CHAPTER 1

OFFSHORE RENEWABLE ENERGY DEVELOPMENT IN THE BELGIAN PART OF THE NORTH SEA

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Abstract

By the end of 2020, with the completion of the Northwester 2 and Seamade projects, an installed capacity of 2.26 Gigawatt (GW), consisting of 394 offshore wind turbines, will be operational in the Belgian part of the North Sea (BPNS). They are expected to produce an average of 8 TWh annually, which is around 10% of total national electricity demand. Although no new projects are scheduled in the next few years, long term developments include an additional zone for 2 GW of offshore wind energy which has been identified in the new marine spatial plan.

With 523 km² reserved and planned for offshore wind farms in Belgium, 344 km² in the adjacent Dutch Borssele zone, and 122 km² in the French Dunkerque zone, cumulative ecological impacts are likely to form a major concern in the coming years. These anticipated impacts, both positive and negative, triggered an environmental monitoring program focusing on various aspects of the marine ecosystem, but also on the human appreciation of offshore wind farms. This introductory chapter provides an overview of the status of offshore renewable energy development in the BPNS.

1. Offshore wind energy development in Belgium

With the Royal Decree of 17 May 2004, a 264 km² area within the BPNS was reserved for the production of electricity from water, currents or wind. It is located between two major shipping routes: the north and south traffic separation schemes. In 2011, the zone was adjusted on its Northern and Southern side in order to ensure safe shipping traffic in the vicinity of the wind farms. After this adjustment the total surface of the area amounted to 238 km² (fig. 1). A second area of 285 km² is reserved in the marine spatial plan that came in force on 20 March 2020.

The European Directive 2009/28/EC, on the promotion of electricity produced from renewable energy sources in the internal electricity market, imposes a target figure for the contribution of the production of electricity from renewable energy sources upon each Member State. For Belgium, this target figure is 13% of the total energy consumption, which must be achieved by the end of 2020. Offshore wind farms in the BPNS will make an important contribution to that goal.

