A closer look at the development of wind, wave & tidal energy in the UK

Employment opportunities and challenges in the context of rapid industry growth

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Employment opportunities and challenges in the context of rapid industry growth

The wind and wave & tidal industries in the UK face a number of significant barriers to growth. Building on our experience in the renewable energy sector, Bain & Company has focused this analysis on employment and skill-related issues. The report identifies three different scenarios for the development of the wind and wave & tidal industries. It identifies steps that can be taken to resolve problems to help achieve the UK's ambitious 2020 targets for renewable energy production.

Sector development in Europe to date: early investment is paying off

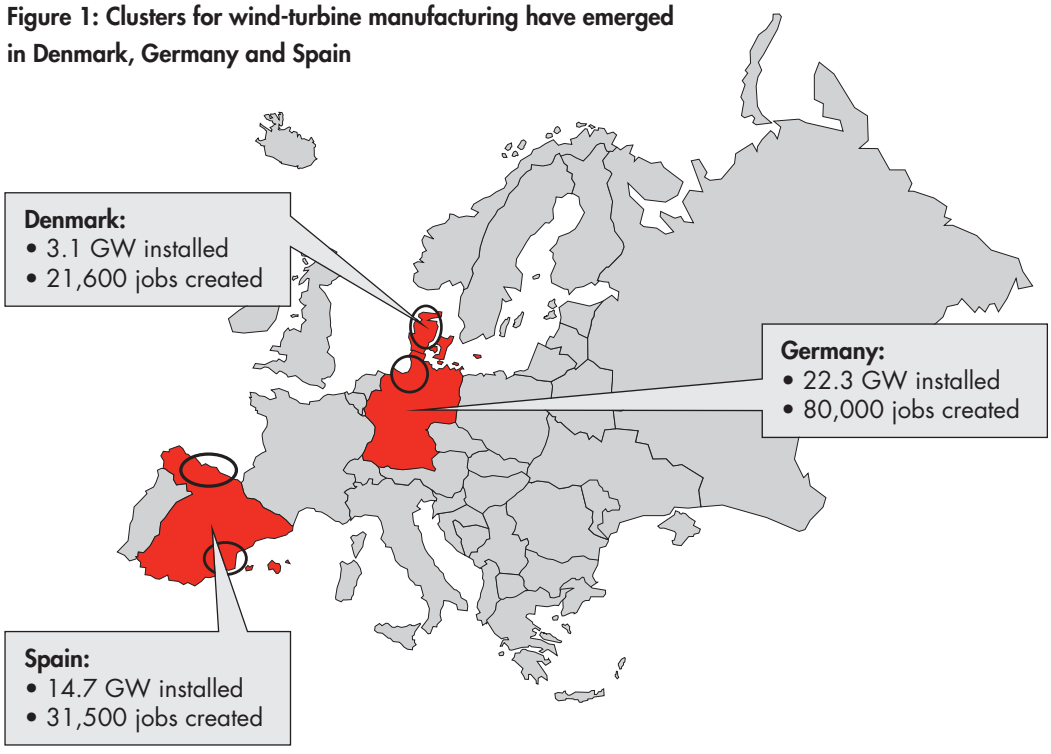
The wind industry is now established as one of the highest-growth industries in Europe. It has grown at an average rate of 12 percent over the last 5 years, and at the end of 2007, the cumulative installed capacity had reached 57 gigawatts (GW). That has led to significant job creation, with approximately 145,000 people employed in the European Union (EU) wind energy sector at the end of last year.

Germany, Spain and Denmark have secured the majority of the benefits from that growth and now account for more than 70 percent of the EU's installed capacity. Moreover, due to significant exporting from Germany and Denmark, these three countries account for more than 90 percent of the EU's wind-sector employees.

Bain's analysis points to four factors that were common to these countries and critical to the rapid growth of their wind industries:

- **Support schemes** to reduce commercial uncertainty (e.g. feed-in tariff);
- Rapid building of **new infrastructure** (e.g. the grid) to accommodate the wind industry;
- A swift process for gaining **planning consent** for the installation sites;

Figure 1: Clusters for wind-turbine manufacturing have emerged in Denmark, Germany and Spain



- **Support for wind energy in local communities**, generated either through opportunities for participation in ownership of wind farms or through tax revenues paid to local authorities by wind farms for tangible benefits to the community.

These four factors attracted the wind-turbine manufacturers, and manufacturing clusters developed near their factories. Those clusters consisted of material and component suppliers, as well as universities and research institutions that provided tailored education and R&D support. Today, the three main clusters in Northern Germany, Spain, and Jutland, Denmark account for more than half of employment in the EU's wind energy sector.

