CHAPTER 1

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

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Abstract

Offshore wind farms are expected to contribute significantly to the Belgian 2020 targets for renewable energy. At present, an installed capacity of 1.5 Gigawatt (GW), consisting of 318 offshore wind turbines, is operational in the Belgian part of the North Sea (BPNS). Two other projects, Seamade and Northwester 2, are scheduled to become operational in 2020. With the revision of the marine spatial plan, the federal government is looking to reserve an additional zone for 2 GW of offshore wind. With 522 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 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

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 2020. Offshore wind farms in the BPNS are expected to make an important contribution to achieve that goal.

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 284 km² is reserved in the

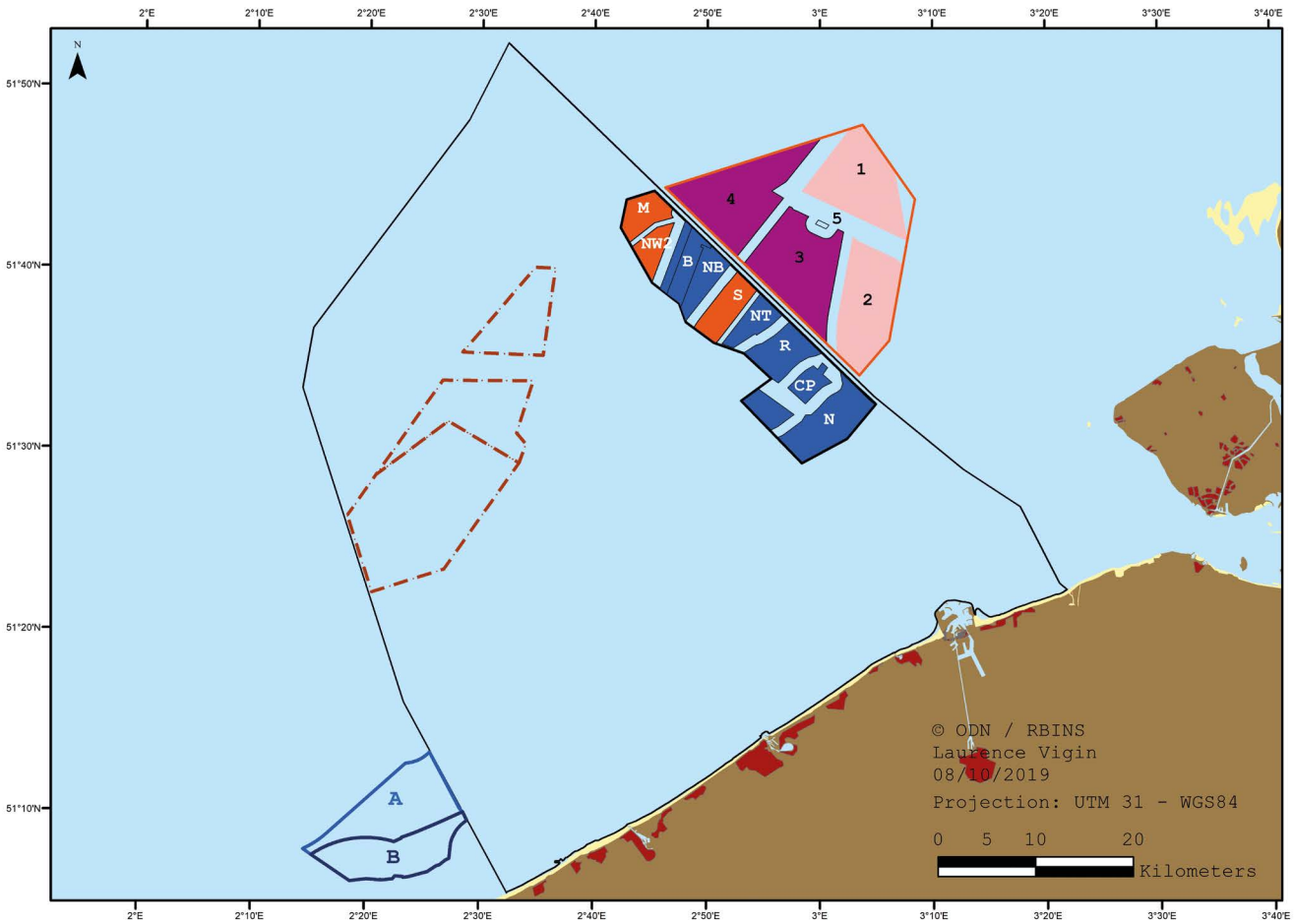

Figure 1. Current and planned zones for renewable energy in and around the Belgian part of the North Sea with indications of wind farms that are operational (blue), currently under construction (orange) or set to start construction end 2019 (purple) or 2020 (pink). A-B sites of proposed Dunkerque offshore wind farm. Dashed lines: locations of the new renewable energy zone as proposed in the draft of the marine spatial plan 2020-2026.