On 31 December 2019, Belgium submitted a National Energy and Climate Plan to

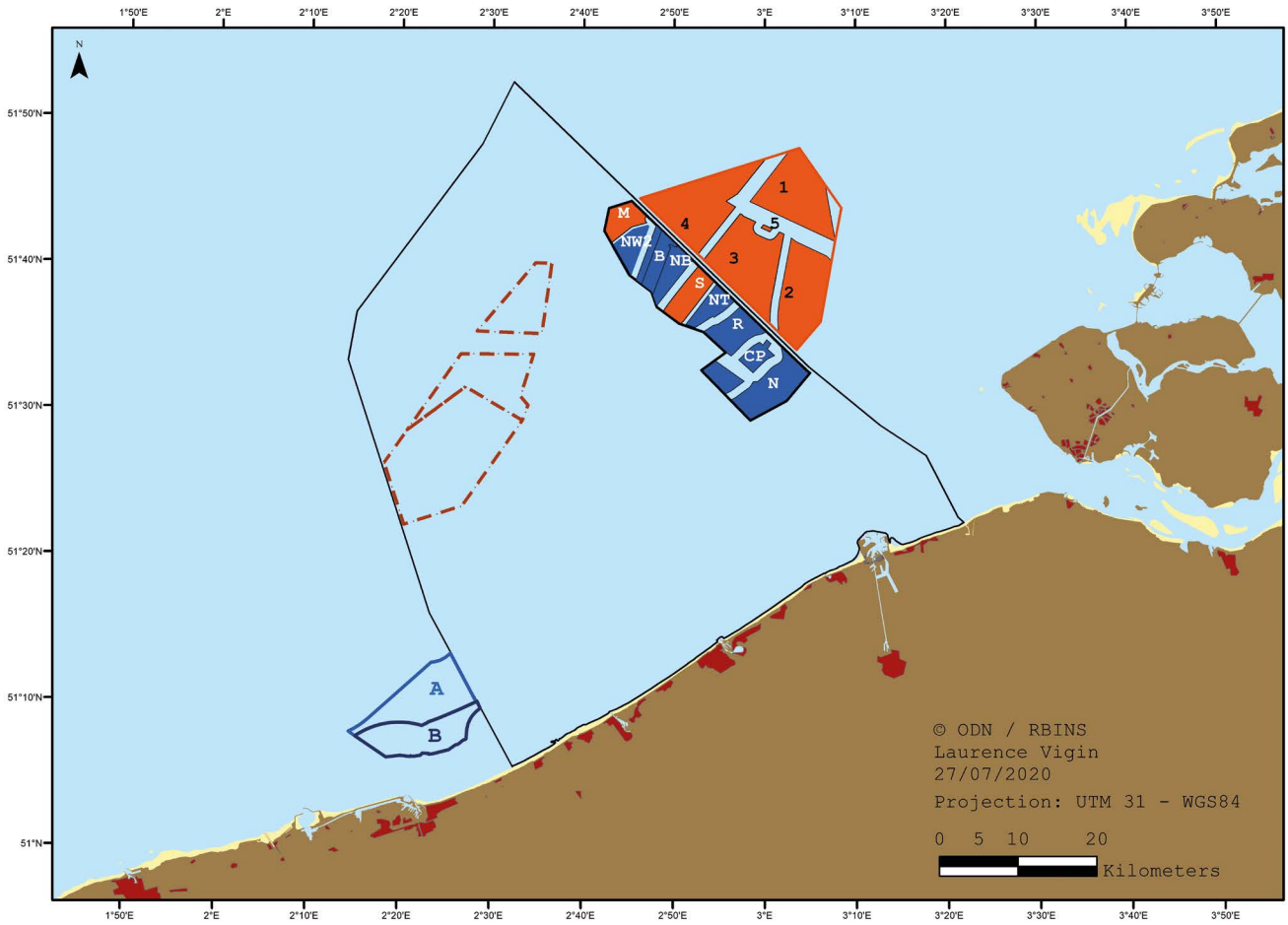

Figure 1. Current and planned zones for renewable energy in and around the Belgian Part of the North Sea with indications of wind farms that are operational (blue) or currently under construction (orange). N: Norther, CP: C-Power, R: Rentel, NT: Northwind, S: Seamade - former Seastar zone, NB: Nobelwind, B: Belwind, NW2: Northwester 2, M: Seamade - former Mermaid zone, 1-5: Borssele wind farm zones 1-5 (Netherlands), A-B: sites of proposed Dunkerque offshore wind farm (France). Dashed lines: locations of the new renewable energy zone as delimited in the marine spatial plan 2020-2026.

the European Commission which envisions a target figure of 17.5% for the contribution of the production of electricity from renewable energy sources by 2030. This plan anticipates 4 GW of operational offshore wind.

Prior to installing a renewable energy project, a developer must obtain (1) a domain concession and (2) an environmental permit. Without an environmental permit, a project developer is not allowed to build and exploit a wind farm, even if a domain concession was granted.

When a project developer applies for an environmental permit an administrative procedure, mandatory by law, starts. This procedure has several steps, including a public consultation during which the public and other stakeholders can express any comments or objections based on the environmental impact study (EIS) that is set up by the project developer. Later on, during the permit procedure, the Management Unit of the North Sea Mathematical Models (MUMM), a Scientific Service of the Operational Directorate Natural Environment (OD Nature) of the Royal Belgian Institute of Natural Sciences, gives advice on the acceptability of expected environmental impacts of the future project to the Minister responsible for the marine environment. MUMM's advice includes an environmental impact assessment, based on the EIS. The Minister then grants or denies the environmental permit in a duly motivated decree.

