6

Energy (including cables and pipes)

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6.1 Offshore wind energy

Europe is the world leader in offshore wind energy. In 2019, 5,047 turbines were installed and connected to the power grid in European seas, with a total installed capacity of 22,072 MW. These wind turbines are distributed over 110 wind farms in 12 different countries (*Offshore wind in Europe: Key trends and statistics 2019*). Most wind turbines are located in the North Sea, with the United Kingdom, Germany and Denmark being the leading European actors in offshore wind energy. In Belgium, six wind farms were operational at the end of 2019 (C-Power, Belwind, Nobelwind, Northwind, Rentel and Norther), totaling 341 wind turbines and a total installed capacity of 1,556 MW (*MUMM*, *BOP*, *4C Offshore*). This ranks us in fourth place in Europe and fifth worldwide (*Offshore wind in Europe: Key trends and statistics 2019*).

In 2020 Seamade (zone Mermaid and zone Seastar) and Northwester II will become operational, after which Belgium's offshore wind farms will have a total capacity of 2,230-2,280 MW and will produce approximately 8 TWh per year for a total of nearly 500 wind turbines. This corresponds to 10% of the total Belgian electricity consumption and approximately 50% of the electricity consumption by households (*MUMM*, *BOP*, *Vande Velde 2014*, *CLIMACT 2017*, *Degraer et al. 2018*). Plans for further expansion in newly designated areas after 2020 are being examined in the context of the revision of the marine spatial plan (*4C Offshore*, *MSP 2020-2026, public consultation 2018*). In the preliminary draft MSP (2020-2026), approved by the federal Council on 20 April 2018, three zones with a total surface area of 221 km² at 35-40 km off the coast are reserved for the production of renewable energy (figure 1). The focus lies on wind energy with an estimated production value of 2,000 MW.

6.1.1 Policy context

At the European level, the energy policy is developed by the European Commission's Directorate-General for Energy (*DG ENER*) the European Council and the European Parliament. An important aspect of this energy policy concerns the renewable energy strategy (which includes offshore wind energy). A key instrument in this context is directive 2009/28/EC on the promotion of the use of energy from renewable sources. This directive stipulates that Belgium must include 13% renewable energy in its final energy consumption[1] by 2020. Furthermore, this directive obliges each Member State to elaborate a national action plan on how to achieve the renewable energy goals (*Nationaal actieplan België hernieuwbare energie 2010*). Work is in progress to amend this directive in order to better respond to climate change with the original objective of achieving at least 27% renewable energy in Europe by 2030 (COM (2016) 767). On 18 June 2018, it was decided to adjust this target to 32% renewable energy (*EC communication*) within the same timeframe. The Directorate-General for Maritime Affairs and Fisheries (*DG MARE*) also developed a 'Blue Growth' policy (COM (2012) 494). This is a long-term strategy for a more sustainable growth in marine and maritime sectors which includes offshore energy production (Blue Energy, COM (2014) 8), see also *DG MARE – Ocean Energy*.

The Belgian renewable energy policy is, in principle, a regional competence. However, as the Belgian part of the North Sea (BNS) falls under federal competence the policy on the production of electricity from water, currents or winds and the transmission grid at sea is developed at federal level by the federal minister responsible for energy and the federal minister (or secretary of state) responsible for the North Sea (*FPS Economy, S.M.Es, Self-Employed and Energy*, more information on the division of competences: the *Nationaal actieplan België hernieuwbare energie 2010*).

An overview of the European and national legislation concerning the electricity market is given on the website of the *CREG* and the *FPS Economy, S.M.Es, Self-Employed and Energy*.

6.1.2 Spatial use

In the current marine spatial plan (RD of 20 March 2014), the wind farms are located near the eastern border of the BNS at approximately 23 km from the coast, in a zone dedicated to the development of energy from wind, water and currents (*FPS Health, Food Chain Safety and Environment*). The offshore wind sector has submitted an application to the federal Government to provide additional space for new offshore wind energy projects with an additional capacity of 2,000 MW in the renewed MSP (2020-2026) (*BOP, Marine Spatial Plan 2020-2026*, *4C Offshore*). The draft MSP (2020-2026) includes three new concession zones for renewable energy (221 km²), located some 35-40 km off the coast and allowing an additional production of approximately 2,000 MW of wind energy. The preliminary draft MSP was approved by the federal Council on 20 April 2018 and is scheduled to be passed by the king in 2019 (*MSP 2020-2026, public consultation 2018*).

[1] Target for the share of energy from renewable sources in the gross final consumption of energy.

SPATIAL USE - ENERGY

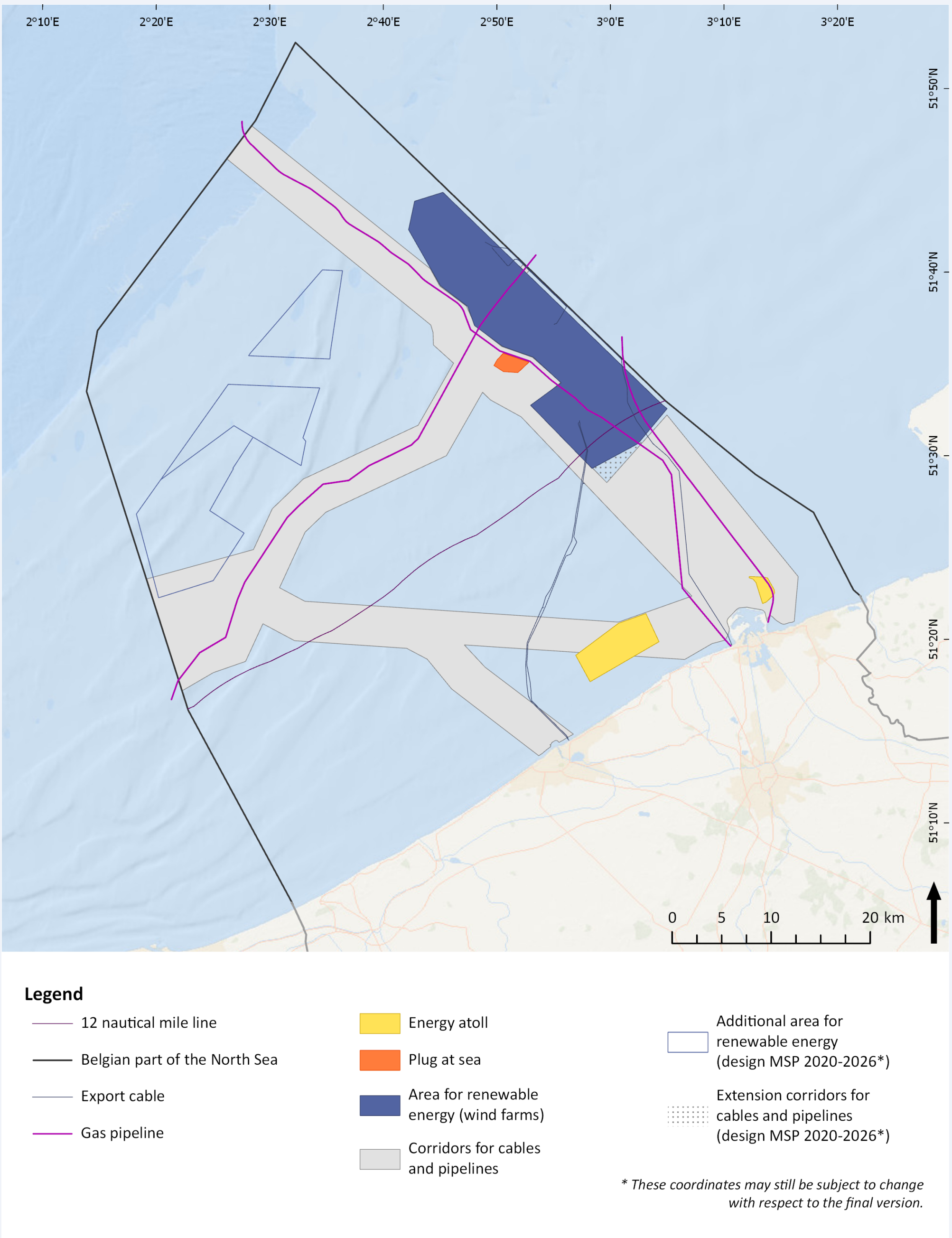

Figure 1. The location of the concession zones for wind farms and energy atolls, the Modular Offshore Grid and the pipeline and cable corridors in the BNS (Source: RBINS, *marineatlas.be* (based on the RD of 20 March 2014), *MSP 2020-2026, public consultation 2018*).

Prior to the installation of the wind farms, a study was carried out on the seabed, the wind supply and the transmission capacity for an optimal development of renewable energy at sea in the eastern concession zone (*Le Bot et al. 2004*, *project BELSPO*).

In addition, the spatial needs for other users of the sea must also be taken into account (see sources in **6.1.4 Impact on the marine environment**). In this context, a ban on regular (non-wind park related) shipping has been introduced in Belgium in the zone of the wind farms, as well as in the areas reserved for hydroelectric energy storage installations

(the so-called energy atoll) and offshore substations of the transmission system operator (RD of 11 April 2012). From the operational phase onwards, a safety zone of 500 metres (measured from the outer boundary) will be established around artificial islands, installations or infrastructure for the generation of energy from water, currents and winds (e.g. offshore wind farms) (RD of 11 April 2012) (see also theme **Maritime transport, shipping and ports**).
The spatial demarcation of the domain concessions for wind farms in the BNS and the history of this demarcation are discussed in more detail in figure 1 and tables 1 and 2.

In order to actually realise an offshore wind farm, the project must have several permits (see also **Procedure domain concession** and **Procedure environmental permit**). Currently, the following federal permits are required:

- A ministerial decree for the granting of a domain concession by the federal minister for Energy and the North Sea;
- A ministerial decree for the granting of an authorisation by the federal minister/secretary of state responsible for the North Sea for the construction of the wind farm, the cables and operation following an advice from the MUMM (RBINS) and an Environmental Impact Assessment (EIA);
- A ministerial decree for the granting of a permit for the installation of offshore cables by the federal minister for Energy and the North Sea (see also **6.6 Pipes and cables**).

Table 1. History of the spatial demarcation of the concessions zones for offshore wind farms in the BNS.

	History of the spatial demarcation of the concession zones
RD of 20 December 2000	Procedure and preconditions to obtain a concession zone (no demarcation yet).
Cabinet of 19 December 2003	Ministers responsible for North Sea and Energy are instructed to demarcate an area for offshore energy parks.
RD of 17 May 2004	Demarcation of an area for offshore wind farms of 264 km².
Cabinet of 3 December 2010	Ministers responsible for the North Sea and Energy are instructed to adjust the north-western part of the demarcated area as a result of frequent and incompatible use.
RD of 3 February 2011	Modification of the northwestern part of the demarcated zone (area of 238 km²).
RD of 20 March 2014	Establishment of a marine spatial plan in which, *inter alia*, the zone stipulated by the RD of 17 May 2004 and amended by the RD of 2011 is included (see also *Van de Velde et al. 2014*).
Federal cabinet, 20 April 2018	Approval of a draft MSP with a new concession zone for offshore wind energy of 221 km². This zone is located about 35-40 km off the coast and represents a production of 2 GW. The draft version is expected to be adopted by the king in 2019.

Table 2. An overview of the location and utilised space of the different concession zones for offshore wind in the BNS (*FPS Economy, S.M.E.s, Self-Employed and Energy*, *MUMM*, *BOP*), see also EIAs for the respective parks under 6.1.4 'Impact on the marine environment'.