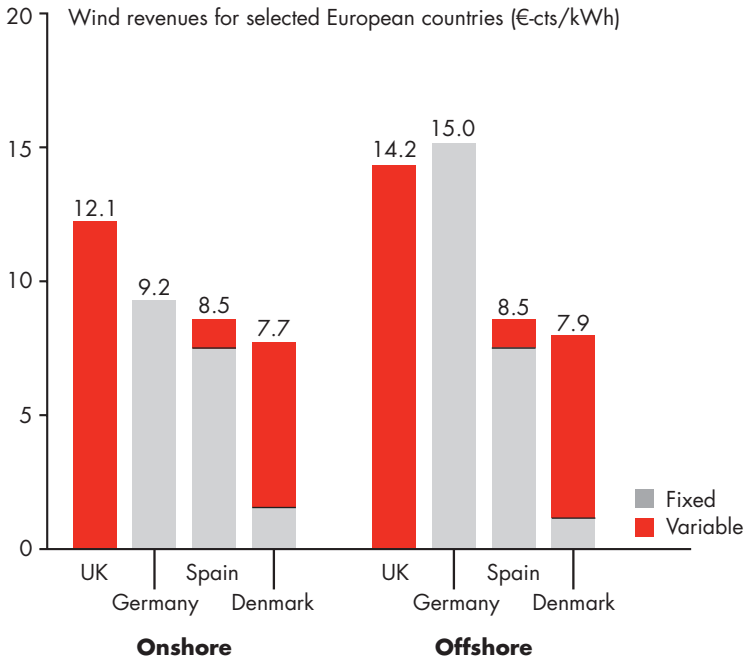
The UK wind industry: a follower with increasing momentum

The UK largely missed out on this early-growth phase. Industry experts claim that the lack of a proper support scheme, with elements such as feed-in tariffs, was the primary reason for the slow start. A few manufacturers chose to build plants in the UK, but the industry did not develop large-scale momentum beyond those few investments.

With the introduction of a market-based incentive structure (the Renewables Obligation, or RO) in 2002, the dynamics of the UK wind industry were fundamentally changed. The RO is proving to be an effective mechanism for making onshore wind projects commercially viable. Whereas prior to 2002, cumulative installed capacity was less than 600 megawatts (MW), by 2007 it had increased to 2.2 GW growing at more than 35 percent per year. However, whilst large parts of the wind industry value chain have become firmly established in the UK (e.g. development, technical consulting and construction and installation), the majority of turbines are being imported from the continent.

The current level of employment in the UK wind industry stands at approximately 5,000. Of these employees, a large percentage are located in parts of the value chain where the business models are local in nature (such as development or construction and installation).

Figure 2: The UK now has an attractive revenue scheme



Market outlook 2020: a step-change opportunity

Europe is now poised to experience accelerated growth in the wind industry, to a large extent fuelled by aggressive EU targets for power generation from renewable sources that have been set for all member states. The UK will need to add about 260 terawatt hours (TWh) of renewable energy production by 2020 in order to meet its target, according to the Department for Business, Enterprise & Regulatory Reform (BERR) and the UK's Renewables Advisory Board (RAB). Wind energy is expected to be the primary contributor, with 35 percent to 40 percent of the overall renewables target. In our estimates, that translates into 11 GW of onshore capacity and 14 GW of offshore capacity that must be added over the next 12 years.

The UK is currently well placed to benefit from the investments flowing into the offshore wind sector. The offshore market is still emerging, and the UK is strongly positioned to capture a significant share of installations due to its excellent offshore wind conditions and the offshore operating experience accumulated in the British oil & gas industry.

In this analysis, the benefits from the development of a strong UK wind industry are measured along three dimensions:

- Capacity installed;
- Level of investment (both domestic and foreign);
- Domestic employment generated.

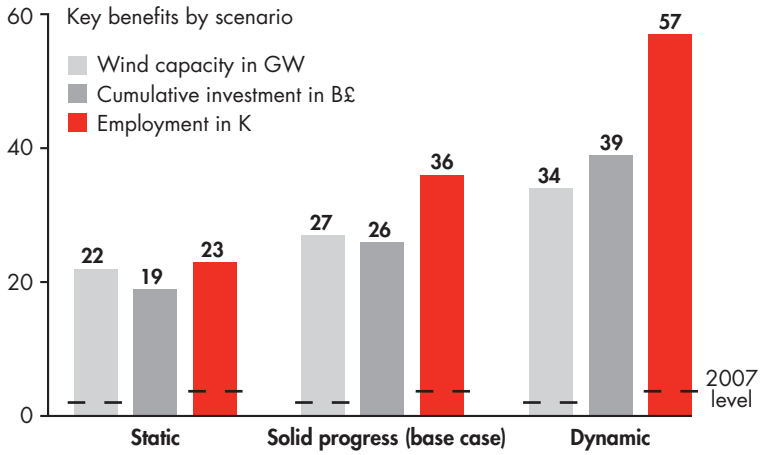
Our sensitivity analysis shows that the size of the opportunity along each of these dimensions will be mainly driven by three factors: political support, degree of local content in production, and development of the export business.

