

D6.1 SURVEY OF PLANS FOR DEVELOPMENT OF OFFSHORE WIND POWER IN THE NORDIC REGION

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Terminology

1 Introduction

This report is related to Nordic research project on cooperation agreement under the Nordic Energy Research, “DC grids for integration of large scale wind power” (OffshoreDC). The project work package 6 concerns “Feasibility study of offshore grids in the Nordic region”, for which the *most probable future scenarios and cases foreseen most beneficial for the whole Nordic power system to be investigated* are to be defined. This report provides information and data needed in the project about the offshore wind power development up to year 2030.

The main source of information is the Twenties project presentation [1] and report (NOT PUBLISHED YET) concerning offshore wind power development plans and wind farm locations as well as different wind power scenarios. Other sources are also taken into account to improve scenarios and to keep scope whole Nordic region [2]-[16]. The countries relevant and looked at are especially the Nordic countries, Denmark, Finland, Norway and Sweden, as well as the countries/areas around the North Sea and Baltic Sea, United Kingdom, the Netherlands, Germany, Poland, Lithuanian, Latvia, Estonia and Russia.

The actual wind farm capacities and locations are required information for the project work package 6, and thus this information is included in this report when available.

2 Twenties project review

The latest Twenties report draft of offshore interconnectors is from spring 2012. This forms the base data for this chapter. The Twenties report categorizes the plans into two scenarios, baseline and high scenario, for two target years, 2020 and 2030. The baseline scenario is the scenario most-likely to happen, and the high scenario is an optimistic offshore wind power development scenario. Approximate installed offshore wind power capacity is 40 GW in the baseline scenario and 56 GW in the high scenario by 2020. By 2030 installed offshore wind power capacity could be 114 GW in the baseline scenario and 141 GW in the high scenario. Figure 1 shows the country-wise estimates for European offshore wind power capacity in 2020 and 2030 [1]. These figures were compared to the EWEA estimates and are in good accordance with each other [1].

Scenarios

Country	MW installed end 2020		MW installed end 2030	
	Baseline	High	Baseline	High
Belgium	2,156	2,156	3,956	3,956
Denmark	2,811	3,211	4,611	5,811
Estonia	0	0	1,695	1,695
Finland	846	1,446	3,833	4,933
France	3,275	3,935	5,650	7,035
Germany	8,805	12,999	24,063	31,702
Ireland	1,155	2,119	3,480	4,219
Latvia	0	0	1,100	1,100
Lithuania	0	0	1,000	1,000
Netherlands	5,298	6,298	13,294	16,794
Norway	415	1,020	3,215	5,540
Poland	500	500	500	500
Russia	0	0	500	500
Sweden	1,699	3,129	6,865	8,215
UK	13,711	19,381	39,901	48,071
TOTAL	40,671	56,194	113,663	141,071

Figure 1 Offshore wind farm scenarios. [1]

Figure 2 shows offshore wind power development plans both for the North Sea and the Baltic Sea. North Sea area includes UK, Norway, Denmark, Germany, Netherlands, France and Belgium. Part of UK offshore wind farm projects and all Ireland OWF projects are designed to Irish Sea and those usually are mentioned with North Sea projects. Baltic Sea area includes Sweden, Finland, Estonia, Latvia, Lithuania, Poland, Russia, Germany and Denmark.