Project name	Location	Total surface area (excl. safety zone)	Water depth	Distance to coast
C-Power	Thorntonbank	19.8 km²	12 - 27.5 m	27 - 30 km
Belwind	Bligh Bank	17 km²	15 - 37 m	46 - 52 km
Northwind (former Eldepasco)	Lodewijkbank	14.5 km²	16 - 29 m	37 km
Nobelwind (former Belwind phase 2)	Bligh Bank	18 km²	15 - 37 m	46 - 52 km
Rentel	Southwest Schaar	22.7 km²	26 - 36 m	33 km
Norther / North Sea Power	South of the Thorntonbank	44 km²	14 - 30 m	23 km
Seamade-Mermaid	Northwest of the Bligh Bank	16.7 km²	24.4 - 50.0 m	50 - 54 km
Seamade-Seastar	In between the Lodewijkbank and the Bligh Bank	18.4 km²	22 - 38 m	40 km
Northwester 2 (former Mermaid Zuid)	Northwest of the Bligh Bank	11.7 km² (potential expansion in EIA up to 15.2 km²)	24.2 - 39.9 m	51 km
Total surface area reserved for windfarms (incl. safety zone)		**238.0 km²**		

PROCEDURE DOMAIN CONCESSION

Each project must pass the procedure for the designation of a domain concession zone for the proposed project area (figure 2). This procedure and the conditions for granting a concession are stipulated in the RD of 20 December 2000. As a result of an amendment of the aforementioned RD by the RD of 28 September 2008, applications for obtaining a domain concession for the construction and operation of installations in the maritime areas, in which Belgium can exercise its jurisdiction, are directed to and dealt with by the representative of the minister. His proposal to grant or refuse the permit is then passed on to the federal minister for Energy (see also the MD of 16 March 2009) (*MUMM*, *CREG*, *Degraer et al. 2018*).

PROCEDURE ENVIRONMENTAL PERMIT

Each project must go through an environmental permit procedure, in accordance with the law on the protection of the marine environment (law of 20 January 1999), the RD of 7 September 2003 (procedure for the licensing and authorisation of certain activities in the BNS) and the RD of 9 September 2003 (rules of the environmental impact assessment) (figure 2). The Environmental Impact Assessment (EIA) is carried out by the Management Unit of the North Sea Mathematical Models of the Royal Institute of Natural Sciences (*RBINS-MUMM*) on the basis of an Environmental Impact Report (EIR) drawn up on behalf of the permit applicant. The MUMM subsequently advises the competent minister (or secretary of state) on the expected environmental effects (website *OD Natural Environment, RBINS*). The latter then approves or rejects the application by ministerial decree. A granted permit also imposes by law a monitoring of the effects of the project on the marine environment.

When additional permits are required by other legislation for installations in the concession zone (e.g. the environmental permits), the permit of the concession zone remains suspended until any additional license or authorisation has been granted and until notification is made in accordance with the applicable legislation. If any of the additional required permits or authorisations is definitely refused, the domain concession expires on the day of notification of this refusal. In Belgium, nine domain concessions have already been granted to different project developers (table 2)[2].

6.1.3 Societal interest

THE ENERGY PRODUCTION OF OFFSHORE WIND FARMS

Based on modelling by WindEurope, the central scenario estimates that by 2020 204 GW of wind energy will be installed in Europe with a share of approximately 25% for offshore wind energy (*Wind energy in Europe: outlook to 2020, WindEurope 2017*). By 2030, the installed capacity of wind energy would increase to 320 GW, of which 66 GW coming from offshore wind energy. This would cover 24.4% of European electricity demand (*Wind energy scenarios for 2030, WindEurope 2015*).

The total capacity that could theoretically be installed in the BNS was already assessed in 2009 by *Mathys et al. (2009)* (*OPTIEP-BCP project, BELSPO*), taking into account a number of preconditions, as well as other user functions. The total capacity of all projects that were granted a concession in the BNS amounts to approximately 2.2 – 2.3 GW, although this figure can still vary slightly depending on the configuration of the last wind parks (table 3, *MUMM*, *BOP*). In 2019, six wind farms were fully operational with a total installed capacity of 1,566 MW for 341 turbines (*MUMM*, *BOP*) (figure 3). The annual production of the planned and operational wind farms is shown in table 3.

EMPLOYMENT

According to estimates, the offshore wind energy sector in Europe could create 170,000 jobs by 2020, with an additional 130,000 jobs by 2030 (COM (2012) 494). The more recent *Wind energy scenarios for 2030* report from *WindEurope* estimates these figures to be slightly higher (minimum 307,000 jobs).

In Belgium, approximately 5,000 jobs were created during the construction of the first three offshore wind farms. The construction of an average offshore wind project (300 MW) generates approximately 1,400 direct jobs and an equal amount of indirect jobs during the development and construction phase. The exploitation phase creates an average of 100 new jobs per wind farm.

[2] A modified permit procedure for the new wind farms (preliminary draft MSP 2020-2026) will be determined within the current legislature (2014-2019).

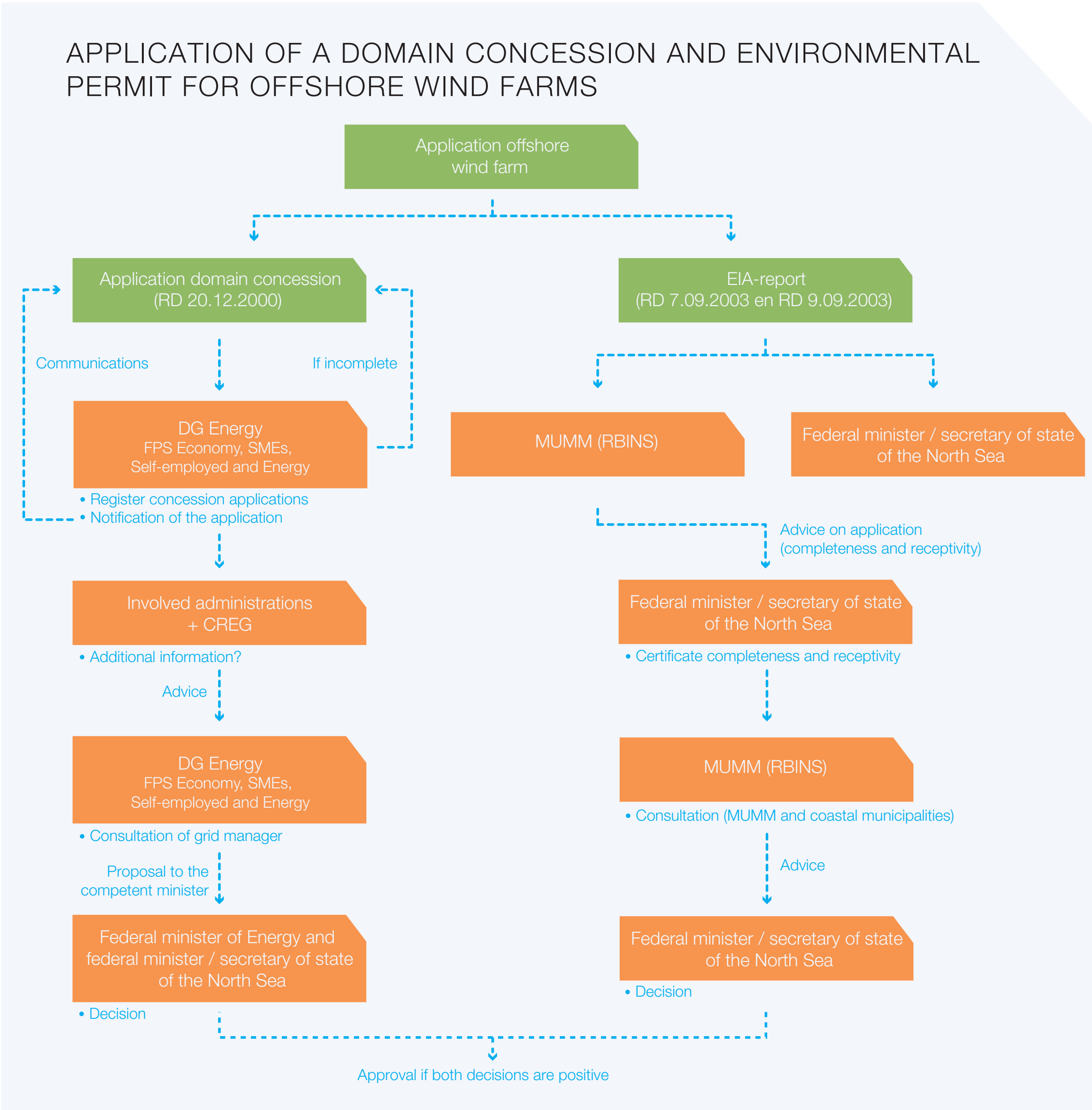

Figure 2. Flowchart for the application of a domain concession and environmental permit for offshore wind farms (RD of 20 December 2000, RD of 9 September 2003).

The realisation of the planned parks would therefore lead to approximately 20,000 temporary jobs (expressed in man-years) and 800 new permanent jobs during exploitation (minimum 20 years) (*BOP 2014*). A recent socio-economic study of the *BOP* (*CLIMACT 2017*) adjusted these figures to 15,000 to 16,000 jobs in the offshore wind industry (by 2020) and also demonstrated strong economic benefits with in the long term (2030) an annual increase in GDP of over 1 billion euro, an improved trade balance by more than 1.4 billion euro, etc. (see also *Economic impact study Belgian shipping cluster: Update 2017 2017*).

The construction of offshore wind turbines also creates new jobs in the ports, with the port of Ostend specifically presenting itself as an energy port. This resulted into 366 new, mainly specialised, jobs in 2016 (*Annual report Port of Oostende 2016*). It should be noted that economic activities concerning offshore wind farms are also happening in the port of Zeebrugge. However, no figures are available for this.

6.1.4 Impact on the marine environment

The installation of wind farms in the BNS has a number of positive and negative effects on the ecosystem and on the users of the sea (tables 4 and 5). The impacts on the marine environment that should be addressed in the environmental impact assessment (EIA) have been stipulated in the RD of 9 September 2003 on EIA. The EIAs,

Table 3. An overview of the status, the number of turbines and the total capacity of the wind farms in the BNS. (This information was collected from various sources: website *MUMM*, *BOP*, *4C Offshore*, see also EIAs of the respective farms under 6.1.4 Impact on the marine environment (depending on the source, the figures may differ slightly)).

Project name	Status	Number of turbines	Total capacity	Annual production
C-Power	Operational since 2009, fully operational since 2013	54	325 MW	1,050 GWh/year (power for 300,000 households)
Belwind	Fully operational since 2011 + GE Haliade (6 MW) operational since 2013	56	171 MW	560 GWh/year (power for 162,000 households)
Northwind (former Eldepasco)	Fully operational since 2014	72	216 MW	875 GWh/year (power for 250,000 households)
Nobelwind (former Belwind phase 2)	Fully operational since 2017	50	165 MW	679 GWh/year (power for 180,000 households)
Rentel	Concession and environmental permit granted	42	309 MW	1,140 GWh/year (power for 300,000 households)
Norther / North Sea Power	Concession and environmental permit granted Under construction (2018), operational by 2019	44	370 MW	1,340 GWh/year (power for 400,000 households)
Seamade-Seastar	Concession and environmental permit granted Construction planned in 2019, operational by the end of 2020	30*	252 MW*	power for 263,437 households
Seamade-Mermaid	Concession granted Environmental permit (April 2015) Construction planned in 2019, operational by the end of 2020	28*	235 MW (+5 MW** wave energy)*	power for 233,593 households
Northwester 2	Concession granted Environmental permit December 2015 Construction planned in 2019, Operational by 2020	23*	219 MW*	770 GWh/year (power for 220,000 households)

** Number of turbines and total capacity can vary from final value.*
*** The most recent values, as communicated by the BOP, suggest an installed capacity up to 20 MW.*

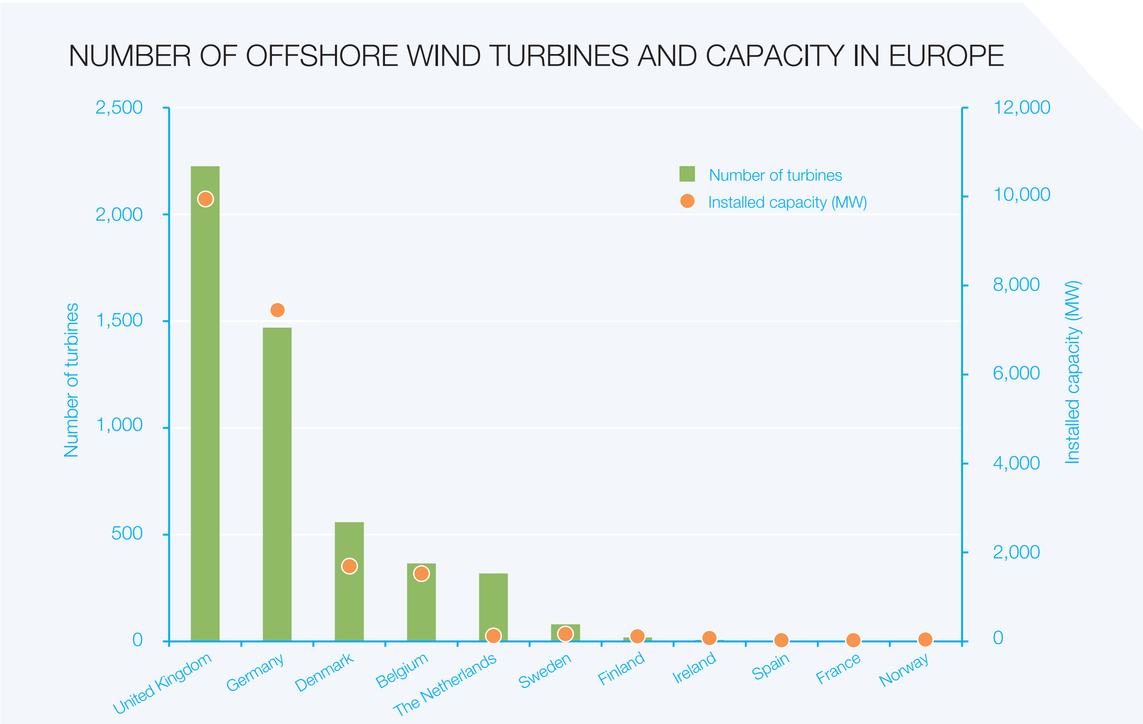

Figure 3. Number of offshore wind turbines and installed capacity (MW) in Europe in 2018 (*Offshore wind in Europe. Key trends and statistics 2019*).