Based on our understanding across a number of countries and comparable high-growth industries, we see three potential scenarios for the UK wind industry:

- **Solid progress** scenario (base case). This scenario assumes clear political support for wind energy, market leadership in offshore development, the UK becoming self-supplying, and achieving a limited degree of export in knowledge-related activities such as technical consulting and offshore operations. By 2020, this scenario would lead to wind capacity of 27 GW, which is broadly in-line with current market consensus. This scenario would generate cumulative investment of £26B and 36,000 jobs. (Design & Manufacturing would cover 35 percent of the UK's offshore turbine market along with a limited amount of export);

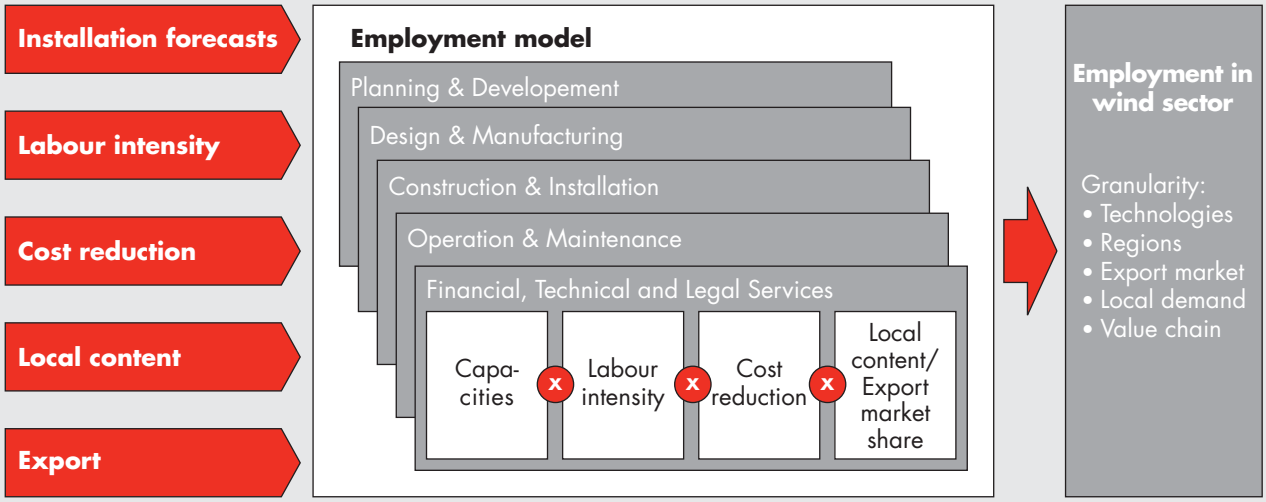
- **Dynamic** scenario (best case). This scenario assumes stronger political support for wind

Figure 3: Potential benefits by 2020 in three industry development scenarios



Methodology – how we modeled UK employment scenarios

The employment model used is based on five key input variables: Capacity (installed and cumulative), labour intensity (as measured in full-time employees (FTE) per MW), cost reduction (via learning rate), local content and export market share. Applying these, the model calculates employment split into technologies, regions, the export market, and the domestic market along the value chain.



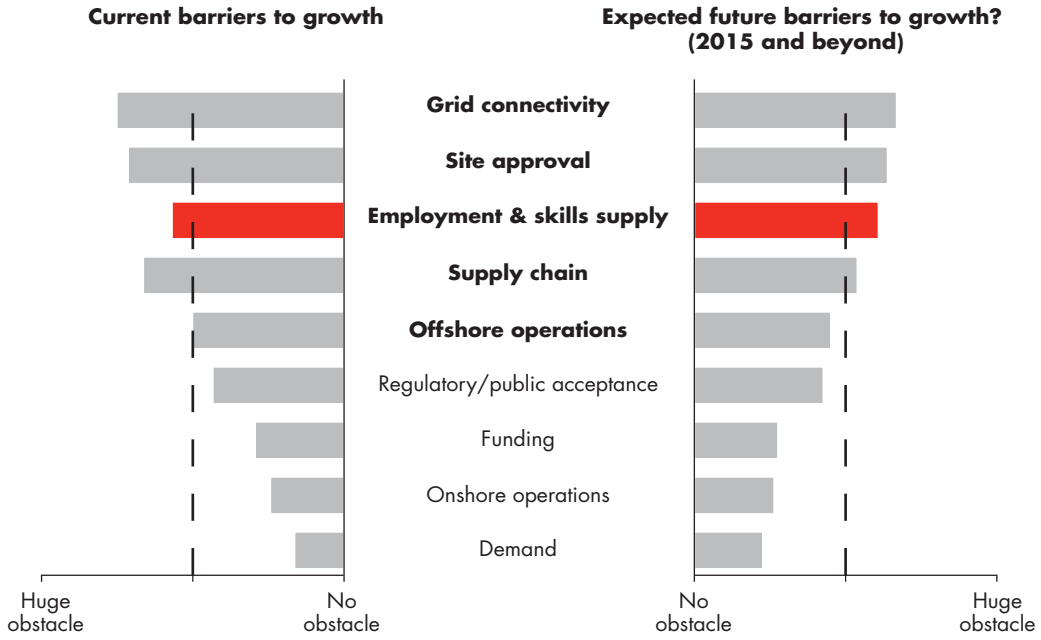
The evolution of employment is captured by a scenario engine. The respective parameters were estimated based on public data and Bain experience and were confirmed or refined through a series of expert interviews.

