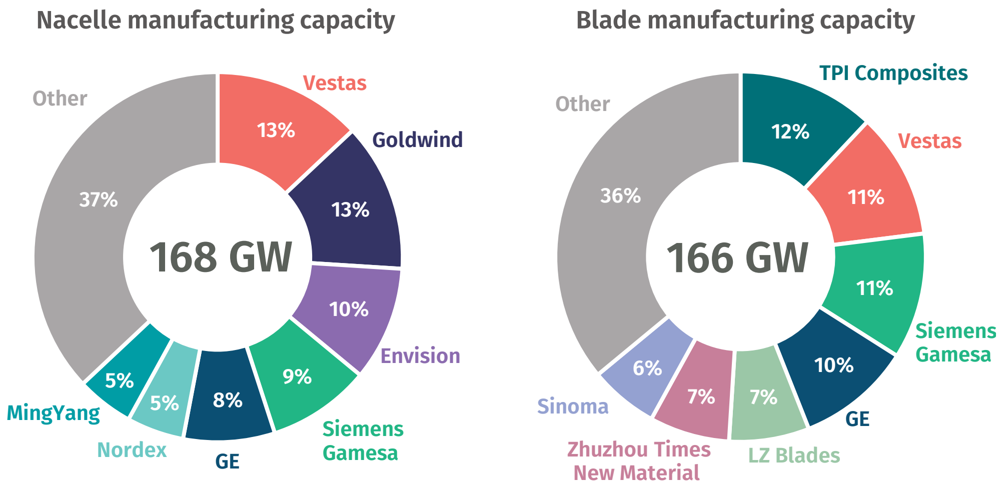
The wind manufacturing supply chain is centred around pivot players called 'original equipment manufacturers' (OEMs), which design the entire wind turbine, produce most of their key components and are responsible for their assembly.

Global manufacturing capacity is currently concentrated into a handful of companies, with the seven largest entities accounting for around two-thirds of the global manufacturing capacity in nacelles and blades (figure 2.3). Chinese companies such as Goldwind, Envision and MingYang feature among the top industry players. In 2022, together with another seven Chinese firms, they accounted for 58.3 per cent of total capacity installed (BloombergNEF 2023), up from 17 per cent only 10 years earlier.

FIGURE 2.3

Global wind manufacturing capacity is concentrated in few companies

Global nacelle (left) and blade (right) manufacturing capacity by major companies in 2022



Source: Authors' analysis of Rystad Energy 2023

Note: Manufacturing capacity does not represent actual production, but only potential production.

Until recently, markets for wind components have displayed a relatively sticky geographical configuration into regional areas.[12] Logistics challenges, high transportation costs and established long-term relations with developers have so far shielded European OEMs from Chinese competition in the European market, unlike in the solar PV industry, where imports of cheaper Chinese panels eradicated Europe's native companies throughout the 2010s (IEA 2022).

12 In the EU, less than 2 per cent of the market share for commissioned wind turbines in 2022 was attributed to Chinese OEMs (JRC 2023). In the UK, no single Chinese company had installed wind capacity in the years 2021 and 2022 (BloombergNEF 2023).

For those reasons, European OEMs – namely Vestas, Siemens Gamesa, Nordex and others – which in 2012 enjoyed a 38 per cent global market share for additional installed capacity, have seen their global share falling only marginally to 30 per cent in 2022 (JRC 2023).

However, as opposed to their Chinese competitors, over the past years European OEMs have been experiencing lower and decreasing profit margins, which resulted in significant losses in 2022 (table 2.2).

TABLE 2.2

Financial figures of main European and Chinese wind manufacturing players in 2022

Company	Revenues in $m and (per employee)	Net results in $m and (net margin)	Employees	Investments in $m and (per employee)	R&D in $m and (per employee)
Goldwind	6,915	**363**	11,200	1,344	212
	(617,413)	**(5.2%)**		(120,000)	(18,944)
Vestas	15,260	**-1,656**	28,438	863	105
	(536,631)	**(-10.9%)**		(30,340)	(3,705)
Siemens Gamesa	10,640	**-1,018**	27,604	849	315
	(385,471)	**(-9.6%)**		(30,764)	(11,426)
Mingyang	4,579	**514**	11,475	293	122
	(399,008)	**(11.2%)**		(25,513)	(10,628)
Nordex	5,998	**-524**	9,111	216	658
	(658,331)	**(-8.7%)**		(23,747)	(72,248)

Source: Authors' calculations based on Refinitiv data

According to specialised reports, and as confirmed by our external stakeholders, this is explained by a series of contingent factors:

- shortages of components and materials following the pandemic and geopolitical crises (in particular Ukraine and the Middle East), since European OEMs are less vertically integrated than Chinese competitors, depending more on foreign Tier 2 and Tier 3 suppliers
- inflation in the price of components (especially offshore) and materials (especially steel, lithium, nickel and rare earth elements)
- increased cost of borrowing (as opposed to China), impacting wind manufacturers' balance sheets but also slowing down the pace of installation for offshore developers, as they require huge upfront financing.

In the absence of supporting policy measures such as those enjoyed by Chinese wind manufacturers (and increasingly US players with IRA), European OEMs' financial fragility could impede the expansion of manufacturing capacity required to meet Europe's wind deployment targets. European OEMs could be further hampered by the competition they face outside Europe with financially stronger Chinese players. Wind turbines manufactured in China are currently between 20 to 40 per cent less expensive than those produced in Europe, according to the industry experts we have consulted, due to shorter supply chains and domestic production subsidies.

3. THE CURRENT STATE OF UK WIND MANUFACTURING

The UK specialisation in wind manufacturing should be considered in the broader European context, given the regional make-up of the industry's supply chain. Any meaningful comparative analysis of the UK wind manufacturing sector needs to be performed with respect to similar European countries, rather than with larger economic blocks, such as China or the US.

For example, the 588MW Beatrice offshore wind farm (84 turbines) in Moray Firth, completed in 2019, was installed with the contribution of UK and European manufacturers (Rystad Energy 2023). The port of Nigg was used as a marshalling port for assembly and storage of the various components. Some of these parts were made in the UK: wind turbine blades were made by the Siemens Gamesa factory in Hull, array cables were manufactured at the JDR Cables site in Hartlepool, wind turbine towers were produced by the CS Wind plant in Campbeltown (closed in 2020), and 26 out of 84 foundation jackets came from the former BiFab (now Harland & Wolff) facility in Methil. The remaining 56 jackets were made in Belgium (28) and in Denmark (30). Nacelles were provided by the Siemens Gamesa factory in Cuxhaven. The transformer modules were manufactured by Siemens in Germany (Dresda). A Norwegian company, Nexans, supplied the offshore export cables produced in Halden. Other components were sourced from Germany and the Netherlands.

3.1. THE UK'S MISSED OPPORTUNITY IN MANUFACTURING WIND TURBINES

In the years 2008–22, the UK's installed capacity of wind power went from less than 3GW to 28.5GW. The UK had the second-highest installation rate overall and ranked first in offshore wind in Europe.[13] The UK's share of European wind power installed increased from 4.6 to 12.2 per cent, making it a leading nation in the region – the number one in offshore wind.[14]

But despite this astonishing growth in wind power *capacity*, the UK has missed a unique opportunity to become a leading nation in wind turbine[15] (and related components) *manufacturing*. Unrivalled wind installation programmes in the UK have mainly benefited producers in neighbouring European countries, notably Denmark and Germany.

Available data[16] – reported in figure 3.1 (left) – shows that over the years 2008–22 the UK produced wind turbines for an average annual value of 119.5 million euros

13 EU member states plus the UK.

14 The UK's total installed capacity in offshore wind power in 2022 (13.8GW) amounts to approximately the same as the EU's total (16.3GW)

15 We have considered figures from Eurostat's PRODCOM database, specifically referring to the PRODCOM code for 'wind-powered generating sets' identified as 28112400. This is a proxy variable – adopted also by the EU Joint Research Centre for their industry studies – that can track the EU's manufacturing output in the wind industry.

16 The PRODCOM time series provided by Eurostat often lack completeness due to occasional gaps in statistical surveys conducted by the national statistics offices of EU member states. In the case of the UK, the ONS stopped recording any PRODCOM figure after 2019, due to Brexit.

in current prices,[17] a much lower figure compared to the three leading European producers: Denmark (4.1 billion euros), Germany (2.3 billion euros) and Spain (1 billion euros). This means that, over that period, the UK accounted for only 1.4 per cent of wind turbines production value manufactured in Europe, despite representing 15.2 per cent of total wind installations.[18] The UK failed to exploit its huge domestic demand for wind turbines by capturing a higher share of their manufacturing value.

The UK's weak specialisation in wind manufacturing is confirmed by its dependency on imported wind equipment. In the years 2019–21, the UK has been the world's largest importer of wind turbines (JRC 2022). On average over the period 2008-2022, it has recorded an annual net deficit of 432 million euros in the trade balance[19] of wind generating sets. Converted to approximately £365 million, this amounts to 0.5 per cent of the UK's trade deficit in 2022.

We have calculated that if the UK had attained the same production value of wind turbines relative to the volume of wind installation per inhabitants as the three European competitors, it would have been able to generate an additional average annual production value of 2.4 billion euros compared to Denmark, 1.8 billion euros relative to Germany, and 1.4 billion euros in comparison with Spain. Spread over the 15-year period, these annual figures would have resulted in 36, 27.5 and 21.4 billion euros[20] respectively (figure 3.1, right).

These estimates refer to a single product code and likely underrepresent the broader economic potential of local manufacturing suppliers that could be activated. Nonetheless, they give an indication of the vast economic opportunities that could be harnessed by sourcing a larger portion of future offshore wind projects with domestically manufactured components.

17 Available figures show a modest catch up in the UK value especially following the opening of the Siemens Gamesa blades factory in Hull in 2016. In 2018, the value of production sold of UK wind turbines was 356 million euros, 4.3 per cent of Europe's total.

