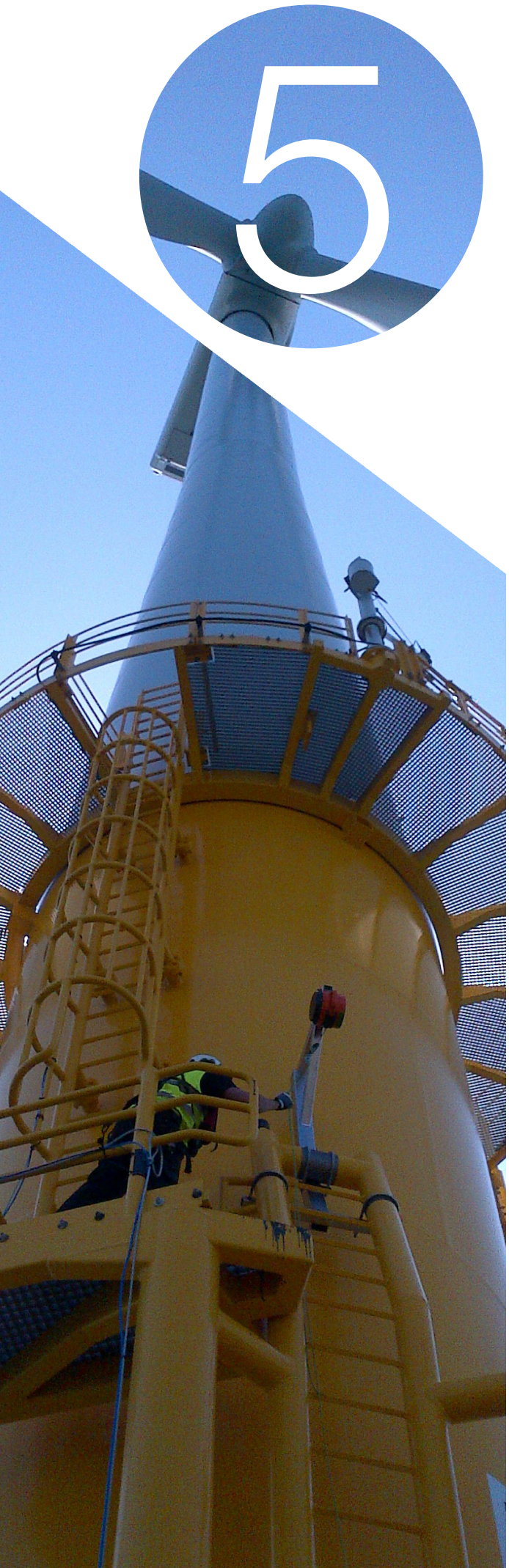

5 Energy (including cables and pipelines)

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5.1 Offshore wind energy

Europe is the world leader in the offshore wind energy sector. In 2014, 2,488 turbines were installed and connected to the power grid in the European seas, with a total installed capacity of 8,045.3 MW. These wind turbines are distributed over 74 wind farms in 11 different countries (*The European offshore wind industry, EWEA 2015*). The UK, Germany and Denmark are currently the main actors in Europe regarding offshore wind energy. In Belgium, three wind farms (C-Power, Belwind and Northwind) were operational at the end of April 2014 totalling 182 wind turbines and a total installed capacity of 712 MW, which ranks us fourth in Europe (*The European offshore wind industry, EWEA 2015*). In 2015, part of the Belwind concession zone was transferred to *Nobelwind*.

In the following years, five additional offshore wind farms are scheduled to be constructed: Seastar, Mermaid, Northwester 2, Norther and Rentel. When all of these projects will be realised (prognosis: 2020), their total capacity will be around 2,200 MW with a production of 8 TWh each year. This corresponds to 10% of the total Belgian electricity consumption (*Vande Velde 2014*).

5.1.1 Policy context

At the European level, the policy with regard to energy is developed by the *Directorate-General for Energy*. An important aspect of this policy is the strategy regarding sustainable energy (including offshore wind turbines). A crucial instrument in this context is directive 2009/28/EC concerning the promotion of the use of energy from renewable sources. This directive stipulates that Belgium should incorporate 13% of renewable energy into its final energy consumption by 2020[1]. Furthermore, the directive also determines that each member state needs to elaborate a national action plan on how to reach the renewable energy goals (*nationaal actieplan België hernieuwbare energie 2010*).

Besides, the Directorate-General for Maritime Affairs and Fisheries (*DG MARE*) has developed the so-called Blue Economy 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) 08).

The policy concerning renewable energy is a regional competence (*Vlaamse beleidsnota energie 2014-2019*). However, as the Belgian North Sea (BNS) is a federal competence, the policy with regard to offshore wind energy is developed on the federal level by the minister responsible for energy and the minister (or state secretary) responsible for the North Sea (*FPS Economy, S.M.E.s, Self-Employed and Energy*, more information about the division of competences: *het nationaal actieplan hernieuwbare energie 2010*).

The websites of the Commission for the Regulation of Electricity and Gas (*CREG*) and the *FPS Economy* provide an overview of European and national legislation on the electricity market.

5.1.2 Spatial use

Prior to the installation of the wind farms, a study was conducted with regard to the seabed, wind supply and grid capacity in the available areas for an optimal development of the offshore wind energy (*Le Bot et al. 2004*, *project BELSPO*). This kind of survey is *inter alia* important for the selection of the foundation type of the turbines (*Van de Walle 2011*). In addition, the spatial needs of other users of the sea need to be considered as well (see section on **Impact**).

The spatial demarcation of the zones selected for the installation of the wind farms in the BNS is tackled in figure 1 and table 1 and 2.

In order to actually realise an offshore wind farm, a project must have multiple permits. Currently the following federal permits are required:

- A ministerial decision for the granting of a concession zone by the minister responsible for Economy;
- A ministerial decision for the granting of a permit for the construction of the wind farm, the cables and the

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

operation by the minister (or state secretary) responsible for the North Sea. This decision is based on an Environmental Impact Assessment (EIA) and an advice from MUMM (RBINS);
- (A ministerial decision for the granting of a permit for the installation of offshore cables by the minister responsible for Economy (see also **Pipelines and cables**)).

PROCEDURE WITH REGARD TO CONCESSION ZONES

Each project should also pass the procedure for the designation of a concession zone for the proposed project area (figure 2). This procedure and the conditions for the granting of a concession have been stipulated in the royal decree of 20 December 2000. As a result of a modification by the royal decree of 28 September 2008, applications for a concession zone for the construction and operation of offshore installations in the BNS have to be directed to and are handled by the delegate of the Minister, who subsequently advises the Minister responsible for Energy (see also the ministerial decree of 16 March 2009).

Table 1. History of the spatial demarcation of the concession 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 the North Sea and Energy were given the task to demarcate areas for offshore energy farms
RD of 17 May 2004	Demarcation of an area for offshore wind farms of 260 km²
Cabinet of 3 December 2010	Ministers responsible for the North Sea and Energy were given the task to adjust the northwestern 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 the zone of the RD of 17 May 2004 with the subsequent adjustments by the RD of 3 February 2011, was included (see also *Van de Velde et al. 2014*)

Table 2. An overview of the location and use of space of the various concession zones for offshore wind farms in the BNS (*Brochure FPS Economy*, website *MUMM*, see also EIAs of the different wind farms in the section Impact).

