

## Chapter 2. Offshore wind energy development in the Belgian part of the North Sea & anticipated impacts: an update

---

R. Brabant\*, S. Degraer & B. Rumes

*Royal Belgian Institute of Natural Sciences, Management Unit of the North Sea Mathematical Models (MUMM), Marine Ecosystem Management Section, Gulledele 100, 1200 Brussels*

\*Corresponding author: [R.Brabant@mumm.ac.be](mailto:R.Brabant@mumm.ac.be)



Turbine transport and installation on the Thorntonbank

Photo MUMM / RBINS

## 2.1. Context

The European Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market, imposes upon each Member State a target figure of the contribution of the production of electricity from renewable energy sources that should have been achieved in 2010. For Belgium, this target figure was 6 % of the total energy consumption. In January 2008, the European Commission launched its new Climate Plan, and a new target for Belgium was set at 13 % to achieve by 2020. Offshore wind farms in the Belgian part of the North Sea (BPNS) are expected to make an important contribution to achieve that goal.

With the Royal Decree of 17 May 2004 a zone in the Belgian part of the North Sea (BPNS) was reserved for the production of electricity. It is located between two major shipping routes: the north and south traffic separation schemes (TSS). In 2011, the zone was adjusted on its Northern and Southern side because of the need for a safer shipping traffic in the vicinity of the wind farms. After this adjustment the total surface of the area is 238 km<sup>2</sup> (Figure 1). The initial surface was 264 km<sup>2</sup>.

Prior to installing a wind farm, a developer must obtain (1) a domain concession in the zone reserved for wind energy development 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. That procedure has several steps, including a public hearing during which the public can express any objections. Later on during the permit procedure, the Management Unit of the North Sea Mathematical Models (MUMM) of the Royal Belgian Institute of Natural Sciences renders advice on the possible environmental impact of the future project to the Minister responsible for the marine environment. MUMM's advice includes an environmental impact assessment, based on an environmental impact study that is set up by the project developer. The Minister then grants or denies the environmental permit in a duly motivated decree.

The environmental permit includes a number of terms and conditions intended to minimize 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. The environmental monitoring is a legal obligation and is a competency of the federal government. The monitoring has two goals:

- to enable the authorities to mitigate or even halt the activities in case of extreme damage to the marine ecosystem;
- to understand and evaluate the impact of offshore wind farms on the different aspects of the marine environment and consequently support the future policy regarding offshore wind farms.

The monitoring is lead by MUMM, but MUMM collaborates with several other institutes that each have a specific expertise of the marine environment. The costs of the monitoring program are paid by the permit holders.

At present, four companies were granted a domain concession and an environmental permit to build and exploit an offshore wind farm: C-Power in 2004, Belwind in 2008, Northwind (formerly Eldepasco) in 2009 and Norther in early 2012. C-Power had its permit revised in 2006 and 2008, and the monitoring programme was adapted accordingly (Table 1).

C-Power and Belwind have already started their construction activities at the Thorntonbank and Bligh Bank, respectively, while Northwind's construction activities (72 turbines of 3MW) on the Lodewijkbank (formerly Bank zonder Naam) are expected to start in April 2013. The Norther project is located in the southernmost part of the wind energy zone and will presumably start its construction in 2014. More detailed information on projects can be found via [www.c-power.be](http://www.c-power.be), [www.belwind.be](http://www.belwind.be) & [www.northwindenergy.eu](http://www.northwindenergy.eu). Information on the Norther project can be found on the websites of [www.airenergy.be](http://www.airenergy.be) and [www.electrawinds.be](http://www.electrawinds.be).

Three other projects, Rentel, Seastar and Mermaid, were granted only a domain concession so far (Figure 1). Rentel, obtained a concession in between C-Power and Northwind (Figure 1). On July 2<sup>nd</sup>

2012, they have submitted their application to obtain an environmental permit. The concession of Seastar, in between Belwind and Northwind, was withdrawn in 2011, but, on June 1<sup>st</sup> 2012 the project obtained a new concession. Finally, on June 25<sup>th</sup> 2012, the project Mermaid was granted a domain concession in the northernmost part of the zone reserved for energy production. This is the seventh and, for now, last concession foreseen for the construction of wind farms in the Belgian part of the North Sea.

