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Development patterns of the offshore wind farms in the Baltic Sea Region

REGION BLEKINGE

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Content

1. Introduction

Renewable energy sources and energy-related related issues are gaining more and more resonance within different discourses. Energy questions have been focused on within scientific, political, economic, environmental etc. array. When dealing with the energy resources of the future, questions referring to wind energy, its storage and relevance for both environment and economy appear to outweigh renewable energy-related deliberations, and even more with regard to the fact that the wind energy is being successfully employed at the present and carries with it a great potential to expand. However, the emphasis so far has been mainly put on the offshore wind industry in the North Sea as well as, with respect to the countries in question, on the onshore wind resources. The development of the offshore wind sector in the Baltic Sea Region has been paid far less attention. In this light, the article in hand briefly sheds the light on the present and future development patterns of the offshore wind farms within the Baltic Sea region, especially with the focus to reveal best practices and the potential prevailing in terms of the offshore wind energy sector development, challenges faced so far and the remaining ones as well as near future perspectives.

2. Mapping offshore wind farms in the Baltic Sea Region

The development of the offshore wind energy sector and therefore of the wind farm establishment depends on the following factors: grid infrastructure, a well-established supply chain, maritime special planning solutions and technological development etc.[1] Thus, the development, interplay and presence of all these particular determinants can lead towards a well-functioning wind energy market in the Baltic Sea Region. Nevertheless, it has to be highlighted here that each country in question has adopted its own strategy to foster the offshore wind energy market[2].

[1] Sustainable Energy and Transportation Systems, in EcoRegion Perspectives, 5th issue, 2011, http://baltic-ecoregion.eu/downloads/1_PerspectivesEnergy_and_Transportwebsite_version.pdf, retrieved on 13.02.2012, p. 35.
[2] Ibid., p. 37.

Concerning the scope of the offshore wind farms in the Baltic Sea Region, there have been differentiated offshore wind farms in use (1), offshore wind farms under construction (2), offshore wind farms approved (3), offshore wind farms planned (4) and offshore wind farms denied (5)[3].

When taking into account number and performance data of the wind farms in the BSR in 2010, the offshore wind energy development in Germany, Denmark, Sweden and Lithuania results in the following constellation[4].

Table 1: Offshore wind farms in the BSR

	Operating		Authorised		Submitted Applications		Concept Phase		Dormant	
	No. of farms	Capacity (MW)	No. of farms	Capacity (MW)	No. of farms	Capacity (MW)	No. of farms	Capacity (MW)	No. of farms	Capacity (MW)
Germany	2	50	5	1.593	8	1.607	6	966	0	0
Denmark	9	487	2	436	0	0	2	525	0	0
Sweden	5	163	4	1.531	5	2.034	7	4.323	0	0
Lithuania	0	0	0	0	0	0	0	0	5	No data

When focusing on individual countries within the BSR and their involvement into the utilisation of the offshore wind energy, the current and development patterns in Germany, Denmark, Sweden and Lithuania yield following data.

2.1 Country profile: Germany

Currently, there have been approved following offshore wind farm projects in Germany[5].

[3] Ostsee: Offshore Windparks, 2011, http://www.bsh.de/en/Marine_uses/Industry/CONTIS_maps/BalticSeaOffshoreWindfarms.pdf, retrieved on 06.02.2012.

[4] Source: adopted from Sustainable Energy and Transportation Systems, in EcoRegion Perspectives, 5th issue, 2011, http://baltic-ecoregion.eu/downloads/1_PerspectivesEnergy_and_Transportwebsite_version.pdf, retrieved on 13.02.2012, p. 36.