Environmental Impact Reports (EIRs) and any amendments can be consulted on the relevant *website* of the RBINS-OD Natural Environment (table 4). In addition, numerous scientific studies have been conducted to better understand the impact of the wind farms on the marine environment in the BNS (non-exhaustive overview in table 5).

Table 4. An overview of the EIRs, EIAs and additional documents of the wind farms in the BNS.

Wind farm	EIRs, EIAs and additional documents
C-Power	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* + *MER - Wijziging en uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010*, *MEB C-Power 2004*, *MEB C-Power wijziging 2006*
Belwind / Nobelwind	*MER Offshore Windpark Bligh Bank. Belwind NV 2007*, *Di Marcantonio et al. 2007 – MEB Belwind*
Northwind (former Eldepasco)	*MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008*, *Di Marcantonio et al. 2009 – MEB Eldepasco*
Rentel	*Milieueffectenrapport windpark Rentel 2012*, *Rumes et al. 2012 – MEB Rentel*
Norther / North Sea Power	*MER Norther project en wijzigings MER*, *Rumes et al. 2011 – MEB Norther*, *Rumes et al. 2013 – MEB wijzigingsaanvraag*
Seamade-Mermaid	*MER Mermaid en Northwester 2*, *Rumes et al. 2015 – MEB Mermaid*
Seamade-Seastar	*MER - windpark Seastar 2013*, *Rumes et al. 2013 – MEB Seastar*
Northwester 2	*MER Mermaid en Northwester 2*, *Rumes et al. 2015 – MEB Mermaid*

Table 5. An overview of scientific studies concerning the effects of offshore wind parks on the environment and other users.

Impact on the environment / other users	Literature
Effects on the hydrodynamic regime	*De Wachter and Volckaert 2005 (GAUFRE project BELSPO)*, *Van den Eynde et al. 2010*, *Verhaeghe et al. 2011*, *Van den Eynde et al. 2013*, *Vanhellemont and Ruddick 2014*, *Baeye and Fettweis 2015*
Effects on sediment transport and geomorphology	*De Wachter and Volckaert 2005 (GAUFRE project BELSPO)*, *Van den Eynde et al. 2010*, *Verhaeghe et al. 2011*, *Van den Eynde et al. 2013*, *Vanhellemont and Ruddick 2014*
Underwater noise	*De Wachter and Volckaert 2005 (GAUFRE project BELSPO)*, *Norro et al. 2010*, *Norro et al. 2011*, *Norro et al. 2012*, *Norro et al. 2013*, *Haelters et al. 2013a*, *Debusschere et al. 2014*, *Norro and Degraer 2016*, *Debusschere et al. 2016*, *Debusschere 2016*, *Norro 2017*, *Norro 2018*
Effects on fish and benthos (introduction of hard substrate, habitat loss, disturbance, etc.)	*De Wachter and Volckaert 2005 (GAUFRE project BELSPO)*, *Reubens et al. 2010*, *Coates and Vincx 2010*, *Derweduwen et al. 2010*, *Kerckhof et al. 2011*, *Reubens et al. 2011b*, *Van Hoey et al. 2011*, *Verhaeghe et al. 2011*, *Kerckhof et al. 2012*, *Coates et al. 2012*, *Vandendriessche et al. 2012*, *Coates et al. 2013a*, *Coates et al. 2013b*, *Vandendriessche et al. 2013a*, *De Mesel et al. 2013*, *Vandendriessche et al. 2013b*, *Reubens et al. 2013*, *Reubens 2013*, *Coates 2014*, *Rumes et al. 2013*, *De Mesel et al. 2015*, *Kerckhof and Degraer. 2016*, *Reubens et al. 2016*, *Derweduwen et al. 2016*, *Vandendriessche et al. 2016*, *Derweduwen et al. 2016*, *De Backer et al. 2017*, *Colson et al. 2017*, *De Backer and Hostens 2017*, *Kerckhof et al. 2017*, *ICES WGMBRED Report 2017, PERSUADE project BELSPO*, *De Backer and Hostens 2018*, *De Backer and Hostens 2018*, *Lefaible et al. 2018*, *Kerckhof et al. 2018*
Effects on birds and bats	*Stienen et al. 2002a*, *Stienen et al. 2002b*, *De Wachter and Volckaert 2005 (GAUFRE project BELSPO)*, *Everaert and Stienen 2007*, *Stienen et al. 2007*, *Vanermen et al. 2009*, *Brabant and Jacques 2009*, *Vanermen et al. 2010*, *Vanermen et al. 2011*, *Verhaeghe et al. 2011*, *Vanermen et al. 2012*, *Brabant et al. 2012*, *Vanermen et al. 2013a*, *Vanermen et al. 2013b*, *Vanermen et al. 2013c*, *Brabant et al. 2015*, *Vanermen et al. 2016*, *Brabant et al. 2016*, *Brabant et al. 2016*, *RAVEN project BELSPO*, *Vanermen et al. 2017*, *Brabant and Degraer 2017*, *Vanermen et al. 2018*, *Brabant et al. 2018*
Effects on marine mammals	*Stienen et al. 2002a*, *De Wachter and Volckaert 2005 (GAUFRE project BELSPO)*, *Evans 2008*, *Haelters et al. 2010*, *Haelters et al. 2011*, *Verhaeghe et al. 2011*, *Haelters et al. 2012*, *Haelters et al. 2013a*, *Haelters et al. 2013b*, *Haelters et al. 2014*, *Haelters et al. 2016*, *Rumes et al. 2017*, *Rumes en Debosschere 2018*
Impact on water and air quality	*Maes et al. 2004 (MARE-DASM project BELSPO)*, *De Wachter and Volckaert 2005 (GAUFRE project BELSPO)*, *Verhaeghe et al. 2011*
Disturbance of the seascape	*De Wachter and Volckaert 2005 (GAUFRE project BELSPO)*, *Vanhulle et al. 2010*, *Houthaeve and Vanhulle 2010*, *Di Marcantonio et al. 2013*
Maritime safety	*De Wachter and Volckaert 2005 (GAUFRE project BELSPO)*, *van Iperen and van der Tak 2009, Verhaeghe et al. 2011* (see also theme **Maritime transport, shipping and ports**)
Spatial impact (including conflicts with other users)	*Maes et al. 2004 (MARE-DASM project BELSPO)*, *De Wachter and Volckaert 2005 (GAUFRE project BELSPO)*, *Vandendriessche et al. 2011*, *Verhaeghe et al. 2011*, *Vandendriessche et al. 2013*, *Vandendriessche et al. 2016*

6.1.5 Sustainable use

MEASURES CONCERNING THE IMPACT ON THE MARINE ENVIRONMENT

On an international level, OSPAR published a guide (*OSPAR Guidance on Environmental Considerations for Offshore Wind Farm Development 2008*) about the impact of wind turbines on the marine environment. Within the context of the *ASCOBANS-agreement* (on the conservation of small cetaceans), the impact of wind turbines on marine mammals was evaluated (*Evans 2008*). In 2009, a resolution was issued against the adverse effects on marine mammals caused by underwater noise as a result of the construction of installations (pile-driving of the turbine foundations in the seabed, burial of the sea cables, etc.) for the generation of renewable energy at sea. As a consequence, a list of guidelines for reducing underwater noise has recently been published (*Prideaux 2016*). Based on the monitoring results of the construction phase of the first wind farms, a seasonal ban on piling for the coming wind farms from 1 January to 30 April is put into place in the BNS.

At the European level, the Marine Strategy Framework Directive (MSFD, 2008/56/EC) provides a framework to reduce or avoid the environmental impact of wind farms at sea. For instance, the supply of energy, including underwater noise, is identified as one of the descriptors for a good environmental status (GES) (*descriptor 11*). Other descriptors in the MSFD relevant to the installation of wind turbines at sea are: seabed integrity (*descriptor 6*), the introduction of non-indigenous species (*descriptor 2*) and the permanent alteration of hydrographic conditions (*descriptor 7*).

At the Belgian level, a monitoring programme has been established in the BNS to monitor the impact of wind turbines on the marine environment. This programme is co-ordinated by the *MUMM* and has a dual objective:

- To adapt, reduce or even stop the activities in the event of extreme damage to the marine environment;
- To gain a proper insight into the impact of wind turbines at sea on the environment in order to be able to support the policy, management and design of future wind turbines.

The monitoring programme studies the physical, biological and socio-economic aspects of the marine environment (e.g. *Degraer and Brabant 2009*, *Degraer et al. 2010*, *Degraer et al. 2013*, *Degraer et al. 2016*, *Degraer et al. 2017*, *Degraer et al. 2018*) in relation to a baseline condition (e.g. *De Maersschalck et al. 2006*, *Henriet et al. 2006*, *Van den Eynde 2005*).

The offshore wind parks can be used as a laboratory for multiple use of space. In this context, the Actieplan Zeehond examined the impact of artificial reefs and resting places within the parks on biodiversity and productivity (*Action Plan Zeehond 2012*). In addition, two pilot projects for integrated aquaculture have already been identified within the *AQUAVALUE roadmap*, for example, the *EDULIS project* tests mussel farming within the C-Power and Belwind wind farms. The marine spatial plan (RD of 20 March 2014, see also *Van de Velde et al. 2014*) and the *Long-term vision of the North Sea 2050* encourage multiple use of space within the wind farms, with opportunities for aquaculture, nature development, wave and tidal energy, etc. However, given the current high density of the wind farms, the possibilities are limited.

THE DEVELOPMENT OF OFFSHORE WIND ENERGY – BOTTLENECKS AND MEASURES

At the European level a number of policy initiatives have already been taken to promote the development of offshore wind energy. These include (not exhaustive):

- The *Strategic Energy Technology Plan* (SET-Plan, COM (2007) 723) – A strategic plan to accelerate the development of cost-effective, low carbon technologies. Ideas about a new, integrating strategy for the coming years was communicated in 2015 (C (2015) 6317);
- COM (2008) 768 on offshore wind energy – Action is needed to achieve the energy policy objectives for 2020 and beyond;
- In the framework of the Integrated Maritime Policy (COM (2007) 575), a long-term strategy for more sustainable growth in the marine and maritime sectors has been developed (Blue Growth, COM (2012) 494). Specifically, for the blue energy sector (including offshore wind energy), COM (2014) 8 developed eight measures to exploit the potential of ocean energy in Europe's oceans and seas by 2020 and beyond;
- COM (2016) 860 on Clean energy for all Europeans – Communicates a regulatory framework in which Europe aims to achieve the transition to clean energy, including offshore, based on three pillars (energy efficiency, renewable energy leadership and affordable energy for consumers);
- In 2016, the countries of the North Sea region signed a *political declaration* (2016) in which they confirm a policy of cooperation. The objective is twofold: on the one hand, to facilitate the cost-effective use of wind energy and, on the other hand, to improve interconnection between the countries in the region;

- In support of the European energy policy, and at the request of the European Commission, *ETIPWind* (a SET-plan product) developed a strategic research and innovation agenda (*SRIA 2018*). It presents visions for cost reduction, the facilitation of network integration, the maintenance of technological leadership and the retention of expertise in Europe.

