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The evolution of offshore wind power in the united kingdom

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ABSTRACT

In the United Kingdom wind power is recognised as the main source of renewable energy to achieve the European Union 2020 renewable energy targets. Currently over 50% of renewable power is generated from onshore wind with a large number of offshore wind projects in development. Recently the government has re-iterated its commitment to offshore wind power and has announced that offshore wind subsidies are to increase from £135/MWh to £140/MWh until 2019. This paper provides a detailed overview of the offshore wind power industry in the United Kingdom in terms of market growth, policy development and offshore wind farm costs. The paper clearly shows that the United Kingdom is the world leader for installed offshore wind power capacity as pro-active policies and procedures have made it the most attractive location to develop offshore wind farm arrays. The key finding is that the United Kingdom has the potential to continue to lead the world in offshore wind power as it has over 48 GW of offshore wind power projects at different stages of operation and development. The growth of offshore wind power in the United Kingdom has seen offshore wind farm costs rise and level off at approximately £3 million/MW, which are higher than onshore wind costs at £1.5–2 million/MW. Considering the recent increase in offshore wind power subsidies and plans for 48 GW of offshore wind power could see more offshore wind power becoming increasingly financially competitive with onshore wind power. Therefore offshore wind power is likely to become a significant source of electricity in the United Kingdom beyond 2020.

Contents

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1. Introduction

The United Kingdom's (UK) renewable energy strategy stated that 15% of electricity would have to come from renewable sources to achieve the European Union's (EU) 2020 Renewable Energy Directive and tackle climate change [1]. In 2013 offshore wind was identified as the main renewable energy source for achieving the 2020 target [2]. This was a considerable policy change from the early 1990s where the replacement of coal fired generation plants with combined cycle gas turbines resulted in the majority of carbon dioxide emissions reductions in the UK [3]. Over the same period gas production peaked and since 2005 the UK has become a net importer of natural gas [3]. In addition the UK's existing electricity generating plant is approaching the end of its predicted life cycle. It is estimated that some 80% of current thermal plant will need to be replaced by 2030. This includes 8.5 GW of coal power stations closing by 2017 due to the revised large combustion plant directive [4] and 9 GW of nuclear plants [5]. Therefore the 2030 target of 40 GW of offshore wind energy in the UK is critical to achieving National and European renewable electricity targets [2]. A review of published information worldwide indicates offshore generating capacity has increased fourfold from approximately 1.1 GW to 4.9 GW in the last five years. Denmark was the major developer in the early 2000s but it was the UK that has developed the most in the last five years, as shown in Fig. 1.

Although there is nearly 5 GW of offshore wind installed worldwide the industry is still in its infancy stage similar to onshore wind in the 1990s. Throughout the last five years the large equipment manufacturers have invested heavily in offshore wind turbine research and development despite the global economic crisis [6–8]. This private investment has been supported by government policies and feed-in tariffs, particularly in the UK. The development of offshore wind in the UK over the last ten years has seen project costs vary for a number of reasons. Studies have shown costs are linked to increasing water depths and distance from shore [9,10]. Additional driving factors have been identified as rising material costs, commodities and labour costs, and rising cost of offshore turbines due to supply chain constraints [5,11–14]. A key finding of this research is that capital costs for offshore wind turbines appear to be levelling off and the UK is in a strong position to take advantage and achieve their EU 2020 targets.

This paper contains seven sections. Section 1 presents the introduction. Section 2 discusses development status of the UK offshore wind industry from 2000 to 2025. The technology development of offshore wind turbines using published information, data and web sources is covered in Section 3. Section 4 describes the UK market in terms of policy development and national attractiveness. Section 5 discusses UK development costs and financial strategies. Section 6 analyses the impact economies of scale have on the capital costs for offshore wind projects under varying distances to shore and turbine costs. The trend for future capital costs for offshore wind power projects is also analysed. Section 7 discusses the key findings of the paper.

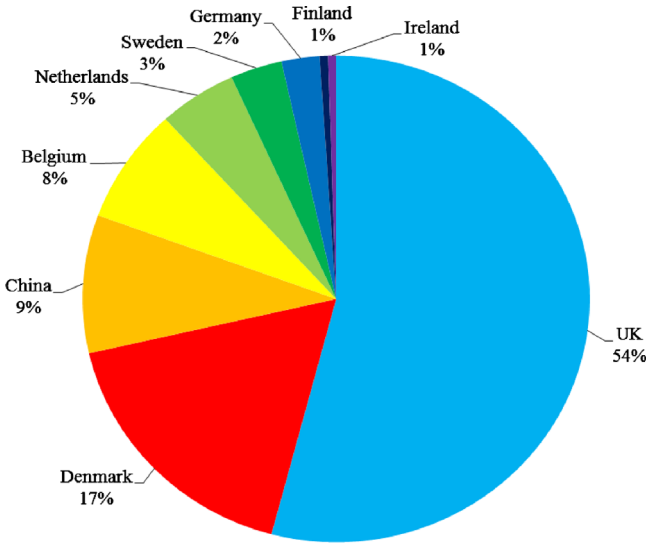
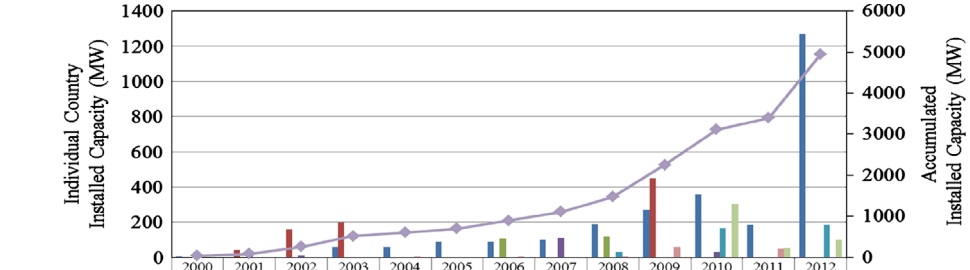


Fig. 2. International breakdown of installed offshore wind capacity.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
UK	4	0	0	60	60	90	90	100	187	270	357	184	1271
Denmark	0	40	160	200	0	0	0	0	0	448	0	0	0
Netherlands	0	0	0	0	0	0	108	0	120	0	0	0	0
Sweden	0	11	10	0	0	0	0	110	0	0	30	0	0
Belgium	0	0	0	0	0	0	0	0	30	0	165	0	185
Germany	0	0	0	0	5	0	3	0	5	60	0	48	0
China	0	0	0	0	0	0	0	0	0	0	303	51.5	99.3
Accumulated (MW)	36	87	257	517	607	697	898	1108	1475	2252.8	3109.7	3393.1	4947.7

Installation Year

Fig. 1. Worldwide installed offshore wind capacity (2000–2012).