CHAPTER 1

OFFSHORE RENEWABLE ENERGY DEVELOPMENT IN THE BELGIAN PART OF THE NORTH SEA – 2021

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Abstract

With the completion of the Northwester 2 and Seamade projects in 2020, an installed capacity of 2.26 Gigawatt (GW), consisting of 399 offshore wind turbines, is 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 the total national electricity demand. An additional zone for 3.15 to 3.5 GW of offshore wind energy has been identified in the marine spatial plan 2020-2026. As "Blue Growth" matures to a sustainable blue economy, it has been tasked with ensuring the environmental sustainability of the natural capital of the oceans and seas (EU, 2021).

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 continue to be a major concern. These anticipated impacts, both positive and negative, triggered an environmental monitoring program focusing on various aspects of the marine ecosystem components, 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 March 20th, 2020.

The European Directive 2001/77/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 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 includes 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.

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 II & Mermaid (Table 1; Fig. 1). On July 20th 2018, the Seastar and Mermaid projects were

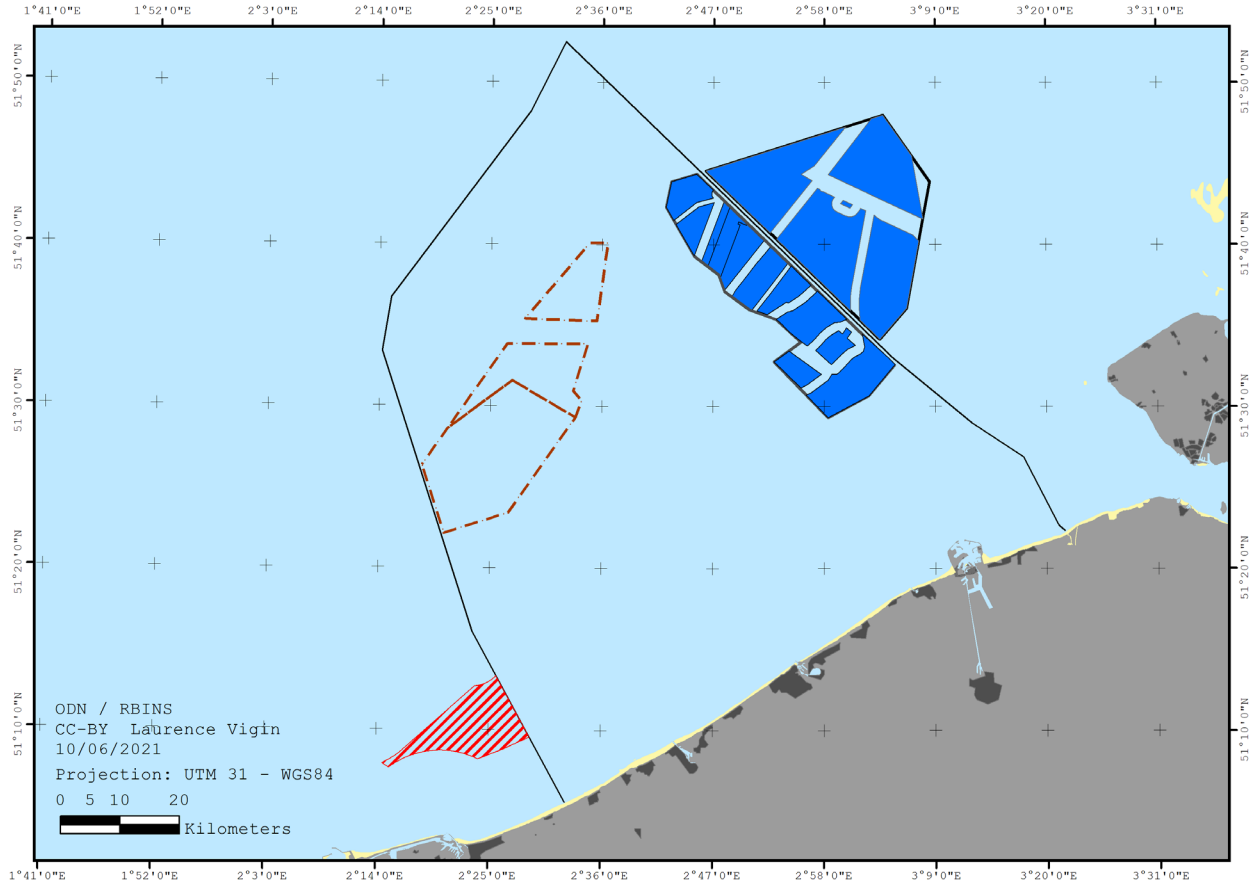

Figure 1. Current and planned zones for renewable energy in and around the Belgian Part of the North Sea with indications of wind farms that are operational (blue), the proposed Dunkerque offshore wind farm (shaded red area) and the new renewable energy zone as delimited in the marine spatial plan 2020-2026 (dashed lines).

merged and the resulting project was named Seamade NV. A little less than 400 wind turbines are operational in the Belgian part of the North Sea (Fig. 2). The entire first area has a capacity of 2.26 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 mitigate and/or minimize 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.

