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The North Sea Offshore Wind Service Industry: Status, perspectives and a joint action plan

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ABSTRACT

The Offshore Wind Service sector is about to established itself as an industrial sector with an own identity, own organisation, and with large future challenges. The article introduces this new sector, including assessment of present and future market sizes. The overall aim of the research reported in this article was to increase the innovation capacity of the European offshore wind servicing (OWS) sector by establishing cross-regional cooperation and intensifying the relationship between research and the offshore wind industry. The article uses the concept of innovation system foresight (ISF). The linking of the two concepts of foresight and innovation systems has been explored by several studies, but ISF takes a further integration of the two concepts. The article presents a set of concrete actions at multiple levels to support the development of the offshore wind service sector. The findings provides an input for a concerted effort for supporting both the offshore wind development and the emerging clusters of offshore wind services around the North Sea. In addition, the article addresses the value of the ISF approach to such policy development.

1. Introduction

As Europe is working its way towards a low carbon future as laid out in the European Strategic Energy Technology Plan (SET-Plan) [1], the importance of renewable energy sources is growing. In particular, there are high expectations of the role of offshore wind, and the installed capacity is projected to increase significantly towards 2020 and beyond [2,3]. However, offshore wind energy is relatively expensive as measured by Levelized Cost of Energy (LCoE), and thus the industry has outlined an ambitious goal of reducing the cost of offshore wind by 40% by 2020 compared by the average LCoE by 2012 [4].

While capital expenditure of major components and other up-front costs play a major role in LCoE, the services for project development installation, operations and maintenance (O & M) contribute up to 46% of LCoE (capital and operating expenditure, CAPEX and OPEX). O & M services' contribution alone is estimated between 25% and 28% [5–7]. From these numbers, it is apparent that while much attention is rightly paid to the development of the physical components for offshore wind farms and the associated technologies, the services associated with offshore wind farms hold potential for cost reduction as well. Furthermore, the North Sea is currently the most important site for offshore wind installations, and industry clusters based on Offshore Wind Services (OWS) are emerging in regions around the North Sea.

Recently, several studies have analysed the North Sea offshore wind innovation system [8–10]. Among the conclusions is that there is a need for concentrated action to improve the function of the European offshore wind innovation system [9]. However, an orchestration of the interests, stakeholders and policies of countries involved in a European offshore wind innovation system is difficult. Hence, the aim of this article is partly to report on the results of the project European Clusters for Offshore Wind Servicing (ECOWindS) funded by the European Union's Regions programme. The project focussed on the engineering part of off shore wind servicing, and did not consider financial services, planning or other non-engineering parts of wind servicing. The work

Abbreviations: CAPEX, Capital expense; ECOWindS, European Clusters for Offshore Wind Servicing; EERA, European Energy Research Alliance; EWEA, European Wind Energy Association's; GW, Gigawatts(-s); GWO, Global Wind Organization; HSEQ, Health, safety, environmental and quality; ISF, Innovation System Foresight; JAP, Joint Action Plan; LCoE, Levelized Cost of Energy; MW, Megawatt(-s); OH & S, Occupational Health and Safety; O & M, operations and maintenance; OPEX, Operating expense; OWS, Offshore Wind Services; RDI, Research, Development, and Innovation; SET-Plan, European Strategic Energy Technology Plan; STEPLED, Social, Technological, Economic, Political, Legal, Environmental, Educational and Demographic factors; SWOT, Strengths and Weaknesses, and Opportunities and Threats; TIS, Technological Innovation Systems; TSO, Transmission System Operator; TPWind, European Wind Energy Technology Platform; UK, The United Kingdom of Great Britain and Northern Ireland; WAB, Windenergie Agentur Bremen-Bremerhaven

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presented in this article is one of the results of ECOWindS. The project was funded by the European REGIONS program: Transnational cooperation between regional research-driven clusters. ECOWindS was a collaboration between research-driven clusters within offshore wind servicing in four regions around the North Sea.

One of the key goals and tangible outcomes of the ECOWindS project was a 'Joint Action Plan' (JAP). The JAP is essentially a roadmap for OWS. It comprises a portfolio of actions that include direct and indirect research, development, and innovation (RDI) activities, including network and capacity building, development of test sites and standards. In the broader ecosystem of offshore wind there are existing strategic research agendas and roadmaps [4,11–13], however they do not address offshore wind *services* thus there was a felt need to develop the JAP to support specifically OWS-relevant RDI.

The theoretical framework for this study builds on the Technological Innovation Systems (TIS) and the associated functions perspective. A TIS can be defined as a set of networks of actors institutions that jointly interact in a specific technological field and contribute to the generation, diffusion and utilization of variants of a new technology and/or a new product [14]. A key proposition in the literature is that there are key functions that enable the development of a TIS, and if the functions are strong and 'work properly', the innovation system develops and grows [9,15,16]. Usually, seven such functions are used in the analyses: 1) Experiments by entrepreneurs, 2) Knowledge development, 3) Knowledge exchange, 4) Guidance for search, 5) Market formation, 6) Resource mobilisation, and 7) Creation of legitimacy. A detailed discussion of these functions can be found elsewhere [16,17]. Furthermore, this article uses the concept of Innovation System Foresight (ISF) that combines the concept of foresight with the innovation systems approach (Andersen & Andersen 2014; Andersen et al., 2014). Innovation Systems Foresight (ISF) is defined as a systemic, systematic, participatory, future-intelligence-gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilising joint actions to improve innovation system performance with the ultimate goal of improving desirable socio-economic performance [18].