energy, recognition of the UK as the global centre of expertise in offshore development and manufacturing clusters that allow the UK to become self-supplying and a significant exporter of both knowledge and components. By 2020, this scenario would lead to wind capacity of 34 GW, which is broadly in-line with the current estimate from the British Wind Energy Association (BWEA). This scenario would generate a cumulative investment of £39B and 57,000 jobs. (Design & Manufacturing would cover 70 percent of the UK market for offshore turbines and would be exporting a similar volume to continental Europe);

- **Static** scenario (worst case). This scenario assumes a lack of political support for wind energy, failure to achieve leadership in offshore development and the absence of manufacturing within the UK that would lead to significant imports and limited exports. By 2020, this scenario would lead to wind capacity of 22 GW, cumulative investment of £19B and 23,000 jobs. (Design & Manufacturing would remain at its current level, i.e. covering 15 percent of the UK market for offshore turbines).

Which scenario will become a reality will depend on whether barriers to future growth can be anticipated and overcome by industry players and public stakeholders in the UK. Bain has, therefore, investigated these potential show-stoppers in detail.

Figure 4: Employment & skills supply is expected to become more critical over time



Source: Industry experts

The challenge: potential barriers to future growth

In recent years, the UK has launched a number of initiatives to ignite growth within the sector by confronting critical issues such as grid access (Transmission Access Review), national planning (Planning Bill), local planning (the Killian Pretty Review), and the supply chain (establishment of the Office for Renewable Energy Development) amongst others. However, despite these actions, the industry still faces significant challenges. According to industry experts, these are the top five obstacles to growth in the UK wind industry:

- **Grid connectivity.** Grid capacity is limited in the areas where there is good wind supply and site approval is achievable. Getting significant transmission capacity built out to remote locations can take up to 10 years. The dominant view is that gaining access to grid connectivity and the actual connection of wind farms will remain a challenge;

- **Site approval.** Experts throughout the industry share the view that the UK is one of the most difficult places in Europe to get planning consent; it can take up to five times as long as in best-practice European countries. The UK is a densely populated island, and the planning process is very complicated, with many stakeholders having deeply entrenched positions. Although the site approval issue is unlikely to be fully resolved, current initiatives may drive some improvement in the short term. In addition to this, the site approval process is less complex offshore, so the shift in emphasis to offshore will gradually reduce the significance of this bottleneck;

- **Employment and skills supply.** The UK faces a significant demand/supply imbalance in the wind energy labour market already, and the sector continues to grow. The pools of people with the skills and experience to perform many of the roles are limited. As growth accelerates, filling the new roles will be challenging, and a number of specialist roles will become even more difficult to fill. Industry players currently see this issue as the fourth most significant barrier to growth in the sector, though it is set to increase in importance (see below for more in-depth analysis);

