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Offshore wind power policy and planning in Sweden ☆

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ABSTRACT

The main objective of this paper is to analyze the role of policy support schemes and planning systems for inducing offshore wind power development in Sweden. Specifically, it highlights the different types of economic, political and planning-related conditions that face offshore wind power investors in Sweden, and provides brief comparisons to the corresponding investment conditions in Denmark, Norway and the UK. The analysis shows that in Sweden existing policy incentives are generally too weak to promote a significant development of offshore wind power, and the paper provides a discussion about a number of political and economic aspects on the choice between different support schemes for offshore wind in the country. Swedish permitting and planning procedures, though, appear favorable to such a development, not the least in comparison to the corresponding processes in the other major offshore wind countries in Europe (e.g., the UK). On a general level the paper illustrates that the success and failure stories of national offshore wind policies and institutions cannot be easily transferred across country borders, and the analysis shows that both the political and the legal frameworks governing the investment situation for offshore wind farms in Denmark, Norway, Sweden and the UK differ significantly.

1. Introduction

The current concerns about climate change relate strongly to the past technological developments, which have fundamentally changed the structure of the energy sector by making possible the diffusion of new and less costly technologies. The energy production processes introduced during the 20th century – most notably those relying on the combustion of fossil fuels – have given rise to a significant increase in the emissions of greenhouse gases out of which carbon dioxide is the most important. The balance of evidence suggests, though, that these emissions are having a distinct negative impact on the global climate (e.g., IPCC, 2007). Somewhat paradoxically, policy makers worldwide now hope that future technological developments will solve the problems that technical change has caused in the past. This requires policy efforts in the energy sector to be heavily focused on innovation and technology diffusion activities as a complement to policies addressing explicitly the reduction of carbon emissions (e.g., emissions trading, carbon taxes, etc.) (Jaffe et al., 2005).

An essential component of the European Union's energy policy is the promotion of renewable energy sources in its Member Countries, and for the electricity sector the Renewables (RES-E) Directive (2001/77/EC) has played a key role in this policy endeavor. In addition to climate change, several other political ambitions are also provided as arguments for an increased reliance on electricity produced by renewable energy sources. These include, first and foremost, improved security of supply in the Union, but also social cohesion, local employment and environmental protection are put forward as key arguments. While the RES-E Directive has outlined quantitative goals for the development of renewable electricity in each country until the year 2010, it has also provided substantial freedom on the parts of national governments to select the policy instruments needed to fulfill these goals. The existing policy support schemes for renewable electricity (e.g., feed-in tariffs, green certificates, etc.) have primarily succeeded in stimulating the diffusion of relatively mature technologies, such as onshore wind power, but it has become increasingly important to also support the development of the more immature energy technologies in order to make it possible to comply cost-effectively with more stringent climate policy commitments in the future. In order to design efficient policies, though, a proper understanding of the economic, legal and institutional conditions that govern technology innovation and diffusion in the electric power sector is needed. Investments in new carbon-free electric power sources typically face a number

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of economic, political and institutional hurdles, and these can often differ across countries as well as across different renewable electricity technologies.

The main objective of this paper is to analyze the role of policy support schemes and planning systems for inducing offshore wind power development in Sweden. Specifically, we make use of economic and legal analysis to identify the different types of economic, political and planning-related uncertainties that face offshore wind power investors in Sweden. This implies that we assess the lifetime engineering costs of different types of wind power projects in Sweden, and then analyze the impact of the different policy instruments in use on the competitive cost position of these projects under varying rate-of-return requirements. We also recognize, though, that investment decisions will be influenced by the legal frameworks conditioning the permitting, planning and location of wind farms. The paper therefore also provides an analysis of important legal provisions and selected case law examples concerning the assessment of the environmental impacts of wind mills and the planning procedures for offshore wind mill installations in Sweden.

Throughout the paper we make brief comparisons to the corresponding investment conditions in three other European countries: Denmark, Norway and the United Kingdom (UK). In all of these countries there are great potentials for substantial future expansions of offshore wind power, and Denmark and the UK are already at the forefront of offshore wind development worldwide (see Section 2). Similar inter-country comparisons have been made for onshore power (e.g., Toke et al., 2008), but few previous studies highlight the special conditions offshore. The analysis indicates that the political and legal conditions for offshore wind power development differ considerably across these countries, and in the paper we also conclude that in Sweden these conditions vary considerably for onshore versus offshore wind power installations. The establishment of onshore wind farms in Sweden is negatively affected by the legal provisions governing the assessment of the environmental impacts of wind mills and the planning procedures for mill location (e.g., Söderholm et al., 2007). In contrast, Swedish offshore installations are primarily hampered by lack of policy support, while the legal conditions overall appear favorable.