PROJECT NAME	LOCATION	TOTAL AREA (excl. safety zone)	WATER DEPTH	DISTANCE TO THE COAST
Mermaid	Northwest of the Bligh Bank	16.7 km²	24.5 - 39.5 m	50 km
Northwester 2	Northwest of the Bligh Bank	11.7 km² (potential expansion in EIA to 15.2 km²)	24.2 - 39.9 m	46 km
Belwind / Nobelwind	Bligh Bank	35.6 km²	15 - 37 m	46 - 52 km
Seastar	In between the Lodewijk Bank and the Bligh Bank	18.4 km²	22 - 38 m	38 km
Northwind (formerly Eldepasco)	Lodewijk Bank	9.0 km²	16 - 29 m	37 km
Rentel	Southwest Schaar	18.4 - 27.3 km²	22 - 38 m	31 km
C-Power	Thornton Bank	13.7 - 18.1 km²	12 - 27.5 m	30 km
Norther / North Sea Power	South of the Thornton Bank	28.2 km²	14 - 30 m	21 km
Total area reserved for wind farms (incl. safety zones)		238.0 km²		

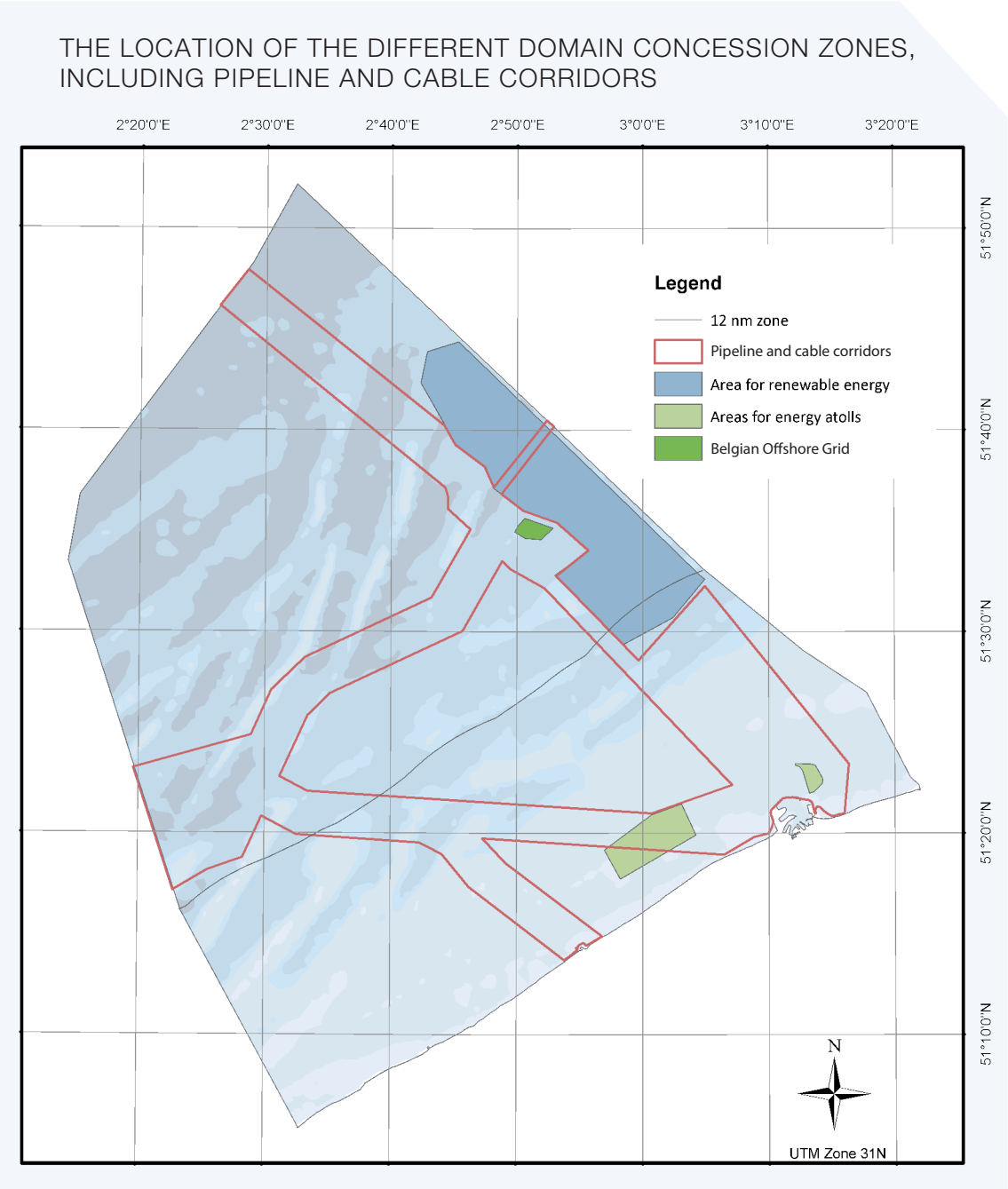

Figure 1. The location of the concession zones for wind farms and energy atolls, the Belgian Offshore Grid and the pipeline and cable corridors in the BNS (Source: KBIN/IRSNB, *marineatlas.be*, based on RD of 20 March 2014).

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 royal decree of 7 September 2003 (procedure for the licensing and authorisation of certain activities in the BNS) and the royal decree of 9 September 2003 (rules of the environmental impact assessment). The environmental impact assessment (EIA) is performed by the Management Unit of the North Sea Mathematical Models (MUMM, RBINS) which subsequently advises the competent minister (or state secretary) (*website MUMM*).

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. Moreover, a notification of this authorisation should be made in accordance with the applicable law. If any of the additional required permits or final permissions are refused, the concession zone expires on the date of notification of this refusal. In Belgium, 8 concession zones have already been granted to different project developers (table 2).

In Belgium, a ban on regular shipping (not wind farm related) has been established in the zone of the offshore wind turbines as well as in areas reserved for installations for hydro-electric energy storage (so-called energy atolls) and offshore substations of the network operator (royal decree of 11 April 2012). From the operational phase onwards, a safety zone of five hundred meters (measured from the outer boundary) is established around artificial islands, installations or infrastructure for the generation of energy from water, currents and winds (e.g. offshore wind farms) (decree of 11 April 2012).

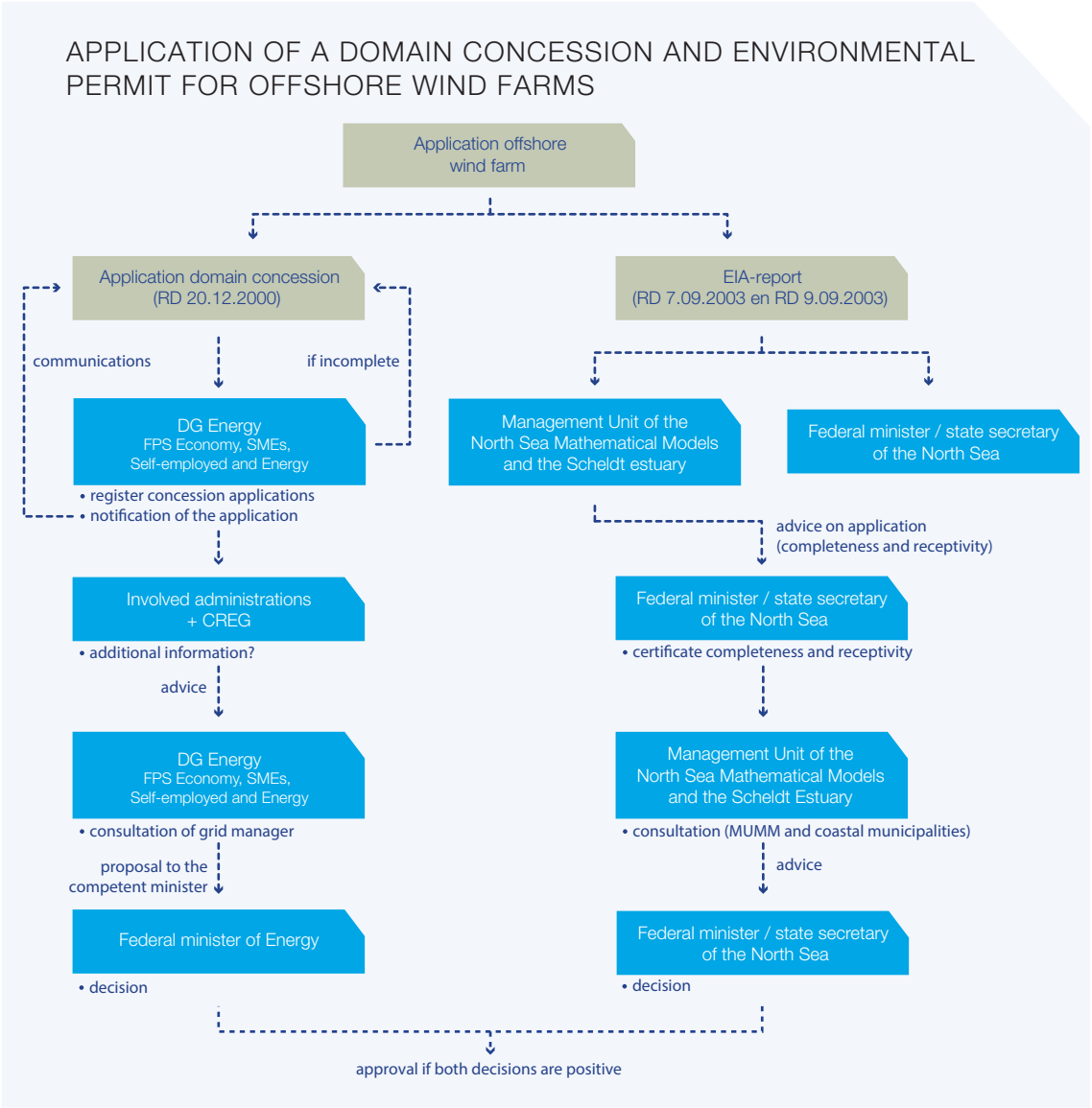

Figure 2. Flowchart for the application of a concession zone and environmental permit for offshore wind farms (RD of 20 December 2000, RD of 9 September 2003).