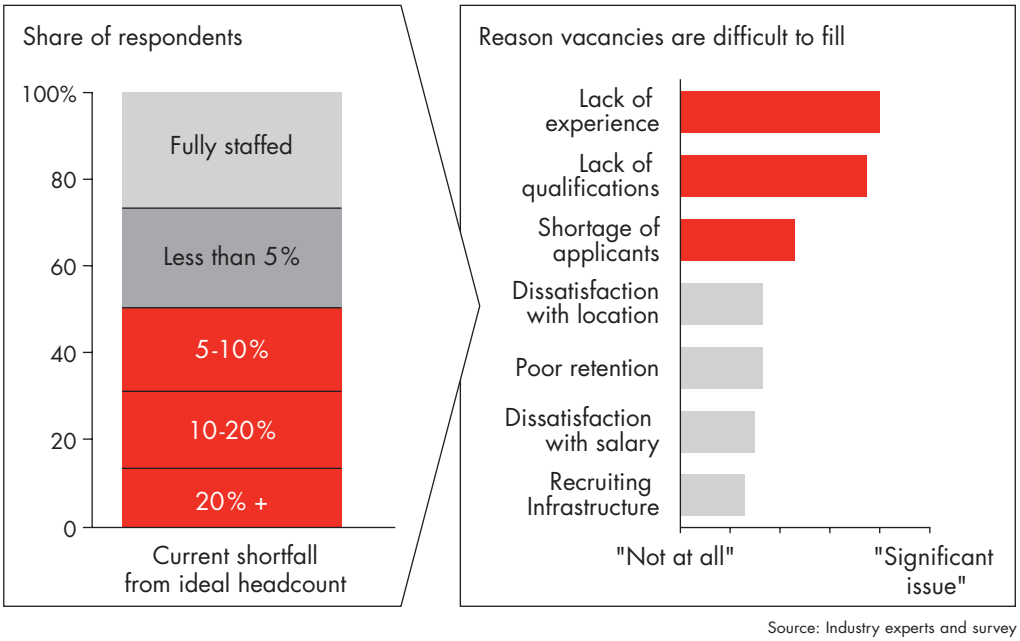
- **Supply chain.** A number of points in the supply chain are prone to shortages – the most important of which are wind turbines, themselves, vessels, cables, and offshore substations. Significant manufacturing capacity is due to come into operation into Europe in the near future, and when it does it will go some way towards addressing certain bottlenecks. Nevertheless, supply chain shortages will remain a concern, particularly in offshore wind;

- **Offshore operations.** The offshore environment presents unique challenges due to tidal activity, the hostility of the environment in stormy weather, and the remoteness of many sites. The trends towards larger turbines and sites which are further offshore will magnify the challenges. Despite this, experts believe that time and experience will allow the development of the expertise and skills that will gradually address such issues.

All five of these growth barriers must be tackled if the UK is to maximise its chances of success in the offshore wind arena.

Employment and skills supply

Figure 5: Significant vacancy levels are driven by a lack of experience, a lack of qualifications, and a shortage of applicants



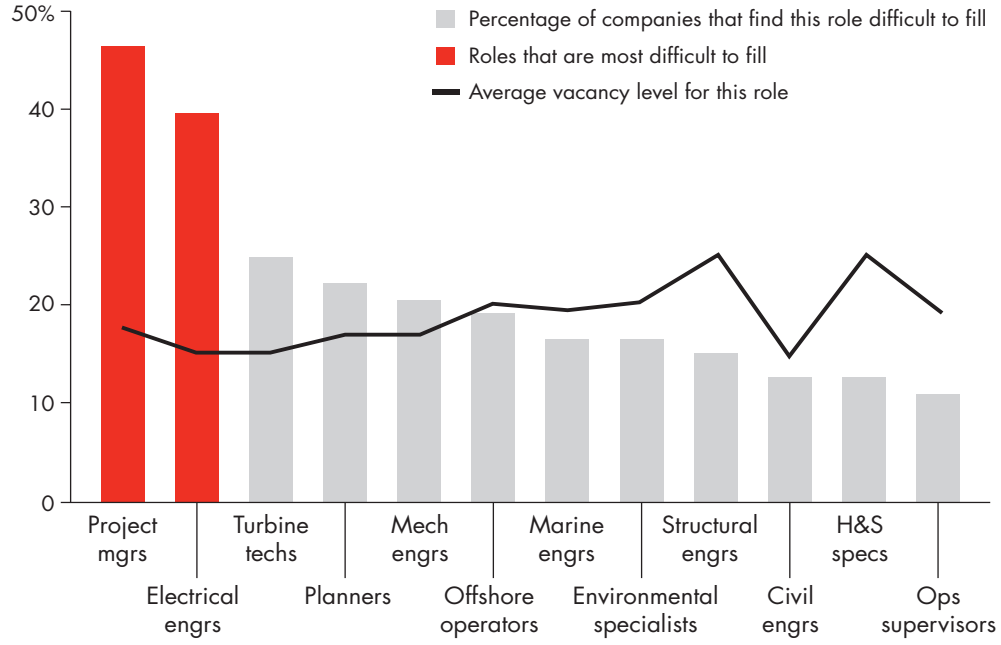
Source: Industry experts and survey

In the scenarios described above, it is estimated that 18,000 to 52,000 additional FTEs will be needed to support the UK wind industry in the medium-term future. However, the industry is already facing a considerable staffing challenge today: more than half of companies currently have **vacancy levels** of above 5 percent. In certain **specialist roles** that shortage is significantly higher. The urgency of the shortage is directly linked to the maturity of the industry: roles critical to the planning & development stage (e.g. project managers) are currently in particularly short supply. Acute areas of shortage are:

- **Project managers:** 46 percent of companies find this role hard to fill. Project managers are usually qualified engineers who are responsible for managing either the development or the construction process;
- **Electrical engineers:** 40 percent of companies find this role hard to fill. Electrical engineers are qualified to design and construct the high-voltage connections between the wind farm and the national grid;
- **Turbine technicians:** 25 percent of companies find this role hard to fill. Turbine technicians have the skills and qualifications required to operate inside the nacelle of a wind turbine.