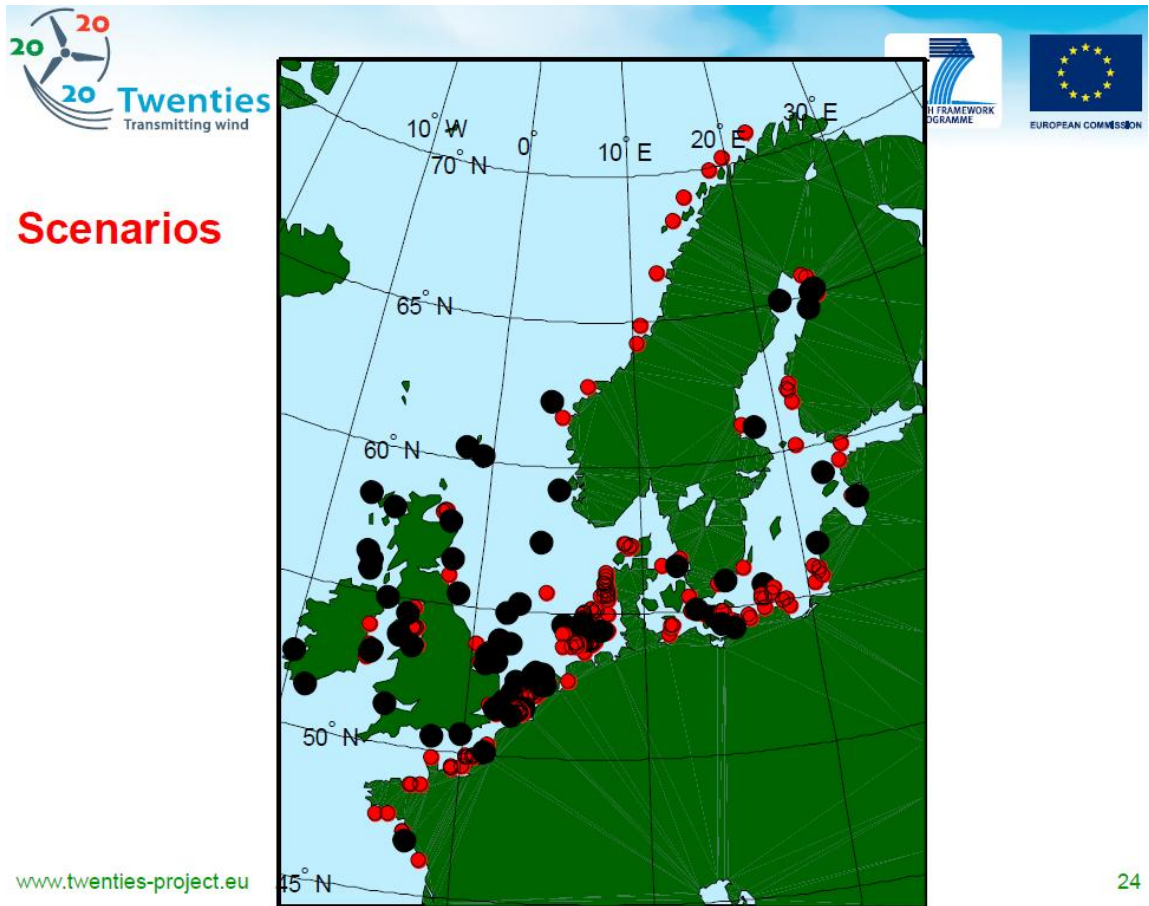


Figure 2 Offshore wind farm scenarios from Twenties for 2020 (red) and 2030 (red+black). [1]

2.1 Nordic region

Ten countries have possibility to install offshore wind farms on the Baltic Sea area. The individual wind farm projects with capacity and coordinates are listed below on tables for each country for both scenarios. 0/1 in column “By 2020” tells if the wind farm is estimated to be in operation by 2020 (1 yes). Otherwise (0 no) the wind farm is assumed to be in operation by 2030.

Finland

Table 1

Country	Scenario [MW]		Coordinates		By 2020
	Base	High	Lat	Lon	
Finland					y/n
Oulun - Haukiputaan alue 1	100	150	65,219	24,994	1
Pori 1	3	3	61,624	21,325	1
Pori 2	90	160	61,639	21,332	1
Kemi Ajos Test Turbine	3	3	65,638	24,524	1
Kemi Ajos I & II	30	30	65,655	24,513	1
Kristinestad	230	400	62,238	21,226	1
Suurhiekkä	288	400	65,292	24,651	1
Kemi Ajos III	120	230	65,619	24,552	1
Tornio	54	225	65,739	24,237	0
Oulunsalo - Hailuoto	130	180	65,012	25,131	0
Raahë - Maanahkiainen	300	500	64,595	24,145	0

Oulun - Haukiputaan alue 2	400	650	65,179	24,954	0
Inkoon - Raaseporin	180	300	59,859	23,888	0
Raahe - Pertunmatala	48	72	64,753	24,272	0
Raahe - Ulkonahkiainen	140	210	64,795	24,445	0
Ostra Skargaarden	105	120	60,134	20,889	0
Siipyy	240	400	62,075	21,12	0
Korsnäs	600	800	62,6607	20,932	0
Total	3061	4833			