5.1.3 Societal interest

THE ENERGY PRODUCTION OF OFFSHORE WIND FARMS

Based on the European member states' national action plans for renewable energy, 494.6 TWh of electricity will be produced by wind energy by 2020, of which 133.3 TWh will be generated offshore. It is possible that by 2030 more capacity will be present offshore than on land. In total, 4% and 14% of the demand for energy in the EU could be covered by offshore wind energy by 2020 and 2030 respectively (COM (2012) 494, see also *study energy potential EEA*).

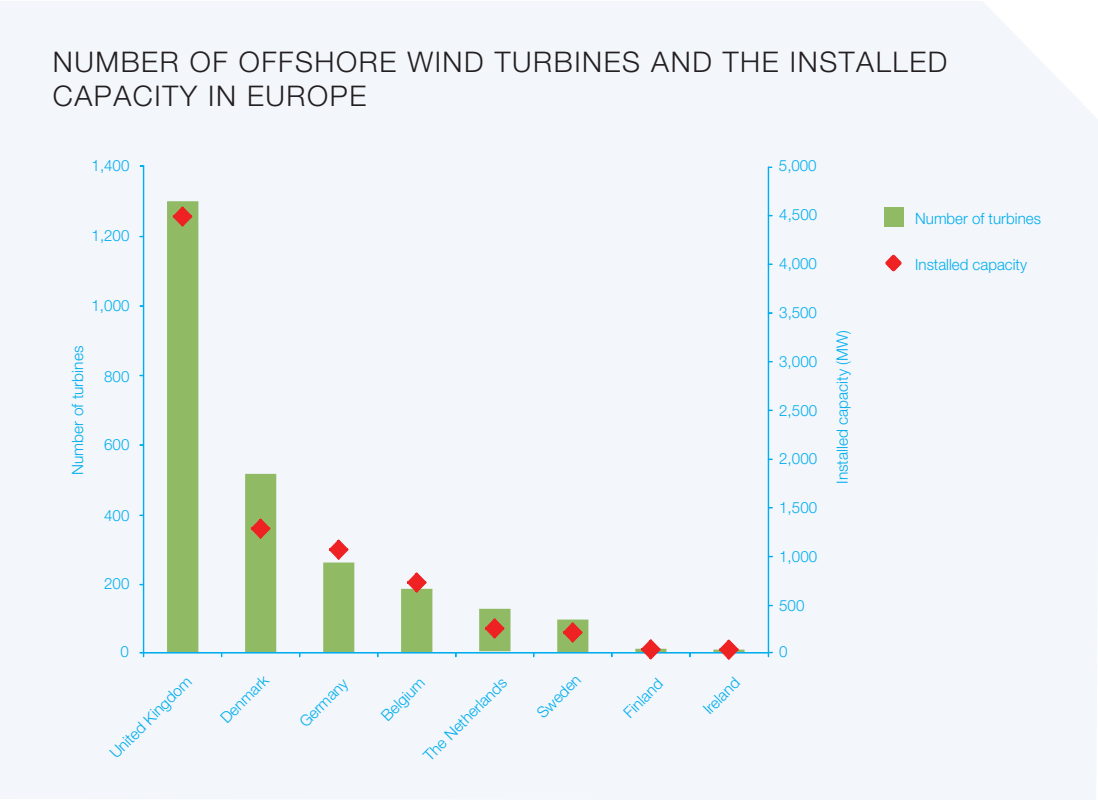

Figure 3. The number of offshore wind turbines and the installed capacity in Europe in 2014 (*The European offshore wind industry, EWEA 2015*).

The total capacity that could potentially be installed in the BNS was first assessed in 2009 by *Mathys et al. (2009)* (*OPTIEP-BCP project BELSPO*). The total capacity of all projects that were granted a concession zone by 2014 amounts to around 2.2 GW, but this figure may vary depending on the configuration of the farms (table 3, *Brochure FPS Economy*). In 2014 two wind farms were completely operational and one was partially operational, totalling an installed capacity of 712.2 MW (*The European offshore wind industry, EWEA 2015*) (figure 3). The annual production of wind farms that are currently operational is given 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).

In Belgium around 5,000 jobs were created during the construction of the first three wind farms. The construction of an average offshore wind farm (300 MW) generates approximately 1,400 direct jobs during its development and construction phase and an equal amount of indirect jobs. The exploitation phase creates on average 100 new jobs for every wind farm. Hence, the realisation of the 8 planned farms could lead to around 20,000 temporary workplaces (expressed in man year) and 800 new, permanent jobs during exploitation (minimum of 20 years) (*Vande Velde 2014*).

Table 3. An overview of the status, the number of turbines and the total capacity of the wind farms in the BNS (website *MUMM*, see also EIAs of the various wind farms in the section Impact).

PROJECT NAME	STATUS	NUMBER OF TURBINES	TOTAL CAPACITY	ANNUAL PRODUCTION
C-Power	Operational since 2009, completely operational since 2013	54	325 MW	1,050 GWh/year (electricity for 300,000 households)
Northwind (formerly Eldepasco)	Completely operational since 2014	72	216 MW	875 GWh/year (electricity for 250,000 households)
Belwind / Nobelwind	Phase 1: operational since December 2010 Phase 2: construction planned for 2016 (Nobelwind)	111	336 MW	550 GWh/year (electricity for 160.000 households)
Rentel	Concession and environmental permit granted Construction planned for 2017	47 - 78	289 - 468 MW	
Norther / North Sea Power	Concession and environmental permit granted Construction planned for 2017	47 - 100	258 - 470 MW	(electricity 300.000 households)
Seastar	Concession and environmental permit granted Construction planned for 2018	41	246 MW	
Northwester 2	Concession granted	22 - 32	217 - 227 MW	
Mermaid	Concession granted Environmental permit (end of February 2015)	27 - 41	232 - 266 MW / 20 - 61 MW (capacity of pilot project wave power convertors)	900 – 1.200 GWh/ year

The construction of offshore wind turbines also increases employment in the port of Ostend, which focuses on services with regard to offshore energy. 180 new, mainly specialised workplaces were created by 2014 (*Gerard 2014*). It should be mentioned that economic activities related to the offshore wind farms are also being undertaken in the port of Zeebrugge. However, no statistics are available for this port.

5.1.4 Impact

The installation of wind farms in the BNS has a number of effects on the ecosystem and on the users of the sea (table 4 and 5). The impacts on the marine environment that should be addressed in the environmental impact assessment (EIA) have been stipulated in the royal decree of 9 September 2003 on EIA. The EIAs and related documents are available on the website of *MUMM* (table 4). In addition, numerous scientific studies have been conducted in order to elucidate the impact of wind turbines on the marine environment (table 5).