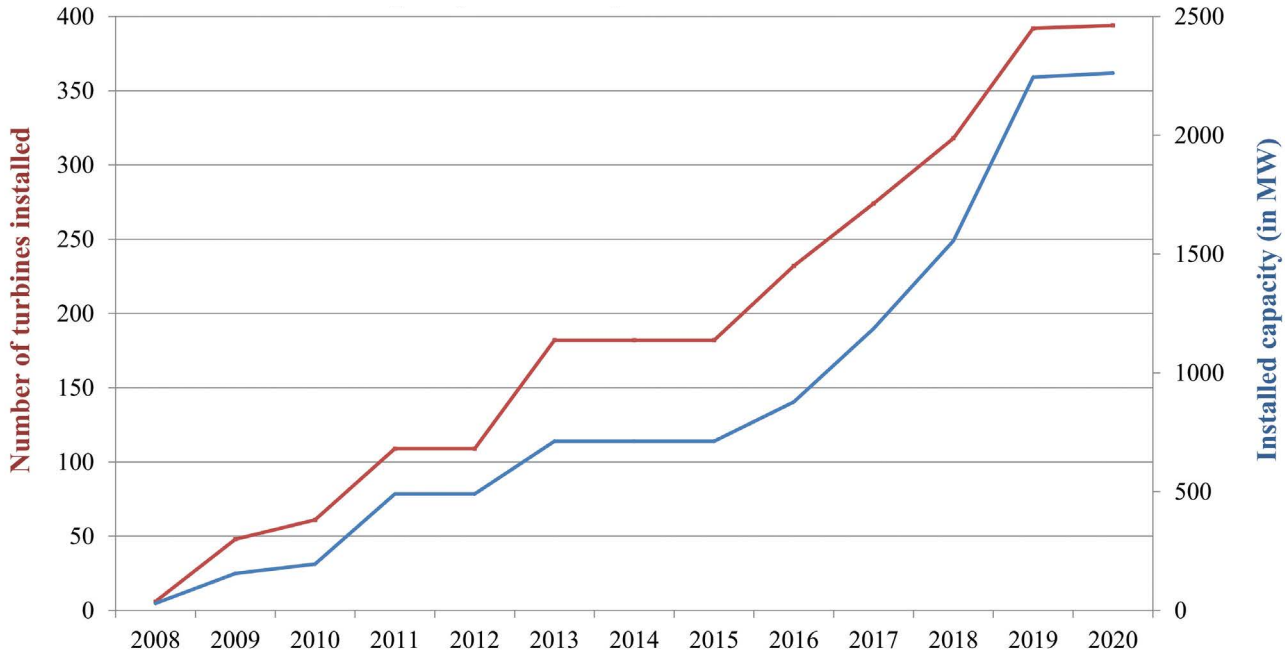

Figure 2. Number of offshore wind turbines installed and installed capacity in the Belgian part of the North Sea since 2008.

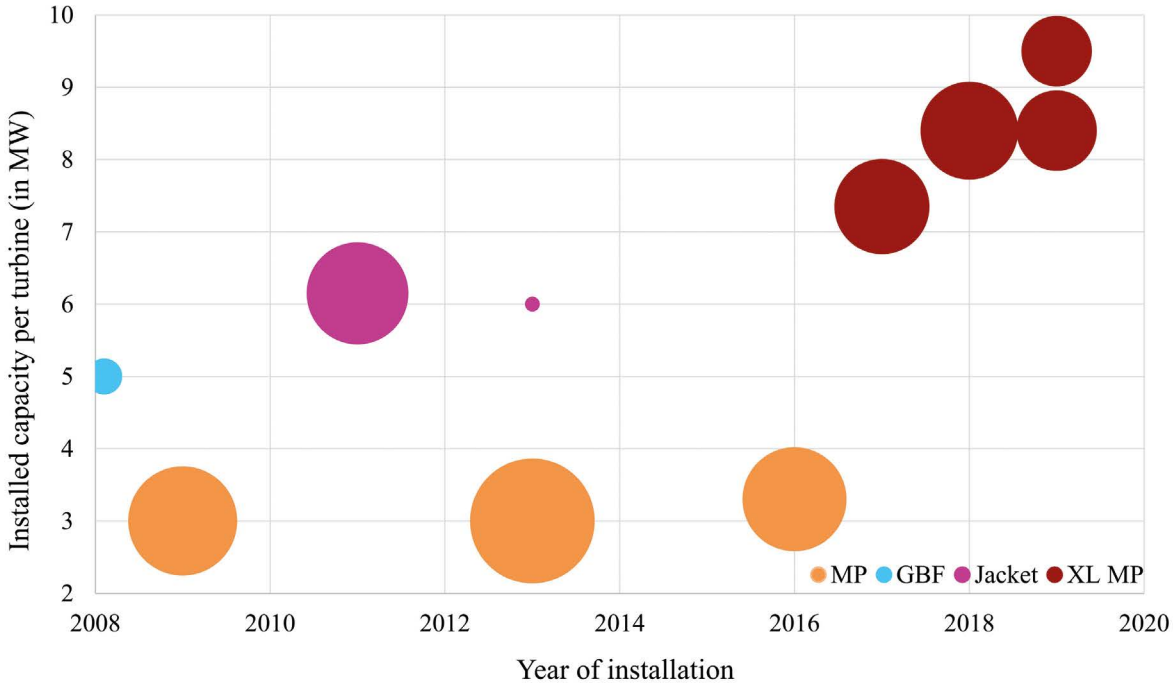

Figure 3. Overview of the timing, individual capacity and foundation type of offshore wind turbines installed in the Belgian part of the North Sea since 2008. The size of the bubbles is proportional to the number of turbines installed per project or phase (see table 1). MP: monopile foundation; GBF: gravity based foundation; Jacket: jacket foundation; XL MP: monopile foundations exceeding approx. 7 m in diameter.