18 Measured in MW.

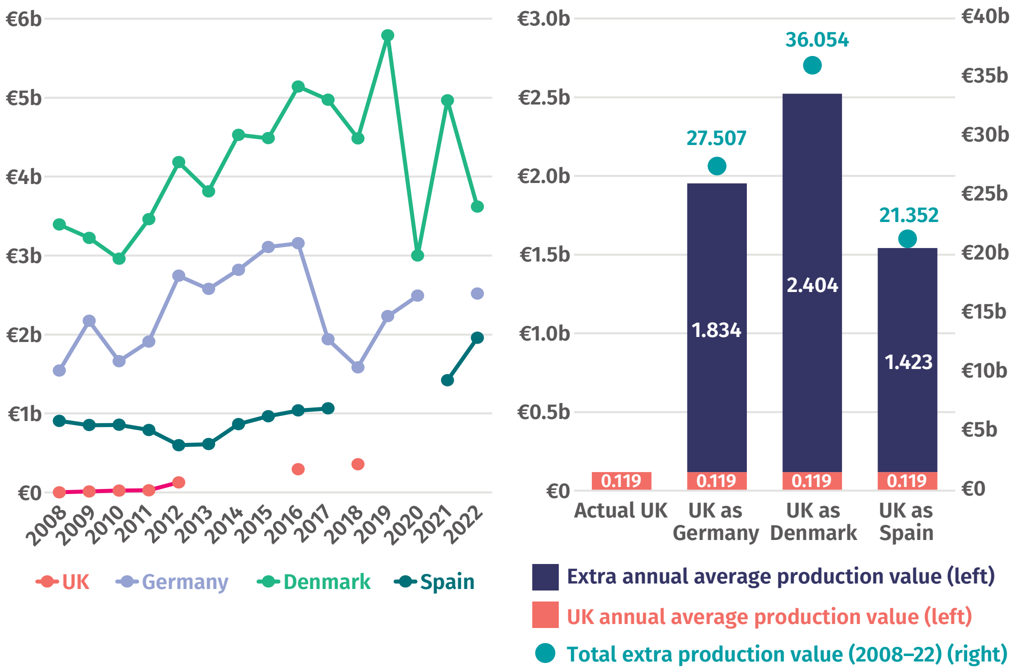
19 In comparison with Germany, Denmark and Spain which have been net exporters of wind turbines, with average values of 1.4 billion, 1.8 billion and 659 million euros respectively. Source: PRODCOM data from Eurostat.

20 These estimates would be slightly lower in nominal pound prices by a factor of 0.84, that is the annual average exchange rate €/£ over the years 2008–22.

FIGURE 3.1

The UK has recorded modest production values in wind turbines despite record-level installation rates

Left: Annual production value of wind-powered generating sets in the UK, Denmark, Germany and Spain over the years 2008–22. Right: Estimate of the economic value the UK could have attained if it had the same production-to-per-capita installation rates of other leading European nations (2008–22)



Source: Authors' calculations based on Eurostat's PRODCOM database
Notes: Values are expressed in millions of euros in current prices.

From an employment perspective, previous IPPR analysis also shows how countries with more established wind manufacturing capabilities like Germany and Denmark create more jobs for every MW of wind capacity installed (Emden et al 2023b). We find that if the UK had chosen to act with similar coordination and long-term thinking and employed the same number of people per MW installed as Denmark, it could have employed 98,000 more people to deliver the 27.1GW of wind power it reached in 2021. Even if it employed the same number of people per MW as Germany, it would still have employed over 21,000 more people.

3.2. THE RELATIVE SPECIALISATION OF THE UK IN EUROPE'S WIND MANUFACTURING SUPPLY CHAIN

The UK's relative specialisation in the wind manufacturing supply chain should be evaluated in the broader European context, by comparing national production shares. Figure 3.2 shows the production shares of European[21] nations relative to the five main wind manufacturing components in 2022.[22] The UK appears among the top

21 It includes the EU, the UK and Turkey.

22 Reported values of manufacturing shares are taken from a survey on wind manufacturing capacity in Europe performed by Rystad Energy in the first half of 2022. As such, they do not reflect subsequent developments incurring later in the same year.

five European countries only with respect to cables (fourth position) and blades (fourth[23] position).

The leading European competitors across these major components are broadly Germany,[24] Denmark and Spain, followed by France. These four countries account for more than 90 per cent of nacelle manufacturing capacity. Germany hosts six nacelle factories, Spain has four, Denmark has three and France has two, while the UK has none.

Remarkably, the UK's production capacity in offshore blades is lower than France's, which also hosts two offshore blade manufacturing units, despite having installed only 500MW of offshore wind power capacity in 2022 (as compared to almost 14GW in the UK).

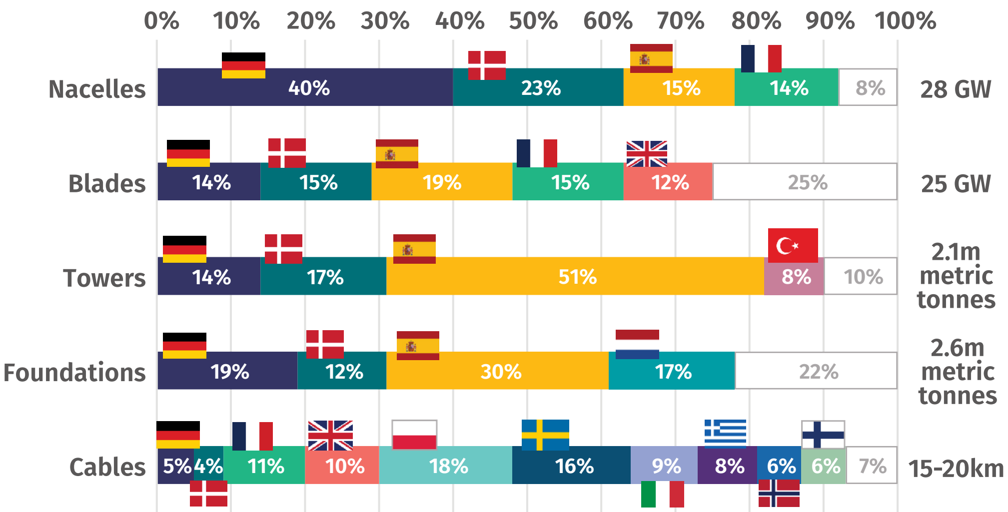
Spain is the leading European nation in tower manufacturing – and in onshore blades – with over half of Europe's capacity, followed by Denmark and Germany, while the UK does not have any facility specifically dedicated to producing steel wind towers.

Even if the UK could catch up in offshore foundations when SeAH Wind's new Teesside factory becomes operational (see section 3.3), Spain remains the largest producer in Europe with its state-owned shipbuilding company Navantia making more than 20 per cent of Europe's offshore wind foundations.

The UK is relatively well placed in Europe in cable manufacturing, with a specialisation in low and medium voltage and a variegated number of domestic players, including the leading company JDR Cable,[25] which is also expanding its domestic presence with a new factory in Blyth (see section 3.3).

FIGURE 3.2

The UK lags behind in every major segment of the European wind manufacturing supply chain
Distribution of manufacturing capacity among European nations for the five most important components of the wind supply chain



Source: Authors' analysis of Rystad Energy 2023

23 With Nordex ceasing its rotor blade production at the Rostock plant in the second half of 2022, Germany does not currently manufacture blades. Before that date, the UK was ranking fifth in terms of blade manufacturing capacity in Europe, as figure 3.2 shows.

24 In 2021 Germany experienced the closing down of Vestas' blade manufacturing factory at Lauchhammer.

25 JDR Cable is a subsidiary of the Polish group TFKable, the third largest electrical cable manufacturer in Europe.

3.3. THE IDENTIFICATION OF UK WIND MANUFACTURING FACILITIES

The UK has 14 production units specialised in wind manufacturing (see table 3.1), comprising two for blades, one for turbine towers, three for foundations, and eight for electric cables. As previously mentioned, **the UK lacks any dedicated production site for nacelles**.

The two most important wind manufacturing sites[26] in the UK are the **blade production** units of Vestas in Newport (opened in 2011) and of Siemens Gamesa in Hull (opened in 2016 and expanded significantly in the past two years). In 2021, GE announced the opening of a new blade factory[27] in Teesside, but the decision was reversed only one year later.

The Tata Steel unit in Hartlepool produces steel plates that are used for **wind tower** components but does not make standardised final products. The UK has lacked a wind tower manufacturer since the closing down of CS Wind's Campbeltown manufacturing site in 2020.[28]

There are also two modest producers of **offshore foundations** in Methil (Harland & Wolff) and Newcastle (Smulders), but from 2024 they will be supplemented by the new SeAH Wind plant in Teesside, which is set to become the largest facility of its kind in the world.

While the UK hosts a substantial number of manufacturing sites producing electric **cables** (such as ABB, Prysmian, Slingco, and JDR Cables), these sites do not exclusively serve wind farms, unlike the previously mentioned wind manufacturing facilities. However, one exception is the new JDR Cables facility in Blyth, poised to emerge as a cutting-edge subsea cable manufacturing plant specifically tailored for the offshore renewables industry.

26 Vestas is going to produce blades for its V174-9.5MW wind turbine at the Newport plant, while Siemens Gamesa has more than doubled the size of its manufacturing site to host the production of blades for its SG 14-222 DD wind turbine (14MW).

27 LM Wind Power, the blade subsidiary of GE for its turbines, had plans to allocate its newly announced Teesside facility specifically for the production of LM 107.0 P blades designed for GE's Haliade-X 12MW offshore wind turbine. This manufacturing plant was expected to employ a workforce of 750 individuals.

28 In August 2021, the Spanish company GRI Industries unveiled plans for a wind tower facility at the Able Marine Energy Park in North Lincolnshire, with the capacity to produce 100 offshore towers annually. However, no progress has been reported since the announcement.

TABLE 3.1

List of the UK's 14 production units specialised in wind manufacturing components (blades, towers, foundations, cables)

Company	Product	Location	Estimated number of jobs	Type
Vestas	Blades	Newport	650	Offshore
Siemens Gamesa	Blades	Hull	1,000	Offshore
Tata Steel	Towers	Hartlepool	300	Both
SeAH Wind (in 2024)	Foundations	Redcar	750	Offshore
Harland & Wolff	Foundations	Methil	170	Offshore
Smulders	Foundations	Newcastle	300	Offshore
ABB	Cables	Warrington	200	Both
ABB	Cables	Aberdeen	100	Both
ABB	Cables	Stonehouse	100	Both
JDR Cables	Cables	Hartlepool	270	Offshore
JDR Cables	Cables	Littleport	100	Offshore
JDR Cables (in 2024)	Cables	Blyth	170	Offshore
Slingco Ltd	Cables	Rawtenstall	65	Both
Prysmian	Cables	Wrexham	400	Both

Source: Authors' analysis of Wind Europe's supply chain figures[29] and individual company reports

Wind Europe[30] has also classified some UK suppliers of subcomponents for the wind manufacturing industry. The representative sample reported in table 3.2 features companies specialising exclusively in wind components (such as Tekmar Energy for submarine cable protections, Variohm Eurosensor for wind direction sensors) and others with broader product portfolios, where wind components constitute only a small fraction of their main business lines (such as BGB Innovations for slip rings or Industrial Clutch Parts for brakes). Most of these companies function as subsidiaries of larger, often foreign, industrial groups, yet their UK-based wind component manufacturing units tend to be relatively small in scale.