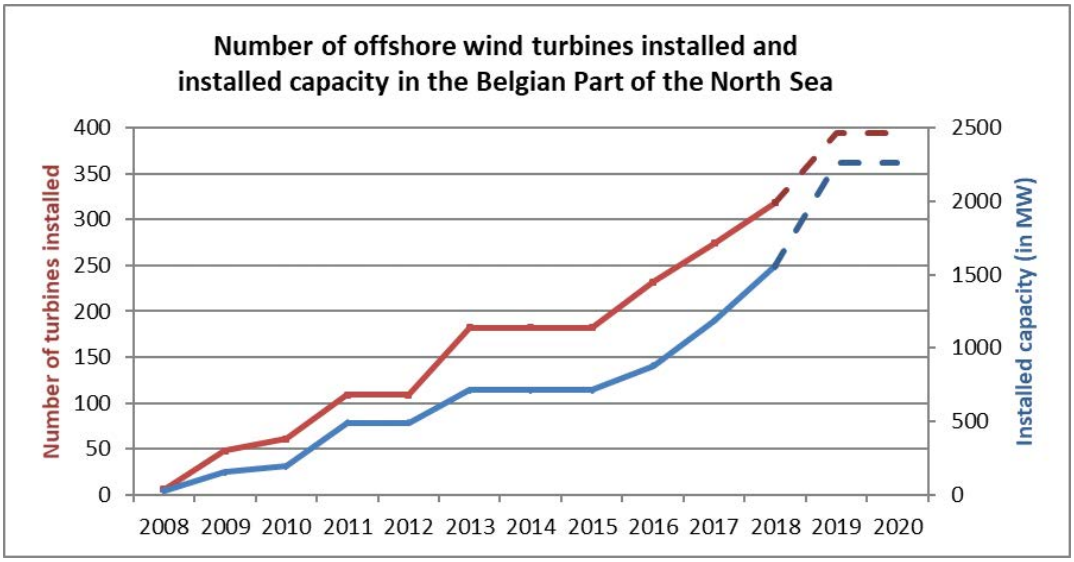

Figure 2. Number of offshore wind turbines installed and installed capacity in the Belgian part of the North Sea since 2008.

Table 1. Overview of wind farms in the Belgian part of the North Sea (situation on 20 April 2019)

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 and 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 mid-2019
SeaMade		58	8.4	487 + 5*	Construction foreseen to start in 2019
Northwester 2		23	9.5	219	Construction foreseen to start in 2019

*including 5 MW of wave energy

marine spatial plan that will come in force on 20 March 2020 (more information in §2).

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). On 20 July 2018, the merger between the Seastar and Mermaid projects was finalised and the resulting merged project was named Seamade NV. In a rush to meet the 2020 goals, near-continuous pile driving activities can be expected from Mid-2019 to Mid-2020 in the Belgian and adjacent Dutch Borssele zone. By the end of 2020, when all Belgian wind farms are built, there will be a little less than 400 wind turbines in the Belgian part of the North Sea (fig. 2). The first entire 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 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 a 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 2014, Belgium approved a marine spatial plan for the BPNS by Royal Decree. The 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). 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 and gravel extraction, pipelines and cables, military activities, tourism and recreation, and scientific research are included. The current marine spatial plan is valid for a period of six years and thus in 2020 a new plan will come into effect. In this revision of the marine spatial plan (MRP 2020-2026), the Belgian federal government has delineated a second zone for renewable energy of 284 km² located at 35-40 km offshore (fig. 1). This second zone would be suitable for an additional 2 GW of installed capacity. 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/km in this new zone in order to be able to realize maximum energy yields, and thereby reduce production costs. 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.

The second Belgian zone for marine renewable energy is partly located inside the Habitats Directive area "Vlaamse Banken". A targeted research programme was designed in order to determine whether and under what conditions renewable energy development is compatible with the natural values of this marine protected area. This programme commenced in 2019 and will last four years. The first results will become available from December 2019 onwards.

3. Grid reinforcement and the Modular Offshore Grid (MOG)

The first three offshore wind farms were connected to the electricity grid by a limited strengthening of the existing high-voltage grid. For the next six projects, a comprehensive network upgrade was necessary. To meet this necessity, Elia launched the Stevin project which includes a new power station near the port of Zeebrugge and a high voltage network from Zeebrugge to Zomergem. This project was completed in November 2017. However, further grid reinforcement is needed given the plans to expand wind capacity with a second concession area for offshore wind in the Belgian part of the North Sea. In this framework, Elia proposed the Ventilus project which includes a new power station near the port of Ostend and a high voltage network from Ostend to Brugge although the exact route still is to be determined. Ventilus will be a 380-kV high-voltage line with a capacity of 6 GW. In the long term, Ventilus will also make it possible to build a second subsea connection with the United Kingdom, alongside the existing Nemo Link project that became operational at the start of 2019.