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

WIND FARM	ENVIRONMENTAL IMPACT REPORTS, EIAs AND ADDITIONAL DOCUMENTS
C-Power	*MER voor een Offshore Windturbinepark op de Thorntonbank. Deel 2: Hoofddocument MER 2003* + *MER - Wijziging & uitbreiding offshore windturbinepark Thorntonbank. C-Power N.V. 2010*, *MEB C-Power 2004*, *MEB C-Power wijziging 2006*
Northwind (formerly Eldepasco)	*MER – Offshore Windturbinepark Bank zonder Naam. Eldepasco NV 2008*, *Di Marcantonio et al. 2009 – MEB Eldepasco*
Belwind / Nobelwind	*MER Offshore Windpark Bligh Bank. Belwind NV 2007*, *Di Marcantonio et al. 2007 – MEB Belwind*
Rentel	*Milieueffectenrapport windpark Rentel 2012*, *Rumes et al. 2012 – MEB Rentel*
Norther / North Sea Power	*MER Norther-project* and *wijzigingsMER*, *Rumes et al. 2011 – MEB Norther*
Seastar	*MER - windpark Seastar 2013*, *Rumes et al. 2013 – MEB Seastar*
Northwester 2	*MER Mermaid en Northwester 2*, *Rumes et al. 2015 – MEB Mermaid*
Mermaid	*MER Mermaid en Northwester 2*, *Rumes et al. 2015 – MEB Mermaid*

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

IMPACT ON THE ENVIRONMENT/USERS	LITERATURE
Effects on the hydrodynamic regime	*De Wachter & Volckaert 2005* (*GAUFRE project BELSPO*), *Van den Eynde et al. 2010*, *Verhaeghe et al. 2011*, *Van den Eynde et al. 2013*, *Vanhellemont & Ruddick 2014*, *Baeye & Fettweis 2015*
Effects on the sediment transport and geomorphology	*De Wachter & Volckaert 2005* (*GAUFRE project BELSPO*), *Van den Eynde et al. 2010*, *Verhaeghe et al. 2011*, *Van den Eynde et al. 2013*, *Vanhellemont & Ruddick 2014*
Underwater noise	*De Wachter & Volckaert 2005* (*GAUFRE project BELSPO*), *Norro et al. 2010*, *Norro et al. 2011*, *Verhaeghe et al. 2011*, *Haelters et al. 2012*, *Norro et al. 2012*, *Norro et al. 2013*, *Haelters et al. 2013a*, *Debusschere et al. 2014*
Effects on the fish and benthos (introduction of hard substrate, habitat loss, disturbance, etc.)	*De Wachter & Volckaert 2005* (*GAUFRE project BELSPO*), *Kerckhof et al. 2010*, *Reubens et al. 2010*, *Coates & Vincx 2010*, *Derweduwen et al. 2010*, *Reubens et al. 2011a*, *Kerckhof et al. 2011*, *Reubens et al. 2011b*, *Vandendriessche et al. 2011*, *Coates et al. 2011*, *Van Hoey et al. 2011*, *Verhaeghe et al. 2011*, *Kerckhof et al. 2012*, *Coates et al. 2012*, *Vandendriessche et al. 2012*, *Derweduwen et al. 2012*, *Coates et al. 2013a*, *Coates et al. 2013b*, *Vandendriessche et al. 2013a*, *Vandendriessche et al. 2013b*, *Reubens et al. 2013*, *Reubens 2013*, *Coates 2014*, *De Mesel et al. 2013*, *Rumes et al. 2013*, *De Mesel et al. 2015*
Effects on seabirds	*Stienen et al. 2002a*, *Stienen et al. 2002b*, *De Wachter & Volckaert 2005* (*GAUFRE project BELSPO*), *Everaert & Stienen 2007*, *Stienen et al. 2007*, *Vanermen et al. 2009*, *Brabant & 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*
Effects on marine mammals	*Stienen et al. 2002a*, *De Wachter & 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*
Impact on the water and air quality	*Maes et al. 2004* (*MARE-DASM project BELSPO*), *De Wachter & Volckaert 2005* (*GAUFRE project BELSPO*), *Verhaeghe et al. 2011*
Impact on the seascape	*De Wachter & Volckaert 2005* (*GAUFRE project BELSPO*), *Vanhulle et al. 2010*, *Houthaeve & Vanhulle 2010*, *Di Marcantonio et al. 2013*
Maritime safety	*De Wachter & Volckaert 2005* (*GAUFRE project BELSPO*), *van Iperen & van der Tak (2009)*, *Verhaeghe et al. 2011* (see also **Maritime transport, shipping and ports**)
Spatial impact (e.g. conflicts with other users)	*Maes et al. 2004* (*MARE-DASM project BELSPO*), *De Wachter & Volckaert 2005* (*GAUFRE project BELSPO*), *Vandendriessche et al. 2011*, *Vandendriessche et al. 2013*

5.1.5 Sustainable use

MEASURES CONCERNING THE IMPACT ON THE MARINE ENVIRONMENT

On an international level, OSPAR has published a guide (*OSPAR Guidance on Environmental Considerations for Offshore Wind Farm Development 2008*) in which the impact of wind turbines on the marine environment is discussed. Within the context of the *ASCOBANS Agreement* (on the conservation of small cetaceans), the impact of wind turbines on marine mammals has been evaluated (*Evans 2008*). In 2009, a *resolution* was issued against the negative effects on marine mammals of underwater noise during the construction of offshore energy installations.

At the European level, the Marine Strategy Framework Directive (2008/56/EC) (MSFD) provides a framework to reduce or avoid the impact of offshore wind farms on the environment. In this context, underwater noise and other forms of energy are identified as one of the descriptors for a Good Environmental Status (GES) (*Tasker et al. 2010*). Other descriptors of the MSFD which are relevant for the installation and operation of offshore wind turbines are the integrity of the seabed (*Rice et al. 2010*), non-indigenous species (*Olenin et al. 2010*) and the permanent alteration of hydrographic conditions.

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 coordinated by MUMM and has a twofold objective:

- To adjust, reduce or even stop the activities if extreme damage to the marine environment occurs;
- To gain insight into the impact of offshore wind turbines on the environment to support the policy, management and design of future wind turbines.

The monitoring programme examines the physical, biological and socio-economic aspects of the marine environment (*Degraer & Brabant 2009*, *Degraer et al. 2010*, *Degraer et al. 2011*, *Degraer et al. 2012*, *Degraer et al. 2013*) compared to a reference condition (e.g. *De Maersschalck et al. 2006*, *Henriet et al. 2006*, *Van den Eynde 2005*).

Within the framework of the *action plan Zeehond (2012)*, the offshore wind turbines are used as a laboratory for testing the effects of artificial reefs and artificial resting places in order to increase the biodiversity and productivity. In the marine spatial plan (royal decree of 20 March 2014, see also *Van de Velde et al. 2014*) the multiple use of space in wind farms is encouraged with opportunities for aquaculture, nature development, wave and tidal energy production, etc.

THE DEVELOPMENT OF OFFSHORE WIND ENERGY - CHALLENGES AND MEASURES

At the European level, a number of measures have been taken to stimulate the development of offshore wind energy. For example:

- The Strategic Energy Technology Plan (SET-plan, COM (2007) 723) – A strategic plan to accelerate the development of cost-efficient technologies with low carbon emissions.
- COM (2008) 768 on offshore wind energy – Action needed to deliver on the energy policy objectives for 2020 and beyond.
- In the context of the Integrated Maritime Policy (IMP, COM (2007) 575) a long-term strategy has been developed for sustainable growth in marine and maritime sectors (Blue Growth, COM (2012) 494). For the blue energy sector (e.g. offshore wind energy), measures have been drafted to maximise the potential of ocean energy in European seas and oceans by 2020 and beyond in COM (2014) 8.

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 the projects in the context of *Oceans of Tomorrow (2014)*.

The Belgian federal government has decided on a series of measures to stimulate the renewable energy production 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 that transmission system operator ELIA has to finance one third of the cost of the submarine cable, up to a maximum amount of 25 million euros per project (see also **Pipelines and cables**).

- The royal decree of 16 July 2002 develops a system for granting certificates which guarantee the origin of the produced energy as well as 'Green Current Certificates' (GCC) for electricity produced from water, currents or wind in the BNS. The Commission for the Regulation of Electricity and Gas (*CREG*) grants GCCs to energy producers that hold a concession zone and a certificate with a guarantee of the origin. Minimum prices have been established for the resale of certificates received for green energy production. For energy generated by offshore wind turbines, the network operator is obliged to purchase the GCCs at a minimum price of 107 euro/MWh for the production from the first 216 MW of the installed capacity and 90 euros/MWh from the installed capacity above the first 216 MW. This purchase obligation must constitute a part of the contract between the concessionaire and the network operator and should be approved by *CREG*.

The development of wind energy in the BNS has been limited by the challenges related to the connection to the electricity grid for several years. Both on land and offshore, there is a need for grid reinforcement (*Soens 2005*, *Mathys et al. 2009* (*OPTIEP-BCP project BELSPO*)). Within the Stevin project, network operator ELIA is working on an additional high-voltage power line connecting Zomergem and Zeebrugge (completion expected by 2017-2018), which should reinforce the 380 kV power grid (*Tant 2014*, *website ELIA*).