29 See: https://windeurope.org/about-wind/campaigns/local-impact-global-leadership/

30 The authors would like to thank Wind Europe for sharing their database of European wind manufacturing companies.

TABLE 3.2

List of key UK domestic suppliers of subcomponents for the wind manufacturing industry and their product specialisations

Company	Specialisation	Location
Tekmar Energy	Cable protections	Newton Aycliffe
Bruce Anchor	Mooring for floating wind farms	Aberdeen
GMT Rubber-Metal-Technic	Anti-vibration mounts	Leeds
Industrial Clutch Parts	Breaks	Whaley Bridge
Ingeteam	Converters and generators	Woking
Babcock International	Transformers	Rosyth
BGB Innovations	Slip rings for wind turbines	Grantham
Cooper & Turner Ltd	Safety critical fasteners	Sheffield
Flender	Gearboxes	Leeds
Heason Technology	Precision control equipment	Slinfold
Variohm Eurosensor	Wind direction sensors	Towcester
FT Technologies	Wind direction sensors	Sunbury-on-Thames

Source: Authors' analysis of Wind Europe's supply chain figures

The geographical localisation of the UK wind manufacturing supply chain[31] follows a distinct pattern, as displayed in figure 3.3. Small subcomponent suppliers (shown in grey) are predominantly situated inland, primarily in England. Conversely, manufacturing units responsible for main offshore wind components[32] are strategically positioned along coastal sites, mainly concentrated in the North East and in or near ports.

While smaller components can be efficiently supplied from various locations with minimal transportation costs, the size of larger elements such as offshore blades, foundations, and towers makes their overland transportation difficult. Situating production near ports allows wind-manufactured components to be more easily installed closer to offshore wind farms or to be readily exported via sea routes.

This highlights the strategic importance of retrofitting maritime ports to create optimal industrial ecosystems for attracting potential investments in new wind manufacturing facilities (see section 5.4).

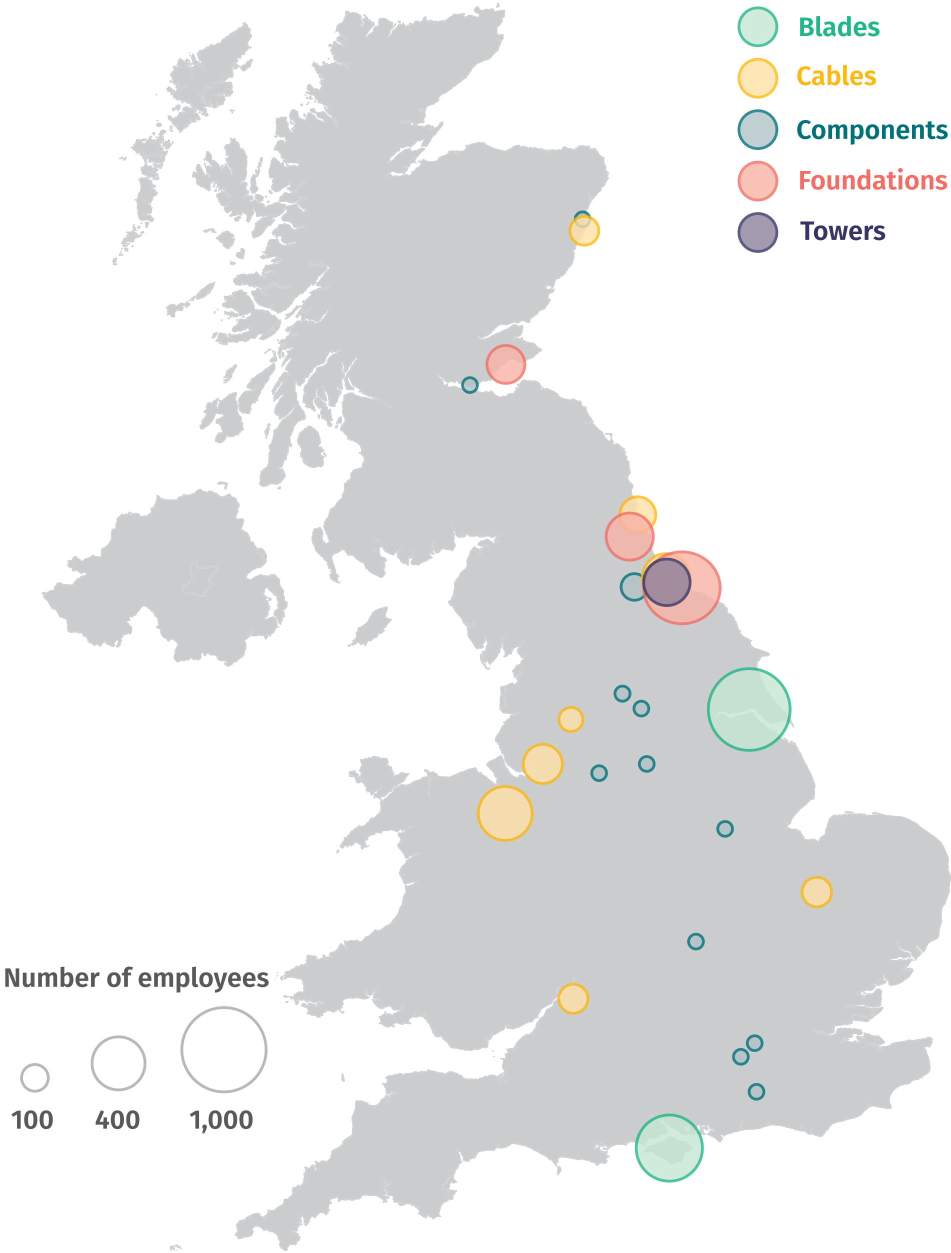
31 The map does not include R&D centres on wind technologies, the most relevant ones being Vestas' in the Isle of Wight and LM Wind Power's at Southampton, together with the Catapult centres in Blyth and Glasgow.

32 Cables represent a relative exception. Manufacturing sites for cables are typically situated in inland areas, as they are also serving onshore electrical infrastructures. However, the new JDR Cables unit specialising in offshore wind cables is located precisely on the seaside in Blyth.

FIGURE 3.3

Wind manufacturing facilities are mainly concentrated in the North East and located on the seaside

Geographical location of wind manufacturing facilities in the UK



Source: Authors' calculations based on Wind Europe's supply chain figures

Note: This separates the five main segments of the wind manufacturing supply chain and shows key domestic suppliers of components for wind turbines, cables and foundations. The size of each circle corresponds to the number of employees operating in each facility.

3.4. CHALLENGES FOR THE UK WIND MANUFACTURING SUPPLY CHAIN

Any further expansion of the UK's wind manufacturing supply chain should address the following challenges:[33]

- the absence of a major native OEM, more responsive to domestic policy priorities
- foreign dependency on steel plates (steel accounts for 90 per cent of total materials in an offshore wind farm), set to increase after Tata Steel announced the closing down of its blast furnaces in Port Talbot
- deficiencies in port infrastructure and quayside facilities for offshore wind manufacturing, particularly floating
- low shipbuilding capacity for building specialised vessels
- skill shortages, including difficulties in retraining workforce from offshore oil and gas sector (Catapult 2023)
- difficulty in accessing available public funding for supporting investments
- unsupportive policy and regulatory regime concerning wind deployment (as mentioned in section 1.2).

33 Most of these challenges are reported in the Catapult Offshore Wind Supply Chain Confidence Survey, which in 2023 has registered an increase – relative to the previous year 2022 – in the share of respondents that have reported declining overall confidence in the future growth of their organisation.

4.
EXPANDING UK WIND MANUFACTURING TO MEET WIND DEPLOYMENT NEEDS

4.1. 'MAKING' AND 'BUYING' IN THE UK

Previous chapters demonstrate that the argument that says the UK should 'buy cheaper' instead of 'making costlier' is flawed in the case of wind energy. Particularly in offshore wind, the critical and enabling role of domestic supply chains has been the focus of recent reports by industry bodies (Renewable UK 2024) and government alike (Baringa 2024).

Chapter 2 has illustrated the inevitable failure of a cost-saving approach based on importing wind products, due to global supply chain shortages and competition for scarce wind equipment, which could further increase with current geopolitical tensions affecting global trade. The case for relying on imported goods encompasses other hidden costs such as a structural technological and energy dependency from abroad – becoming a matter of national security – and a reduced exchange rate stability due to the further deterioration of the UK's current account balance.

Chapter 3 has highlighted how the relatively weak specialisation in wind manufacturing makes the UK even more dependent on foreign imports, as it aims to achieve its ambitious wind energy installation targets. At the same time, relevant – although insufficient – investments made in recent years have demonstrated the possibility for an advanced economy to develop a stronger domestic wind manufacturing industry. Countries like France are testimony to the importance of achieving energy security and decarbonisation targets by ramping up manufacturing capacity in wind technologies (see box 4.1).

BOX 4.1: FRANCE CATCHING UP IN WIND MANUFACTURING DESPITE BEING A LAGGARD IN WIND DEPLOYMENT

The UK's low level of specialisation in wind manufacturing can be partly attributed to the historical lack of a native British OEM – unlike other European countries with their respective wind manufacturing national champions, such as Vestas in Denmark, Siemens and Enercon in Germany, and Gamesa in Spain. However, over the past 15 years, global OEMs have demonstrated a willingness to invest in countries that possess technical capabilities, potential demand, enabling infrastructures and an adequate set of supportive policies.

This finds confirmation in the case of France. Before 2022, France had almost no existing installed capacity in offshore wind and its 2022 national plan sets a modest 3.6GW target for offshore wind by 2030, exactly 10 times lower than the UK target for additional capacity between 2023 and 2030. At the same time, France is more specialised than the UK in every single segment of the manufacturing supply chain.

This has not always been the case: back in 2016, France's wind turbine production was valued at a mere €56.2 million, as compared to the UK's €292.6 million. France has only recently expanded its wind manufacturing specialisation, by inaugurating new blade and nacelle manufacturing plants, such as the Siemens Gamesa production unit in Le Havre – the world's first to manufacture offshore nacelles and blades in the same plant.

As IPPR recently argued (Narayanan et al 2024), the UK cannot just rely on 'buying' green products without a significant dose of 'making'. It needs to build dynamic comparative advantages in activities that bring long-term strategic autonomy as well as socioeconomic benefits, often overshadowed by the emphasis on short-term financial costs.

In the case of wind manufacturing, investing in developing a domestic supply chain allows the possibility of localising investments in less affluent areas to reduce regional imbalances, creating qualified and well-paid jobs (see box 4.2 and figure 4.1). Particularly in offshore wind manufacturing, investment by major OEMs brings positive economic spillovers through induced complementary activities (such as business services, specialised suppliers, and so on). The Offshore Wind Industry Council estimates that an adequate development of the broad wind manufacturing supply chain in the UK can generate £92 billion of gross value added by 2040 (OWIC 2023). Similarly, Renewable UK (2024) calculates that £2.8 billion of investments in the broad domestic supply chain can generate up to £25 billion of gross value added between 2024 and 2035, with the potential to create 10,000 additional jobs.