Sweden

Table 2

Country	Scenario [MW]		Coordinates		By 2020
	Base	High	Lat	Lon	y/n
Stora Middelgrund	540	540	56,607	12,113	1
Petlandsskar	90	90	63,547	20,335	1
Yttre Stengrund	10	10	56,167	16,021	1
Kriegers Flak 2	640	640	55,07	13,103	1
Storgrundet	265	265	61,145	17,464	1
Klocktarnan	660	660	65,07	22,03	1
Bockstigen	3	3	57,036	18,15	1
Utgrunden I	11	11	56,344	16,28	1
Lillgrund	110	110	55,511	12,779	1
Kaarehamn	0	50	56,984	17,022	1
Skottarevsprojektet	150	150	56,824	12,346	1
Trolleboda	180	180	56,298	16,176	1
Taggen Vindpark	300	300	55,862	14,566	1
Seawind Lake Vanern	90	90	59,223	13,307	1
Vindpark Vanern	30	30	59,262	13,387	1
Finngrunden	1500	1500	60,997	18,24	0
Soedra Midsjoebanken	700	1000	55,672	17,267	0
Utgrunden II	86	86	56,375	16,266	0
Blekinge Offshore AB	1500	2500	55,932	15,021	0
Total	6865	8215			

Norway

Norway OWF projects are planned to be installed in North Sea and not to Baltic Sea.

Denmark

Total 19 OWF projects and ten of these are operating or waiting commissioning. Three are in Kattegat, four are parts of Kriegers Flak, and two projects near Bornholm island.

Table 3

Country	Scenario [MW]		Coordinates		By 2020
	Base	High	Lat	Lon	y/n
Denmark					

Anholt	400	400	56,604	11,209	1
Avedøre Holme	11	11	55,601	12,464	1
Frederikshavn	11	11	57,443	10,562	1
Kriegers Flak A K2	200	200	55,05	12,984	1
Kriegers Flak A K3	200	200	54,994	12,822	1
Kriegers Flak A K4	200	200	55,005	13,068	1
Kriegers Flak B K1	200	200	55,077	12,874	1
Middelgrunden	40	40	55,689	12,668	1
NearshoreLAB	36	36	57,457	10,637	1
Nysted (Rødsand 1)	166	166	54,549	11,714	1
Rødsand 2	207	207	54,555	11,548	1
Samsø	23	23	55,723	10,584	1
Sprogø	21	21	55,343	10,958	1
Store Middelgrund MG1	200	200	56,5	12,095	1
Tunø Knob	5	5	55,968	10,355	1
Vindeby	5	5	54,969	11,129	1
Århus Bugt	100	100	56	10,48	1
Rønne Banke RB1	200	200	54,891	14,749	0
Rønne Banke RB2	200	200	54,927	14,653	0
Total	2425	2425			

2.2 Baltic countries

Estonia

Estonia has four OWF sites planned.

Table 4

Country	Scenario [MW]		Coordinates		By 2020
	Base	High	Lat	Lon	y/n
Estonia					
Hiumaa	700	700	59,084	22,282	0
Neugrund	190	190	59,319	23,551	0
Kihnu South	560	560	58,001	24,034	0
Kihnu SouthWest	245	245	58,063	23,703	0
Total	1695	1695			

Latvia

Latvia has only two planned OWF sites with a dormant status. Those are waiting legislation for the offshore areas.

Table 5

Country	Scenario [MW]		Coordinates		By 2020
	Base	High	Lat	Lon	y/n
Latvia					
Liepaja	900	900	56,732	20,947	0
Baltic Wind Park	200	200	56,82	20,771	0

Total	1100	1100			
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Lithuania

Lithuania has five OWF sites planned.

Table 6

Country	Scenario [MW]		Coordinates		By 2020
	Base	High	Lat	Lon	y/n
L1	200	200	55,984	20,443	0
L2	200	200	55,907	20,86	0
L3	200	200	55,771	20,773	0
L4	200	200	55,617	20,95	0
L5	200	200	55,457	20,471	0
Total	1000	1000			