On 20 March 2020, the second marine spatial plan for the BPNS (Royal Decree of May 22nd, 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, indicators and targets addressing marine protected areas and the management of human uses including commercial fishing, offshore aquaculture, offshore renewable energy, shipping, dredging, sand

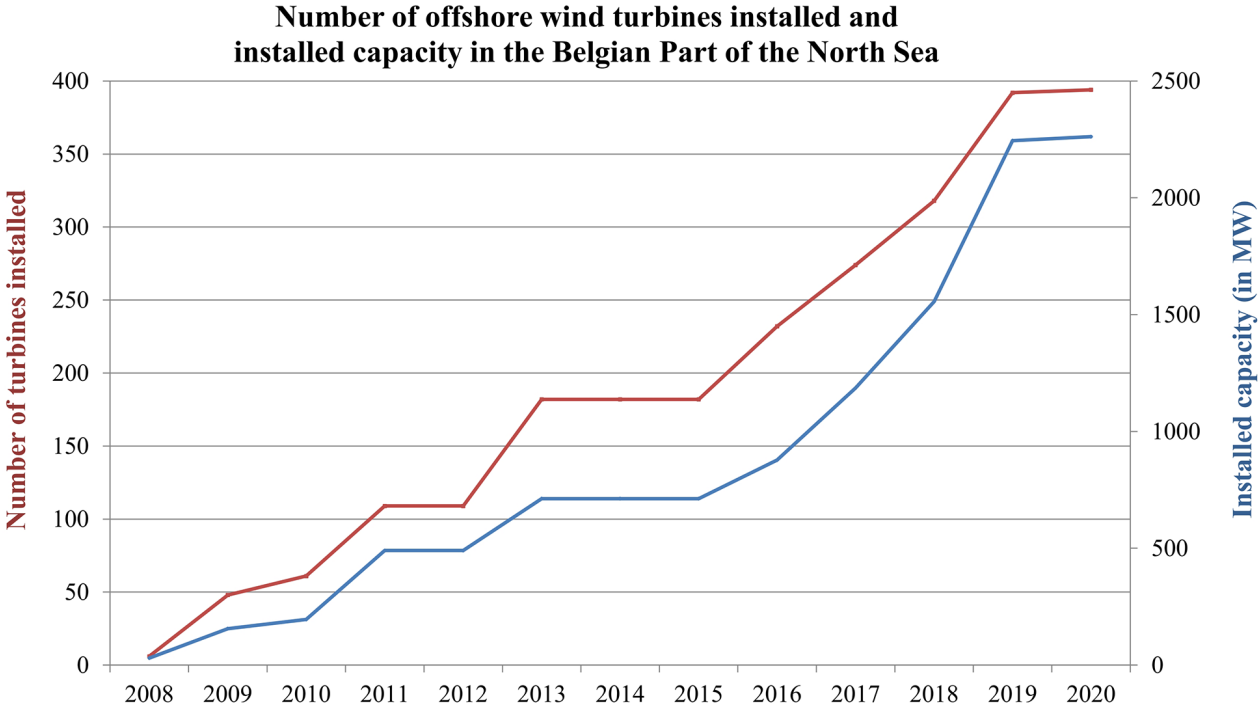

Figure 2. Number of offshore wind turbines installed and installed capacity in the Belgian Part of the North Sea since 2008.