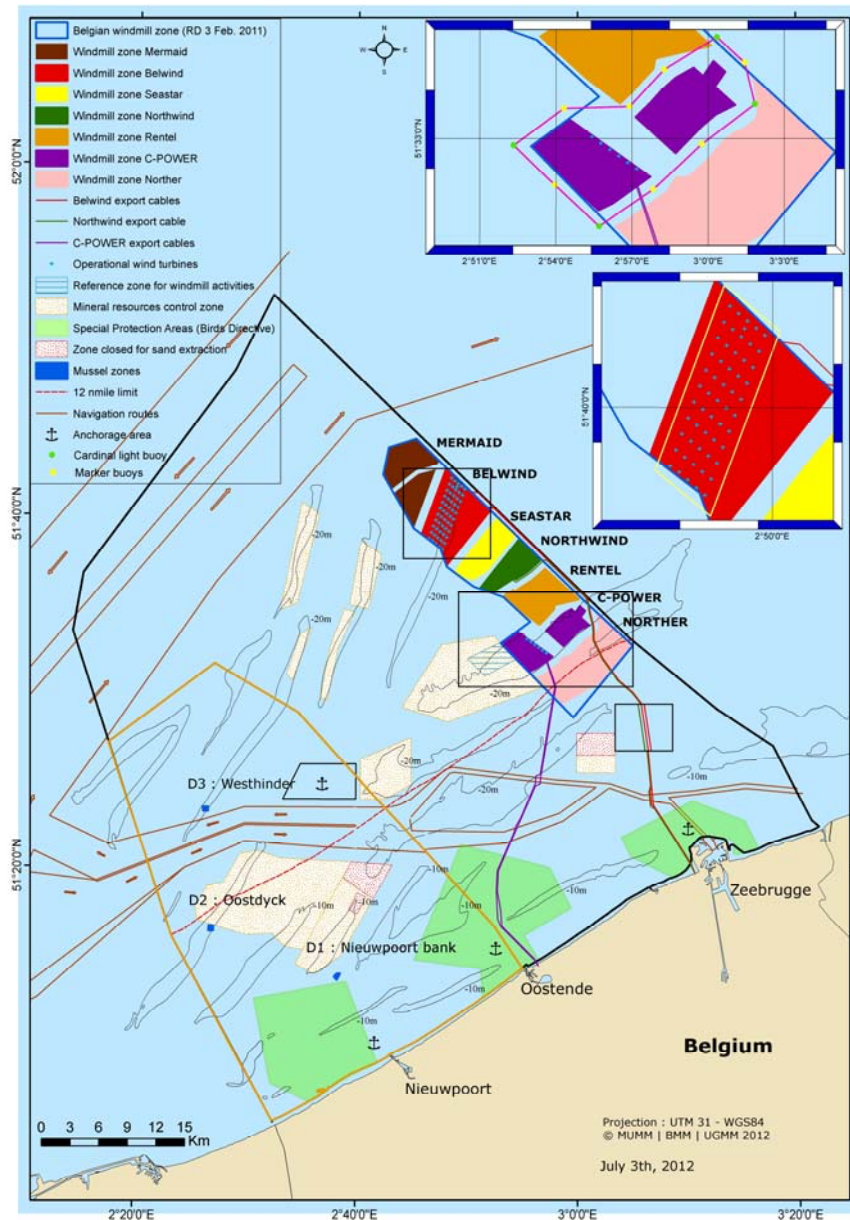


Figure 1. Zone reserved for the production of renewable energy by the Royal Decree of 17 May 2004 (<http://www.mumm.ac.be/EN/Management/Atlas>)

Table 1.

Overview of the dates when the projects were granted a domain concession and an environmental permit.

Project	Concession obtained	Permit application	Permit obtained
C-Power	27/06/03	17/6/2003 22/9/2005 -	14/04/2004 10/05/2006 25/04/2008
Belwind	5/6/2007	19/6/2007	20/2/2008
Northwind	15/5/2006	12/12/2008	19/11/2009
Norther	5/10/2009	10/5/2011	18/1/2012
Rentel	4/6/2009	2/7/2012	procedure ongoing
Seastar	1/6/2012	No application yet	
Mermaid	25/6/2012	No application yet	

## 2.2. Ongoing wind farm projects

### 2.2.1. C-Power

The C-Power project is located on the Thorntonbank (Figure 1). This is a sandbank located 27 km of the Belgian coast. Water depth in the concession area varies between 18 and 24 m.

The C-Power concession is divided in two sub-areas (A and B). Across the two sub-areas 54 turbines will be installed. Phase I (30,5 MW), a pilot phase, consists of six turbines that were installed on row D of sub-area A and the first 150 kV offshore cable (Figure 2). The six 5MW Repower turbines are operating since the 10<sup>th</sup> of May 2009. Phase II and phase III will each consist of 24 turbines of 6.15 MW. The installed capacity of the entire wind farm will be 325 MW.