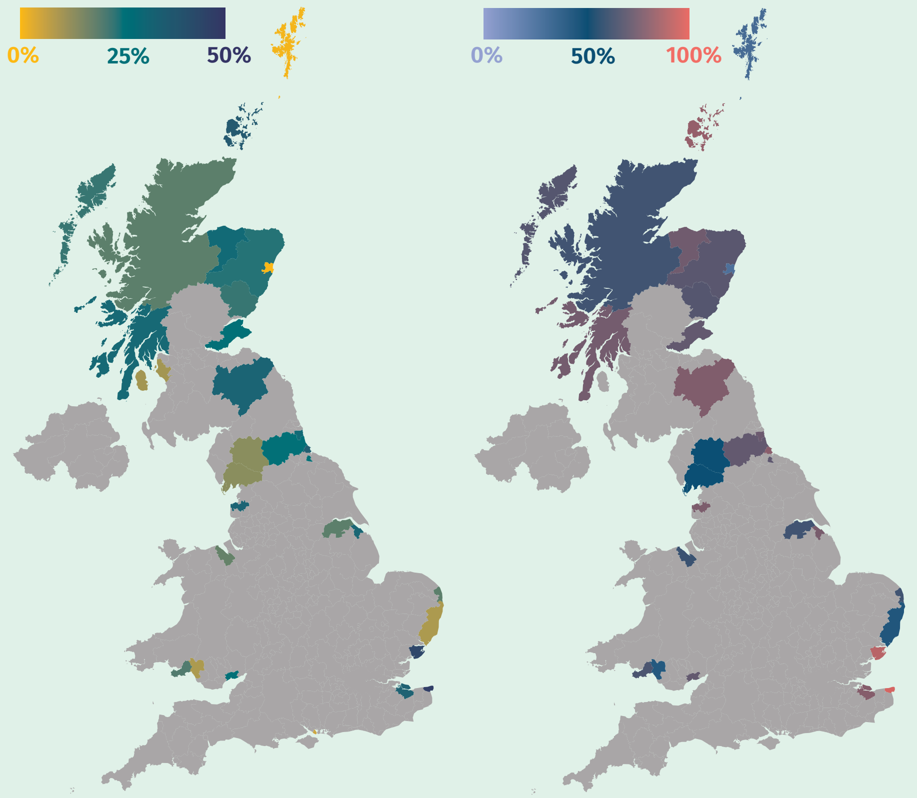
BOX 4.2: GREEN WIND MANUFACTURING JOBS ARE WELL-PAID JOBS

Just as employment in wind turbine deployment generally commands higher wages than regional averages, the same is true for wind turbine manufacturing as figure 4.1 shows. On average, blade technician and blade engineer roles command wages that are 23 per cent and 60 per cent higher respectively than regional averages.

FIGURE 4.1

Wind manufacturing jobs can reduce income inequality and regional imbalances

Current median blade technician (left) and blade engineer (right) salaries compared to regional median salaries in local authority with port areas that could be suitable for offshore wind



Source: Emden et al 2023a

4.2. THE UK'S CURRENT COMPETITIVE STRENGTHS FOR FUTURE COMPARATIVE ADVANTAGES

The UK can and should expand its wind manufacturing sector by leveraging on its current competitive strengths. First of all, as recent IPPR analysis demonstrates (Narayanan et al. 2024), wind manufacturing is the most related green industry to the UK's existing capabilities. This allows the possibility to increase the UK's specialisation in wind manufacturing via diversification of present industrial activities, rather than building on the desert.

Secondly, the UK enjoys a huge prospective market for wind power. This represents a significant opportunity for domestic wind manufacturing companies that could enter in preferred supplier agreements with wind developers. The key to success will be how auctions incorporate non-price criteria such as local content requirements into contracts for difference (see further elaboration in section 5.4).

The UK is also in a unique position to leapfrog its competitors by producing larger and more efficient turbines, while other countries remain stuck with partially outdated investments and existing manufacturing plants needing costly retrofitting. European demand for these larger turbines is expected to be substantial, but manufacturing capacity is currently low. In 2022, the European manufacturing capacity for blades and nacelles[34] bigger than 12MW was merely 2GW overall despite these large turbines being demanded for installation in the near future. Europe's demand for turbines larger than 12MW is estimated to be 12GW from 2026 and 29GW by 2030 (Rystad Energy 2023). Consequently, the UK has the opportunity to become the host to new manufacturing facilities that make larger wind turbines, potentially outcompeting existing production units on the European continent.

Furthermore, the UK can also exploit the great technological potential that floating offshore wind offers, thanks to its ambitious 5GW installation target by 2030 and to the existence of competitive domestic developers, which are key in testing and designing technologies for floating wind.

It shouldn't be forgotten that the UK also enjoys a competitive advantage in its geographical location facing the North Sea. Coastal sites on the North Sea present prime opportunities for establishing manufacturing facilities specialising in offshore wind products.

Finally, the UK possesses competitive engineering capabilities and hosts leading research institutions, including world-class universities. Applied research, technology development and testing are also competitively performed by the Offshore Renewable Energy Catapult, which is also involved in developing the UK's wind manufacturing supply chain. This is particularly strategic for manufacturing technologies in floating offshore wind, which require further research and testing applications.

4.3. THE SUPPLY CHAIN EXPANSION NEEDED FOR THE UK TO BECOME A LEADING WIND MANUFACTURING NATION

Here we estimate the potential expansion of the UK wind manufacturing supply chain, aimed at contributing to the realisation of the UK government's wind installation targets by 2030, and estimate the potential 'size of the prize' in economic terms based on a methodology implemented by the US National Renewable Energy Laboratory (NREL) with respect to the US offshore wind supply chain (NREL 2023).

Our calculation for the UK considers the government's target of 50GW and the Labour party's more ambitious target of 55GW by 2030, which would be met by installing an additional 36GW and 41GW of offshore wind power capacity respectively (between 2022 and 2030). This would require more than 2,500 wind turbines with an average size of 14MW.

Assuming that 50 per cent of this wind installation demand is satisfied by domestic manufacturing capacity, to achieve its most conservative 2030 target the UK would need approximately 20 wind manufacturing facilities.[35] While blades, monopile foundations and cables could be partially sourced by the already operating plants, under this scenario the UK would need to dispose of at least two new nacelles manufacturing facilities and two additional tower manufacturing facilities, one new blade manufacturing facility and two extra manufacturing facilities of foundations. Further figures are reported below in table 4.1, including estimates for the slightly more ambitious Labour proposal.

34 Out of 25GW and 28GW of total production capacity of blades and nacelles respectively.

35 Under this estimate, the UK would also need the availability of two to three installation vessels, three cable lay vessels, three to five transport vessels and three to four heavy-lift vessels.

TABLE 4.1

Different scenarios for the UK wind manufacturing supply chain providing components to meet the government's targets of offshore wind installation

Installation target		50GW by 2030 (Government)		55GW by 2030 (Labour)	
% met by UK manufacturing		100%	50%	100%	50%
Manufacturing facilities		41	20	46	23
of which		31	16	36	18
Turbines	Blades	6	3	7	3
	Nacelles	5	2	5	3
	Tower	5	2	5	3
Foundations	Monopile	4	2	4	2
	Jacket	1	1	1	1
	Gravity-based	1	1	1	1
	Floating	2	1	3	1
Cables	Array cable	2	1	3	1
	Export cable	5	2	5	3
Wind turbines (average size 14MW) & Foundations		2,520	1,260	2,871	1,435
Miles of cable		8,160	4,080	9,296	4,648
Installation vessels		5-7	3	5-8	3-4
Cable lay vessels		5	3	5	3
Transport vessels		5-10	3-5	5-11	3-6
Heavy-lift vessels		5-7	3	5-8	3-4
Full-time equivalent workforce (min-max)		15,000-59,000	7,500-30,000	17,000-67,000	8,500-33,500
Investment cost in manufacturing facilities (£ billion)		6.4	3.2	7.3	3.6

Source: Authors' calculations based on NREL 2023

Under the baseline government scenario and assuming 50 per cent of new installation is met by the UK supply chain,[36] the corresponding investment costs for manufacturing facilities producing wind turbine components, substructures and cables would amount to £3.2 billion.[37] This figure represents an overestimate of the actual need for the UK, given that some of that production capacity is already in operation. In any case, it would constitute only a small fraction of the total £50 billion investment estimated by the government in its low electrification scenario to achieve the 2030 installation target (HM Government 2023).

The timing required for such capital investments would not exceed the five years and can be shortened with facilitated permitting and planning rules, as shown in

36 Assuming no previous manufacturing capacity existed as in the US estimates, while the UK does have some existing capacity in offshore blades, foundations and cables (as reported in sections 3.2 and 3.3).

37 Considering an average monthly exchange rate £/$ for the first nine months of 2023 of 1.24.

table 4.2. Investment costs for typical wind turbine manufacturing facilities range around £200–250 million, whereas they amount to £320 million for a cable factory and vary for offshore foundation depending on the type.

TABLE 4.2

Technical and economic characteristics of a typical manufacturing facility producing offshore wind components

Component	Throughput	Investment cost (£ million)	Permitting and construction time (years)	Direct jobs (number)
Blade	225/year	240	3-5	500
Nacelle	100/year	200	3-5	230
Tower	100/year	200	3-5	290
Monopile	100/year	320	2	550
Jacket	50/year	10	N/A	550
Gravity-based Foundation	50-60/year	40	1-2	300
Floating platforms	50/year	80	1	240
Cable	550 km/year (array) 250 km/year (export)	280	5-6	230

Source: Authors' calculations based on NREL 2023
Note: Figures for investment costs have been converted into pound sterling from USD and rounded using the 1.24 average monthly exchange rate £/$ of first nine months of 2023.

Based on NREL estimates (2022b), the corresponding number of full-time equivalent jobs that the UK could activate across the entire wind manufacturing supply chain ranges from a minimum of 7,500 to a maximum of 30,000 in the 'UK 50%' scenario. This depends on the percentage of indirect job activation[38] (from a minimum of 25 to a maximum of 100 per cent) in the manufacturing of components (Tier 1), subassemblies (Tier 2), subcomponents (Tier 3), and materials (Tier 4).

Finally, nacelle manufacturing has the greatest job potential among all components within the offshore wind industry. The jobs associated with nacelle assembly are further bolstered by the fabrication and assembly of numerous internal subcomponents (such as generators, gearboxes and power converters), each with its own distinct supply chains for parts and materials. NREL (2022b) estimates that the nacelle accounts for 42.2 per cent of the total number of jobs needed for manufacturing a typical offshore wind turbine (including its foundation and cables).

38 Indirect job creation is a multiple of direct job creation in the wind manufacturing supply chain. Direct jobs involve the fabrication or assembly of a component or subcomponent within a manufacturing plant, while indirect jobs are related to the supply chain for producing parts or materials used in these components or subcomponents.

5. A GREEN INDUSTRIAL STRATEGY FOR THE UK WIND SECTOR

This report highlights a crude reality: without a green industrial strategy centred on expanding wind manufacturing capacity, the UK will fail to meet its ambitious target for wind energy installation by 2030.

Industrial strategies aren't inherently negative or positive – what matters is how they're conceived and put into practice. Well-designed and successful industrial strategies must have stated objectives, should provide a long-term orientation to key economic players, need to coordinate the set of policy measures, and have coherent and clear governance.