The first five operational wind farms each ensure the export of their electricity to the onshore grid. Several proposals were formulated to develop a shared connection, a so-called "plug-at-sea", which would allow the remaining projects to share an export connection and would allow for integration in an as yet to be developed

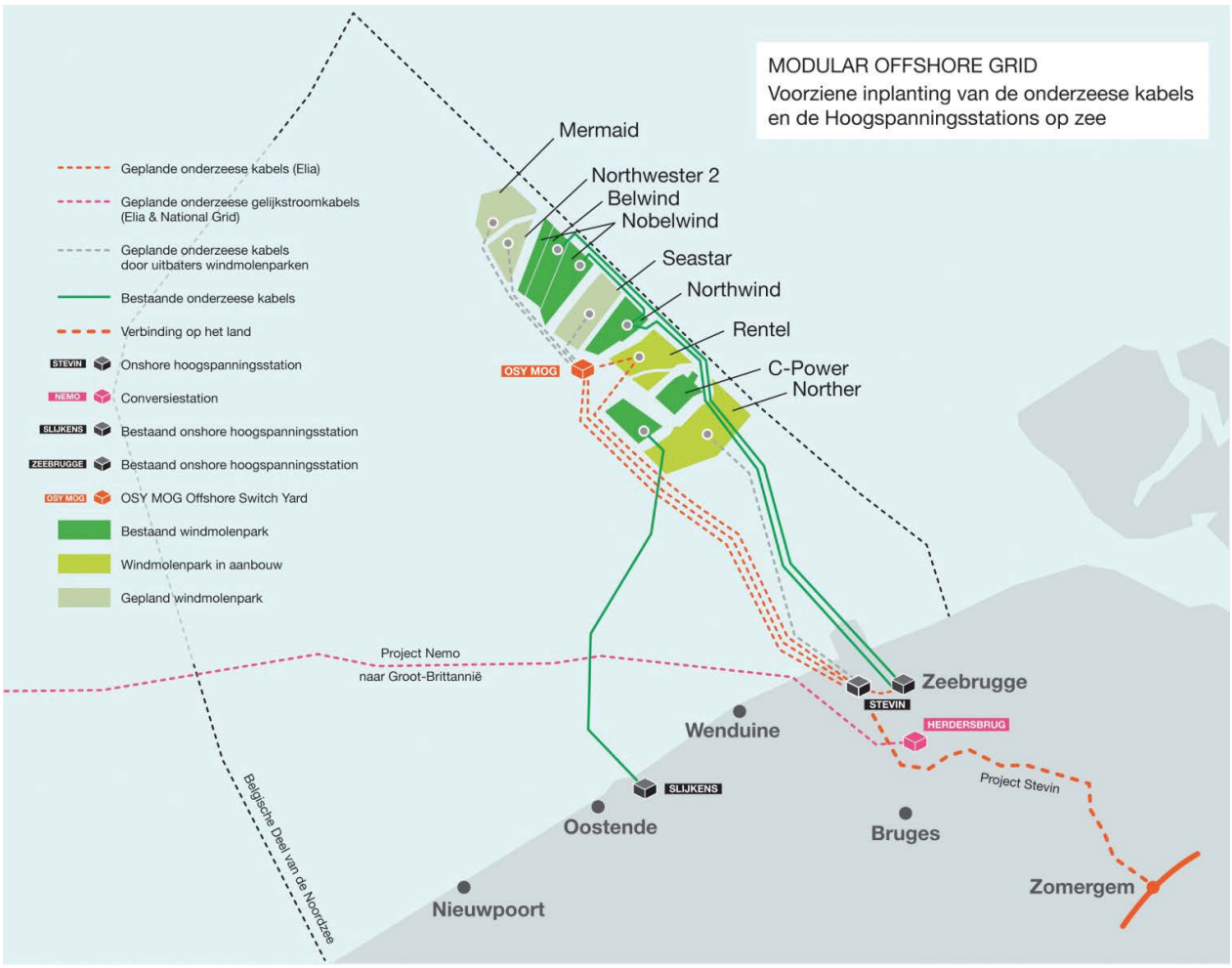

Figure 3. Design of the Modular Offshore Grid (MOG) (source: http://www.elia.be).

international offshore grid. In its current iteration, the Modular Offshore Grid (MOG), consisting of a single Offshore Switch Yard (OSY) located near the Rentel concession and four export- and/or interconnection cables, connects the remaining three wind farms to the grid (fig. 3). Construction of the MOG started in November 2018 and is expected to be operational by September 2019.

4. 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 realised. 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 allows for an installed capacity of 5 MW of WECs no actual WEC deployment is foreseen in the near future.

Figure 4. The NEMOS Ostend Research Station.

Test sites are an essential element of any emerging technology developments including wave energy extraction. One such test site, for the NEMOS Wave Energy Converter, was constructed of the coast of Ostend in April 2019 (fig. 4). A monitoring programme focusing on underwater sound and the impact on soft substrate benthos was imposed. After an operational test phase that ends in 2020, the installation was scheduled to be dismantled and removed. However, on 19 January 2018, the POM West-Vlaanderen introduced a request for an environmental permit to continue the exploitation of this maritime innovation and development platform until 2033.