[5] Federal Maritime and Hydrographic Agency, 2011, http://www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/index.jsp, retrieved on 06.02.2012

Table 2: Offshore wind farms in the German waters of the Baltic Sea

No.	Name of the Offshore Wind farm project	Particulars			
		Location	Approved on	Start of construction	Technical specification
1.	"EnBW Windpark Baltic 2" (former: Kriegerks Flack) ENBW Ostsee Offshore GmbH	30 km northern Rügen	6. April 2005	30. June 2012	80 installations
2.	"Arkona Becken Südost" AWE Arkona-Becken-Entwicklungs-GmbH	35 km north-east of Rügen	15. March 2006	31. December 2017	80 installations
3.	"Wikinger" (former: Ventotec Ost 2) Iberdrola Renovables Offshore Deutschland GmbH	35 km north east of Rügen	16. May 2007	31. December 2015	80 installations

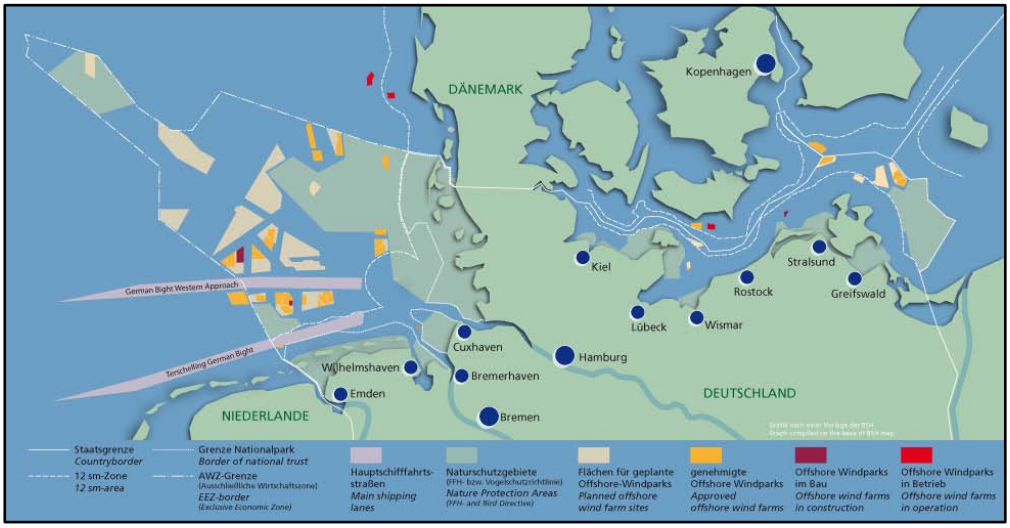
In Germany, the Federal Maritime and Hydrographic Agency (German: Bundesamt für Seeschifffahrt und Hydrographie (BSH)) is responsible for the approval of offshore wind farm development projects and undertakes the application procedure for wind farms in the German EEZ, where most of the German offshore wind farms are planned to be installed. An offshore wind farm project is approved, first, if it does not negatively affect the safety and efficiency of the navigation (1) and does not harm the marine environment (2). Concerning these requirements, such issues as protection of the marine environmental features, e. g. birds, fish, sea bottom and water etc. are scrutinised with the aim to avoid any risk and protect the environment. Second, in case offshore wind farm projects involve more than 20 turbines, an environmental impact assessment is needed. Finally, the BSH and the competent institutions deal with the threats the project might pose to the navigation and thus affect the navigation safety[6].

German has with its newly commissioned Baltic 1 wind farm a capacity of 50 MW installed offshore turbines in the Baltic Sea off Rostock and 19 projects under development[7]. The offshore wind farm Baltic 1 is Germany's first offshore wind farm in the Baltic Sea. It was launched in the beginning of May 2011 and is located 16 km

[6]Federal Maritime and Hydrographic Agency, 2011, http://www.bsh.de/en/Marine_uses/Industry/Wind_farms/index.jsp, retrieved on 06.02.2012.
[7] Sustainable Energy and Transportation Systems, in EcoRegion Perspectives, 5th issue, 2011, http://baltic-ecoregion.eu/downloads/1_PerspectivesEnergy_and_Transportwebsite_version.pdf, retrieved on 13.02.2012, p. 36.

north of the Darss / Zingst peninsula[8].