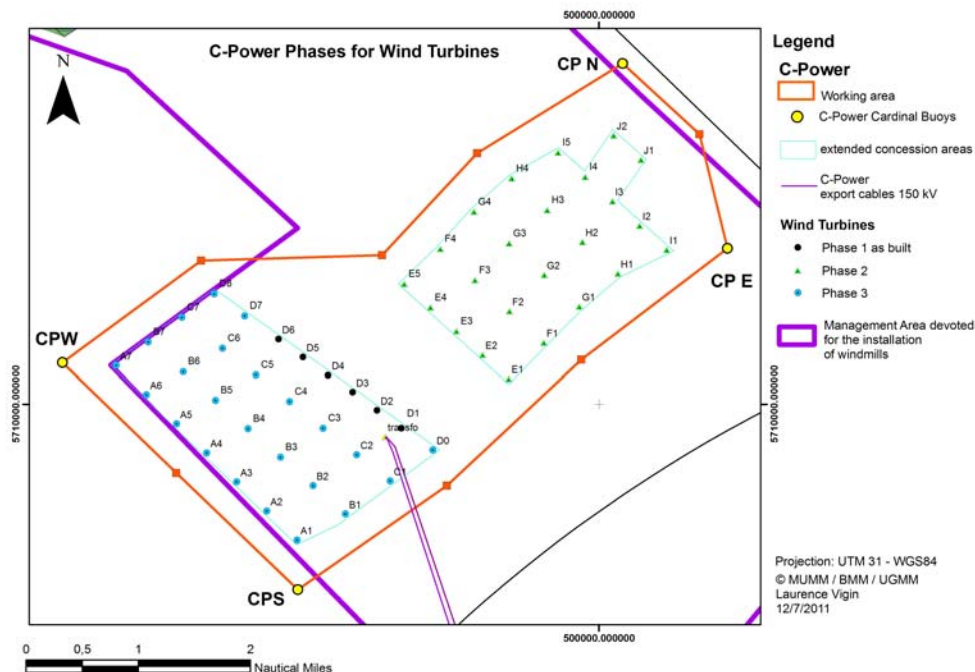


Figure 2. Layout of the C-Power project.

C-Power used gravity based foundations (GBF) for its phase I. These GBFs are hollow, concrete structures that are filled with sand, upon installation on the seabed. More detailed information can be obtained from Peire *et al.* (2009) and Brabant & Jacques (2010).

The foundation type for the phase II and III turbines is different from the pilot phase since jacket foundations, instead of the GBFs, were installed. These foundations consist of a steel jacket with four



legs. The foundations were installed using the pre-piling concept: four pin-piles were driven into the seabed and the legs of the foundation were grouted on the pre-piles. The piles vary in length depending on the water depth at their location and are in the range of 21.0 to 49.5 m.

C-Power started on April 7<sup>th</sup> 2011 with the piling works. On August 21<sup>st</sup> 2011, all pin-piles for the phase II and phase III turbines were in place. Before the pre-piling of the pin-piles started, bottom surveys were conducted in 2010 and the seabed needed to be prepared. Details on this can be found in Brabant *et al.* (2011). All jacket foundations were installed in 2011 and the first half of 2012 (Figure 3). The installation of the 6 MW Repower turbines is now ongoing, 24 of the turbines were already installed by the end of June 2012. The offshore transformer station (OTS, figure 4) and the second export cable are already installed. Both sub sea power cables come ashore near Ostend.



Figure 3. Phase III jacket installation (Photo C-Power).



Figure 4. The OTS was installed on March 17<sup>th</sup> 2012. On the background the six phase I turbines (photo C-Power).

### 2.2.2. Belwind

The Belwind project is situated on the Bligh Bank at about 40 km off the Belgian coast (Figure 1 & 5). The water depth in the concession area varies between 15 and 40 m. Once finalized, the park will consist of 110 Vestas V90 turbines and an offshore high voltage station (OHVS), with a total installed capacity of 330 MW. The construction of the park is divided in two phases.