2.3 Eastern middle Europe: Poland, part of Germany and Kaliningrad region (Russia)

Germany

Table 7

Country	Scenario [MW]		Coordinates		By 2020
	Base	High	Lat	Lon	y/n
Wikinger	400	400	54,834	14,068	1
Arkona-Becken SO	400	400	54,782	14,121	1
Breitling	3	3	54,161	12,131	1
Beltsee	125	125	54,438	11,508	1
GEOFRéE	25	25	54,249	11,397	1
Strom-Nord	0	270	54,874	13,852	1
EnBW Baltic 2	288	288	54,982	13,162	1
EnBW Baltic 1	48	48	54,609	12,651	1
Strom-Nord	270	270	54,874	13,852	0
Arcadis Ost 1	350	350	54,833	13,595	0
Adlergrund 500	72	72	54,818	14,095	0
Adlergrund GAP	186	186	54,822	14,129	0
Arkona-Becken SO	500	500	54,782	14,121	0
Seewind	150	150	54,96	13,194	0
Beta Baltic	115	115	54,277	11,403	0
Adlergrund Nordkap	155	155	54,849	14,062	0
Baltic Power	480	480	54,967	13,221	0
Arkona See Sud	0	200	54,78	13,868	0
Baltic Eagle	0	480	54,828	13,865	0
Total	3567	4517			

Poland

There are four potential offshore wind farm zones in Baltic Sea near coast of Poland. Technical wind power potential within designated wind power zones is approximately 35 GW, but accounting for some economic constraints the potential is around 20 GW [10]. These can be seen from a map developed by the Maritime Institute in Gdańsk [9]. Total count of 109 offshore wind farm sites with a total area of 2503.45 km² were designated [10]. The offshore wind farm zones are [10]:

- Vicinity of Ławica Odrzańska – 25 sites, 637.98 km², average distance to shore is approximately 80 km
- Ławica Środkowa – 22 sites, 501.61 km², average distance to shore is approximately 45 km
- Żarnowiec – 12 sites, 284.22 km², average distance to shore is approximately 40 km
- Ławica Słupska – 50 sites, 1079.64 km², average distance to shore is approximately 35 km

Non-withstanding the designated zones, the Twenties report includes 500 MW of offshore wind power in 2020 and 2030 as there is considerable uncertainty in the realisation of the projects.

Table 8.

Country	Scenario [MW]		Coordinates		By 2020
	Base	High	Lat	Lon	
Poland					y/n
P4 a	500	500	54.5	14.5	1
P1	600	600	54.3	15.3	0
P2	300	300	54.55	16.3	0
P3	300	300	54.7	16.15	0
P4 b	300	300	54.5	15.5	0
P5	300	300	54.6	15.2	0
P6	300	300	55.2	17.1	0
P7	300	300	54.9	17.2	0
P8	300	300	55	18.3	0
P9	300	300	54.8	18.75	0
P10	300	300	54.9	18.9	0
P11	300	300	55.05	18.5	0
P23	300	300	55.2	17.3	0
P24	300	300	55.3	17.8	0
P25	300	300	55.5	17.9	0
P26	300	300	55.3	17.1	0
Total	5300	5300			

Russia (Kaliningrad region)

Russia has two OWF projects near Kaliningrad, but the status for both of them is dormant [2]. Russia has own separate synchronous system (RU) and it is excluded from the ENTSO-E Regional Plan Baltic Sea report.

3 NREAPs scenarios

National renewable energy action plan NREAP has targets by year 2020, which are compared against the Twenties estimates in Table 9. For Germany the figures contain all potential onshore and offshore projects. To create a scenario for the Baltic Sea area, the projects from the North Sea have to be separated from those in Baltic Sea. According to the Twenties report approximately 14 % of all Germany's potential offshore wind power plant projects are placed in Baltic Sea area.

Table 9. Comparison to 2020 NREAPs of the Baltic Sea countries.

By year 2020	Onshore [MW]	Offshore [MW]	Total [MW]	Difference to Twenties report [MW]
Denmark	2621	1339	3960	¹
Estonia	400	250	650	250
Finland	2500	0	2500	-864
Germany	35000	3000	38000	i)
Latvia	236	180	416	180
Lithuania	500	0	500	0
Poland	6150	500	6650	0
Sweden	4365	182	4547	-2897
Total	51772	5451	57223	

i) Denmark and Germany have offshore wind farm projects in North Sea and in Baltic Sea. NREAP figures do not differentiate between the Sea areas and hence the comparison cannot be made.

According to Twenties project Germany could have 8000...13000 MW offshore wind farm capacity potential by 2020. Germany has around 100 potential offshore wind farm projects and large scale planning and building has started with Alpha Ventus and EnBW Baltic 1 projects. There are many uncertainties in how fast new projects are activated and could be connected to the transmission grid.

According to Twenties project Denmark could have 2800...3200 MW offshore wind farm potential capacity by 2020.