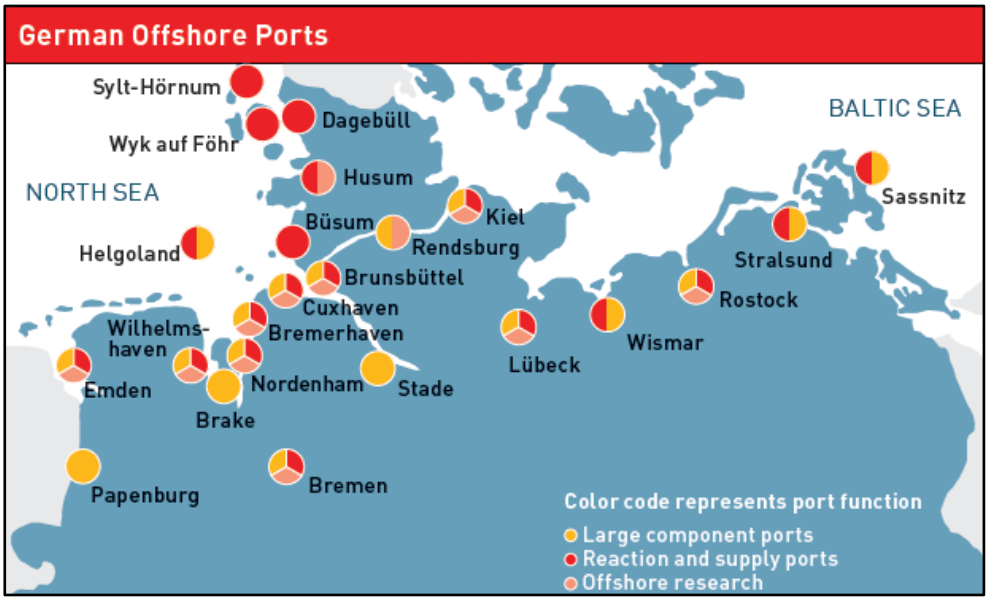
Figure 1: Offshore wind farms in Germany[9]



As can be seen in the following figure, German ports along the Baltic Sea coast are being expanded in order to meet offshore wind industry demands. As a result, European Union and federal state level authorities together with private companies have made essential investments for development of heavy load port terminals in close proximity to production facilities[10]. Nevertheless, when compared to the North Sea ports, the ports along the coastline of the Baltic Sea appear to have far less focused on the development of the offshore wind energy market in the Baltic Sea till now.

[8] Germany Trade & Invest, 2011, The German Wind Energy Industry: Europe's Primary Wind Energy Market, http://www.gtai.de/GTAI/Content/EN/Invest/_SharedDocs/Downloads/GTAI/Fact-sheets/Energy-environmental/fact-sheet-wind-energy-in-germany.pdf, retrieved on 28.02.2012, p. 2.
[9] Source: Offshore Wind Energy in Germany, http://www.southbaltic-offshore.eu/regions-germany.html, retrieved on 16.02.2012.
[10] Germany Trade & Invest, 2011, The German Wind Energy Industry: Europe's Primary Wind Energy Market, http://www.gtai.de/GTAI/Content/EN/Invest/_SharedDocs/Downloads/GTAI/Fact-sheets/Energy-environmental/fact-sheet-wind-energy-in-germany.pdf, retrieved on 28.02.2012, p. 2.

Figure 2: German offshore ports[11]



Beyond this, as it is evident from the figure above, ports at the Baltic Sea coast, namely, Kiel, Lübeck, Wismar, Rostock, Stralsund and Sassnitz in Schleswig-Holstein and Mecklenburg-Vorpommern are connected through the Kiel Canal which serves as one of the most heavily used artificial seaways in the world with the North Sea. Thus, the ports concerned are optimally located at the centre of all future northern European offshore wind energy sector development[12].