Furthermore, Europe has invested in research on offshore wind energy (COM (2008) 534). The different aspects of the development of offshore wind energy have been investigated in multiple projects, including FP7-*Oceans of Tomorrow 2014* and the Horizon 2020 programme (*Blue Growth-calls*). Taking into account the age of the first wind farms and the current European energy policy aiming at a switch to sustainable energy, attention is rising for the dismantling of (old) offshore wind turbines with an increasing demand for more scientific substantiation on this matter (*EMB Policy Brief 2017*).

The federal Government has decided on a series of measures to stimulate the generation of electricity from renewable energy in the BNS:

- The electricity law of 29 April 1999 defines measures with regard to the organisation of the energy market to ensure that a certain volume of electricity is delivered by renewable energy sources at a certain price;
- The law of 29 April 1999 stipulates, *inter alia*, that transmission system operator Elia has to finance one third of the cost of the submarine cable connecting the turbines to the coast, with a maximum of 25 million euro per project (see also **6.6 Pipes and cables**);
- The RD of 16 July 2002 develops a system for granting certificates which guarantee the origin of the produced energy as well as 'green certificates' (GC) for electricity produced from water, currents or wind in the BNS. The Commission for the Regulation of Electricity and Gas (*CREG*) grants GCs to energy producers that hold a concession zone and a certificate with a guarantee of the origin. Minimum prices are set for the resale of certificates received for green energy production. For energy generated by offshore wind turbines, the transmission system operator is obliged to purchase the GCs from the green energy producer who requests it at a minimum price:
    - For the Belwind, C-Power and Northwind wind farms, this is set at 107 euro/MWh for the production that follows from the first 216 MW installed capacity. This minimum price falls to 90 euro/MWh for production from an installed capacity above the first 216 MW;
    - For Nobelwind (part of the initial Belwind-domain concession), the minimum price is 107 euro/MWh for the first 45 MW installed capacity and 90 euro for the remaining 120 MW;
    - For Rentel and Norther, the minimum price per GC depends on the electricity price. The minimum price is set by the *CREG* in accordance with the applicable provisions of the RD of 16 July 2002 (Article 14 §1, 1ter)[3]. It provides for an LCOE (levelised cost of energy) of 124 euro/MWh for Norther and 129.8 euro/MWh for Rentel. The support period and purchase commitment is set at 19 years;
    - For the last two wind farms (Northwester 2, Seamade (zone Mermaid and zone Seastar)), the minimum price is set at 79 euro/MWh LCOE for 16 years and renewable by one year and for a maximum of 63,000 full load hours (*BOP*).

In addition, a number of platforms and clusters have been set up to promote the interests of the sector and its development:

- The Belgian Offshore Platform (*BOP*) unites the main Belgian actors that invest in renewable (wind)energy on the Belgian part of the North Sea (concessionaires and direct investors). The BOP aims to stimulate further development through *inter alia* representing the interests of its members in the public sector, utilities and with other instances or people;
- Belgian Offshore Cluster (*BOC*) aims to represent the interests of the offshore industry (suppliers) and to ensure that its Belgian know-how is represented and put on the international map. The BOC intends to create a broad and independent (industrial) support base that maintains the necessary connections between the sector, government and international institutions aiming for qualitative improvement as well as achieving relevant results for the Belgian Offshore Industry;
- The *Blue Cluster*, a spearhead cluster of the Government of Flanders for sustainable and innovative economic development on the BNS, also includes offshore energy. In a first phase, the focus will be on opportunities relating to energy storage and nearshore wind (in which coordination will be sought with the activities of IBN Offshore Energy, see further);
- Flanders' Maritime Cluster (*FMC*), the network organisation for the marine and maritime industry in Flanders, also supports companies active in the Blue Growth sector in general and therefore the offshore energy sector. FMC has been included in the Blue cluster since 2018 (see above).

[3] A new offshore support regime was stipulated in the aforementioned RD of 16 July 2002, which was promulgated and ratified on 9 February 2017. This is a guaranteed minimum price, where the amount of support decreases with increasing electricity price. The calculation of the minimum price is now based on the following formula: minimum price = LCOE - [(electricity reference price x (1 - correction factor) + the value of the guarantees of origin) x (1-transmission loss factor)].

In order to support the Flemish companies active in the value chain of offshore energy with regard to their innovation plans, the innovative company network Offshore Energy (*IBN Offshore Energy*) was launched at the Flemish level. This innovation cluster was developed in early 2017 with the support of the Flemish Agency for Innovation and Entrepreneurship (*VLAIO*) with the core objective of providing support in the realisation of innovative project plans in the field of offshore energy. The IBN is open to both large companies and innovation-centered organisations and is supported through the knowledge institutions by the Offshore Wind Infrastructure Application Lab (*OWI-Lab*). OWI-Lab is conceived from a partnership between Sirris and VUB, to which UGent joined more recently. In addition to its involvement in this cluster, OWI-Lab also has specific test infrastructure and coordinates several projects on cost reduction in offshore wind energy production through research and innovation.

Other initiatives that support the development of the offshore wind sector and facilitate innovation from a regional perspective are:

- *Factories for the Future Blue Energy* – an initiative of the *POM West-Vlaanderen* to bring together various actors from the government, knowledge institutes and companies on 'Blue Energy' (wind, wave and tidal energy) to enforce the sector (*Dangreau 2014*). This is achieved by realising concrete objectives and actions in partnership within three domains: product and process, research and testing, and internationalisation;
- *TUA West* of the province of West Flanders aims to stimulate the integration of knowledge from provincial higher education and research in economic developments. TUA West focuses on selected knowledge acquisition within West Flanders, including Blue Energy.

6.2 Wave and tidal energy

The European Commision's Blue Growth Strategy (COM (2012) 494, *website DG MARE*) highlights blue energy as one of its priority areas. In order to make optimal use of the potential of marine energy (tidal energy, wave energy and energy extraction from temperature and salinity gradients), a number of measures were listed by the Commission (COM (2017) 8). Hence, the potential of marine energy is impressive (*World energy resources marine energy 2016*). The European Commission estimates that, given the right development climate, 10% of Europe's energy needs could be covered by blue energy by 2050 (*website DG Research and Innovation*). However, irrespective of small exceptions, marine energy production in European waters is still limited due to the fact that, unlike wind energy, technology is still in the development phase. By mid-2016, the cumulative capacity reached 252 MW, excluding test and validation infrastructure. Member States' plans indicate an ambition to install a capacity of 665-850 MW by 2020 (*Ocean energy strategic roadmap 2016*, *JRC Ocean Energy Status Report 2016*).

Currently, research to further develop marine energy technologies is ongoing (see for example *website DG Research and Innovation* and *Ocean Energy ERA-NET Cofund*). The status of research (see also *Uihlein and Magagna 2016*), production, projects and policy at national level is followed up in the *Annual Report Ocean Energy Systems (2019)* and the *JRC Ocean Energy Status Report (2016)*. Recently, in the context of the implementation of the SET-plan, a working group was established by the EC to examine the feasibility of the technological research on ocean energy production known as *ETIPOcean*. To this end, a strategic research agenda has been developed (*Strategic research agenda ocean energy 2016*). Publications and research projects related to the development of ocean energy in the Belgian part of the North Sea are listed in table 6 that *inter alia* make clear that the BNS is particularly suitable as a test location due to its low wave climate (estimated potential within wind farm concession zone 4.5 – 5.8 Kw m^{-1}). In

Table 6. An overview of the research on wave and tidal energy on the BNS.

Research subject		Literature
Wave energy	Technological and operational aspects	*Mathys et al. 2009 (OPTIEP-BCP project BELSPO)*, *De Backer et al. 2008*, *Beels 2010*, *Mathys et al. 2012 (BOREAS project BELSPO)*, *De Backer 2009*, *Van Paepegem et al. 2011*, *Stratigaki 2014*
	Economic aspects	*Beels 2010*, *Mathys et al. 2012 (BOREAS project BELSPO)*
	Ecological aspects	*MER Mermaid en Northwester 2*, *Rumes et al. 2015 – MEB Mermaid*, *Rumes et al. 2015*, *MER-NEMOS 2016*, *Haelters et al. 2017 – MEB NEMOS*, *MER Blue Accelerator 2017*
	Potential (wave climate BNS)	*Mathys et al. 2009 (OPTIEP-BCP project BELSPO)*, *De Backer et al. 2008*, *Beels 2010*, *Fernandez et al. 2010*, *Mathys et al. 2012 (BOREAS project BELSPO)*, *De Backer 2009*
	Prototype development	*FlanSea project (project description, Van In 2014)*, *Laminaria (prototype tested on the North Sea)*, *NEMOS*, *MER-NEMOS 2016*
Tidal energy	Technological and operational aspects	*Mathys et al. 2009 (OPTIEP-BCP project BELSPO)*, *Mathys et al. 2012 (BOREAS project BELSPO)*
	Economic aspects	*Mathys et al. 2012 (BOREAS project BELSPO)*
	Potential (tidal climate BNS)	*Mathys et al. 2009 (OPTIEP-BCP project BELSPO)*, *Mathys et al. 2012 (BOREAS project BELSPO)*

order to further stimulate wave and tidal energy in Flanders, partners from the academic community, industry and the government developed an action plan called *Gen4Wave*. The platform's operation has since been integrated into the operation of *IBN Offshore Energy*. At the impulse of the Hydraulic Laboratory (WatLab, MOW), KULeuven and UGent, Gen4Wave's operation also resulted in the construction of a coastal and ocean basin (COB) in *Greenbridge* (Ostend) providing test opportunities for developers of wind, wave and tidal energy and land-sea interactions (*Troch et al. 2017*). This COB test infrastructure is complementary to the plans for a multifunctional offshore test platform (including offshore energy production) in the context of the Blue Accelerator project (*MER Blue Accelerator 2017*). Furthermore, the development of wave energy is also supported by *Factory for the Future Blue Energy* of the West Flanders Development Agency (POM West-Vlaanderen) (*Dangreau 2014*, *Vanden Berghe 2014*).

In the area of the BNS reserved for wind farms, the construction and exploitation of installations for the production of electricity from water and streams is also permitted (RD of 20 March 2014 (MSP) and RD of 20 December 2000, amended by RD of 3 February 2011). In the Seamade zone Mermaid concession zone a pilot project with wave converters is being planned with a capacity of 5 MW[4] for commercial use (*Application Mermaid 2014*). The EIA of this concession zone also discusses the potential impact of these converters on the environment (*Rumes et al. 2015 – MEB Mermaid*, *Rumes et al. 2015*).

The energy production zones included in the draft of the MSP 2020-2026 also provide space for alternative energy sources to wind energy such as tidal, solar and wave energy (*MSP 2020-2026, public consultation 2018*).

6.3 Renewable energy in the coastal zone

The coastal zone has a number of natural characteristics that makes it an interesting region for certain forms of renewable energy. A study into the average wind speeds in Flanders (*Een windplan voor Vlaanderen*) showed that the coast has a considerably higher wind supply (see also *Dehenauw 2002* and *Debrie 2017*). In our wind climate, a production factor[5] of ±11% inland, ±23% near the coast and ±34% offshore (*Brouwers et al. 2011*) can be expected, although this can be estimated more accurately within the offshore parks as they become operational. In addition, measurements reveal that the average duration of sunshine in the coastal zone is 1,700 hours per year compared to 1,550 hours in Uccle (inland). The biggest differences occur in the summer when the coast can receive up to 20 more hours of sunshine per month (*Dehenauw 2002*). The *climate atlas* of the Royal Meteorological Institute of Belgium (RMI) also provides parameters such as sunshine duration and solar radiation for Belgium, that clearly reveal elevated values for the coastal zone. Hence, the coastal zone has an increased potential for solar energy. Of course, other forms of energy production are also present in the coastal zone (e.g. biomass, biogas, etc.). However, given that the coast does not provide a specific climate for this, they will not be discussed further here.