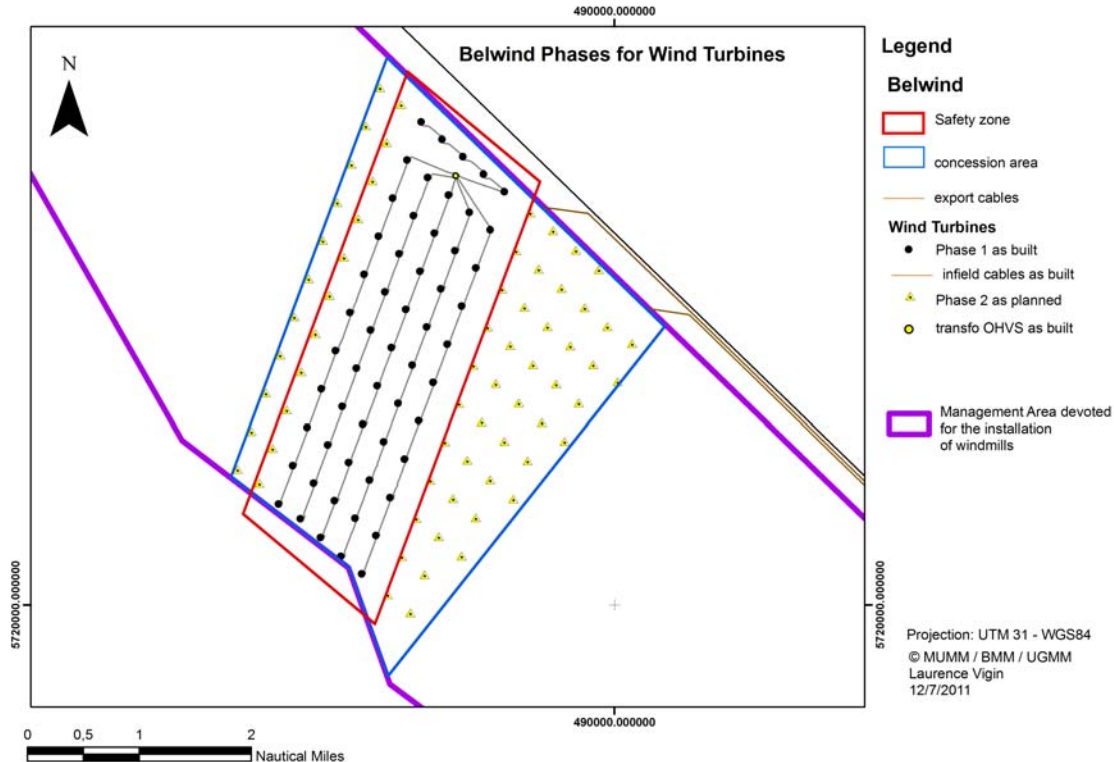


Figure 5. Lay out of the Belwind project.

In 2010, Belwind completed the first phase of their wind farm: 55 Vestas V90-3MW turbines, an OHVS, infield cables and an export cable. The 55 wind turbines are operational since January 13<sup>th</sup>, 2011 (Figure 6). Details on the construction of this first phase can be found in Brabant *et al.* (2011). No construction works were done in 2011. The start of the construction of phase II is foreseen in 2014.



Figure 6. Phase I wind turbines on the Bligh Bank (Photo MUMM / RBINS).

### 2.3. Anticipated environmental impacts

With the construction and exploitation of the above described projects a new offshore activity started in the BPNS. While offshore wind farms help achieving the goals set by 2001/77/EC on the promotion of electricity produced from renewable energy and help in the struggle against climate change, the construction and exploitation of offshore wind farms will also have certain impacts on the marine environment. These can be neutral, positive and/or negative for the marine ecosystem.

The environmental impact assessments (MUMM, 2004, 2007, 2009 & 2011) anticipated a variety of possible impacts. Some of those impacts are already being revealed during the first years of environmental monitoring (Degraer *et al.*, 2010 & 2011), e.g.:

- Increased erosion of the natural sandy sediments around wind turbine foundations because of accelerating currents next to the foundations;
- Increased turbidity during the construction of the wind farms;
- Increased underwater noise pressure, generated during the construction and exploitation phases and the associated impact on marine mammals and fish;
- Colonisation of the introduced hard substrata (i.e. foundations) by epifouling organisms and its consequent stepping-stone effect on invasive species;
- Attraction of fish by the introduced hard substrata;
- Changes within the soft-substratum macro- and epibenthos and fish as a result of e.g. fisheries displacement, altered sediment characteristics and organic enrichment of the sandy sediments by (local) deposition of organic matter produced by the hard substrate epifauna;
- Altered spatio-temporal distribution, densities and migration routes of seabirds and marine mammals;
- Altered public perception of offshore wind farms.