In the NREAP scenario e.g. Finland does not have any offshore wind farm capacity by 2020. Sweden has almost the same offshore wind farm capacity by 2020 as in the end of the year 2011.

4 Mapping the Twenties baseline offshore wind farms in the Baltic Sea

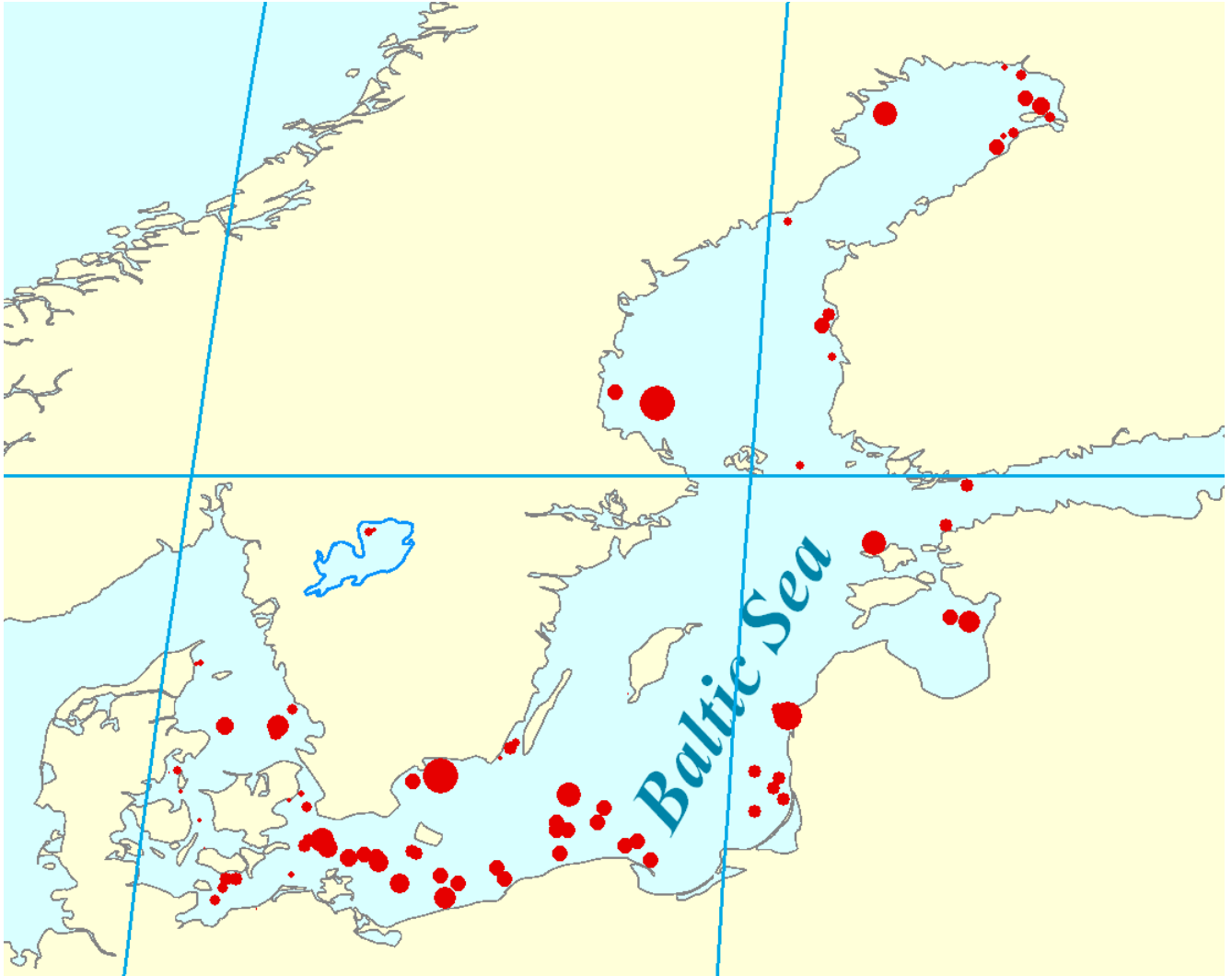


Figure 3 Potential Offshore wind power plants in Baltic Sea area (circle size refers to wind farm size) from the Twenties Base scenario for 2030 [1]. Polish projects are according to the table in the Twenties report and they add up to much more than the 500 MW in the Figure 1.

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