At the European level, the energy policy is developed by the *Directorate-General Energy*. A key instrument in this context concerns the Directive 2009/28/EC on the promotion of the use of energy from renewable sources. This directive stipulates that Belgium must include 13% renewable energy in its final energy consumption by 2020[6]. Furthermore, this directive obliges each Member State to elaborate a national action plan to achieve the renewable energy goals (*Nationaal actieplan België hernieuwbare energie 2010*). A modification with directives to new renewable energy goals towards a share of at least 27% renewable energy by 2030 is currently under preparation (COM (2016) 767). On 18 June 2018, it was decided to adjust this target to 32% renewable energy by 2030 (*EC Statement/18/4155*).

Unlike nearshore energy production, renewable energy on land is a Flemish competence which is largely regulated by the Energy decree of 8 May 2009 (*Department Environment*, *Vlaamse beleidsnota energie 2014-2019*). The Flemish Energy Agency (VEA) implements this policy (*website VEA*). A comprehensive overview of renewable energy legislation and regulations can be found on the *VEA website*. At the end of 2017, a total of 33 concession zones were present in the coastal zone that qualify for green certificates (GC). These represent a total installed capacity of 145.4 MW. The vast majority of the installed capacity is located in Bruges and Ostend (Source: *Vlaamse Regulator van de Elektriciteits- en Gasmarkt, VREG*).

More specifically, 17 wind farms were present in the coastal zone in March 2018, mainly in Zeebrugge (strekdam), Bruges, Gistel, Diksmuide and Middelkerke. These account for an installed capacity of 67.7 MW or 6.6% of the capacity of the Flemish wind turbines (Source: *Vlaamse Regulator van de Elektriciteits- en Gasmarkt, VREG*).

[4] Recent numbers suggest an installed capacity of up to 20 MW (BOP).
[5] The production factor indicates the average power at which energy is produced, expressed as a percentage of the maximum power. It is used in determining the effective power (installed power x production factor).
[6] Target for the share of energy from renewable sources in gross final consumption of energy.

As far as photovoltaic panels for solar electricity are concerned, 17,126 installations with a capacity of less than or equal to 10 kW were present in the coastal zone, representing a total installed capacity of 74.8 MW (31 March 2018). In addition, 404 installations with a capacity of more than 10 kW, with a total installed capacity of 59.5 MW were present (Source: *Vlaamse Regulator van de Elektriciteits- en Gasmarkt, VREG*).

6.4 Natural gas installations at Zeebrugge

Belgium imports over 19 billion m³ of natural gas per year (*Statbel*). In addition, approximately 95 billion m³ of natural gas is reserved in the long term for border-to-border transport. It concerns Dutch and Norwegian natural gas for France and Spain, British natural gas for continental Europe, including Russian natural gas for the United Kingdom as well as natural gas for the Grand Duchy of Luxembourg. Zeebrugge plays an important role in the European gas market. The landing capacity in Zeebrugge corresponds to approximately 10% of the total border capacity needed to supply the EU (*België als aardgasdraaischijf voor Noordwest-Europa: de weg vooruit 2010*). In 2016, a second jetty was put into service in the outer port of Zeebrugge, allowing the simultaneous handling of small and large LNG vessels, and a fifth storage tank of 180,000 m³ LNG (liquefied/liquid natural gas) is currently under construction and is due to be operational by 2018 (*Niet-technische samenvatting MER uitbreiding Fluxys LNG, Zeebrugge*, *Fluxys*).

6.4.1 Policy context

The European policy on energy is developed by the *Directorate-General Energy*. A list of the (European) legislation relevant to natural gas is given on the websites of the *CREG* and the *FPS Economy, S.M.E.s, Self-Employed and Energy*.

The federal Government (*FPS Economy, S.M.E.s, Self-Employed and Energy*) is responsible for the major energy storage, transport and production infrastructures and defines the rate policy for the operators (in this case Fluxys and Fluxys LNG). The transport of gaseous products is regulated by the federal law of 12 April 1965 (the Gas Law) and by a number of royal decrees on rates and more technical aspects relating to network access (code of conduct) (more information: *website Fluxys*, *website CREG*, *website F.P.S. Economy, S.M.E.s, Self-Employed and Energy*). In addition, there is a federal regulator: the Commission for the Regulation of Electricity and Gas (*CREG*). Flanders is competent for, *inter alia*, the public distribution of gas, which is managed by so called *intercommunales*, as well as for the rational use of energy (special law on institutional reform (BWHI) (law of 8 August 1980), more information: *website FPS Economy, S.M.E.s, Self-Employed and Energy*).

6.4.2 Spatial use

The LNG terminal is located in the eastern part of the outport of Zeebrugge. The peninsula on which the LNG terminal is located covers an area of approximately 32 ha. Work is currently being carried out on a fifth storage tank, which is scheduled to become operational in 2018, after which the Zeebrugge LNG terminal will be expanded to include a storage tank, landing platform and additional transmission capacity (*Open season: second capacity enhancement of the Zeebrugge LNG-terminal. Binding phase: offer description 2011*, *Niet-technische samenvatting MER uitbreiding Fluxys LNG, Zeebrugge*).

The marine spatial plan (RD of 20 March 2014, see also *Van de Velde et al. 2014*) provides space for the expansion of the port of Zeebrugge, which, in addition to the LNG terminal also hosts the terminals of the Seapipe and Interconnector gas pipelines (see **6.6 Pipes and cables**).

6.4.3 Societal interest

Zeebrugge is a cornerstone in the supply chain of natural gas to Northwest Europe. In addition to the LNG terminal and the terminals of the Seapipe and Interconnector gas pipelines (see **6.6 Pipes and cables**), the Zeebrugge Hub also forms one of the leading short-term markets in Europe (*Belgium as a natural gas hub for northwestern Europe: the road ahead 2010*, *Brouwers et al. 2011*). As a result of a recent drop in natural gas prices and a high demand from Asia, the transhipment of natural gas in Zeebrugge dropped to 1.3 billion m³ in 2017. In 2010, 62 billion m³ of gas was still traded, at that time worth over 10% of the total natural gas supply capacity of the European Union (*Open season: second capacity enhancement of the Zeebrugge LNG terminal. Binding phase: offer description 2011*, *Maatschappij van de Brugse Zeehaven 2017*).

The installations of the LNG terminal in Zeebrugge are equipped for the reception of ships carrying liquefied natural gas (LNG). Since 2008, there are four active storage tanks with a total handling capacity of 9 billion m³ of natural gas per year, equalling 110 LNG ships with a capacity of up to 217,000 m³ of LNG (*Open season: second capacity enhancement of the Zeebrugge LNG terminal. Binding phase: offer description 2011*, *Brouwers et al. 2011*). An additional storage tank of 180,000 m³ LNG (*Niet-technische samenvatting MER uitbreiding Fluxys LNG, Zeebrugge*) will come into service in 2018 (*Fluxys*), allowing for a transhipment capacity of 11 billion m³ of liquefied natural gas (*Indicatief insversteringsprogramma Fluxys 2017-2026*). Fluxys has also opted for a model of cooperation for the development of an LNG terminal in Dunkirk and participates for 25% in this project. The two terminals will be connected via a new interconnection point in Alveringem and Maldegem, which will allow to bring up to 8 billion m³ of gas to Belgium and elsewhere in Europe from the LNG terminal in Dunkirk.

6.4.4 Impact and sustainable use

The construction of natural gas installations in Zeebrugge implies a certain impact on the environment as well as on other users. These effects are dealt with in the corresponding environmental impact assessments (EIAs, see *MER-database Vlaamse overheid*, *Niet-technische samenvatting MER uitbreiding Fluxys LNG, Zeebrugge*). A number of measures have already been proposed in these EIAs to mitigate or avoid the impact of the LNG terminal on the surrounding area.

The use of natural gas as an energy source has a number of environmental benefits compared to other fossil fuels (*website Fluxys*). Today, the use of LNG as ship fuel is being promoted and is gaining in importance because it emits less harmful substances than diesel or heavy fuel oil (*Policy Statement 2017 North Sea*, *In-Focus LNG as ship fuel 2015*, *Margarino 2014*, see theme **Maritime transport, shipping and ports**).

6.5 Energy storage in the North Sea

Some renewable energy sources such as wind energy, are characterised by a discontinuity in the amount of energy produced. In order to guarantee a continuous supply of offshore energy that is adapted to the temporal variation in use, the *federal Government's coalition agreement (2014)* focuses on the storage of electricity. To enable this, the feasibility of hydroelectric energy storage (pumped storage plant principle) in a so-called energy atoll off the Belgian coast is being studied (see, *inter alia*, a study by the former Environmental-Innovation Platform *(MIP 2013)* of the Government of Flanders).

The marine spatial plan (RD of 20 March 2014, see also *Van de Velde et al. 2014*) defines two zones for energy storage in an energy atoll: off the coast of Wenduine and near the port of Zeebrugge. Concerning the zone near the port of Zeebrugge, such an atoll must be adapted to current port activities and future port expansion. The MSP also stipulates that an energy atoll can only be realised if active environmental management measures are in place. The conditions and the procedure for granting the domain concessions for such an energy atoll were laid down in the RD of 8 May 2014 implementing the law of 29 April 1999 (figure 4). Prior to this RD, the Commission on the Regulation of Electricity and Gas (*CREG*) *advised (2013)* that it is pertinent to reserve a zone for energy storage. Furthermore, the construction of an energy atoll needs to comply to the provisions of the environmental permit procedure, in accordance with the law on the protection of the marine environment (law of 20 January 1999), the RD of 7 September 2003 (procedure for permits and authorisation of certain activities in the BNS), the RD of 9 September 2003 (regulation on environmental impact assessment) and the RD of 12 March 2002 (permit for the laying of sea cables).

The consortium THV iLand submitted an application for obtaining a concession zone for the construction and exploitation of an offshore energy atoll situated near the Wenduine bank (zone 1 in the marine spatial plan). The application was built around a basic scenario with an installed capacity of 550 MW and an available energy content of 2 GWh (*Projectfiche THV iLand 2014*). However, the application was withdrawn in September 2015. Notwithstanding ideas still exist among project developers for an adapted multifunctional island with an energy storage function off the Belgian coast.

The draft of the MSP 2020-2026 no longer includes the two previously defined zones, but includes zones for commercial and industrial activities in which multiple use of space is targeted with energy storage being one of the possible activities (*MSP 2020-2026, public consultation 2018*).

In *Zimmerman et al. (2013)*, the effects of an energy atoll on currents, coastal morphology and coastal safety were investigated. In the study of the former Environmental-Innovation Platform of the Government of Flanders (*MIP 2013*), the ecological, legal and financial-economic aspects of an atoll at four different locations are discussed including a SWOT analysis for each location.