With the monitoring programme, MUMM and its partners (1) assess the extent of the anticipated impacts on the different aspects of the marine ecosystem and (2) aim at revealing the processes behind the impacts. The first objective is basically tackled through the baseline monitoring, focusing on the *a posteriori*, resultant impact quantification, while the second monitoring objective is covered by the targeted or process monitoring, focusing on the cause-effect relationships of *a priori* selected impacts. As such, the baseline monitoring deals with observing rather than understanding impacts and hence leads to area-specific results, which might form a basis for halting activities. Targeted monitoring on the other hand deals with the understanding of the processes behind the impacts of a selected set of hypothesized cause-effect relationships highly relevant to the wind energy sector. This step is not only a pre-requisite for effective regulatory application, but also permits (1) current and future impact mitigation, (2) better prediction of future impacts, as well as (3) moving away from site-specific observations to more generic knowledge. More details on this topic can be found in Degraer & Brabant (2009) and Degraer *et al.* (2010).

In 2009, we reported on the lessons learnt and recommendations from the first two years of environmental monitoring (Degraer & Brabant, 2009). The integrated Degraer *et al.* (2010) report focused on the natural spatio-temporal variability and the evaluation of the early and localized environmental impacts at the C-Power and Belwind sites. This report presents a selection of major findings from the baseline and targeted monitoring activities from 2011, and aims at a continued heading towards an understanding of environmental impacts of offshore wind farms.

### 2.4. References

Brabant, R., Degraer, S. & Rumes, B., (2011). Offshore wind energy development in the Belgian part of the North Sea & anticipated impacts: an update. *In*: Degraer, S., Brabant, R. & Rumes, B., (Eds.) (2011). Offshore wind farms in the Belgian part of the North Sea: Selected findings from the baseline and targeted monitoring. Royal Belgian Institute of Natural Sciences, Management Unit of the North Sea Mathematical Models. Marine ecosystem management unit. pp. 9-16.

- Brabant, R. & Jacques, T.G., (2010). Offshore wind energy development in the Belgian part of the North Sea and anticipated impacts. pp. 9-18. *In*: Degraer, S., Brabant, R. & Rumes, B., (Eds.) (2010). Offshore wind farms in the Belgian part of the North Sea: Spatio-temporal variability and early impact assessment. Royal Belgian Institute of Natural Sciences, Management Unit of the North Sea Mathematical Models, Marine ecosystem management unit. 184 pp. + annexes.
- Degraer, S. & Brabant, R., (Eds.) (2009). Offshore wind farms in the Belgian part of the North Sea: State of the art after two years of environmental monitoring. Royal Belgian Institute of Natural Sciences, Management Unit of the North Sea Mathematical Models, Marine ecosystem management unit. 287 pp. + annexes.
- Degraer, S., Brabant, R. & Rumes, B., (Eds.) (2010). Offshore wind farms in the Belgian part of the North Sea: Spatio-temporal variability and early impact assessment. Royal Belgian Institute of Natural Sciences, Management Unit of the North Sea Mathematical Models, Marine ecosystem management unit. 184 pp. + annexes.
- Degraer, S., Brabant, R. & Rumes, B., (Eds.) (2011). Offshore wind farms in the Belgian part of the North Sea: Selected findings from the baseline and targeted monitoring. Royal Belgian Institute of Natural Sciences, Management Unit of the North Sea Mathematical Models. Marine ecosystem management unit. 157 pp. + annex.
- MUMM, (2004). Milieueffectenbeoordeling van het project ingediend door de n.v. C-Power. Rapport van het Koninklijk Belgisch Instituut voor Natuurwetenschappen, departement Beheerseenheid van het Mathematisch Model van de Noordzee (BMM). 155 pp.
- MUMM, (2007). Milieueffectenbeoordeling van het BELWIND offshore windmolenpark op de Bligh Bank. Rapport van het Koninklijk Belgisch Instituut voor Natuurwetenschappen, departement Beheerseenheid van het Mathematisch Model van de Noordzee (BMM). 183 pp.
- MUMM, (2009). Milieueffectenbeoordeling van het ELDEPASCO offshore windmolenpark op de Bank zonder Naam. Rapport van het Koninklijk Belgisch Instituut voor Natuurwetenschappen, departement Beheerseenheid van het Mathematisch Model van de Noordzee (BMM). 168 pp.
- MUMM, (2011). Milieueffectenbeoordeling van het NORTHER offshore windmolenpark ten zuidoosten van de Thorntonbank. Rapport van het Koninklijk Belgisch Instituut voor Natuurwetenschappen, departement Beheerseenheid van het Mathematisch Model van de Noordzee (BMM). 189 pp.
- Peire, K., Nonneman, H. & Bosschem, E., (2009). Gravity Based Foundations for the Thornton Bank Offshore Wind farm. *Terra et Aqua*, 115, 19 – 29.