The majority of **non-graduate hires** into the sector have experience in some other related industry, such as another renewable energy, oil & gas, or construction. Hiring from other sectors, as well as from other markets, must be actively pursued. The current shortage of skilled personnel within the sector has also led to employees being lured away to work for rival firms. That has resulted in above-average wage increases and a high level of intra-sector mobility over recent years.

Figure 6: Some specialist roles are particularly challenging to fill



Source: Industry survey

Current market estimates suggest that the number of engineers graduating each year in the UK is likely to remain broadly flat over the next 12 years. As a result, the current share of **new engineering graduates** entering the wind sector is unlikely to be sufficient to support the growth demands of the industry. Some of the historical issues driving the low percentage of engineering graduates entering the sector have been addressed, such as unclear industry prospects, concerns about career path progression, and salary levels, but more needs to be done. Given that fresh graduates will not satisfy the demand for specific skills, firms must also look inward and make significant investments in training and HR processes to generate in-house capabilities and experience.

Wave & tidal: a high-potential industry

Wave & tidal-based power generation is often cited as a renewable energy source in which the UK has very strong prospects. The sector comprises a number of different emerging technologies which generate electricity from ocean waves or marine currents. Currently, a relatively broad variety of prototypes can be found in testing and piloting phases.

Figure A: Wave projects in particular gaining momentum

	Manufacturer	Design / Technology	Momentum
Wave	Wave Dragon	Overtopping device	**Deployment** in 2009
	Pelamis Wave Power	Hinged contour device	**Operative** in Portugal and Wales since 2008
	Wavegen	Oscillating water column device	**Operative** and producing electricity for UK national grid since 2000
Tidal	Marine Current Turbines	Fixed underwater rotor blade device	SeaGen **operative** since 2008
	Open Hydro	Underwater turbines fixed on seabed	**Prototype** generated electricity for National Grid in spring 2008
	Hydra Tidal	Floating underwater rotor blade device	**Development** of Morild prototype in joint venture with Statkraft

These technologies build on resources which are theoretically capable of providing up to one-fourth of global and one-fifth of UK electricity consumption (based on Bain analysis with data from CIA world fact book and Carbon Trust). To tap into this potential at a meaningful scale, further R&D is required, the funding of which will have to be supported to a great extent by national governments and international bodies.

Building momentum

Bain & Company has examined the time required to reach inflection for a range of comparable renewable technologies that are now more mature. The analysis shows that commercial viability by 2015 might be achievable if wave & tidal can build up similar momentum to wind energy in its early days, but also that the process could take significantly longer if growth is more comparable to that of solar PV.

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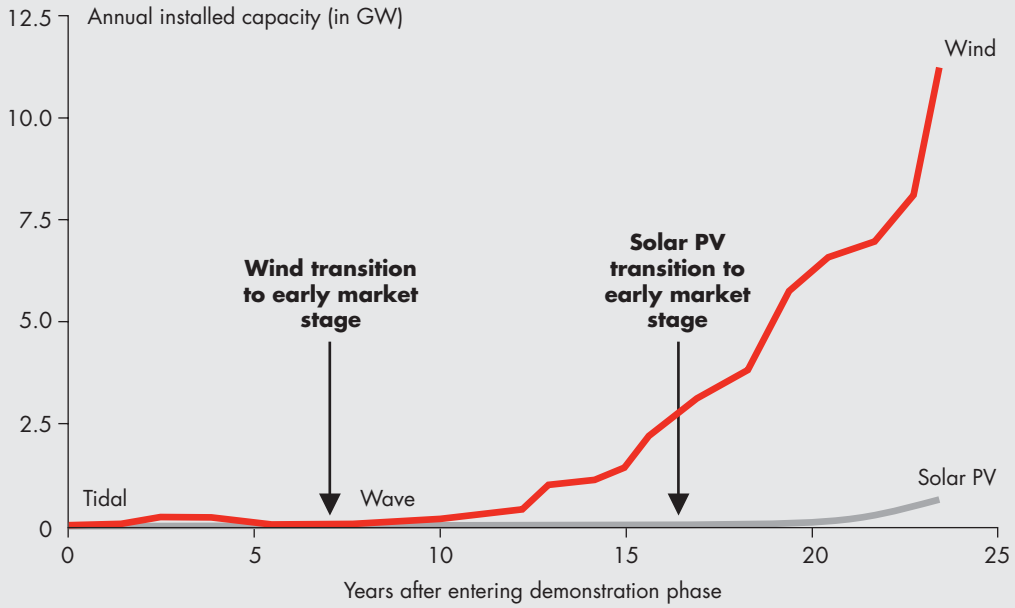
Figure B: Time required to go through demonstration phase for selected RES