In 2023 IPPR set out a comprehensive industrial strategy framework that provides a practical toolkit for policymakers to design industrial strategies (Alvis et al 2023) (summarised in box 5.1).

BOX 5.1: IPPR'S DEFINITIONS OF INDUSTRIAL STRATEGY

Industrial strategy: an economy-wide plan – including its governance aspects – that brings together specific industrial policies to achieve an objective, such as reaching net zero emissions in the case of a green industrial strategy.

Industrial policy: a targeted action that contributes to creating and shaping a specific industry and its related market. Industrial policies are in turns distinguished into production and purchasing measures.

- **Production:** industrial policy measures that affect how goods and services arrive in the market – these include rules like product or service standards or costs like low-cost financing for producers and providers.
- **Purchasing:** industrial policy measures that affect how goods and services are bought or leave the market – these include rules like procurement conditions or costs like tariffs.

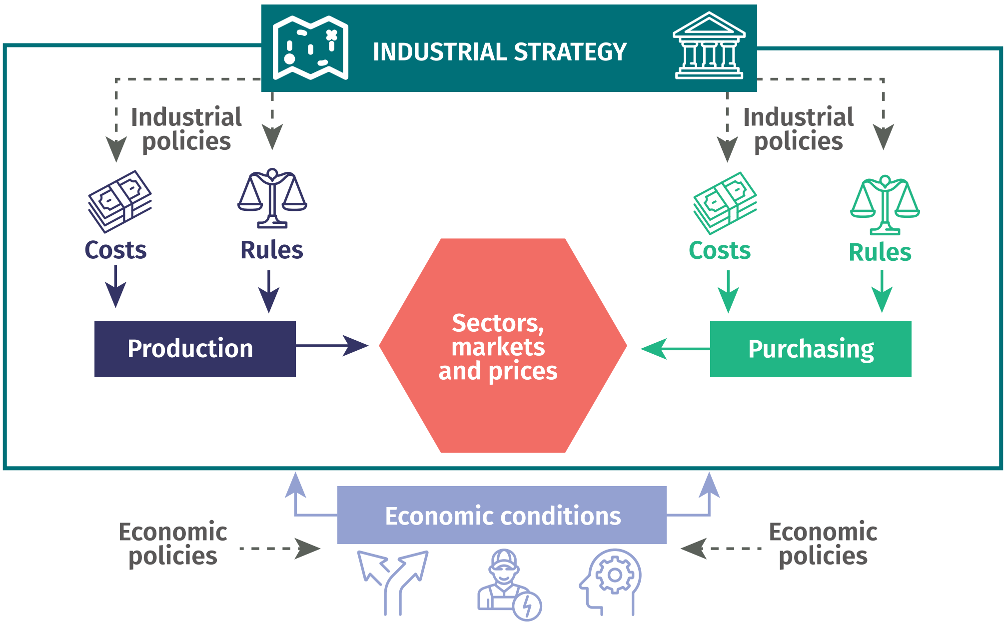
Economic conditions: the underlying aspects of an economy such as its workforce, infrastructure or level of innovation – all of which can be targeted to support specific industries.

Critical to IPPR's industrial strategy approach is the coordination of different policy measures – each of them more or less relevant depending on the sector – towards achieving the ultimate objective: creating and shaping markets or sectors (see a graphical representation in figure 5.1). Previous UK industrial strategies have largely underplayed the coordination element, resulting in a list of unrelated or overlapping instruments.

FIGURE 5.1

IPPR's industrial strategy toolkit

Industrial strategies need to be conceived as comprehensive and coherent sets of policy measures that shape and create new markets and sectors



Source: Alvis et al 2023

5.2. INTERNATIONAL EXAMPLES OF GREEN INDUSTRIAL STRATEGIES FOR THE WIND SECTOR

Countries around the world have embraced a global race to boost domestic net zero supply chains through different green industrial strategies. With China controlling a dominant share of these productions, a global competitive race for net zero technologies is currently unfolding among major economic blocs. The absence of a defined national green industrial strategy sets the UK apart as an outlier in the current global policy landscape (Murphy 2023). Below we summarise the most relevant green industrial strategies for the wind sector adopted globally in recent years.

United States

The Inflation Reduction Act (IRA) is in full force with more than 210,000 clean energy jobs created since August 2022, when it was passed into law (White House 2023). For the wind sector, IRA provides (until 2030) a set of direct 'production' tax credits for US manufacturers of wind components (including vessels) and indirect 'investment' tax credits for wind developers to purchase wind equipment meeting domestic content requirement thresholds. For onshore wind projects installed before 2025, eligible developers must source 40 per cent (20 per cent for offshore wind) of all equipment in the US. After 2026 (2027 for offshore wind), the ratio increases to 55 per cent. Moreover, 100 per cent of steel and iron construction materials must be US-manufactured. Finally, IRA introduces extra incentives aiming to encourage more investments, spanning from loans for energy efficiency in rural small businesses to research and development grants.

European Union

EU member states have recognised that without adequate policy measures, European wind manufacturers will struggle to expand their productive capacity to meet wind installation targets. Between February and March 2023, the EU responded to the IRA by outlining its Green Deal Industrial Plan (European Commission 2023a). Within the Green Deal Industrial Plan (GDIP), the Net Zero Industry Act (NZIA) is specifically devoted to scaling up manufacturing capacity for net-zero technologies needed to achieve Europe's climate targets (European Commission 2023b).

In particular, the EU has agreed to install more than 500GW of wind capacity by 2030 (37GW per year). The NZIA will support this objective through a mix of regulatory, funding and trade measures. NZIA allows national governments to support businesses' capital expenditures (but not operating expenditures), when oriented to develop net zero supply chains. For instance, the European Commission (2024) has recently approved the €2.9 billion French tax credit scheme for supporting investment in net-zero manufacturing technologies (including wind turbines). The European Commission has also increased anti-dumping tariffs on wind towers imported from China from 7.2 to 19.2 per cent.

The European Wind Power Action Plan launched by the European Commission in October 2023 has outlined a set of policies aimed at accelerating permitting and deployment (European Commission 2023c). At the same time, it guarantees direct financial support to wind companies in the forms of grants through the EU Innovation Fund and loans from the European Investment Bank. R&D in wind technologies is also receiving further support by the Horizon programme.

East-Asian economies

Within their respective green industrial strategy plans, Japan, South Korea and Taiwan have introduced obligations for wind power developers to source wind components domestically (GWEC 2023a).

China has long deployed localisation requirements and conditional feed-in tariffs, as well as direct and indirect subsidisation schemes for wind developers. Chinese wind manufacturers have also benefited from a range of direct and indirect industrial subsidies on energy costs and materials, notably steel (Webster 2023).

5.3. CURRENT AND PAST EXAMPLES OF INDUSTRIAL POLICY INITIATIVES FOR THE WIND SECTOR IN THE UK

In the early stages of its offshore wind industry, the UK experienced initial success in aligning the establishment of wind farms with the development of a domestic manufacturing supply chain. Of particular interest was the outcome of a policy strategy implemented by the former regional policy agency ONE North East.[39] This strategy involved the 'transplantation' of wind manufacturing facilities and the 'diversification' of the region's specialisation, achieved through the transfer of knowledge between related sectors (Dawley et al 2015). Notably, ONE North East managed to attract investment from Clipper Windpower for the UK's first offshore wind manufacturing plant, which was dedicated to producing blades near Newcastle. However, the project was halted only a year later when United Technologies acquired Clipper and prohibited any offshore power plans.

Up until last year, the two most relevant policy measures for the wind manufacturing sector in the UK have been the offshore wind sector deal of 2019 and the grant schemes for offshore and floating wind manufacturing, launched in 2021 and 2023 respectively, with the latter still in place.

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39 Abolished in 2012.

With the offshore wind sector deal of 2019 (Department for Business and Trade et al 2019), it was agreed that offshore developers would achieve a 60 per cent UK content for their wind farms by 2030, up from the existing 48 per cent.[40] According to estimates by Catapult, this would imply doubling the share of UK content in the wind turbine from 5 to 10 per cent and increasing the UK content of the balance of plant from 2 to 7 per cent (see appendix A).[41]

To achieve these objectives a series of funding initiatives were undertaken by both industry and the government. Following the recommendations of the Whitmarsh Review (2019) the Offshore Wind Industry Council (OWIC) established the Offshore Wind Growth Partnership (OWGP), a fund managed by the Offshore Renewable Energy Catapult aimed at bolstering the UK wind manufacturing supply chain with a budget of £100 million until 2030. The OWGP supports UK wind manufacturing by providing financial grants and business improvement services. OWGP's grant funding programme includes smaller 'Innovation Grants' (from £25k to £100k) for new product development and larger 'Development Grants' (from £100k to £1m) to foster the growth of companies. Additionally, their business transformation services connect companies with specialists to enhance competitiveness and facilitate capacity expansion.

Second, the UK government has experimented with grant programmes supporting the scaling up of offshore wind manufacturing. The Offshore Wind Manufacturing Investment Scheme (OWMIS), an open challenge fund scheme where manufacturers applied for grants, was launched in 2021 and closed in the same year (BEIS 2021). The scheme activated £900 million investments and was able to support the three most recent manufacturing initiatives in the wind sector (Renewable UK 2021b) – the expansion of Siemens Gamesa's blade factory in Hull, the establishment of SeAH Wind's monopile foundation facility and of the subsea cable factory of JDR Cables in Blyth. In 2023, the government replicated the scheme by allocating £160 million for investments in the floating offshore supply chain (DESNZ 2023), via the Floating Offshore Wind Manufacturing Investment Scheme (FLOWMIS).

Despite their valuable intentions, these initiatives have presented several shortcomings. First, the 60 per cent UK domestic content target for wind developers should have been brought forward to accelerate investment in domestic manufacturing. Second, the amount of public funding available was limited compared to the expected demand that needs to be satisfied until 2030, but also with respect to other European competing nations. Third, the limited duration of programmes such as OWMIS and FLOWMIS cannot provide long-term certainty for potential investors. Fourth, funding was not targeted to specific components of the UK wind manufacturing supply chain. Fifth, they were not sufficiently coordinated with other public financing measures, such as loans made available by the British Business Bank or by the UK Infrastructure Bank.[42] Sixth, and perhaps most importantly, these supply-side measures were not coordinated with the key demand-side instrument of CfDs for the development of wind farms, which until recently have focused on price factors instead of considering conditional schemes where bonuses or top-up payments could be offered to developers who were able to guarantee a higher UK manufactured content.

40 Figures from Catapult: https://guidetoanoffshorewindfarm.com/uk-content

41 Most of the current UK content in the wind turbine is related to operations, maintenance and services (33 per cent) and to installation and commissioning (5 per cent), due to the territorial proximity of wind farms.