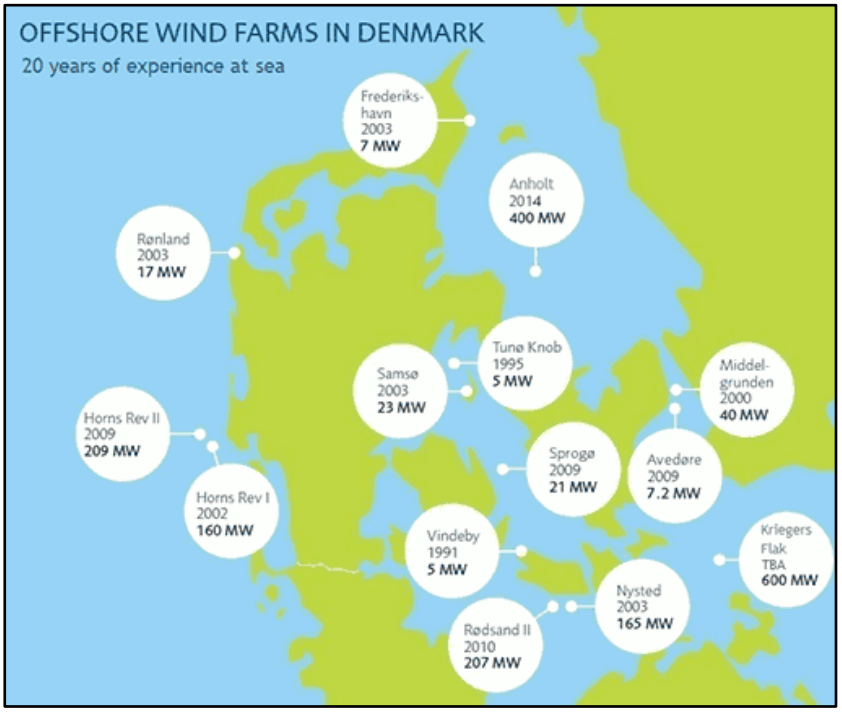
2.2 Country profile: Denmark

When taking into account the current tendencies of the offshore wind farm development in the Baltic Sea Region with a special emphasis on Germany, Denmark, Sweden and Lithuania, Denmark appears to take a leading position in the offshore wind farm development in the Baltic Sea Region, since it has 9 operating wind farms (installed capacity of 487 MW) and 6 offshore projects in different development stages[13]. The overview of the offshore wind farms in Denmark is

[11] Source: Ibid., p. 2.
[12] Ibid., p. 2.
[13] Sustainable Energy and Transportation Systems, in EcoRegion Perspectives, 5th issue, 2011, http://baltic-ecoregion.eu/downloads/1_PerspectivesEnergy_and_Transportwebsite_version.pdf, retrieved on 13.02.2012, pp. 35-36.

presented in the figure below.

Figure 3: Current and future offshore wind farms in Denmark[14]



In 1991, the first offshore wind farm was established in Vindeby and followed by numerous offshore wind farms. In 1997, the Danish Energy Agency published its Offshore Wind Turbine Action Plan that was updated in 2007 with a result to create high wind areas up to 4.600 MW which would cover the entire domestic electricity consumption and even more[15].

From the legislative and administrative perspective, Denmark is using a "one-stop shop" approach, i. e. a project owner who wants to launch an offshore wind turbine project only has to deal with one body, namely, the Danish Energy Authority (DEA). Therefore, the Danish model has led to a quick, cost-effective process. Besides, the DEA involves other relevant authorities, arranges consultations with the relevant

[14] Source: Wind energy regions: Denmark. 20 years of experience at sea, http://www.southbaltic-offshore.eu/regions-denmark.html, retrieved on 17.02.2012.
[15] Denmark – Wind Power Hub, 2011, http://www.e-pages.dk/windpower/21/fullpdf/full4f474e0d4685d.pdf, retrieved on 24.02.2012.

stakeholders as well as issues approvals and licenses necessary[16].