In the most optimistic case, which broadly reflects some of the available projections, the UK wave & tidal sector could add roughly 1.4 GW of capacity by 2020, thereby providing up to 2,100 jobs. This would represent a greenfield opportunity for the UK to create an industry cluster similar to that of Denmark in the wind sector (which in 1995, eight years after the technology entered the demonstration phase, had provided 9,000 jobs).

The country that succeeds in developing Europe's dominant wave & tidal industry cluster would be in a position to harvest a significant share of the economic benefits that the industry generates. Besides the UK, a handful of other EU countries – including Portugal and Denmark – are in a comparatively strong starting position. As private investment will be a function of the proximity of the industry to commercialization, "the winner" is likely to be the country which provides the greatest public support over an extended period of time, thus allowing the development of a robust and affordable technology.

Next steps

Given the binary chance of success of the multiple demonstration-stage technologies currently in development, a national economy should adopt a **portfolio approach** to public investment. The wave & tidal sector will be associated with a high degree of risk until the technology has been proven and should, therefore, be viewed as a distinct set of technologies in a diversified portfolio of investments including but not limited to, other energy-related R&D projects. The industry's progress, and also that of the technologies, should be tracked and managed along a number of metrics, such as the level of private investment and device efficiency and costs.

A potential model for stimulating short-run growth in the industry would be for companies to focus on developing the technology, while the UK government aims at improving the conditions for establishment of manufacturing facilities. Potential roadblocks, such as environmental issues, maritime traffic safety concerns, and streamlining the site approval process, would need to be addressed practively.

Seizing the opportunity: what's required?

Some steps have already been taken to overcome growth obstacles, such as simplifying the connection process, reducing the length of the approval process, and addressing the skills gap. In this section, we reflect the views of industry experts and our own analysis along a set of leveraged actions, both from the public side ("what more can governments do?") and from the private side ("what more can companies do?").

Industry participants highlighted to us that one of the most fundamental prerequisites for kick-starting the emerging offshore industry is a clear, long-term, irrevocable **commitment** from policymakers to supporting the wind industry. This is expected to bring more stability and predictability to the market, thus facilitating incremental investment. Options that the government could consider to achieve this are:

- Extend the Renewables Obligation (e.g. from 2027 to 2040 and beyond);
- Set the obligation level out to 2020, including a headroom mechanism;
- Review progress towards 2020 renewable energy production targets annually, and take action if necessary.

A number of actions are required to boost **employment** and address the skill shortage. The shortage of engineers is not unique to the renewable energy sector and is being addressed at a national level. At the same time, the industry can increase its share of the talent by doing the following things:

- First, the wind industry must seek to attract talent by levelling the playing field with sectors such as oil & gas. That may require the adaptation of taxation schemes for offshore wind employees in order to match the tax breaks available to many offshore employees in oil & gas. In addition, the effective marketing of career paths that are both challenging and fulfilling will increase the attractiveness of the sector;

- Secondly, the government is expected to invest further in education, perhaps through the provision of university grants for engineers or by continuing in technical colleges. Over time, specialised education programmes tailored for the wind industry should be developed;

- Finally, the government and companies alike have a role in establishing an attractive value proposition for the sector based on the opportunities and rewards that a high-growth and ecologically sound sector can present. They also have a role communicating this to potential employees via educational establishments and the media. The government and the private sector need to work together to create a framework for world-class training and professional development.

Two things that would help to address **grid connection** issues are laying out a long-term grid strategy, and enabling the resolution of current inefficiencies by making amendments to the grid governance code. The current market mechanisms encourage a piecemeal and reactive approach to building out the network. A long-term strategy will increase the likelihood that investment in infrastructure is made in a logical and structured fashion. Greater coordination is needed between Ofgem and National Grid to agree to more strategic investment in the grid – for example by allowing capacity to be freed up from stagnant

projects. Companies can maximise their chances of achieving a successful connection by ensuring obligations are clearly understood, giving comprehensive input, and participating as fully as possible in the connection dialogue.