To date, offshore wind farms in the BNS have been individually connected to the electricity grid on land. However, a more coordinated system for connecting offshore energy to the mainland is being investigated, given the technological, economic and ecological advantages. An offshore meshed grid (Belgian Offshore Grid) has been suggested, in which wind farms are connected to high-voltage substations which are in turn connected to the onshore grid (*visie Elia offshore grid 2012*, *MER - Belgian Offshore Grid 2013*, *Aanvraagdossier Belgian Offshore Grid 2013*). The practical implementation of this Belgian Offshore Grid is currently elaborated in a Master Plan Offshore Cables (*Masterplan Zeekabels*) in cooperation with the involved wind farms and other involved stakeholders. The further development of this master plan also depends on the aforementioned Stevin project.

In the future, the construction of a meshed offshore power grid could be connected to an international DC platform. These connections enable the transport of larger capacities across greater distances. Neighbouring countries are currently also working on the expansion of grids in their part of the North Sea. This vision is in accordance with the energy policy of the European Commission and the *North Sea Countries' Offshore Grid Initiatief* in which 10 North Sea countries have signed a memorandum of understanding to develop an offshore network in the North Sea. This network will ensure the future supply of electricity and will provide the necessary onshore connections (*Brochure FPS Economy*, *Offshore Electricity Grid Infrastructure in Europe 2011*). Progress reports of this initiative can be found on *http://www.benelux.int/NSCOGI/*.

The development of the offshore wind farms is also supported by initiatives such as 'Factories of the Future' (*Fabrieken voor de Toekomst*) in which a Blue Energy Cluster was established by the West Flanders Development Agency (*POM West-Vlaanderen*). This cluster consists of the relevant players from government, industry as well as from the scientific field (*Dangreau 2014*). In the roadmap of the Blue Energy Cluster (*Vanden Berghe 2014*), a vision (2025) and gap analysis for this sector have been elaborated. Another initiative which supports the innovation with regard to the offshore wind farms concerns Offshore Wind Infrastructure Application Lab (*OWI-Lab*) which aims to increase the reliability and efficiency of offshore wind farms by investing in testing and monitoring equipment. Furthermore, a number of platforms and clusters which represent the blue energy and related sectors are active: e.g. *Flanders Maritime Cluster*, *Belgian Offshore Cluster* and *Belgian Offshore Platform*.

5.2 Natural gas installations in Zeebrugge

In Belgium, more than 17 billion m³ of natural gas is consumed each year and about 95 billion m³ of natural gas is reserved in the long term for border-to-border transport. This includes Dutch and Norwegian gas for France and Spain, British gas for continental Europe, Russian gas for the UK, 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 which is needed to supply the European Union (*België als aardgasdraaischijf voor Noordwest-Europa: de weg vooruit 2010*). Currently, plans exist to expand the capacity in Zeebrugge using a fifth storage tank of 180,000 m³ LNG (Liquefied Natural Gas) (*Niet-technische samenvatting MER uitbreiding Fluxys LNG, Zeebrugge*).

5.2.1 Policy context

The European policy on energy has been developed by the *Directorate-General for Energy*. An enumeration of the (European) legislations relevant to natural gas is given on the websites of *CREG* and *FPS Economy*.

The federal government (*FPS Economy, S.M.E.s, Self-employed and Energy*) is responsible for the large infrastructures for energy storage, transportation and production, and defines the policy with regard to the rate for the managers (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 concerning rates and the more technical aspects of network access (code of conduct) (for more information: *website Fluxys*, *website CREG*, *website FPS Economy*). Furthermore, there is a federal regulator: the Commission for the Regulation of Electricity and Gas (*CREG*). Flanders is competent for the public distribution of gas, which is managed by the so-called *intercommunales*, as well as for the rational use of energy (special law on institutional reform) (law of 8 August 1980) (more information: *website FPS Economy*).

5.2.2 Spatial use

The LNG terminal is located in the eastern part of the port of Zeebrugge. The peninsula on which the LNG terminal is located covers an area of approximately 32 ha (source: *niet-technische samenvatting MER LNG-terminal Zeebrugge*). At present, there are plans for an expansion with a new 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*). In the marine spatial plan (royal decree of 20 March 2014, see also *Van de Velde et al. 2014*), space is provided for the expansion of the port of Zeebrugge which also hosts, in addition to the LNG terminal, the terminals of the Zeepipe and Interconnector gas pipelines (see theme **Pipelines and cables**).

5.2.3 Societal interest

Zeebrugge is a cornerstone in the supply chain of natural gas to Northwest Europe with the LNG terminal and the terminals of the Zeepipe and Interconnector gas pipelines (see theme **Pipelines and cables**). Furthermore, the Zeebrugge Hub is one of the leading short-term markets in Europe (*België als aardgasdraaischijf voor Noordwest-Europa: de weg vooruit 2010*, *Brouwers et al. 2011*). In 2010, a total of 62 billion m³ of gas was traded in the Zeebrugge Hub (*Open season: second capacity enhancement of the Zeebrugge LNG terminal. Binding phase: offer description 2011*).

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*). At present, there are plans for an additional storage tank of 180,000 m³ of LNG (*Niet-technische samenvatting MER uitbreiding Fluxys LNG, Zeebrugge*). Fluxys has opted for a model of cooperation for the development of an LNG terminal in Dunkirk and participates for 25% in this project. A pipeline connection between the two terminals is being prepared through a new interconnection point in Alveringem and Maldegem.

5.2.4 Impact & sustainable use

The construction of natural gas installations in Zeebrugge implies a certain impact, both on the environment and on other users. These effects are discussed in the corresponding environmental impact assessments (EIAs, see *MER-databank Vlaamse Overheid*, *Niet-technische samenvatting MER uitbreiding Fluxys LNG, Zeebrugge*).

In these EIAs, a number of measures have already been proposed to mitigate or avoid the environmental impact of the LNG terminal (see *MER-databank Vlaamse Overheid*, *Niet-technische samenvatting MER uitbreiding Fluxys LNG, Zeebrugge*).

There are a number of advantages with regard to natural gas as an energy source in comparison to fossil fuels (*website Fluxys*). The use of LNG as fuel for ships is being promoted, since it emits less harmful substances than diesel or heavy fuel oil (*Margarino 2014*, see theme **Maritime transport, shipping and ports**).

5.3 Pipelines and cables

In the OSPAR area, the 1,300 oil and gas platforms are connected with a pipeline network of more than 50,000 km (*OSPAR QSR 2010*). In the Belgian part of the North Sea (BNS), there are 3 gas pipelines with a total length of 163 km (*Verfaillie et al. 2005*, *GAUFRE project BELSPO*):

- The Zeepipe pipeline connects the Distrigaz terminal in the port of Zeebrugge to a pipeline on the Norwegian shelf and has a total length of 814 km;
- The Interconnector pipeline has a length of 215 km and is located between Zeebrugge and Bacton (south coast, UK);
- The Norfra pipeline (now also called Franpipe) is a 840 km long pipeline between the Norwegian shelf and the port of Dunkirk which partially crosses the BNS (*Maes et al. 2000*).

In addition, the North Sea and the North Atlantic Ocean are intersected by telecommunication and power cables. Telecommunication cables are mainly situated in the southern part of the North Sea, in the Celtic Seas and in the trans-Atlantic corridor. Power cables can be found in the North Sea and Celtic Seas (*OSPAR QSR 2010*). On the Belgian Continental Shelf (BCS), there are 27 telecommunication cables, 16 of which are in use, with a total length of 914 km (*Verfaillie et al. 2005*, *GAUFRE project BELSPO*). In the future, the share of power cables will increase due to the installation of offshore wind turbines (see **Offshore wind energy**). In early 2013, four cable licenses had already been delivered (2 C-Power cables, 2 Belwind cables, 1 Northwind cable and 2 Norther cables) of which three cables are in use (2 for C-Power, 1 for Belwind and 1 shared by Belwind and Northwind). The idea of a meshed electricity network (Belgian Offshore Grid) is elaborated in the Master Plan Offshore Cables (*Masterplan Zeekabels*) which coordinates the onshore connection of the wind farms that still need to be built. Finally, a submarine power cable will be realised between Belgium and the UK in the framework of the *NEMO project* (*Milieueffectenrapport - NEMO LINK 2012*, *Brochure NEMO-STEVIN 2013*).

5.3.1 Policy context

The procedure for the installation of power cables in the BNS has been stipulated in the royal decree of 12 March 2002 (see also ministerial decree of 8 May 2008) (figure 4). The applications are sent to the minister of Energy or his delegate. The documents for the application are 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 EIA is performed by the Management Unit of the North Sea Mathematical Models (MUMM).