In Section 2 we briefly review the past development of offshore wind power in Europe. Section 3 analyzes the economics of wind power in Sweden, and the impacts of policy on the lifetime power generation costs. We also address some political and economic aspects on the choice between future technology support policies in Sweden. In Section 4 we discuss environmental permitting and physical planning procedures for offshore wind power in Sweden, and compare these to the respective legal frameworks in Denmark, Norway and the UK.

2. Offshore capacity developments in an European perspective

Fig. 1 displays the development of offshore wind power capacity in Europe since 1998 and onwards. The growth in installed capacity has been high during this period, albeit from very low levels at the end of the 1990s. At the end of 2009, total installed European offshore wind power capacity amounted to 2056 MW, representing about 2 percent of total wind power capacity in Europe (EWEA, 2010). Globally Europe is a dominant player in the offshore wind sector and the associated production of turbines; as late as in 2007 European producers supplied turbines to all offshore wind power projects worldwide (EWEA, 2007).

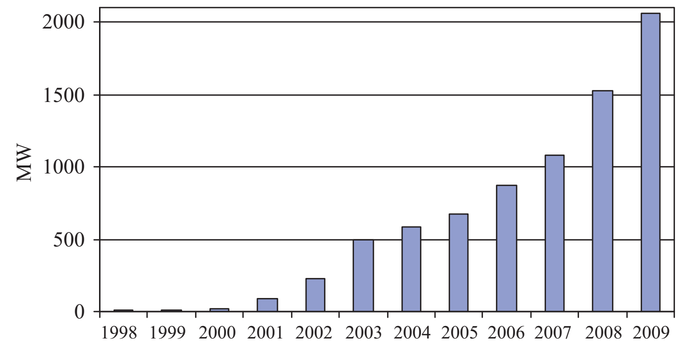

Fig. 1. Installed capacity of offshore wind power in Europe (MW), 1998–2009. *Sources:* EWEA (2008, 2010).

Table 1
Offshore wind power installations by country, 2009.
Source: EWEA (2010).

	Number of farms	Number of turbines	Installed capacity (MW)
United Kingdom	12	287	883
Denmark	9	305	639
Netherlands	4	130	247
Sweden	5	75	164
Germany	4	9	42
Belgium	1	6	30
Ireland	1	7	25
Finland	1	8	24
Norway	1	1	2
Total	38	828	2056

The UK and Denmark are the dominating producers of offshore wind power in Europe, and in 2009 their combined share of European offshore capacity amounted to 74 percent. Table 1 shows that total European offshore capacity is spread across 38 wind farms in nine countries, and 21 of these have been installed in either the UK or Denmark. The Netherlands and Sweden also have substantial offshore wind power resources, and in 2009 Sweden accounted for about 8 percent of total European capacity installed. Norway is still a minor player in the offshore market, and in 2009 the country's installed capacity was only 2.3 MW (EWEA, 2010). Nevertheless, Norway has very favorable wind potentials for increased offshore capacity, but so far the needed policy support to induce additional expansions has been lacking.

Over the years the European offshore wind farms have grown larger and larger, and they are typically built further away from shore and installed in deeper waters. For instance, the Horns Rev 2 wind farm, built in Denmark in 2009, has a capacity of 209 MW. In Sweden there are currently five offshore wind farms operating; most of them are comparatively small in terms of capacity (3–30 MW) but in 2007 the Lillgrund wind farm was established and it comprises 48 turbines with a total capacity of 110 MW. This farm is located about 7–10 km from shore and the water depth is 3–6 m (Meyer, 2007).

The rougher conditions offshore imply, though, that production costs are substantially higher compared to onshore installations. For instance, the investment cost for onshore wind power are normally estimated at Euro 0.8–1.2 million per MW, while the corresponding cost for offshore installations may often end up at Euro 1.7–2.3 million per MW (Lemming et al., 2007). The main reasons for this cost difference are the higher costs for foundation and grid connections at offshore wind farms. For a typical onshore wind power station the cost of foundations normally represents