42 With one major exception represented by the £107 million investment in port infrastructure by UKIB, announced in 2021 for the South Bank Quay development at Teesworks in Teesside. This happened in coincidence with the support provided through OWMIS for SeAH Wind's monopile foundation facility in Redcar, announced in the same year. The intended GE investment in blade manufacturing in Teesside would have probably benefited from the OWMIS scheme.

Recent government announcements seems to go into the right direction. As part of the Green Industry Growth Accelerator (GIGA) initiative, £390 million of public funds are earmarked to expand UK-based supply chains for offshore wind, as stated in the spring budget 2024 (HM Treasury 2024). Moreover, the government is considering introducing non price factors – called 'Sustainable Industry Rewards' (SIRs) – into the CfDs from Allocation Round 7 (DESNZ 2024a). SIRs would advantage CfD applicants taking action at investing in ports and Tier 1 supply chain capacity closer to deployment zones.

Nevertheless, as welcome as these past and recent measures might be, their systemic impact on the domestic wind manufacturing industry remains limited, as they are not yet conceived and incorporated into a comprehensive industrial strategy.

5.4. A GREEN INDUSTRIAL STRATEGY FOR THE UK WIND SECTOR THROUGH IPPR'S TOOLKIT

This section shows how IPPR's industrial strategy framework can be applied to the wind sector and become a practical toolkit for designing a comprehensive green industrial strategy for the wind sector, moving beyond the limiting piecemeal approach.

Table 5.1 outlines a set of policy measures that seek to address some of the key challenges the UK wind sector is facing, as highlighted in previous sections. IPPR's industrial strategy toolkit stresses the importance of coordination, prioritisation and targeting of the different policy instruments. Among them we find measures that facilitate the execution of the strategy ('industrial strategy'), investments in enabling infrastructures, skills and research ('economic conditions'), but also policies that affect the demand for products on the market ('purchasing') and initiatives that influence how products are made ('production').

While being consistent with the objectives of an overall green industrial strategy, not every policy measure has the same level of relevance for the UK wind sector. Consequently, we have assigned different degrees of priority to each measure, based on our analysis and on consultations with external stakeholders.

TABLE 5.1

IPPR's green industrial strategy toolkit applied to the UK wind sector

		Priority	Measures for the wind sector	Challenges addressed
Industrial strategy	Planning	Medium	Recruit people with technical skills into public sector organisations	Lack of public sector planning capabilities
	Governance	Medium	Devolution of decision-making at the local level	Implementation halted by too bureaucratic procedures
Economic Conditions	Infrastructure	**High**	**Public investment in ports and associated infrastructure for offshore wind**	**Lack of adequate port infrastructures for large offshore wind components**
	Infrastructure	**High**	**Public bodies securing the availability of installation vessels**	**Lack of adequate installation vessels for offshore wind farms**
	Infrastructure	Medium-high	Investment in electric grid transmission and distribution and reserve grid connection capacity ahead of CfD rounds	Electric grid unable to sustain higher renewable capacity and the need to increase time taken for grid connections
	Education	Medium	College curricula for wind manufacturing, installation, maintenance and repair	Need for educating future and expanding cohorts of workers in the wind sector
	Skills	Medium-high	Vocational training courses for wind manufacturing and deployment companies	Need for training and re-training (from other sectors) workers into the wind sector
	R&D	Medium-low	UKRI grants and ORE Catapult's investments on research and testing	Competition on most advanced offshore technologies
Production	Cost	**High**	**Coordinated grants and low-cost financing for businesses establishing or expanding wind manufacturing capacity**	**Lack of domestic wind manufacturing facilities – especially nacelles, towers and foundations**
		Medium	Lower energy prices for energy-intensive wind manufacturing facilities	Low cost-competitiveness of the wind manufacturing supply chain
		Medium-low	Lower taxes for wind manufacturing companies	Low cost-competitiveness of the wind manufacturing supply chain
		Low	Export finance for domestically manufactured wind products	Uncertainty of existing destination markets
	Rules	Medium-high	Product standards for wind manufacturers sourcing from domestic suppliers	Low vertical integration of OEMs and dependency from China on Tier 2 and Tier 3 suppliers
		Medium	Standards for decommissioning for the recycling of materials and components	Dependency from China on critical raw materials
		Medium-low	Lower import tariffs for essential components in the wind supply chain	Low cost-competitiveness of the wind manufacturing supply chain
Purchasing	Cost	**High**	**Competitive CfD auction prices for developers conditional on non-price criteria such as local content requirements**	**Uncertainty of existing destination markets and subsidisation of foreign productions**
		Medium-high	Subsidised loans for developers conditional on purchases from domestic manufacturers	High cost of borrowing and subsidisation of foreign productions
	Rules	Medium-high	Introducing CfDs at licensing stage	Slow deployment processes due to developers having to bid for licences and then waiting for the CfD auction
		Medium-high	Re-categorise onshore wind as a Nationally Significant Infrastructure Project	Low bar for local objection (even after recent reforms) to planning applications
		Medium	Upgrade planning inspectorate to speed up consenting process	Increasing number and complexity of projects over-burdening consenting process
		Medium-low	Higher import tariffs on wind products not complying with the UK's sustainability standards	Unfair competition from China undercutting competitors

Source: Authors' analysis

In our assessment, the most critical policy priorities are centred around three main areas and focus mainly on issues affecting offshore wind:

1. **On the purchasing side, fixing the current demand problem**, by securing a consistent commitment to long-term, **regular contracts for difference with developers, combined with non-price criteria such as local content requirements**. As IPPR has previously argued, following the example set by the US Inflation Reduction Act, contracts for difference should contain requirements for developers to source a certain percentage of components from UK manufacturers, to hire a given percentage of the workforce locally and to commit to union access and collective bargaining agreements (Emden et al 2023a). This requirement could be introduced relatively flexibly, such as the establishment of a 'basic rate' for CfDs with minimum local content requirements which could be topped up with bonuses for increasing local investment. In addition, publicly owned entities such as the Labour party's GB Energy (see box 5.2) could participate in the auction itself – also co-investing with other developers – with an explicit mandate to create domestic supply chains and local jobs.
2. **On the production side, supporting businesses to expand UK production capacity across the entire wind manufacturing supply chain**, particularly in wind turbines (nacelles, towers, blades) and essential components for offshore wind farms (cables, foundations). Reactivating the OWMIS scheme in parallel with FLOWMIS, making them permanent and targeted to specific productions (eg nacelles) would provide long-term certainty for businesses to create, expand or renovate existing manufacturing facilities. Particular attention should be devoted to floating technologies (given also the prospective demand of 5GW by 2030), where innovation grants by UKRI financing research and testing of prototypes could attract investments by companies willing to commercialise their products. Capital grants need to be complemented and coordinated with other financing measures, such as those made available from state-owned financial institutions that can co-invest with existing industrial players. For instance, IPPR has proposed the establishment of a National Investment Fund (NIF) – similar to Labour's proposal for a National Wealth Fund – that could provide minority equity finance for new joint-ventures with wind manufacturing companies willing to establish or expand their presence in the UK (Gasperin and Dibb 2023). The British Business Bank could start targeting the development of small and medium domestic suppliers in the wind manufacturing supply chain.
3. **On the economic conditions, upgrade infrastructure capacity of ports and naval vessels for offshore wind installation.** Retrofitting ports is often the prerequisite for large-size offshore wind manufacturing sites. The UKIB could expand its programme for ports renovation, by providing subsidised loans to both local authorities and private developers. Crucially, this investment should focus on non-freeport areas, as freeports can encourage developers to import components and employment rather than build domestic capacity. Specialised naval vessels are also essential for the steady deployment of offshore wind farms, but the investments needed to build new shipyards that could manufacture them would be extremely costly and require a lot of time. Labour's proposed GB Energy could play an important role of operating a national fleet of specialised vessels for offshore wind power installation in the UK.

BOX 5.2: A POLICY MANDATE FOR GB ENERGY IN THE WIND SECTOR

During its 2022 national conference the Labour party announced its intention to establish GB Energy, a publicly owned clean power generation company. A state-owned energy company with a public policy mandate could become a key player in the UK's green industrial strategy for the wind sector. A future GB Energy competing with other wind power developers could be given the mandate of sourcing a significantly higher share of domestically manufactured content for its own wind farms. In its role as a major purchaser of UK-manufactured wind equipment, GB Energy would be best placed to oversee manufacturing investments across the entire supply chain. It could also cooperate with other OEMs by ensuring that they rely as much as possible on domestic Tier 2 and Tier 3 suppliers. GB Energy could also be given a national mandate to secure a long-term supply of critical raw materials – such as dysprosium, neodymium and copper – which are essential for manufacturing wind components (particularly generators). Finally, GB Energy could address the shortage in wind installation vessels, by operating a national fleet that could be made available to other offshore wind developers in the UK.

6.
CONCLUSION: SEIZING WIND POWER FOR A GREEN INDUSTRIAL FUTURE

The wind industry in the UK stands at a critical juncture and must confront an inescapable trilemma. First, the ambitious 2030 targets for wind power installations, set by the Labour party and the government respectively, won't be achieved without addressing existing deployment issues. Second, in the current global scenario, national deployment of wind energy requires further expansion in domestic wind manufacturing. And third, deepening and diversifying the UK's specialisation in wind manufacturing requires a comprehensive green industrial strategy.

IPPR's green industrial strategy for the wind sector stands on three pillars:

- redesign contracts for difference to maximise the purchase of domestic content
- mobilise and coordinate public funding to establish and support major wind manufacturing facilities
- upgrade port infrastructures and secure the availability of installation vessels.

A new collaboration between public entities and private businesses will be essential.

The wind of change is blowing, and the UK has a chance to harness its potential. Wind manufacturing is an industrial powerhouse waiting to be unleashed. It is time for the UK to not just meet energy targets but to lead the charge into a more sustainable, thriving economic future.

REFERENCES

Alvis S, Dibb G, Gasperin S and Murphy L (2023) *Market making in practice*, IPPR. http://www.ippr.org/research/publications/making-markets-in-practice

Baringa (2024) *UK renewables deployment supply chain readiness study*. https://assets.publishing.service.gov.uk/media/6617b12ed88c988e81b95af8/uk-renewables-deployment-supply-chain-readiness-study-executive-summary.pdf

Bloomberg New Energy Finance [BloombergNEF] (2022) *2021 Global Wind Turbine Market Shares*.

Bloomberg New Energy Finance [BloombergNEF] (2023) *2022 Global Wind Turbine Market Shares*.