The procedure for the construction of pipelines is determined by the law of 12 April 1965 on the transport of gas and other gaseous products by pipelines. This law has been supplemented by various royal decrees.

The agreement between Norway and Belgium with regard to the Norfra pipeline has been formalised in the law of 13 May 2003 and in the law of 19 September 1991 concerning the Zeepipe pipeline. The agreement related to the transport of gas in the Interconnector pipeline between Britain, Northern Ireland and Belgium has been formalised in the law of 26 June 2000. For an overview of the legislation with regard to the pipelines in the BNS, see *coastal codex, theme cables and pipelines*.

5.3.2 Spatial use

In the marine spatial plan (royal decree of 20 March 2014, see also *Van de Velde et al. 2014*) a corridor has been demarcated in which cables and pipelines should be bundled as much as possible. Activities which interfere with the installation or exploitation of these cables and pipelines are prohibited in this zone. The spatial use in the proximity of power cables in the BNS is discussed in the royal decree of 13 March 2002 (table 6).

The connection points at the coast for power cables from offshore wind farms are located in Ostend (Slijkens) and Zeebrugge (Belwind and Northwind). For the remaining wind farms, the onshore connection is coordinated by the Master Plan Offshore Cables (*Masterplan Zeekabels*) which elaborates the practical implementation of the Belgian Offshore Grid. This master plan largely depends on the reinforcement of the power grid in the coastal area in the context of the Stevin project which plans a high-voltage connection between Zomergem and Zeebrugge (*Tant 2014*, *website ELIA*).

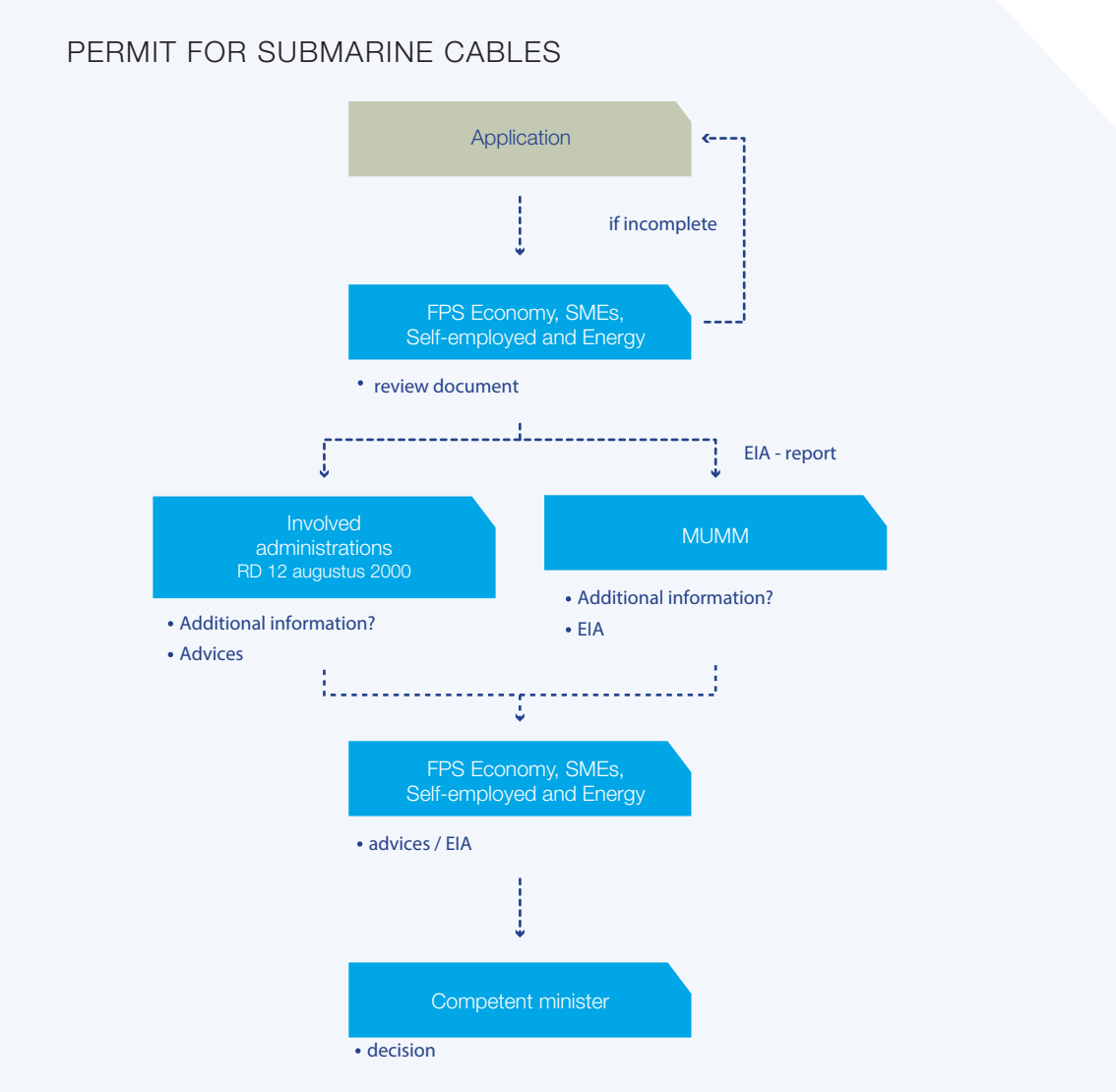

Figure 4. Flowchart of the permit for submarine cables (royal decree of 12 March 2002).

Table 6. An overview of the use of space in the BNS in the proximity of power cables (royal decree of 12 March 2002).

SPATIAL USE IN THE PROXIMITY OF POWER CABLES (RD of 12 March 2002)	
Protected area (250 m on either side)	**Reserved area (50 m on either side)**
Anchoring prohibited	No installation, no cable or pipeline construction
No activities that put the cable at risk (except the installation of a cable under certain conditions)	
Exception:	Exception:
Interventions by the owner in the framework of production	Unipolar cables on the same safety switch, arrival of cables from and departure of cables to a wind turbine in parallel with others, point of arrival from and departure to an infrastructure with one or more cables, convergence point of several cables that are part of the same mechanism to return to the mainland, repaired cables

5.3.3 Societal interest

Due to the increasing importance of offshore wind turbines (see also **Offshore wind energy – Societal interest**), there is a growing demand for submarine power cables for the transport of energy to the mainland. In addition, submarine cables are also important for transnational energy and communication networks (OSPAR QSR 2010).

The transport of gaseous products to our country takes place by means of submarine pipelines:

- The Zeepipe pipeline is managed by Statoil and transports approximately 13 billion m³ of gas per year with a daily capacity of 41 million m³;
- The Norfra pipeline has been operational since 1998 and transports 40 million m³ of gas per day between Dunkirk and the Norwegian shelf. The pipeline has a capacity of 15 billion m³ per year;
- The Interconnector pipeline has been operational since October 1998 between the south coast of England and Zeebrugge. This pipeline is bidirectional and can thus be used for the import / export of gas from / to England. In winter, there is import from England with a capacity of 8.5 billion m³ per year and in summer there is export to England with a capacity of 20 billion m³ per year.
  (*Verfaillie et al. 2005* (*GAUFRE project BELSPO*), *Brouwers et al. 2011*)

5.3.4 Impact

The construction and operation of pipelines and cables have a (local) impact on the marine environment. This impact is usually included in the environmental impact assessment (EIA) of the offshore wind farm concerned (see **Offshore wind energy - Impact**). A number of studies and environmental impact assessments which specifically focus on the effects of cables on the environment are included in table 7.

Table 7. An overview of the effects of the construction and operation of cables and pipelines on the (marine) environment.

IMPACT	LITERATURE
Toxic pollution due to the pipeline's zinc coating	*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*
Sediment disturbance during the 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*
Effect on the 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*
Electromagnetic field around the 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*
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*
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*

5.3.5 Sustainable Use

MEASURES CONCERNING THE IMPACT ON THE MARINE ENVIRONMENT

At present, there are no common programmes or measures to address the impact of pipelines and cables on the marine environment on an international level (*OSPAR QSR 2010*). At the European level, 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 (*Tasker et al. 2010*), the integrity of the seafloor (*Rice et al. 2010*) and non-indigenous species (*Olenin et al. 2010*).