2.3 Country profile: Sweden

In terms of offshore wind farm-related policies, Sweden does not have any explicit policy promoting offshore wind energy development but a kind of certification system for all renewable energy-related projects. So far Sweden has established six offshore wind farms. Five of these are operated by Vattenfall. Most of the current offshore wind farms in Sweden are within area of 10 km from the coast and relatively small. As the largest one is considered Siemens Liligrund that went online in 2008 and has a total capacity of 110 MW from 48 turbines. In 2011, Eon Nordic announced its plan to set up one of the largest offshore wind farm in the world. It should be located approximately 100 km from the South-eastern coast of Sweden, in Södra Midsjöbanken, and equipped with 180-230 wind turbines with a total capacity of 700 MW. Nevertheless, although essential offshore wind energy projects are under development or already implemented, the drawback associated with the offshore wind energy development is one that establishment of offshore wind farms is subject to much more costs than the establishment of onshore ones, especially when taking into account enough land that Sweden has[17].

2.4 Country profile: Lithuania

The wind energy started to be developed in Klaipeda region. Since 2002, there are more than 153 MW of wind power installed onshore. The development of the offshore wind energy appears to be far behind the onshore one. However, from 2006 there have been mapped several prospects to enhance the existing onshore wind energy sector by the offshore wind farms thus contributing to the development of independent energy market in Lithuania[18].

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[16] Sustainable Energy and Transportation Systems, in EcoRegion Perspectives, 5th issue, 2011, http://baltic-ecoregion.eu/downloads/1_PerspectivesEnergy_and_Transportwebsite_version.pdf, retrieved on 13.02.2012, pp. 35-36.

[17].Eon plans 700 MW wind farm in Baltic, http://www.renewablesinternational.net/eon-plans-700-mw-wind-farm-in-baltic/150/505/32807/, retrieved on 16.02.2012.

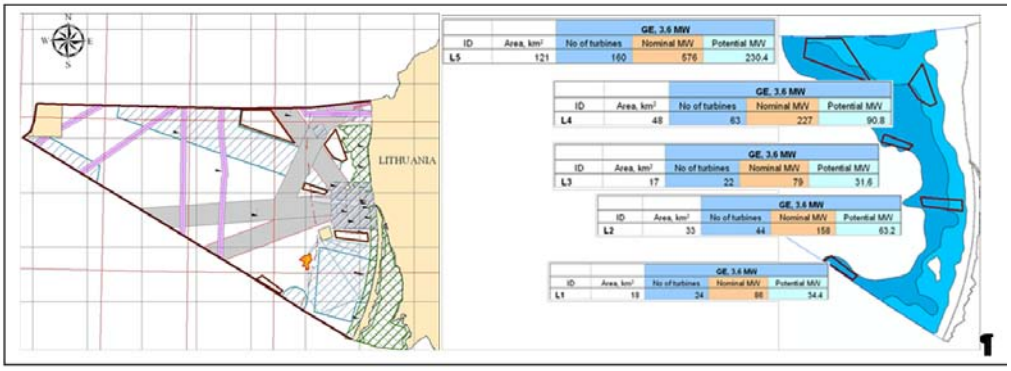
[18] Offshore Wind Energy in Lithuania, http://www.southbaltic-offshore.eu/regions-lithuania.html, retrieved on 16.02.2012.

Nevertheless, as compared to other BSR countries highly employing wind energy-related projects, Lithuania has not yet managed to finish any wind farm project. Reasons behind such a situation are numerous legislative, economic and / or infrastructural problems[19]. For instance, further development of wind farms is suspended due to environmental limitations, i. e. on-going project of new establishment of Natura 2000 protected areas, UNESCO status of cultural heritage of the Curonian Spit and coastal zone of the Baltic Sea etc., or legislative ones, as the State of Lithuania does not provide any order of support of offshore wind energy development[20]. Nevertheless, it has to be pointed out here that although Lithuania has neither operating nor authorised offshore wind farm projects, there are recorded 5 respective projects at a dormant stage that might be launched in the near future, when more favourable conditions will allow to give the green light to the project implementation[21]. Besides, by establishing offshore wind farms more than 1 GW or almost half of Lithuanian electricity demand could be covered[22].