Additional actions are required to further facilitate the **site approval** process. Local support could be stimulated by returning some of the tax revenue generated by a wind farm to the local community. That has proven a key enabler in the countries which have led onshore wind development to date. Another key issue is that the incentives of a number of different stakeholders are often not fully aligned. Government should give more guidance to public sector organisations on its targets so that there is less disruption from them in the planning process. By ensuring that guidelines for these organisations are consistent with energy policy goals, it should be possible to simplify the application process significantly. Companies can try to manage site approval issues by broadening their site portfolio, which will reduce the impact of a failed approval, whilst at the same time, they may maximise their success rate in the site approval process by over-investing in clarity and communication during each approval procedure.

Certain measures have been taken already to address **supply chain** concerns, including the establishment of the national Office for Renewable Energy Deployment, which will help UK firms take advantage of opportunities in renewable energy to build R&D and manufacturing capacity. A key factor in resolving supply chain issues is the creation of the right environment for investment to enter the UK. Companies must then take advantage of that environment and build new R&D or manufacturing capacity to meet the increase in demand generated by growth. The European experience demonstrates that a highly effective way to stimulate growth of the supply chain is through the development of sector clusters. As previously discussed, in key European clusters, the establishment of turbine manufacturing plants was soon followed by component manufacturers, R&D facilities, and educational establishments. Strong infrastructure (port facilities, airport, and roads), a deep supply of qualified but relatively inexpensive labour, proximity of sub-suppliers, and support and incentives from the government are required to kick off the growth of a cluster. Key success factors for cluster building are focus and momentum. By focussing on developing just one cluster, government will help simplify the decision-making process for the investor. Once companies start to invest, the proposition becomes more attractive as suppliers and customers can easily be found. The successful development of an offshore wind cluster in the UK would be a significant accelerator for the UK wind industry.

Finally, the government can help resolve the challenges of **offshore operations** by such measures as underpinning the development of offshore wind with financial support, placing offshore planning into the hands of a single approval body (such as the Infrastructure Planning Commission, which could be achieved by reducing the Marine Management Organisation planning threshold from 100 MW to 1 MW in the Marine Bill), and encouraging investment in ports and related infrastructure. However the required competitive advantage in the offshore environment can only be developed through companies building their own experience in offshore operations.

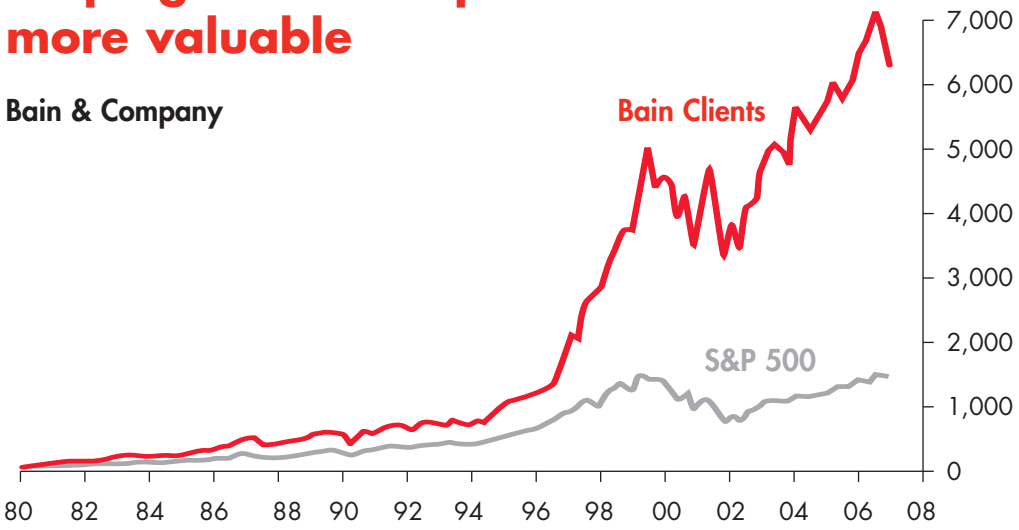
Summary

In summary, the UK wind industry is poised for extraordinary growth, though for that to be fully realised, numerous obstacles must be overcome. There are many specific actions that the government and companies must take to overcome these obstacles. If that can be achieved, and the sector is promoted in the right way, then 50,000 new jobs could potentially be created in the wind industry in the UK.

About this study

Bain & Company conducted this independent study at the invitation of the British Wind Energy Association, on a pro bono basis. The analysis is based on Bain's experience in the global renewable energy sector, more than 35 in-depth interviews with industry experts, an online survey of more than 80 industry participants and a comprehensive review of currently available secondary sources. This information has been used to build a proprietary employment model for the UK wind energy sector from the present day to 2020.

Helping make companies more valuable



Indexed stock price gains beginning at 0 in 1980.

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