At the Belgian level, the effects of power cables on the marine environment are briefly addressed in the monitoring programme for offshore wind farms (*Degraer & Brabant 2009*, *Degraer et al. 2010*, *Degraer et al. 2011*, *Degraer et al. 2012*, *Degraer et al. 2013*) and in the EIAs of the offshore wind farms (*website MUMM*).

MASTER PLAN OFFSHORE CABLES

To date, offshore wind farms in the BNS have been individually connected to the main land grid. However, a more coordinated system for connecting offshore energy to the main land is being investigated, given the technological, economic and ecological advantages. An offshore meshed grid (Belgian Offshore Grid) has been suggested, in which wind farms are connected to high-voltage substations which in turn connect to the onshore grid (*visie Elia offshore grid 2012*, *MER - Belgian Offshore Grid 2013*, *Aanvraagdossier Belgian Offshore Grid 2013*). The practical implementation of the Belgian Offshore Grid is currently elaborated in a Master Plan Offshore Cables (*Masterplan Zeekabels*) in cooperation with the involved wind farms and other involved stakeholders. The further development of this master plan also depends on the Stevin project which deals with the reinforcement of the onshore electricity grid (*Tant 2014*, *website ELIA*).

THE NEMO LINK PROJECT

The *Nemo Link project* is a two-way submarine high-voltage cable between Zeebrugge and Richborough (United Kingdom) of approximately 1,000 MW DC (*Milieueffectenrapport - NEMO LINK 2012*, *Brochure NEMO-STEVIN 2013*). This project should accommodate a better connection between the electricity provider and users in the UK and the European mainland. Economic studies have shown the usefulness of such a connection and the project has been selected by the European Commission as a 'project of common interest' in the framework of the Trans-European Energy Infrastructure (TEN-E, Regulation 347/2013). The application has been completed and the construction should take place in 2017/2018. For the grid connection on the Belgian side, the available capacity created by the Stevin project between Zeebrugge and Zomergem would be partly used (*Brochure NEMO-STEVIN 2013*, *Tant 2014*, *website ELIA*).

NORTH SEA OFFSHORE GRID

On a higher geographical level, energy providers of the countries surrounding the North Sea are considering an Offshore North Sea Grid. This grid interconnects the various clusters of wind farms in the North Sea (and other offshore renewable energy sources) and should ensure that the necessary onshore connections are in place in the future (*Mathys et al. 2009* (*OPTIEP-BCP project BELSPO*), *Offshore Electricity Grid Infrastructure in Europe 2011*, *Brochure FPS Economy*). An overview of the policy framework as well as the technical and economic aspects of this initiative is given in the publication *Offshore Electricity Grid Infrastructure in Europe (2011)*. European plans to develop an offshore network are addressed in the blueprint for an integrated European energy network (COM (2010) 677).

5.4 Tidal and wave energy

In the Blue Growth Strategy of the European Commission (COM (2012) 494, *website DG MARE*), blue energy is considered to be one of the most important fields. With the exception of offshore wind energy, technologies for offshore renewable energy (such as tidal and wave energy production) are still in an early stage of development. This is also apparent from the member states' plans to install only a modest capacity of 2 to 4 GW by 2020. In order to realise the potential of the ocean's energy (tidal energy, wave energy and energy extraction from temperature and salinity gradients), measures have been taken by the Commission (COM (2014) 08). Indeed, the potential of wave energy is impressive. According to *Cruz et al. (2008)* and *Brouwers et al. (2011)*, the total available wave power of all coastlines in the world is comparable to the current global electricity consumption.

At present, a lot of research is being conducted to further develop technologies with regard to ocean energy (see for example *website DG Research and Innovation*, *Ocean Energy Era-Net* and the European projects in the context of the *Ocean of Tomorrow Calls 2014*). In table 8, publications and research projects about the development of ocean energy in the BNS are listed.

Table 8. An overview of the research on wave and tidal energy extraction in 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*
	Potential (wave climate in the 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*
	Development of a prototype	*FlanSea-project* (*beschrijving project*, *Van In 2014*), *Laminaria*
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 in the BNS)	*Mathys et al. 2009* (*OPTIEP-BCP-project BELSPO*), *Mathys et al. 2012* (*BOREAS-project BELSPO*)

In order to further stimulate tidal and wave energy in Flanders, an action plan called *Gen4Wave* has been elaborated by partners from the academic world, the industry and the government. In this plan, a coast and ocean basin will be constructed to test scale models. Additionally, the West Flanders Development Agency (*POM West-Vlaanderen*) has established a Blue Energy Cluster in the framework of the so-called 'Factories of the Future' (*Fabrieken voor de Toekomst*), which *inter alia* focusses on the development of wave and tidal energy (*Dangreau 2014*, *Vanden Berghe 2014*). This development is also stimulated by certain ports such as the port of Ostend (see *BEPPO-project*).

In the area of the BNS reserved for the offshore wind farms, the construction and exploitation of installations for tidal and wave energy production is allowed as well (RD of 20 March 2014 and RD of 20 December 2000, amended by RD of 3 February 2011). A pilot project with wave converters is planned in the Mermaid concession zone (*Aanvraag Mermaid 2014*). The EIA of this concession zone discusses the potential impact of these convertors on the environment (*Rumes et al. 2015 – MEB Mermaid*, *Rumes et al. 2015*).

5.5 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 buffer this variability, hydro-electrical energy storage in a so-called energy atoll in the BNS is considered (*studie van het Milieu Innovatieplatform van de Vlaamse overheid (MIP, 2013)*, *Van de Walle 2013*). In the coalition agreement of the federal government (*regeerakkoord van de federale regering 2014*) energy storage is deemed one of the important challenges for the following years. Offshore energy storage by means of an energy atoll is discussed in a policy statement of the state secretary for the North Sea (*Beleidsverklaring van de staatssecretaris voor de Noordzee (2014)*). The energy atolls have also been incorporated into the Master Plan 'Flemish Bays' (*Masterplan Vlaamse Baaien (2014)*) in which a long-term (2100) (see also theme **Safety against floods**) vision on the development of the coast is elaborated.

In the marine spatial plan (royal decree of 20 March 2014, see also *Van de Velde et al. 2014*) two zones are demarcated for energy storage in an energy atoll: off the coast of Wenduine and near the port of Zeebrugge. This last one should be adjusted to the current port activities and future port expansion. The marine spatial plan also stipulates that an energy atoll can only be realised when active environmental management measures are in place. The conditions and the procedure for acquiring a concession zone for such an energy atoll have been defined in the royal decree of 8 May 2014 which implements the law of 29 April 1999 (see figure 5). Prior to this royal decree, the Commission on the