Within the scope of the Interreg III A project POWER (2006-2008), there were made first attempts to examine potential for the establishment of the offshore wind farms in the Lithuanian EEZ. The result of investigations undertaken is the fixation of most optimal marine areas suitable for offshore wind energy development in Lithuania. According to the outputs gathered, there have been determined 5 proper marine areas depicted in the following figure as 5 plots with a red frame (left side). On the right side of the picture, the detailed information concerning the 5 potential marine areas in Lithuania for the offshore wind farms is presented.

[19] Sustainable Energy and Transportation Systems, in EcoRegion Perspectives, 5th issue, 2011, http://baltic-ecoregion.eu/downloads/1_PerspectivesEnergy_and_Transportwebsite_version.pdf, retrieved on 13.02.2012, p. 36.
[20] Study on possibilities of offshore wind power parks connection into power grid of Lithuania, 2008, http://www.corpi.ku.lt/power/doc/SSI_LT_grid_1_4_final.pdf, retrieved on 16.02.2012, p. 41.
[21] Sustainable Energy and Transportation Systems, in EcoRegion Perspectives, 5th issue, 2011, http://baltic-ecoregion.eu/downloads/1_PerspectivesEnergy_and_Transportwebsite_version.pdf, retrieved on 13.02.2012, p. 36.
[22] Offshore Wind Energy in Lithuania, http://www.southbaltic-offshore.eu/regions-lithuania.html, retrieved on 16.02.2012.

Figure 4: Potential areas for offshore wind farms in Lithuanian waters of the Baltic Sea[23]



3. Offshore wind farms-related challenges and potential risks

In terms of operational issues concerning the offshore wind farms, there are prevailing deliberations pointing to the potential risks associated with the offshore wind farms which, as contended by researchers, are resulting mainly from collisions between ships and offshore platforms the causes of which being release of hazardous substances. However, it has to be stressed that the increasing risk due to the growing utilisation of the areas available for the use of wind energy might be counteracted and reduced to a considerable extent, as the respective technologies are being constantly enhanced[24].

New navigation risks can be divided into four groups: risk of a ship colliding with or contacting a wind turbine or wind farm structure (1), risk of ship to ship collision resulting from change in navigation to avoid the wind farm area (2), grounding risks (3) and possible secondary risks deriving from effects of the wind farm on, for instance, radar operations[25].

[23] Source: Blažauskas, N. Dr., 2007, Perspectives of the offshore wind energy development in Lithuanian EEZ, POWER, http://corpi.ku.lt/power/conference.htm, retrieved on 16.02.2012.
[24] Dausendschön and Povel, Offshore Windparks – Wirksamkeit kollisionsverhindernder Maßnahmen: Abschlussbericht, 2008, http://www.offshore-stiftung.com/Offshore/195/61/94/60005/design1.html, retrieved on 03.02.2012, p. 5.
[25] Hansen, H. S., 2011. Obstacles for wind energy development due to EU legislation, http://www.southbaltic-offshore.eu/news/imgs-media/Legal_obstacles_for_wind_energy_due_to_EU_legislation_HSH_December_2011.pdf, retrieved on 16.02.2012, pp. 5-6.

As pointed out by Bethke, possible ship collisions are associated with the risk of human safety (e. g. impact on crew of ships or people in wind farms, risk of environmental impacts (oil spill, chemical spill etc.) and large economical costs and risk of power production loss of wind turbine / farm or even of wind turbine. Furthermore, Bethke differentiates between negative and positive impacts of offshore wind farms on shipping. The negative ones include, for example, number of obstructions, as the traffic is forced on shipping lanes. Due to establishment of wind farms, existing shipping lanes might have to be moved and the crew may not notice risk of collision. Additionally, new wind farms may generate longer routes and higher traffic density caused by compression of the shipping lanes. As positive impacts clear traffic rules, landmarks for orientation have been emphasised. Nevertheless, by drawing on respective scientific reports and discussions the allocation of the impacts to the positive or negative ones tends to be highly debatable[26].