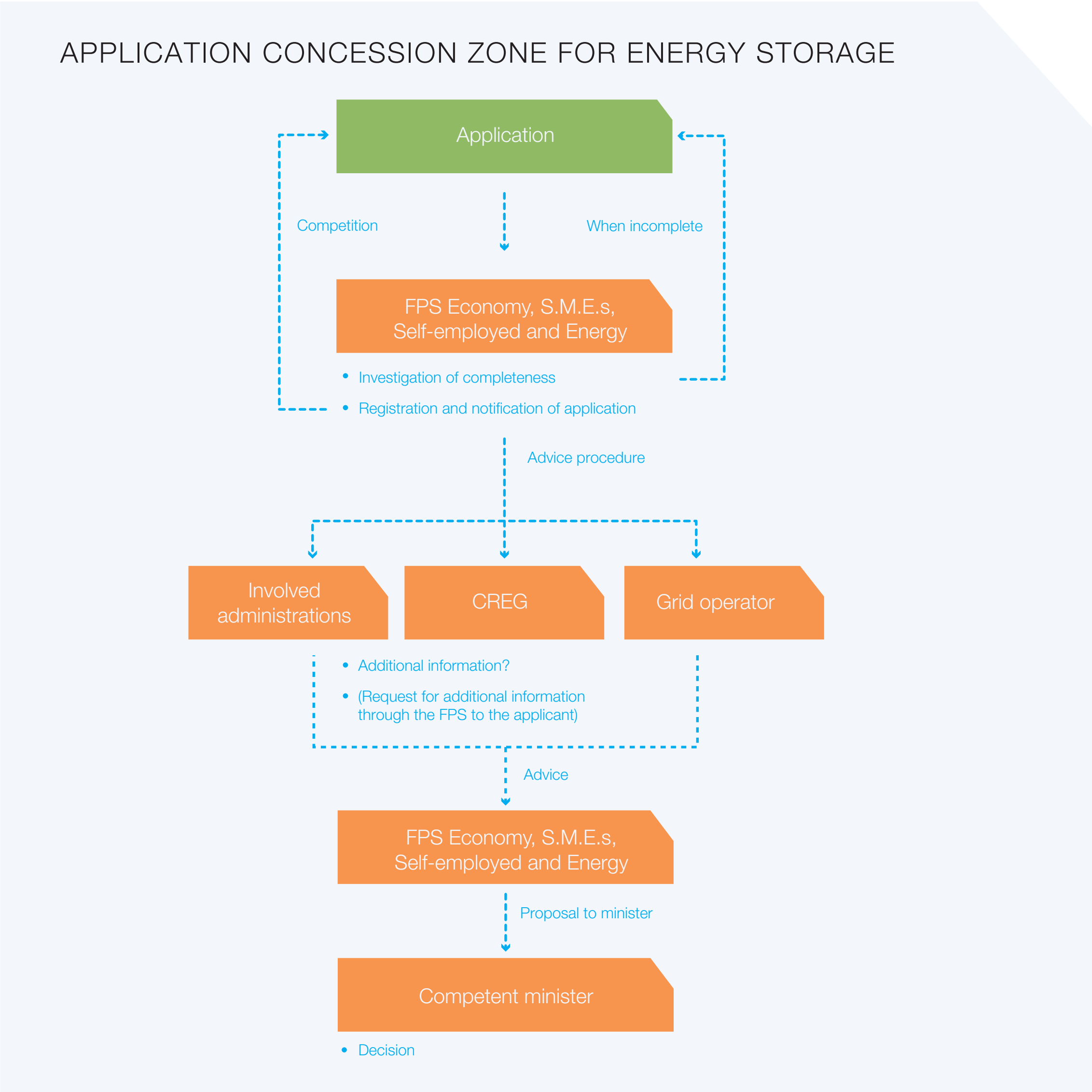

Figure 4. Flowchart for the application of a domain concession for energy storage (RD of 8 May 2014).

Another option to compensate fluctuations in energy generation is to convert the generated energy into hydrogen, the so-called 'Power-to-Gas' principle. The feasibility and valorisation of this technique is being investigated by an Innovative Business Network (IBN) '*Platform Power to Gas*' within the 'Power-to-Gas' project (2014-2020). The first tests in which hydrogen gas generated by offshore wind is produced and then transported through existing gas pipes are currently being prepared in cooperation with the Netherlands (*Power-to-Gas Roadmap for Flanders 2016*).

6.6 Pipes and cables

In the OSPAR area, the 1,300 oil and gas platforms are connected by a pipeline network of more than 50,000 km (*OSPAR QSR 2010*). In the Belgian part of the North Sea (BNS) there are three gas pipes with a total length of 163 km (*Verfaillie et al. 2005*, *GAUFRE project BELSPO*, *MUMM*):

- The Sea Pipe Pipeline (40” diameter) connects the Gassco AS terminal in the port of Zeebrugge with a pipeline on the Norwegian shelf and has a total length of 814 km. Seapipe has been operational since 1993 and has a capacity of approximately 15 billion m³ on an annual basis;
- The Interconnector pipeline is 215 km long (with a diameter of 40”) and is located between the port of Zeebrugge en Bacton (south coast of the UK). The import capacity to Belgium amounts to 20 billion m³ on an annual basis. Interconnector has been operational since 1998. The Interconnector is configured to control gas flow in two directions. The export capacity to the United Kingdom is approximately 25.5 billion m³ on an annual basis;

- The Franpipe pipeline (formerly known as Norfra) is a 840 km long pipeline (with a diameter of 42”) between the Norwegian Draupner E-platform and the French port of Dunkirk, which partly crosses the BNS (*Maes et al. 2000*). This pipeline only passes through the BNS and does not call at a Belgian port. Franpipe has been in operation since 1998 and has an annual capacity of approximately 19.6 billion m³.

In addition, the North Sea and the North-East Atlantic are intersected by telecommunication and power cables. Telecommunication cables are mainly located in the southern part of the North Sea, the Celtic Seas and the transatlantic corridor. Power cables can be found in the North Sea and the Celtic Seas (*OSPAR QSR 2010*). On the Belgian Continental Shelf (BCS) there are a total of 27 telecommunications cables, 16 of which are actively used, representing a length of 914 km (*Verfaillie et al. 2005*, *GAUFRE project BELSPO*). In the future, the share of power cables will increase considerably as a result of the installation of wind turbines off the Belgian coast (see **6.1 Offshore wind energy**). Cable permits were issued in mid-2018 for nine complete cable routes (1 cable for Seamade, Northwester 2, Rentel and Norther; 2 cables for Belwind-Cabelco and C-Power; and 3 cables (partial routes) for Elia) (*MUMM*). Five cables are currently in use (Belwind-Cabelco, C-Power en Rentel). The other wind farms (including Rentel and excluding Norther) will be connected to Elia’s Modular Offshore Grid (see also **Modular Offshore Grid**) (*Elia*, *Federaal Ontwikkelingsplan van het transmissienet 2015-2025*, *Degraer et al. 2018*). Finally, within the framework of the *NEMO project*, an submarine and underground power cable is being laid between Belgium and the United Kingdom (*Milieueffectenrapport - NEMO LINK 2012*, *Brochure NEMO-STEVIN 2013*) (see also **NEMO Link**). The possibility of a second HVDC interconnector cable between the UK and Belgium is currently being investigated within the so called Nautilus project (*Elia*, *Volckaert and Durinck 2018*).

6.6.1 Policy context

The procedure for the installation of cables on the BCP is stipulated in the RD of 12 March 2002 (see also MB of 8 May 2008) (figure 5). Applications are addressed to the federal minister for Energy or his delegate. This application for a permit is submitted to the minister. The dossier is accompanied by the evaluation of the impact on the environment and the advice of all administrations involved. The granting of the permit is motivated by a ministerial decision that specifically takes into account the conclusions of the environmental impact assessment (EIA). The impact on the environment is assessed on the basis of an environmental impact report (EIR) by the Management Unit of the North Sea Mathematical Model (*RBINS-MUMM*).

The procedure for laying pipelines is stipulated in the law of 12 April 1965 on the transport of gaseous products and others by pipelines. This basic law has been supplemented by various royal decrees.

The agreement between Norway and Belgium relating to the Franpipe pipeline was formalised in the law of 13 May 2003 and in the law of 19 September 1991 concerning the Seapipe pipeline. The agreement with regard to the transport of gas in the Interconnector pipeline between Great Britain, Northern Ireland and Belgium was formalised in the law of 26 June 2000. For an overview of the regulations concerning the cables and pipelines in the BNS, see the *Codex Coastal Zone, theme Cables and pipelines* and *Bijlagen bij het KB tot vaststelling van het marien ruimtelijk plan*.

6.6.2 Spatial use

In the marine spatial plan (RD of 20 March 2014, see also *Van de Velde et al. 2014* and *Bijlagen bij het KB tot vaststelling van het marien ruimtelijk plan*) an area (‘corridor’) is defined in which cables and pipelines must be bundled as much as possible. Activities that threaten the installation or exploitation of these cables and pipelines are prohibited in this area. The preliminary draft of the MSP 2020-2026 maintains this zone with its limitations (*MSP 2020-2026, public consultation 2018*). The use of space around power cables in the BNS is further elaborated in the RD of 12 March 2002 (table 7).

The connection points for the power cables of the offshore wind farms are located in Ostend (Slijkens) (C-Power) and Zeebrugge (Belwind, Norther, Nobelwind and Northwind). For the remaining wind farms (Rentel, Seamade and Northwester 2), the onshore connection will be provided via the Modular Offshore Grid, also in Zeebrugge. The onshore connection of power generated by the offshore wind farms is largely dependent on the reinforcement of the power grid in the coastal zone as part of the Stevin project, which involves the construction of a high-voltage connection between Zomergem en Zeebrugge (*Tant 2014*, *website Elia*).

By analogy with the spatial regulations for power cables, special provisions apply to the use of space around pipelines (RD of 19 March 2017, table 8).

Table 7. An overview of the use of space in the proximity of power cables in the BNS (RD of 12 March 2002).

Spatial use in the proximity of power cables (RD of 12 March 2002)	
Protected zone (250 m on both sides)	**Reserved area (50 m on both sides)**
Anchoring prohibited	No installation, no construction of cable or pipeline
No activity with a risk to the cable (except for the installation of another cable under specific conditions)	
Exception: interventions of cable owner for exploitation	Exception: single-pole cables at the same safety switch, arrival and departure cables to a wind turbine in parallel with other cables, arrival and departure point to an installation with one or more cables, convergence point of several cables forming part of the same return mechanism to the mainland, cables which have undergone repair

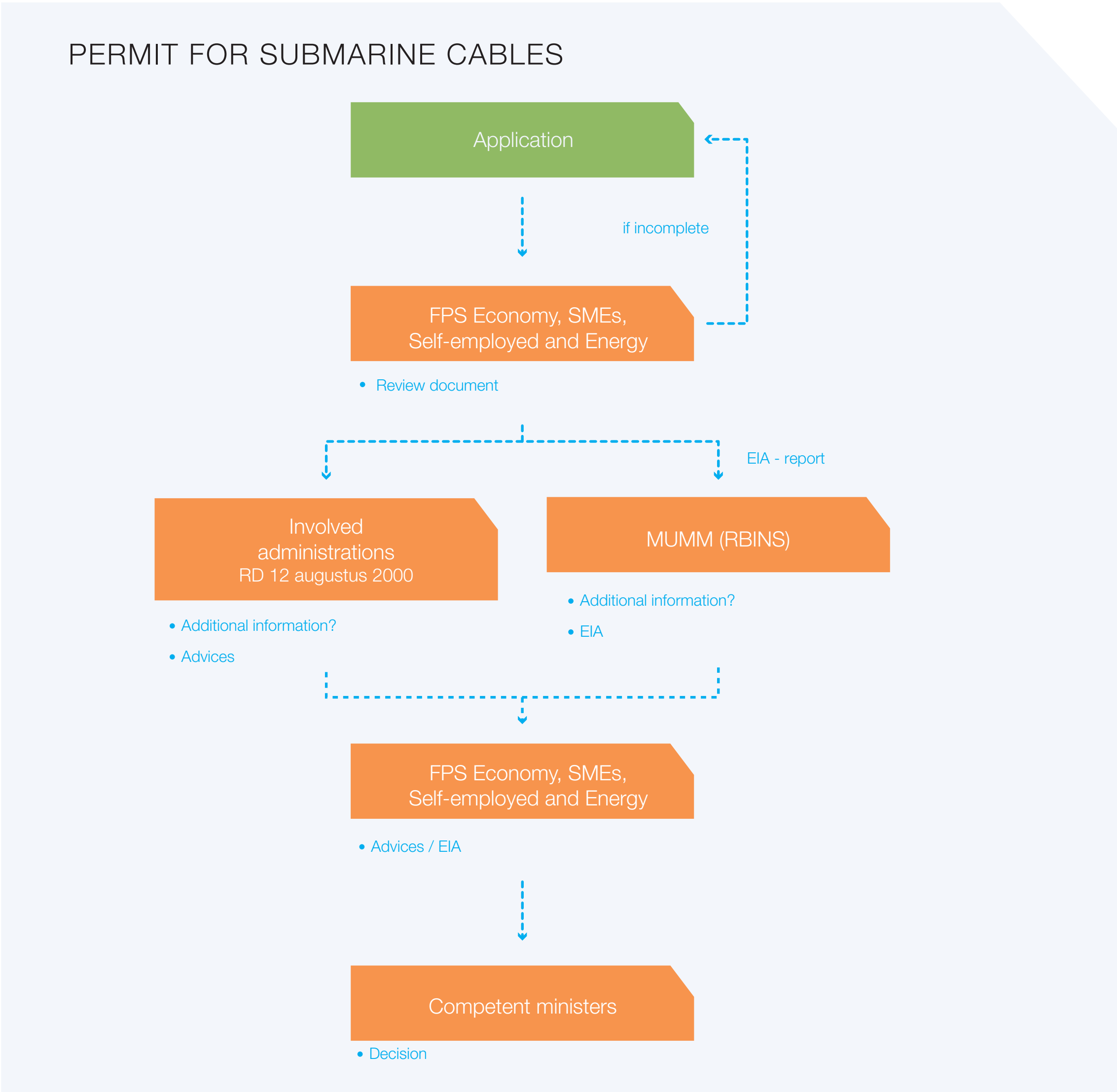

Figure 5. Flowchart for the application for a permit for sea cables (RD of 12 March 2002).