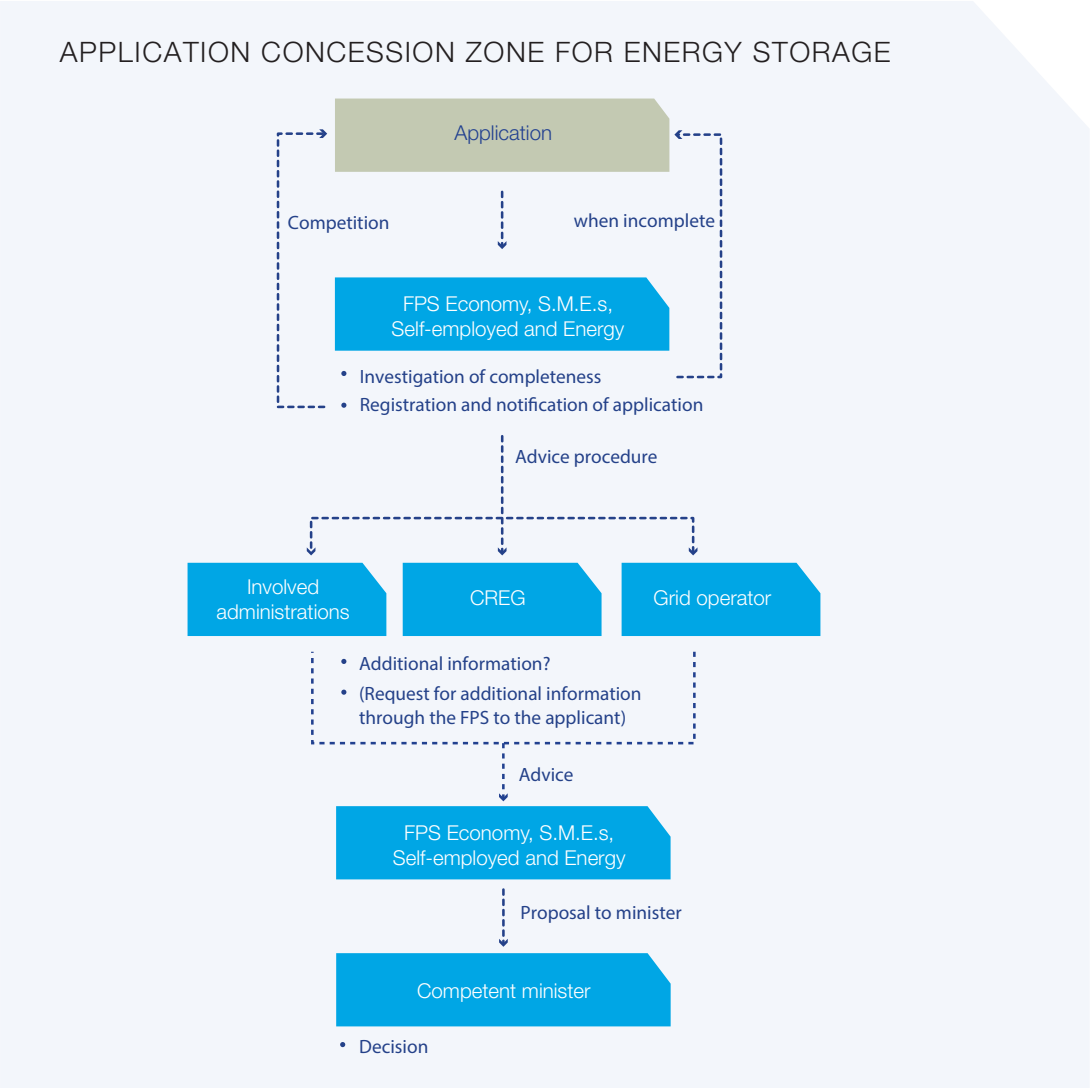

Figure 5. Flowchart for the application of a concession zone for energy storage (RD of 8 May 2014).

Regulation of Electricity and Gas (*CREG*) *advised* that it is pertinent to reserve a zone for energy storage. Furthermore, the construction of an energy atoll needs to comply with the conditions of the environmental permit procedure in accordance with the law on the protection of the marine environment (law of 20 January 1999), the royal decree of 7 September 2003 (procedure for permits and authorisation of certain activities in the BNS) and the royal decree of 9 September 2003 (regulation regarding environmental impact assessment).

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 consisted of a basic scenario with an installed capacity of 550 MW and an available energy content of 2 GWh (source: FPS Economy). However, the application was refused by the state secretary for the North Sea in September 2015.

In *Zimmerman et al. (2013)* the effects on currents, coastal morphology and coastal safety have been investigated. In the study *studie van het Milieu Innovatieplatform van de Vlaamse overheid (MIP, 2013)*, the ecological, legal and economic aspects of an energy atoll are discussed on 4 different locations. For each of these locations a SWOT analysis has been elaborated.

5.6 Renewable energy in the coastal zone

The coastal zone has a number of natural features that make it an interesting region for some forms of renewable energy production. A study about the average wind speeds in Flanders (*Windplan voor Vlaanderen*) has concluded that the coast has a significantly higher wind range (see also *Dehenauw 2002*). In our wind climate, a production factor of ± 11% is present in the inland areas, whereas this factor increases to ± 23% near the coast and to ± 34% at sea (*Brouwers et al. 2011*). Furthermore, measurements have revealed that the duration of sunshine in the coastal zone is on average 1,700 hours per year compared to 1,550 hours in Uccle (inland). The biggest differences occur during summer when the coast receives a surplus of up to 20 hours of sunshine per month (*Dehenauw 2002*). Also, in the Belgian *climate atlas* of the Royal Meteorological Institute of Belgium (RMI), parameters such as *sunshine duration* and *insolation* clearly reveal increased values for the coastal zone. Hence, the coastal zone has an increased potential for solar energy. Of course, other forms of renewable energy production are also present in the coastal zone (e.g. biomass, biogas, etc.). However, as the coast does not constitute a specific environment for these forms of renewable energy, they will not be further discussed here.

At the European level, the policy with regard to energy is developed by the *Directorate General for Energy*. A crucial instrument in this context is directive 2009/28/EC concerning the promotion of the use of energy from renewable sources. This directive stipulates that Belgium should incorporate 13% of renewable energy into its final energy consumption by 2020[2]. Furthermore, the directive also determines that each member state needs to elaborate a national action plan on how to reach the renewable energy goals (*nationaal actieplan België hernieuwbare energie 2010*).

Unlike nearshore energy production, renewable energy on land is a regional competence, which is mostly regulated by the Energy Decree of 8 May 2009 (*Environment, Nature and Energy Department*, *Vlaamse beleidsnota energie 2014-2019*). The Flemish Energy Agency (VEA) implements this policy (*website VEA*). A comprehensive overview of the laws and regulations on renewable energy can be found on the *website of VEA*.

On 1 September 2014, a total of 12,609 installations with a total installed capacity of 223.6 MW that qualify for Green Current Certificates (GCCs) were present in the coastal zone (10 coastal municipalities + 9 hinterland municipalities). The vast majority of the installed capacity is located in Bruges and Ostend (*Vlaamse Regulator van de Elektriciteits- en Gasmarkt, VREG*).

More specifically, 17 wind turbines (with a total installed capacity of 54.8 MW) were present in the coastal zone in September 2014: in Zeebrugge (on the breakwater of the port), Bruges, Gistel, Diksmuide and Middelkerke. These turbines account for 11.3% of the total capacity of Flemish wind turbines (*Vlaamse Regulator van de Elektriciteits- en Gasmarkt, VREG*).

Regarding photovoltaic panels, 12,221 installations <= 10 kW were present in the coastal area, totalling an installed capacity of 55.2 MW (1 September 2014). Furthermore, 356 installations > 10 kW with a total installed capacity of 56.2 MW were present (*Vlaamse Regulator van de Elektriciteits- en Gasmarkt, VREG*).

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

Legislation reference list

Table with international agreements, conventions, etc.

INTERNATIONAL AGREEMENTS, CONVENTIONS, ETC.			
Abbreviation	Title	Year of conclusion	Year of entering into force
ASCOBANS	Agreement on the conservation of small cetaceans of the Baltic, North East Atlantic, Irish and North Seas	1991	1994

Table with European legislation. The consolidated version of this legislation is available on *Eurlex*.

EUROPEAN LEGISLATION			
Abbreviations	Title	Year	Number
Directives			
Marine Strategy Framework Directive (MSFD)	Directive establishing a framework for community action in the field of marine environmental policy	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
Regulations			
	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
Other			
	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	08

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on *Belgisch staatsblad* and the *Justel-databases*.

BELGIAN AND FLEMISH LEGISLATION		
Date	Title	File number
Laws		
Wet van 12 april 1965	Wet betreffende het vervoer van gasachtige producten en andere door middel van leidingen	1965-04-12/30
Bijzondere wet van 8 augustus 1980	Bijzondere wet tot hervorming der instellingen	1980-08-08/02
Wet van 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	1999-01-20/33
Wet van 20 januari 1999	Wet ter bescherming van het mariene milieu en ter organisatie van de mariene ruimtelijke planning in de zeegebieden onder de rechtsbevoegdheid van België	
Wet van 29 april 1999	Wet betreffende de organisatie van de elektriciteitsmarkt, inzonderheid op artikel 6	1999-04-29/42
Wet van 26 juni 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
Wet van 13 mei 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
Royal decrees		
KB van 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
KB van 12 maart 2002	Koninklijk besluit 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	2002-03-12/37
KB van 16 juli 2002	Koninklijk besluit betreffende de instelling van mechanismen voor de bevordering van elektriciteit opgewekt uit hernieuwbare energiebronnen	2002-07-16/39
KB van 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
KB van 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
KB van 17 mei 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

BELGIAN AND FLEMISH LEGISLATION (continuation)		
Date	Title	File number
Royal decrees		
KB van 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
KB van 3 februari 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
KB van 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
KB van 20 maart 2014	Koninklijk besluit tot vaststelling van het marien ruimtelijk plan	2014-03-20/03
KB van 8 mei 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
Ministerial decrees		
MB van 8 mei 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	
MB van 16 maart 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	
Decrees		
Decreet van 8 mei 2009	Decreet houdende algemene bepalingen betreffende het energiebeleid (het energiedecreet)	2009-05-08/27