At present, nine projects were granted a domain concession and an environmental permit (from South to North: Norther, C-Power, Rentel, Northwind, Seastar, Nobelwind, Belwind, Northwester 2 & Mermaid (table 1; fig. 1). On 20 July 2018, the merger between the Seastar and Mermaid projects was finalized and the resulting merged project was named Seamade NV. By the end of 2020, when all Belgian wind farms are built, there will be a little less than 400 operational wind turbines in the Belgian part of the North Sea (fig. 2). The entire first area will have a capacity of 2262 MW and can cover up to 10% of the total electricity needs of Belgium or nearly 50% of the electricity needs of all Belgian households. The capacity density of the first wind energy zone, defined as the ratio of the wind energy zone rated capacity to its ground area, is at 9.5 MW/km² among the highest in Europe which results in a higher levelized cost of electricity then other North Sea countries. The Belgian Offshore Platform, the association of investors and owners of wind farms in the BPNS, has recommended a density of 5 to 6 MW of installed capacity/km² for future developments in order to be able to realize maximum energy yields, and thereby reduce production costs. Over the last decade, installed capacity per turbine has gradually increased with extra-large monopiles (*i.e.* with a diameter larger than 7 m) becoming the dominant foundation type in our (shallow) waters (fig. 3).

The environmental permit includes a number of terms and conditions intended to minimize and/or mitigate the impact of the project on the marine ecosystem. Furthermore, as required by law, the permit imposes an environmental monitoring programme to assess the effects of the project on the marine environment. Based on the results of the monitoring programme, and recent scientific insights or technical developments, permit conditions can be adjusted.

2. Beyond 2020: the marine spatial plan 2020-2026

On 20 March 2020, the second marine spatial plan for the BPNS (Royal Decree of 22 May 2019 establishing the marine spatial planning for the period 2020 to 2026 in the Belgian sea-areas) came into force. This plan lays out principles, goals, objectives, a long-term vision and spatial policy choices for the management of the Belgian territorial sea and the Exclusive Economic Zone (EEZ) for the period 2020-2026. Management actions,

Table 1. Overview of wind farms in the Belgian part of the North Sea

Project		Number of turbines	Capacity (MW)	Total capacity (MW)	Status
C-Power	phase 1	6	5	325	Phase 1 operational since 2009
	phase 2 & 3	48	6.15		Phase 2 & 3 operational since 2013
Belwind	phase 1	55	3	171	Phase 1 operational since 2011
	Alstom Demo project	1	6		Demo turbine operational since 2013
Nobelwind		50	3.3	165	Operational since 2017
Northwind		72	3	216	Operational since 2014
Rentel		42	7.35	309	Operational since 2019
Norther		44	8.4	370	Operational since 2019
Northwester 2		23	9.5	219	Operational since May 2020
SeaMade		58	8.4	487	Operational by the end of 2020

Figure 4. The NEMOS Wave Energy Converter prototype at the site of the Blue Accelerator (photo NEMOS).

indicators and targets addressing marine protected areas and the management of human uses including commercial fishing, offshore aquaculture, offshore renewable energy, shipping, dredging, sand and gravel extraction, pipelines and cables, military activities, tourism and recreation, and scientific research are included. In this revision of the marine spatial plan, the Belgian federal government has delineated three new zones for renewable energy which cover a total area of 285 km² and are located at least 32 km from the coast (fig. 1). These new zones were named the Princess Elisabeth Zone and would be suitable for an additional 2 GW of installed capacity. Storage of energy and grid reinforcement (see below) continue to be major hindrances to the further integration of renewables into the electricity grid and locations are foreseen for reinforcing the offshore electricity grid.

This second Belgian zone for marine renewable energy is partly located inside a designated Natura 2000 area. A targeted research programme was designed in order to determine whether and how renewable energy development is compatible with the conservation objectives for this Natura 2000 area. This programme commenced in 2019 and is expected to last four years. The first results will become available for the 2021 monitoring report.

3. Wave energy in Belgium

Wave energy (or wave power) is the largest estimated global resource form of ocean energy. According to the World Energy Council (World Energy Council Netherlands 2017), the economically exploitable resource ranges from 140 to 750 TWh yr^{-1} for current designs of devices when fully mature and could rise

to levels as high as 2000 TWh yr^{-1} if all the potential improvements to existing devices are realized. Wave energy converters (WEC) have been developed to extract energy and can be deployed from the shoreline out to the deeper offshore waters. In order to stimulate the development of wave energy in Belgium, the Mermaid project obtained its domain concession license only on condition that a certain amount of energy would be generated from waves as well as from wind. However, wave energy developments have not reached the anticipated level of commercial deployment and although the environmental permit of the Mermaid (now Seamade) project allows for an installed capacity of 20 MW of WECs no actual WEC deployment is foreseen in the immediate future.

Test sites are an essential element of any emerging technology developments including wave energy extraction. One such test site, the maritime innovation and development platform Blue Accelerator, was constructed of the coast of Ostend in April 2019. Since October 2019, NEMOS GmbH has been testing and evaluating the performance and survivability of its complete NEMOS Wave Energy Convertor prototype at this site (fig. 4).

References

World Energy Council Netherlands. 2017. “Bringing North Sea energy ashore efficiently”. Tilburg, 59 p.