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

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

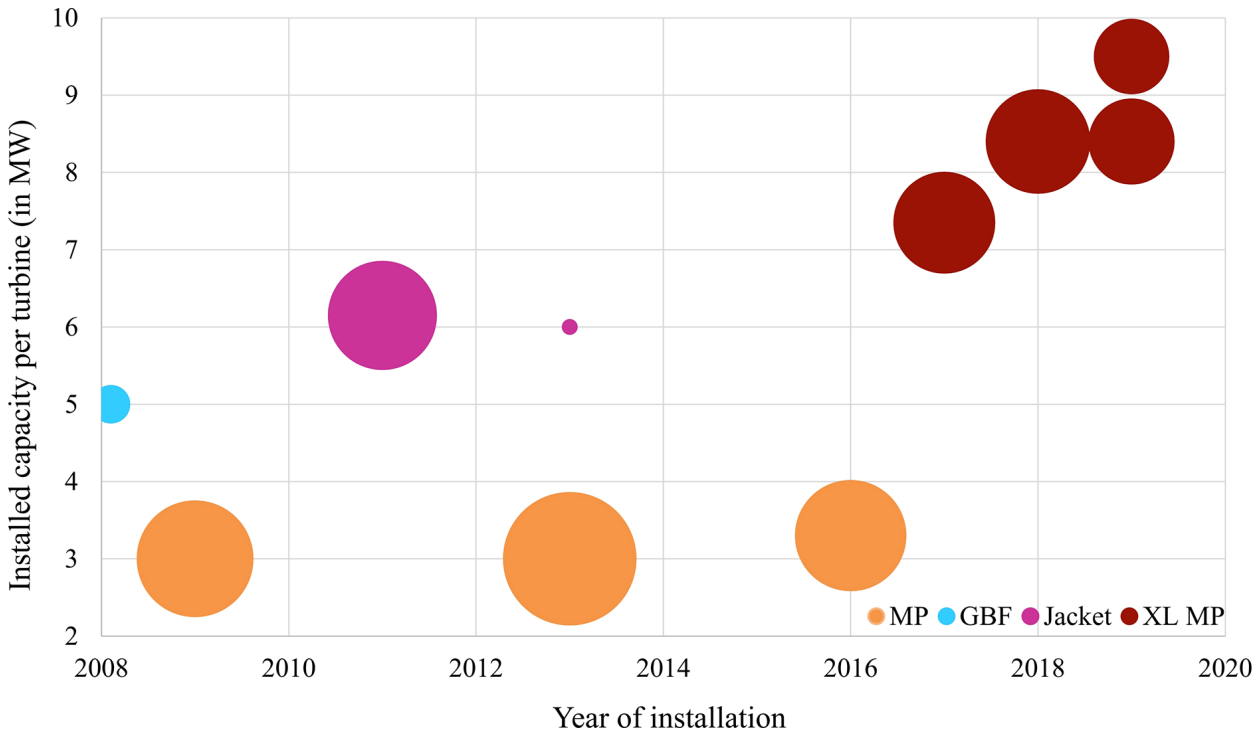

Figure 3. Overview of the timing, individual capacity and foundation type of offshore wind turbines installed in the Belgian Part of the North Sea since 2008. The size of the bubbles is proportional to the number of turbines installed per project of phase (see Table 1). Abbreviations: MP = monopile foundation;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

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 a second zone for renewable energy of 285 km² located at 35-40 km offshore (Fig. 1). This second zone would be suitable for an additional 3.15-3.5 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.

2. WinMon.BE outreach event

18th of May 2021, the WinMon.BE programme organized an outreach event to share and discuss results from the monitoring programme. This symposium was hosted as a side event of the 52nd Liège Colloquium on Ocean Dynamics (Towards an understanding and assessment of human impact on coastal marine environments, 17th–21st of May 2021). This session was targeted at scientists, industry, managers and policy makers. Because of the pandemic safety measures, the event was hosted online. 223 participants joined from 18 nationalities, representing research, industry, consulting, policy and environmental NGOs.

Lessons learned from the WinMon.BE programme were presented and followed by a panel discussion. The presentations addressed key features of the WinMon.BE philosophy, being the importance of long-term data collection, adaptive management and elucidating cause-effect relationships. During the discussion, which was titled 'WinMon.BE: ready for accommodating the future of OWFs?', special attention was paid to the science-management-policy nexus as how to best achieve an environment-friendly implementation and an ecosystem-based management of offshore renewables. The main topics of the questions to the panel and the presenters were the presence of plumes of suspended particulate matter (SPM) in the wake of turbines; the difference in the faunal community found on artificial hard substrates compared to natural gravel beds and how nature inclusive designs can contribute to the restoration of natural gravel beds (e.g., scour protection layers of future wind farms could be designed in such way that they resemble natural gravel bed habitat); organic enrichment of the soft sediment surrounding the turbines; the effects of piling and possible alternative techniques to install turbine foundations with less excessive underwater noise; multi-use of OWF areas (e.g., Belgian multi-use case study on offshore wind farms, nature conservation and (passive) aquaculture); the effects on seabird densities and possible habituation of seabirds to wind farms and the use of individual-based models to assess seabird effects.

3. Multi-use in Belgian offshore wind farms

Rapid development of offshore wind in the Southern North Sea has led to conflict with other maritime users (shipping, fisheries...) as historically these activities have been excluded from wind farms in order to minimize the risk to wind farm operation and infrastructure. This exclusion does however offer opportunities for other marine users who had previously avoided Belgian waters due to the high intensity of shipping. The first Belgian offshore energy zone was thus reserved for the production of electricity not only from wind but also from water and currents, and wind farm operators were obliged to facilitate the development of aquaculture in their concessions. In order to stimulate the development of marine 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 wave energy convertors (WEC) no actual WEC deployment is foreseen in the immediate future.

In 2022, the Blue Accelerator at Ostend will deploy a floating solar power production installation as part of the European SCalable Offshore Renewable Energy Sources (EU-SCORES) project. This project envisions a full-scale demonstration of a 3MW offshore solar photovoltaic system by Oceans of Energy off the Belgian coast co-located with a bottom fixed windfarm.

Other forms of multi-use being tested in Belgian wind farms include the cultivation of seaweed and European flat oyster (*Ostrea edulis*) combined with the restoration of flat oyster reefs at the Belwind wind farm as part of the EU Horizon 2020 project UNITED (Fig. 4).

It is anticipated that in the second Belgian zone for marine renewable energy both aquaculture and fisheries with passive gears will be allowed. It is also partly co-located with a nature conservation zone (see above). Finally, individual projects are expected to make use of a shared platform for the transmission of electricity to the shore (Elia-MoG-II).

Figure 4. Installation of 'oyster tables' to facilitate restoration of European flat oyster (*Ostrea edulis*) reefs in the Belwind wind farm as part of the EU Horizon 2020 project UNITED (© Annelies M. Declercq).

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