Table 8. An overview of the use of space around offshore pipelines in the BNS (RD of 19 March 2017).

Spatial use in the proximity of offshore pipelines (RD 19 March 2017)	
General provision	**Commentary**
Protected zone (1,000 m on both sides)	Each zone is divided into two zones (500 m on both sides)
First zone reserved for exploitation and maintenance by the permit holder	Derogation granted subject to ministerial approval and written approval of the permit holder
Second zone can allow static structures (pipelines, power and telecommunication cables, installations for the generation of power by wind, hydropower or sea waves and artificial islands having no influence on the stability on the seabed)	Provided that written consent of the permit holder is obtained
The above provisions do not apply in the landing zone. There, a minimum distance of 0.50 m is respected between the submarine structures, both in case of crossing and in case of parallel route, in order to allow inspection and maintenance works. Crossings with another operator's pipelines must be requested and approved in writing by the operator of the crossed pipelines.	

6.6.3 Societal interest

Modular Offshore Grid

Due to the increasing importance of energy production at sea (see also **6.1.3 Offshore wind energy – Societal interest**), there is a growing demand for submarine power cables for the transmission of energy to land. The development of wind energy and, by extension, offshore energy in the BNS was initially accompanied by separate connections to the onshore grid. With the '*Modular Offshore Grid*' (MOG), work is being done to ensure that the landing of offshore energy takes place in a more coordinated manner, as this provides technical, economic and ecological benefits. The MOG consists of a meshed offshore power network, or '*plug at sea*', whereby primarily wind farms (Rentel, Northwester 2 and Seamade), but in the future also other alternative energy sources (wind, waves) will be connected to high-voltage substations, which will subsequently connect to the onshore transmission grid (*offshoreWIND, Federaal Ontwikkelingsplan van het transmissienet 2015-2025*). These actions will enable the further development of offshore energy.

The MOG – phase I will consist of one so-called Offshore Switch Yard (OSY) at the Rentel concession zone (figure 6) and of installations placed on the Rentel Offshore High Voltage Station, in the Rentel domain concession. The construction started in 2018 and will be modular, adjusted to the realisation of the wind farms to be built in the eastern part of the BNS. This modular approach also allows a possible future international power interconnection. For this reason, Elia is involved in studies as part of the '*North Seas Countries Offshore Grid Initiative*'. The platform will become operational in 2020 (*visie Elia Offshore Grid 2012*, *MER - Belgian Offshore Grid 2013*, *Aanvraagdossier Belgian Offshore Grid 2013*, *Beleidsverklaring 2017 Noordzee*, *Elia*, *Durinck 2017*, *Degraer et al. 2018*). The cables of the MOG will be landed via a connection with the Stevin station in Zeebrugge. The Stevin project reinforces the onshore transmission grid and concerns a 380 kV high-voltage connection between Zeebrugge and Zomergem (*Tant 2014*, *website Elia*). The Stevin station was put into operation at the end of 2017 and its final completion, including sub projects, is planned for 2020. Work is also currently underway on additional power cables between the United Kingdom and Belgium in the context of the so-called *NEMO Link project* (see below **Nemo Link**), which after completion will (partly) be integrated into the Stevin project.

NEMO LINK

A secure and reliable power supply is essential for everyone's activities and for economic growth. A sufficiently large and reliable energy production that can meet the power demand for electricity at all times is crucial in this. An important role lies in the development of international connections between diversified, renewable or non-renewable, energy sources (*Federaal Ontwikkelingsplan van het transmissienet 2015-2025*).

The *Nemo Link project* has an important role in this. The Nemo Link project is a partly submarine and partly underground electrical HVDC connection (bi-directional cable connection of approximately 1,000 MW) between Zeebrugge and Richborough (United Kingdom) (*Milieueffectenrapport - NEMO LINK 2012*, *Brochure NEMO-STEVIN 2013*, *Federaal Ontwikkelingsplan van het transmissienet 2015-2025*).

This project aims to improve the connection between the high-voltage grid in the United Kingdom and the European mainland. Economic studies have shown the relevance of such a link and the project was selected by the European Commission as a 'Project of Common Interest' in the framework of the Trans-European Energy Infrastructure (TEN-E,

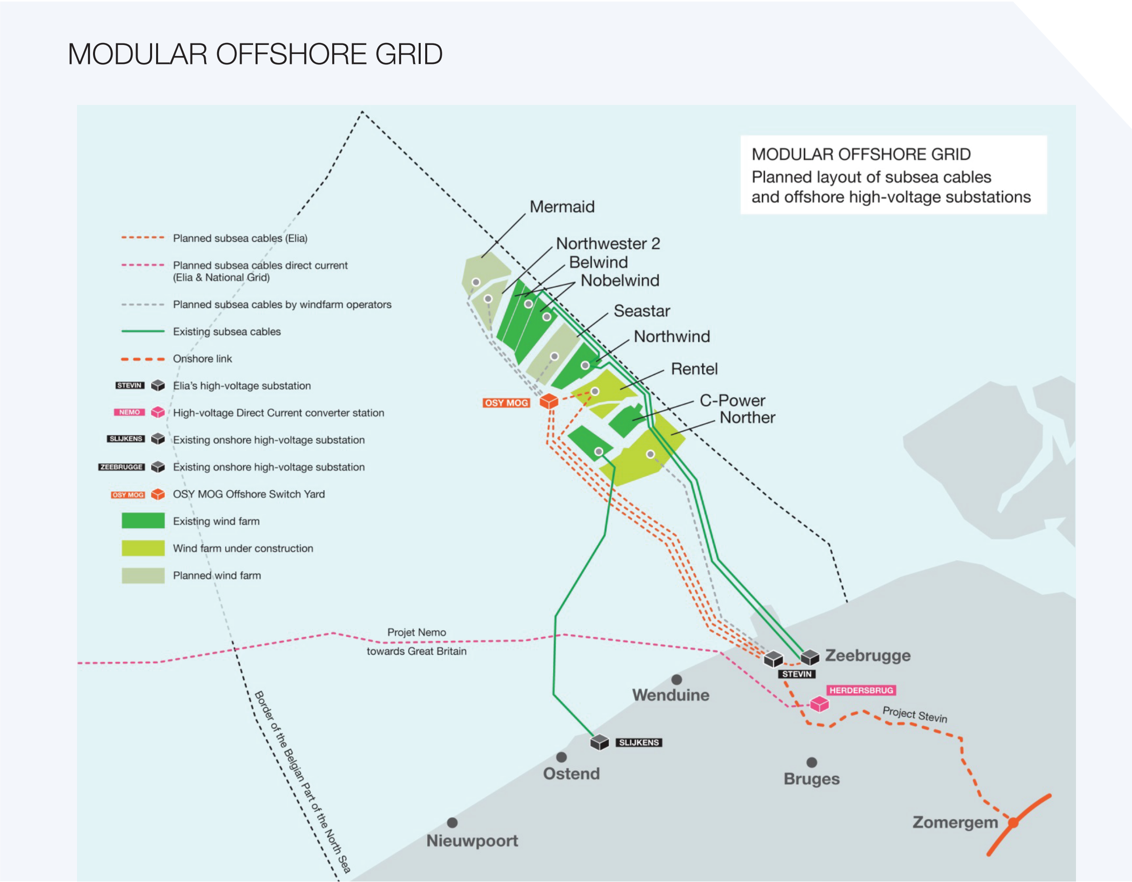

Figure 6. Spatial location of the MOG – phase I and the localisation of planned submarine cables in the BNS (Source: *Elia*).

Regulation (EU) No 347/2013). For grid integration on the Belgian side, a connection to the Stevin project is being created (*Brochure NEMO-STEVIN 2013*, *Tant 2014*, *website Elia*). The construction of the Belgian section of the Nemo link will take place in 2018, with commissioning foreseen for early 2019. The possibility of a second HVDC interconnector cable between the UK and Belgium is currently being investigated within the so called Nautilus project (*Elia*, *Volckaert and Durinck 2018*).

NORTH SEA OFFSHORE GRID

Submarine cables are also important for transnational energy and communications networks (*OSPAR QSR 2010*). In the context of the creation of an integrated European energy network (COM (2010) 677), Europe is promoting the development of a North Sea Offshore Grid between the ten neighbouring North Sea countries (*Mathys et al. 2009* (*OPTIEP-BCP project BELSPO*), *Offshore Electricity Grid Infrastructure in Europe 2011*). The intention is to integrate the Belgian offshore power grid into a European power grid with DC connections. Such connections allow to transport greater power over longer distances and ensure the supply of energy. This vision is in line with the European Commission's energy policy (see also studies *Intelligent Energy Europe*). A first initiative in this direction was the establishment of the *North Sea Countries Offshore Grid Initiative* (*NSCOGI*) wherein 10 North Sea countries concluded a Memorandum of Understanding (MoU) to evaluate the possibility of developing a coordinated offshore grid in the North Sea and associated onshore connections with a view to economic profitability and achieving the renewable energy objectives in 2020 (*Offshore Electricity Grid Infrastructure in Europe 2011*). The progress of the initiative was monitored in progress reports on the following website: *www.benelux.int/NSCOGI*. The initiative for increased regional cooperation on affordable European offshore energy is currently gaining momentum under the *North Seas Energy Cooperation*. The intention for a closer cooperation has already been consolidated in a *political declaration (2016)* and in the meantime *implementation objectives (2016)* have also been formulated. An overview of the policy framework, the technical and the economic aspects is given in the *Offshore Electricity Grid Infrastructure in Europe (2011)*.

PIPES

The transport of gaseous products to our country takes place by means of submarine pipes (*Verfaillie et al. 2005* (*GAUFRE project BELSPO*), *Brouwers et al. 2011*):

- Zeepipe has been operational since 1993 and is operated by Gassco. The pipeline transports about 13 billion m³ of gas per year with a daily capacity of 42 million m³;
- The Franpipe pipeline (former Norfra pipeline) is operated by Gassco and has been operational since 1998, transporting 55 million m³ of gas per day between Dunkirk and the Norwegian shelf. The pipeline has a capacity of 19.6 billion m³ per year;
- The Interconnector Pipeline operated by IUK has been transporting gas between the south coast of the UK and Zeebrugge since October 1998. This pipeline is bidirectional and can therefore be used for the import/export of gas from/to the UK. In winter, imports from the United Kingdom take place with a capacity of 20 billion m³ per year (personal communications, *FPS Economy, S.M.Es, Self-employed and Energy, General Directorate Energy*) and in summer exports to England take place with a capacity of approximately 25.5 billion m³ per year.

6.6.4 Impact

The installation and exploitation of cables and pipelines has a (local) impact on the marine environment. This impact is taken into account in the EIAs that must be included to the permit applications for the cables and pipelines concerned. A number of studies and environmental impact assessments which specifically focus on the effects of cables on the environment are included in table 9.

Table 9. An overview of the environmental effects of the installation and exploitation of cables and pipelines in the BNS.