Carrara S, Alves Dias P, Plazzotta B and Pavel C (2020) *Raw materials demand for wind and solar PV technologies in the transition towards a decarbonised energy system*, Publication Office of the European Union. https://op.europa.eu/en/publication-detail/-/publication/19aae047-7f88-11ea-aea8-01aa75ed71a1/language-en

Catapult (2023) *Offshore Wind Supply Chain Confidence Survey Report*. https://ore.catapult.org.uk/?orecatapultreports=offshore-wind-supply-chain-confidence-survey-2023

Climate Change Committee [CCC] (2023) *Delivering a reliable decarbonised power system*. https://www.theccc.org.uk/publication/delivering-a-reliable-decarbonised-power-system/

Dawley S, MacKinnon D, Cumbers A and Pike A (2015) 'Policy activism and regional path creation: The promotion of offshore wind in North East England and Scotland', *Cambridge Journal of Regions, Economy and Society*, 8(2): 257–272. https://doi.org/10.1093/cjres/rsu036

Department for Business Energy and Industrial Strategy [BEIS] (2021) *Offshore Wind Manufacturing Investment Scheme Programme Guidance*. https://www.gov.uk/government/publications/offshore-wind-manufacturing-investment-support-scheme-investment-programme

Department for Business and Trade, Department for Energy Security and Net Zero, and Department for Business, Energy & Industrial Strategy (2019) *Offshore wind: Sector Deal*. https://www.gov.uk/government/publications/offshore-wind-sector-deal

Department for Energy Security and Net Zero [DESNZ] (2023) *Floating Offshore Wind Manufacturing Investment Scheme: Guidance*. https://www.gov.uk/government/publications/floating-offshore-wind-manufacturing-investment-scheme

Department for Energy Security and Net Zero [DESNZ] (2024a) *Introducing a CfD Sustainable Industry Reward: government response to consultation*. https://assets.publishing.service.gov.uk/media/65ef95fdff117000116158e9/cfd-sustainable-industry-reward-consultation-government-response.pdf

Department for Energy Security and Net Zero [DESNZ] (2024b) *Energy Trends: UK renewables*. https://www.gov.uk/government/statistics/energy-trends-section-6-renewables

Emden J and Murphy L (2019) *A just transition: Realising the opportunities of decarbonisation in the north of England*, IPPR. http://www.ippr.org/research/publications/a-just-transition

Emden J, Murphy L and Gunson R (2020) *Net zero North Sea: A managed transition for oil and gas in Scotland and the UK after Covid-19*, IPPR. http://www.ippr.org/research/publications/net-zero-north-sea

Emden J, Evans J and Murphy L (2023a) *Fairer winds: Workers' rights in the age of transition*, IPPR. http://www.ippr.org/research/publications/fairer-winds

Emden J, Murphy L, Hawkey D, Narayanan P and Gasperin S (2023b) *From missed chances to green advances: The case for a green industrial strategy*, IPPR. http://www.ippr.org/research/publications/from-missedchances-to-green-advances

European Commission (2023a) *A Green Deal Industrial Plan for the Net-Zero Age*. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan_en

European Commission (2023b) *Net Zero Industry Act*. https://single-market-economy.ec.europa.eu/industry/sustainability/net-zero-industry-act_en

European Commission (2023c) *European Wind Power Action Plan*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023DC0669

European Commission (2024) 'The Commission has approved a €2.9 billion French State aid scheme for supporting investment in green industries to foster the transition towards a net-zero economy'. https://ec.europa.eu/newsroom/comp/newsletter-archives/50192#:~:text=The%20European%20Commission%20has%20approved%20a%20%E2%82%AC2.9%20billion%20French,the%20Green%20Deal%20Industrial%20Plan.

European Commission Joint Research Centre [JRC] (2022) *Clean Energy Technology Observatory: Wind energy in the European Union – 2022 status report on technology development, trends, value chains and markets*. https://publications.jrc.ec.europa.eu/repository/handle/JRC130582

European Commission Joint Research Centre [JRC] (2023) *Clean Energy Technology Observatory: Wind energy in the European Union – 2023 status report on technology development, trends, value chains and markets*. https://publications.jrc.ec.europa.eu/repository/handle/JRC135020

Gasperin S and Dibb G (2023) *Growing green: A proposal for a national investment fund*, IPPR. http://www.ippr.org/research/publications/growing-green

Global Wind Energy Council [GWEC] (2023a) *Global Wind Report 2023*. https://gwec.net/globalwindreport2023/

Global Wind Energy Council [GWEC] (2023b) *Global Offshore Wind Report 2023*. https://gwec.net/gwecs-global-offshore-wind-report-2023/

Global Wind Energy Council [GWEC] (2023c) *Mission Critical: Building The Global Wind Energy Supply Chain for a 1.5°C World*. https://gwec.net/supplychainreport2023/

Global Wind Energy Council [GWEC] (2024) *Global Wind Report 2024*. https://gwec.net/global-wind-report-2024/

HM Government (2023) *Offshore wind net zero investment roadmap*. https://www.gov.uk/government/publications/offshore-wind-net-zero-investment-roadmap

HM Treasury (2024) *Spring budget 2024*. https://assets.publishing.service.gov.uk/media/65e8578eb559930011ade2cb/E03057752_HMT_Spring_Budget_Mar_24_Web_Accessible__2_.pdf

Horton H (2023) 'Gove may be lifting England onshore ban, but wind still faces hurdles', *Guardian*. https://www.theguardian.com/environment/2023/sep/05/michael-gove-lifting-england-onshore-ban-wind-energy-faces-hurdles

International Energy Agency [IEA] (2021) *Net Zero by 2050: A roadmap for the global energy sector*. https://www.iea.org/reports/net-zero-by-2050

International Energy Agency [IEA] (2022) *Solar PV global supply chains*. https://www.iea.org/reports/solar-pv-global-supply-chains

International Energy Agency [IEA] (2023a) *Energy Technology Perspectives 2023*. https://www.iea.org/reports/energy-technology-perspectives-2023

International Energy Agency [IEA] (2023b) *Critical Minerals Market Review 2023*. https://www.iea.org/reports/critical-minerals-market-review-2023

International Energy Agency [IEA] (2024) *Renewables 2023*. https://www.iea.org/reports/renewables-2023

International Renewable Energy Agency [IRENA] (2023) *Renewable energy statistics 2023*. https://mc-cd8320d4-36a1-40ac-83cc-3389-cdn-endpoint.azureedge.net/-/media/Files/IRENA/Agency/Publication/2023/Jul/IRENA_Renewable_energy_statistics_2023.pdf?rev=7b2f44c294b84cad9a27fc24949d2134

Labour Party (2023) *Make Britain a clean energy superpower*. https://labour.org.uk/wp-content/uploads/2023/10/Mission-Climate.pdf

Murphy L (2023) *Winning the global green race: Lessons for the UK from the US' Inflation Reduction Act*, IPPR. http://www.ippr.org/research/publications/winning-the-global-green-race

National Renewable Energy Laboratory [NREL] (2022a) *2021 Cost of Wind Energy Review*. https://www.nrel.gov/docs/fy23osti/84774.pdf

National Renewable Energy Laboratory [NREL] (2022b) *The demand for a domestic offshore wind energy supply chain*. https://www.nrel.gov/docs/fy22osti/81602.pdf

National Renewable Energy Laboratory [NREL] (2023) *A supply chain road map for offshore wind energy in the United States*, NREL. https://www.nrel.gov/wind/offshore-supply-chain-road-map.html

Offshore Wind Industry Council [OWIC] (2023) *UK supply chain capability analysis: Summary report*. https://www.owic.org.uk/_files/ugd/1c0521_8481391e44014ceda91900ce301adb53.pdf

ORE Catapult (2019) *Guide to an offshore wind farm*. https://guidetoanoffshorewindfarm.com/wind-farm-costs

Pick T (2023) *Seizing our opportunities: Independent report of the Offshore Wind Champion*, March 2023. https://assets.publishing.service.gov.uk/media/642d1bb8fbe620000c17dcb7/independent-report-of-the-offshore-wind-champion.pdf

Pranesh N, Dibb G, Vanino E and Gasperin S (2024) *Manufacturing matters*, IPPR. http://www.ippr.org/articles/manufacturing-matters

Renewable UK (2021a) *The onshore wind industry prospectus*. https://cdn.ymaws.com/www.renewableuk.com/resource/resmgr/media/onshore_wind_prospectus_fina.pdf

Renewable UK (2021b) 'Record year of over £900 million investment in UK offshore wind manufacturing'. https://www.renewableuk.com/news/581592/Record-year-of-over-900-million-investment-in-UK-offshore-wind-manufacturing-.htm#:~:text=Analysis%20published%20today%20by%20RenewableUK,in%20the%20UK%20in%202000.

Renewable UK (2023) *Autumn Budget 2023: UK response to the Inflation Reduction Act. Briefing focusing on offshore wind supply chain management*.

Renewable UK (2024) 2024 Offshore Wind Industrial Growth Plan. https://cdn.ymaws.com/www.renewableuk.com/resource/resmgr/publications/reports/Offshore_Wind_Industrial_Gro.pdf

Rystad Energy (2023) *The state of the European wind energy supply chain*. https://www.rystadenergy.com/insights/the-state-of-the-european-wind-energy-supply-chain

Sibieta L, Tahir I and Waltmann B (2022) 'Plans will leave spending on adult education and apprenticeships 25% below 2010 levels by 2025', Institute for Fiscal Studies. https://ifs.org.uk/news/plans-will-leave-spending-adult-education-and-apprenticeships-25-below-2010-levels-2025

Statista (2023) 'Average rotor diameter of onshore wind turbines worldwide from 2000 to 2025'. https://www.statista.com/statistics/1085649/onshore-wind-turbines-average-rotor-diameter-globally/

The Crown Estate (2022) *Offshore Wind Report 2022*. https://www.thecrownestate.co.uk/our-business/marine/offshore-wind-report-2022

Webster J (2023) 'China's wind industrial policy "succeeded" – but at what cost?', Atlantic Council. https://www.atlanticcouncil.org/blogs/energysource/chinas-wind-industrial-policy-succeeded-but-at-what-cost/#:~:text=China's%20wind%20industry%20policies%20included,say%20stealing%E2%80%94foreign%20intellectual%20property

White House (2023) 'In 2023, President Biden's Investing in America agenda delivered results for American families, Natalie Quillian blog post. https://www.whitehouse.gov/briefing-room/blog/2023/12/22/in-2023-president-bidens-investing-in-america-agenda-delivered-results-for-american-families/

Whitmarsh M (2019) *The UK offshore wind industry: Supply chain review*, ORE Catapult. https://ore.catapult.org.uk/?industryreports=the-uk-offshore-wind-industry-supply-chain-review-by-martin-whitmarsh

Wind Europe (2024) 'Things looking up again for offshore wind in the UK'. https://windeurope.org/newsroom/news/things-looking-up-again-for-offshore-wind-in-the-uk/

Winser N (2023) *Electricity Networks Commissioner: Companion report findings and recommendations*, Energy Systems Catapult. https://es.catapult.org.uk/report/electricity-networks-commissioner-report/#:~:text=Key%20points,reduced%20to%20around%20seven%20years

APPENDIX
UNFOLDING THE WIND MANUFACTURING VALUE CHAIN

Understanding the complexity of the wind value chain is essential for elaborating tailored industrial strategies. Figure A1 illustrates the long value chain of a typical wind farm that encompasses mining and refining processes, manufacturing of key components, assembly operations for end use and installation, and end-of-life recycling.