Furthermore, ship-wind turbine collisions presuppose high potential costs that might be ascribed to the main three areas, namely, property, life and environment. Consequently, within the area of property, cost of repair, total loss, damage or loss of cargo, el. power production, delay, temporary replacement, salvage, search and rescue can be mentioned. Environment-related costs imply cost of clean-up and compensation of business losses, for instance, in fishing or tourism sector etc.[27]

4. Identifying future perspectives

As pointed out above, several factors are essential for the development and strengthening of the offshore wind energy market. One of the best practices that can be transferred to the BSR offshore wind energy market appears to be comprehensive offshore wind farm supply chain applicable for the North Sea. As exemplified, the offshore wind farm supply chain in case of the North Sea is concentrated in the port of Bremerhaven, where several industrial entities

[26] T. Bethke, 2005, Risk Analysis of Ship-Offshore Wind Farm Collisions: Focus on potential noxious emissions, http://www.dmkn.de/downloads/2e/1e/i_file_51481/InWaterTec2005_Bethke.pdf, retrieved on 28.02.2012.
[27] Ibid.

manufacturing different components for the offshore wind farms are located as well. Here, the location of these particular industrial entities close to the port is crucial, as it makes construction of wind farms faster and more efficient. As a result, this good practice utilised in the North Sea offshore wind energy market might be transferred to the one in the BSR.

Beyond this, establishment of the transnational offshore grid represents one of the common challenges for the offshore wind energy sector in the BSR. As a result, it would accelerate the process of the regional energy market integration leading towards grid access to offshore farms, balance the variability of their output on the market and improve the ability to trade electricity among countries. Some proposals concerning the offshore grid connections have been already generated, for instance, the connection between Germany, Denmark and Sweden via a joint wind farm (Kriegers Flak) or the new connection between Sweden and Lithuania (NordBalt)[28].

5. Summary

The discussion above revealed that the Baltic Sea Region brings with it a considerable potential to develop the offshore wind energy market and expand the utilisation of offshore wind farms. As has been mapped within diverse discourses, infrastructural and technical prerequisites, e. g. experiences in establishment of offshore wind farms, know-how in developing offshore infrastructure and facilities or necessary environmental preconditions are available. Furthermore, due to the proximity of future offshore wind farms the integration of the energy market within the region, better interconnectedness as well as coverage of electricity consumption and supply become possible. Besides, the development of the BSR offshore wind energy market might be fostered by bearing on good practices accumulated in the North Sea.

Offshore wind energy-related discrepancies prevail, however, when scrutinising the

[28] Sustainable Energy and Transportation Systems, in EcoRegion Perspectives, 5th issue, 2011, http://baltic-ecoregion.eu/downloads/1_PerspectivesEnergy_and_Transportwebsite_version.pdf, retrieved on 13.02.2012, p. 37.

countries in question separately. By drawing on the offshore wind energy tendencies represented by individual countries within the Baltic Sea Region Germany, Denmark, Sweden and Lithuania, it is clear that Denmark takes a leading position in terms of development of the offshore wind energy market and is followed by Germany and Sweden. In contrast to these particular regions, Lithuania appears to lag far behind in terms of development, although the potential has been recognised. From the regional profile generated it becomes evident that the wind energy sector has to be fostered not only by scientific and private actors but to gain attention within political array. Therefore, the development of the offshore wind farms in the Lithuanian waters of the Baltic Sea presupposes, primarily, political actions and state assistance.

Beyond this, environmental issues seem to hamper the expansion of the offshore wind farms in the BSR due to existing / planned protected areas or heritage cultural sites as well as individual national priorities or relocation of them thus jeopardising the offshore wind energy sector development.

The main drawback, however, lies in the fact that BSR countries used to focus on the offshore-wind related initiatives individually. In this light, experiences gained can be more or less ascribed to one or two countries concerned. As a result, joint action approaches leading towards strengthening of the Baltic Sea Region's competitiveness in terms of the offshore wind energy sector within European and global markets are of vital importance.

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