Impact	Literature
Toxic pollution from zinc-coated pipeline	*Maes et al. 2004 (MARE-DASM project BELSPO)*
Introduction of hard substrate on the seabed (pipeline) => non-indigenous species	*Maes et al. 2004 (MARE-DASM project BELSPO)*, *OSPAR QSR 2010*, *MER - Belgian Offshore Grid 2013*, *Rumes et al. 2014 – MEB Belgian Offshore Grid*, *Durinck 2017*
Sediment disturbance during construction and removal of cable / substrate (including increased turbidity and release of pollutants adsorbed by soil particles)	*Milieueffectenrapport - NEMO LINK 2012*, *MER - Belgian Offshore Grid 2013*, *Van den Eynde et al. 2013*, *Rumes et al. 2013 – MEB NEMO*, *Rumes et al. 2014 – MEB Belgian Offshore Grid*, *Durinck 2017*
Effect on temperature of the surroundings	*OSPAR QSR 2010*, *Milieueffectenrapport - NEMO LINK 2012*, *MER - Belgian Offshore Grid 2013*, *Rumes et al. 2013 – MEB NEMO*, *Rumes et al. 2014 – MEB Belgian Offshore Grid*, *Durinck 2017*
Electromagnetic field around cables	*OSPAR QSR 2010*, *Milieueffectenrapport - NEMO LINK 2012*, *MER - Belgian Offshore Grid 2013*, *Rumes et al. 2013 – MEB NEMO*, *Rumes et al. 2014 – MEB Belgian Offshore Grid*, *Durinck 2017*
Underwater noise when installing cables / pipelines	*Milieueffectenrapport - NEMO LINK 2012*, *MER - Belgian Offshore Grid 2013*, *Rumes et al. 2013 – MEB NEMO*, *Rumes et al. 2014 – MEB Belgian Offshore Grid*, *Durinck 2017*
Impact on other users	*Verfaillie et al. 2005 (GAUFRE project BELSPO)*, *Milieueffectenrapport - NEMO LINK 2012*, *MER - Belgian Offshore Grid 2013*, *Rumes et al. 2013 – MEB NEMO*, *Rumes et al. 2014 – MEB Belgian Offshore Grid*, *Durinck 2017*

6.6.5 Sustainable use

MEASURES IMPACTING ON THE MARINE ENVIRONMENT

At present, no common programs or measures exist at the international level to address the impact of pipes and cables on the marine environment (*OSPAR QSR 2010*). *OSPAR 2016* does list a collection of measures to mitigate the emission and impact of underwater noise caused by human activity, but for the time being cables and pipelines are not mentioned separately. At European level, however, the Marine Strategy Framework Directive (2008/56/EC) (MSFD) can be regarded as a framework to address the impact of submarine cables and pipelines. This directive comprises the following descriptors for a good environmental status (GES) of the marine environment: underwater noise and other forms of energy (*descriptor 11*), seabed integrity (*descriptor 6*) and non-indigenous species introduced by human activities (*descriptor 2*). Recently, by request of the European Commission, a baseline environmental assessment study was drafted (*BEAGINS 2017*) about the development of energy production, energy storage and power cable projects in the North Sea and Irish Sea. In addition to analysing potential risks and limitations, the study also includes recommendations for mitigation. This to create a framework to ensure that environmental aspects are properly taken into account during the development of offshore energy systems.

At the Belgian level, the effects of power cables on the marine environment are considered in the environmental impact assessments (EIAs) and monitoring programmes of the Modular Offshore Grid and the Nemo Link connection (see table 9). Furthermore, the effects of the individual cables for wind farms are discussed in the monitoring programme of the offshore wind farms (*Degraer and Brabant 2009*, *Degraer et al. 2010*, *Degraer et al. 2011*, *Degraer et al. 2012*, *Degraer et al. 2013*) and their respective EIAs (*MUMM*). The assessment of potential environmental impacts from pipeline construction is reflected in the associated EIAs.

Legislation reference list

Overview of the relevant legislation at the international, European, federal and Flemish level. For the consolidated European legislation we refer to *Eurlex*, the national legislation can be consulted in the *Belgisch staatsblad* and the *Justel-databanken*.

International agreements, treaties, conventions, etc.

Title	Year of conclusion	Year of entering into force
Agreement on the Conservation of small cetaceans in the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS)	1991	1994

European legislation

Title	Year	Number
Opinion of the European Economic and Social Committee on the 'Communication from the Commission — Towards an integrated Strategic Energy Technology (SET) Plan: accelerating the European energy system transformation'	2015	6317
Communication from the commission to the European Parliament, The Council, The European Economic and Social Committee, The Committee of the Regions and the European Investment Bank – Clean Energy For All Europeans	2016	860
Communication from the Commission - An Integrated Maritime Policy for the European Union	2007	575
Communication from the Commission - A European strategic energy technology plan (SET-plan) - 'Towards a low carbon future' {SEC(2007) 1508} {SEC(2007) 1509} {SEC(2007) 1510} {SEC(2007) 1511}	2007	723
Communication from the Commission - A European strategy for marine and maritime research: a coherent European research area framework in support of a sustainable use of oceans and seas	2008	534
Communication from the Commission - Offshore Wind Energy: Action needed to deliver on the Energy Policy Objectives for 2020 and beyond	2008	768
Communication from the Commission: Energy infrastructure priorities for 2020 and beyond - A Blueprint for an integrated European energy network	2010	677
Communication from the Commission - Blue Growth opportunities for marine and maritime sustainable growth	2012	494
Communication from the Commission - Blue Energy Action needed to deliver on the potential of ocean energy in European seas and oceans by 2020 and beyond	2014	8
Directive establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive (MSFD))	2008	56
Directive on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC	2009	28
Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (Recast)	2016	767
Regulation (EU) on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009 Text with EEA relevance	2013	347

Belgian and Flemish legislation

Abbreviation	Title	File number
Decree of 8 May 2009	Decreet houdende algemene bepalingen betreffende het energiebeleid (het energiedecreet)	2009-05-08/27
RD of 20 December 2000	Koninklijk besluit betreffende de voorwaarden en de procedure voor de toekenning van domeinconcessies voor de bouw en de exploitatie van installaties voor de productie van elektriciteit uit water, stromen of winden, in de zeegebieden waarin België rechtsmacht kan uitoefenen overeenkomstig het internationaal zeerecht	2000-12-20/35
RD of 12 March 2002	Koninklijk besluit betreffende de nadere regels voor het leggen van kabels die in de territoriale zee of het nationaal grondgebied binnenkomen of die geplaatst of gebruikt worden in het kader van de exploratie van het continentaal plat, de exploitatie van de minerale rijkdommen en andere niet-levende rijkdommen daarvan of van de werkzaamheden van kunstmatige eilanden, installaties of inrichtingen die onder Belgische rechtsmacht vallen	2002-03-12/37
RD of 16 July 2002	Koninklijk besluit betreffende de instelling van mechanismen voor de bevordering van elektriciteit opgewekt uit hernieuwbare energiebronnen	2002-07-16/39
RD of 7 September 2003	Koninklijk besluit houdende de procedure tot vergunning en machtiging van bepaalde activiteiten in de zeegebieden onder de rechtsbevoegdheid van België	2003-09-07/32

RD of 9 September 2003	Koninklijk besluit houdende de regels betreffende de milieu-effectenbeoordeling in toepassing van de wet van 20 januari 1999 ter bescherming van het mariene milieu in de zeegebieden onder de rechtsbevoegdheid van België	2003-09-09/30
RD of 17 May 2004	Koninklijk besluit tot wijziging van het koninklijk besluit van 20 december 2000 betreffende de voorwaarden en de procedure voor de toekenning van domeinconcessies voor de bouw en de exploitatie van installaties voor de productie van elektriciteit uit water, stromen of winden, in de zeegebieden waarin België rechtsmacht kan uitoefenen overeenkomstig het internationaal zeerecht	2004-05-17/44
RD of 28 September 2008	Koninklijk besluit tot wijziging van het koninklijk besluit van 20 december 2000 betreffende de voorwaarden en de procedure voor de toekenning van domeinconcessies voor de bouw en de exploitatie van installaties voor de productie van elektriciteit uit water, stromen of winden, in de zeegebieden waarin België rechtsmacht kan uitoefenen overeenkomstig het internationaal zeerecht	2008-09-28/42
RD of 3 February 2011	Koninklijk besluit tot wijziging van het koninklijk besluit van 20 december 2000 betreffende de voorwaarden en de procedure voor de toekenning van domeinconcessies voor de bouw en de exploitatie van installaties voor de productie van elektriciteit uit water, stromen of winden, in de zeegebieden waarin België rechtsmacht kan uitoefenen overeenkomstig het internationaal zeerecht	2011-02-03/12
RD of 11 April 2012	Koninklijk besluit tot instelling van een veiligheidszone rond de kunstmatige eilanden, installaties en inrichtingen voor de opwekking van energie uit het water, de stromen en de winden in de zeegebieden onder Belgische rechtsbevoegdheid	2012-04-11/15
RD of 20 March 2014	Koninklijk besluit tot vaststelling van het marien ruimtelijk plan	2014-03-20/03
RD of 8 May 2014	Koninklijk besluit betreffende de voorwaarden en de procedure voor de toekenning van domeinconcessies voor de bouw en de exploitatie van installaties voor hydro-elektrische energie-opslag in de zeegebieden waarin België rechtsmacht kan uitoefenen overeenkomstig het internationaal zeerecht	2014-05-08/28
RD of 19 March 2017	Koninklijk besluit betreffende de veiligheidsmaatregelen inzake de oprichting en de exploitatie van installaties voor vervoer van gasachtige producten en andere door middel van leidingen	2017-03-19/07
MD of 8 May 2008	Ministerieel besluit houdende aanstelling van ambtenaren bedoeld in artikel 25 van het koninklijk besluit van 12 maart 2002 betreffende de nadere regels voor het leggen van elektriciteitskabels die in de territoriale zee of het nationaal grondgebied binnenkomen of die geplaatst of gebruikt worden in het kader van de exploratie van het continentaal plat, de exploitatie van de minerale rijkdommen en andere niet-levende rijkdommen daarvan of van de werkzaamheden van kunstmatige eilanden, installaties of inrichtingen die onder Belgische rechtsmacht vallen	
MD of 16 March 2009	Ministerieel besluit houdende aanwijzing van de ambtenaren die ermee belast zijn de Minister te vertegenwoordigen en toe te zien op de toepassing van het koninklijk besluit van 20 december 2000 betreffende de voorwaarden en de procedure voor de toekenning van domeinconcessies voor de bouw en de exploitatie van installaties voor de productie van elektriciteit uit water, stromen of winden, in de zeegebieden waarin België rechtsmacht kan uitoefenen overeenkomstig het internationaal zeerecht	
Law of 12 April 1965	Wet betreffende het vervoer van gasachtige producten en andere door middel van leidingen	1965-04-12/30
Law of 8 August 1980	Bijzondere wet tot hervorming der instellingen	1980-08-08/02
Law of 19 September 1991	Wet houdende goedkeuring van de overeenkomst tussen de regering van het Koninkrijk België en de regering van het Koninkrijk Noorwegen inzake het vervoer per pijpleiding van gas van het Noorse Continentaal Plat en uit andere gebieden naar het Koninkrijk België, en van wisseling van brieven inzake de uitlegging van artikel 2, §2 van deze overkomst, ondertekend te Oslo op 14 april 1988	1991-09-19/
Law of 20 January 1999	Wet ter bescherming van het mariene milieu en ter organisatie van de mariene ruimtelijke planning in de zeegebieden onder de rechtsbevoegdheid van België	1999-01-20/33
Law of 29 April 1999	Wet betreffende de organisatie van de elektriciteitsmarkt, inzonderheid op artikel 6	1999-04-29/42
Law of 26 June 2000	Wet houdende instemming met de Overeenkomst tussen de Regering van het Koninkrijk België en de Regering van het Verenigd Koninkrijk van Groot-Brittannië en Noord-Ierland inzake het vervoer van aardgas door middel van een pijpleiding tussen het Koninkrijk België en het Verenigd Koninkrijk van Groot-Brittannië en Noord-Ierland, ondertekend te Brussel op 10 december 1997	2000-06-26/57
Law of 31 January 2003	Wet houdende de geleidelijke uitstap uit kernenergie voor industriële elektriciteitsproductie	2003-01-31/38
Law of 13 May 2003	Wet houdende instemming met de Overeenkomst tussen de Regering van het Koninkrijk België en de Regering van het Koninkrijk Noorwegen inzake het leggen van de « Norfra » gaspijpleiding op het Belgische continentaal plat, en de Bijlagen 1, 2 en 3, ondertekend te Brussel op 20 december 1996	2003-05-13/40