Furthermore, the cost breakdown of a typical wind farm differs between onshore and offshore (fixed-bottom and floating) installations, with turbines themselves representing a different proportion of the total levelised cost of energy (LCOE).[43] As illustrated in figure A2, in a typical onshore wind farm, manufactured turbines account for 48.2 per cent of total LCOE. This value is much lower in offshore plants – 22.4 per cent for fixed-bottom and 17.1 per cent for floating – given the higher balance of systems (substructure and foundation, electrical infrastructure, installation) and operating expenditure costs.

The main manufacturing components of a wind plant are all in the turbine (that is, nacelle, rotor and tower), the electrical cables, the foundation and the substructure (in the case of offshore wind). Table A1 further illustrates that the nacelle is the most valuable component in an offshore wind turbine (40 per cent of its total value), followed by the rotor (19 per cent) and by the tower (7 per cent). Together they account for two-thirds of the total value of the single turbine. Noteworthy is also the manufacturing value of foundations and cables, accounting for an extra 28 and 17 per cent respectively of the total value of the wind turbine.

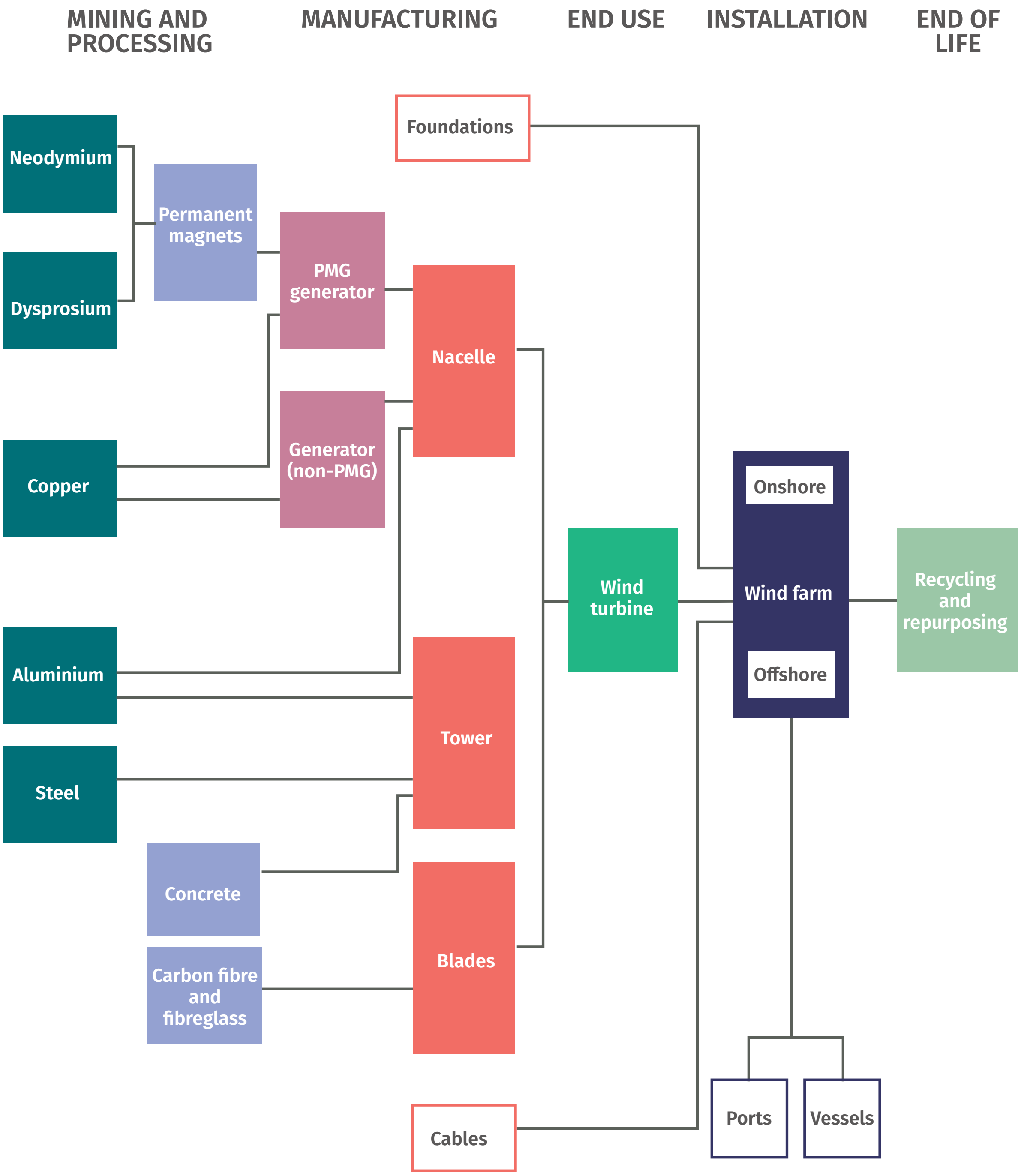
In this report we have concentrated on those five key manufacturing components of a wind farm. First, because these segments represent the most valuable sections in the wind value chain. Second, because these components can become a source of export growth for producing countries. Wind manufacturing facilities benefit from their proximities to wind farms, through lower transportation costs, but can also produce components for export markets. This is why countries can have a strong specialisation in wind manufacturing even with a relatively modest wind energy sector, as is the case of Denmark, or increasingly France. And third, manufacturing activities, especially those specialised in offshore wind, have the potential to stimulate the growth of local suppliers. These are often small and medium enterprises that thrive in the industrial ecosystem established by the presence of large wind manufacturing facilities.

43 The levelised cost of energy or electricity (LCOE) serves as a metric for comparing various energy generation methods across different locations. It represents the average total cost incurred in constructing and operating an energy-generating plant per unit of total energy produced over the plant's assumed lifetime.

FIGURE A1

Breakdown of the wind value chain

The wind manufacturing value chain illustrated from upstream mining and processing, to the various manufacturing segments that lead to its end use, installation and end-of-life activities

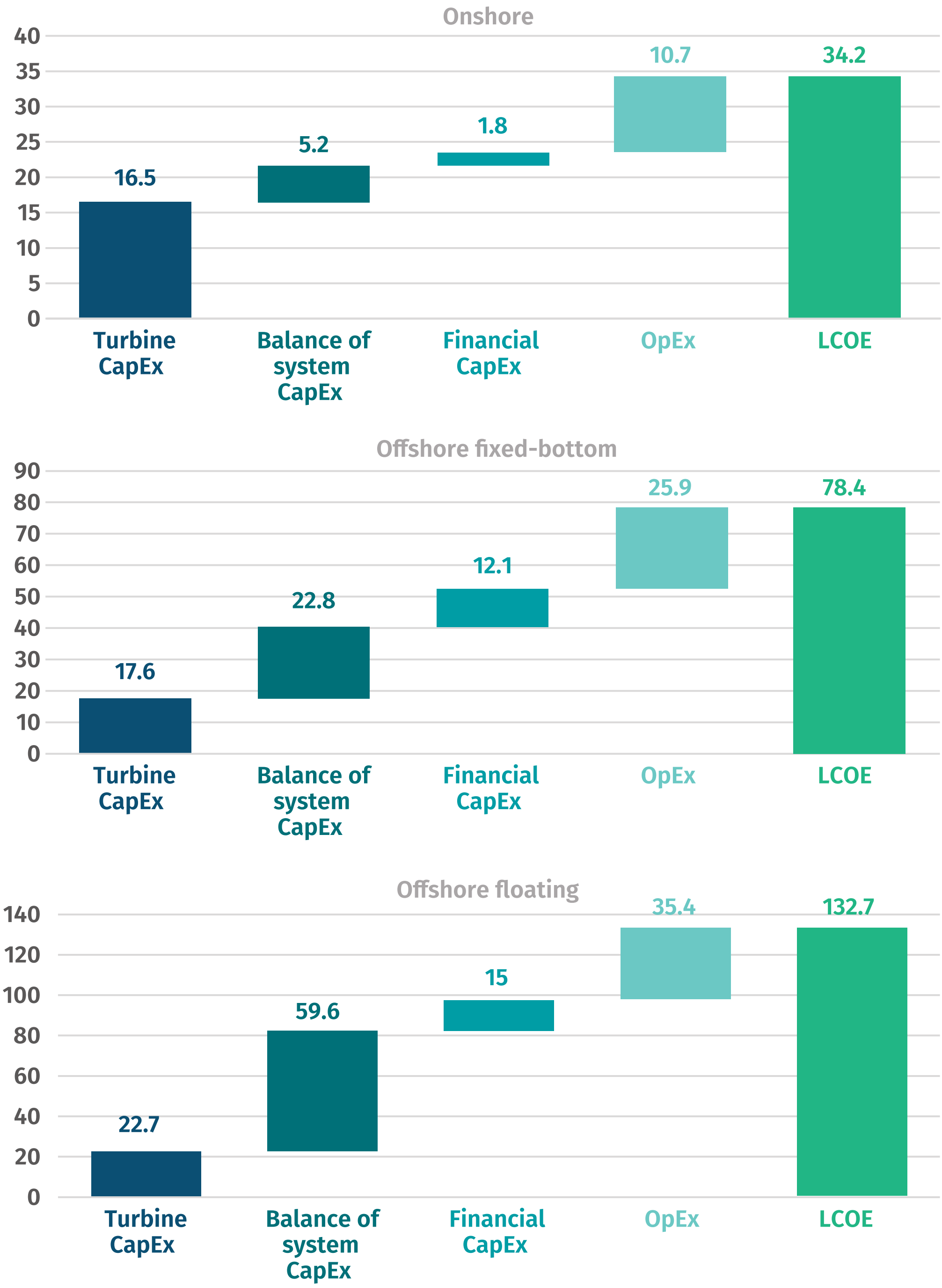


Source: Authors' analysis of Carrara et al 2020

FIGURE A2

Cost breakdown for the typical wind plant

Levelised cost of energy (LCOE) for onshore (top), fixed-bottom offshore (centre) and floating offshore (bottom) wind farms



Source: Authors' analysis of NREL 2022a

Note: LCOE is measured in 2021 US dollars per megawatt-hour.

TABLE A1

Nacelles, rotors and towers account for two-thirds of a wind turbine's costs, cables and foundations around half of that value

The cost of main wind manufacturing components in a typical offshore wind farm expressed in £/MW

Component	Rounded cost (£/MW)
Turbine	**1,000,000**
Nacelle	**400,000**
Gearbox	70,000
Generator	100,000
Other components	230,000
Rotor	**190,000**
Blades	130,000
Other components	60,000
Tower	**70,000**
Steel	60,000
Other tower	10,000
Other (includes assembly, wind turbine supplier aspects of installation and commissioning)	**340,000**
Foundation	**280,000**
Cables	**170,000**

Source: Authors' analysis of ORE Catapult (2019)

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