The rest of the article is organized as follows. The second section lays out the theoretical framework for the analysis. The third section explains the methodology for ISF in this instance. The fourth section reviews the OWS innovation system around the North Sea. The fifth section proposes actions for strengthening the innovation system. The article closes in the sixth section with discussion and conclusions.

2. Innovation system foresight

The EcoWindS project must be seen in the perspective of the concept of regional Smart Specialization, which aims to support the European Cohesion target by enabling regions to identify their relative strengths and leverage them, while avoiding imitation or duplication and head-on competition with other regions [19]. The concept of smart specialization was first introduced in 2008 by an expert group of academics (Knowledge for Growth, K4G) that was established by the European Commission to revive the European Union's Lisbon Strategy [20,21]. The concept was rapidly adopted at the highest level of policy and became one of the key stones in the EU2020 strategy. However, the fast adoption of the concept has to a wide extent taken place without a solid theoretical and empirical foundation, and smart specialization strategies are criticised for being more based on hopes than empirical facts [20,22–24].

As mentioned in the introduction this article built on the theoretical concept of innovation system foresight (ISF) [18,25,26]. The nexus between foresight and innovation systems has been explored by some studies and until recently there seems to be only a little communication between the innovation system research and foresight [27]. Most studies have focused on how foresight can contribute to innovation system analysis [28–31]. Others have explored practical applications of an integrated framework of innovation system analysis and foresight [32]. The innovation system foresight takes a further integration of the two fields of research.

First, most of the studies that focus on how foresight can contribute to innovation system policies adopt a predictive understanding of the future. Previous studies note that there is a strong need for assessing future development paths in innovation in order to develop effective innovation policy strategies [31,33]. However, forward looking (predicting, forecasting, and explorative) is only one approach to foresight. The other is normative (anticipative, backcasting) [34,35]. ISF emphasises understanding the evolutionary path of a given system in its context and the processes that drive that development, borrowing from the field of innovation studies in conception of innovation systems and their evolution [18,26,36,37]. There are some assumptions that come with this orientation. First and foremost, foresight and its implications and recommendations are context dependent [38–40]. It follows that foresight needs to include an analysis of the context and forces that drive the development, an explanation of the system [37], to offer evidenced recommendations for innovation policy. Traditionally foresight has had a limited impact to decision making [27], and one of the key reasons is that to process and outputs do not serve the needs of the stakeholders of the system [41,42]. ISF by definition addresses this by including a comprehensive analysis of the system and context to arrive to conclusions about its foreseeable development.

3. Methodology

The project ECOWindS project can be characterized as an ISF process [18,25]. The ECOWindS project ran from November 2013 to October 2015. During that time, the process had three main phases, each of which contained sub-phases (see Fig. 1). The planning phase comprised preparation and organisation of the foresight exercise. The main phase was the most comprehensive, as well as the most time-consuming and labour-intensive part of the foresight process. It is in this phase that the regional advantages were analysed, visions and objectives were set and prioritized, and actions were planned. The main phase was divided into four sub-phases: mapping, foresighting, prioritising and planning. The follow-up phase comprised two sub-phases: dissemination and learning.

3.1. Planning and organising the project

The planning and organisation phases of the EcoWindS project primarily took place in the formulation of the project. The project was funded by the European Union's Framework Programme 7's CAPACITIES programme: Regions of Knowledge. The overall aim of the Regions of Knowledge programme was to strengthening the research potential of European regions, in particular by encouraging and supporting regional 'research-driven clusters' associating universities, research centres, enterprises, regional authorities and other stakeholders across Europe. The total budget was EUR 1,757,714. The duration of the project was 3 years: November 2013 to October 2015.

The partner regions were: South Denmark (Region South Denmark), East of England (East Anglia, Counties of Cambridge, Suffolk and Norfolk), North West Germany (Bremen-Bremerhaven region, federal states [Bundesländer] of Bremen, Hamburg, and Niedersachsen, and as an extended region Schleswig-Holstein, Mecklenburg-Vorpommern and Nordrhein-Westfalen as well) and Møre in West Norway. The overall aim of the project was to increase the innovation capacity of the European offshore wind servicing (OWS) sector by establishing cross-regional cooperation and intensifying the relationship between research and the offshore wind industry. A further aim was to contribute to reduction of offshore wind power cost, and by extension European competitiveness and achieving the SET Plan [1] goals for renewable energy generation. During the project, it emerged that the overarching specific goal was, aligned with the European Wind Energy Association's (EWEA) 2020 target, a 40%