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UPDATE SOCIO-ECONOMIC ANALYSIS OF THE USE OF THE BELGIAN MARINE WATERS AND OF THE COST OF DEGRADATION

Marine Strategy Framework Directive - Art. 8.1.c

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Executive summary

The European Marine Strategy Framework Directive 2008/56 / EC (MSFD) establishes a framework for achieving or maintaining a good environmental state of the marine environment by the EU Member States by 2020. An initial assessment of the state of the marine waters in Belgium was made in 2012, as required by the MSFD. This assessment included an economic and social analysis of the use of the Belgian waters and the costs associated with the degradation of the marine environment.

The study updates and extends the economic and social analysis reported in 2012 according to the Marine Water Accounts approach (European Commission, 2010), further considering progress and recommendations made at EU and OSPAR level. The study presents results for the OSPAR common socio-economic indicators: Gross value added (unit: Million EUR), Employed persons (unit: FTE), Production value (unit: Million EUR). Besides the sectors considered under the common OSPAR approach (Fisheries and aquaculture, Shipping (or maritime transport), Ports, Oil and Gas, Offshore Wind Energy), the study takes further into consideration sectors with high relevance for the Belgian context (e.g. sand extraction, tourism). The reference period is 2011-2015, with a preference for 2014-2015. Where possible, internally available data from authorities were used and complemented by external data from stakeholders. The approach generally relies on obtaining suitable division keys to disaggregate the economic statistics. If no data are available for this period, the most recent datasets were used.

This report provides further an insight into the cost of degradation of the marine environment of the Belgian part of the North Sea by an estimation of annual costs based on the current cost of existing measures to avoid (reduce or minimize) degradation and the restoration costs based on additional/new measures to reach Good Environmental Status (GES). This method is described as the thematic approach within the European guidance document (European Commission, 2010). Given the assumptions used and bearing in mind the measures for which no data are available, the total costs of measures that avoid degradation of the Belgian North Sea environment have been calculated to be at least € 2.873.031 per year. A large share of this total cost is related to monitoring of the environmental impacts e.g. from aggregate extraction.

Next to this, insight is provided into the potential applicability of the ecosystem services approach methodology to calculate ecosystem benefits gained when Good Environmental Status is reached. In terms of the applicability of the ecosystem services approach concept, it is concluded that the methodology and empirical application are not mature enough yet to be applied within the current reporting cycle of the Marine Strategy Framework Directive. Further progress need to be made to fully apply this method within an MSFD context.

Key words: *Marine Strategy Framework Directive, Costs, North Sea, Ecosystem Approach*

To begin summary results are presented in Table 1, which gives an overview of the economic key figures for the Belgian North Sea Economy for the reference period 2011-2015, based on the available data. Besides marine activities, the study considers sectors in the coastal area (on land) with a strong and clear link to the North Sea including tourism and recreational activities and ports. A further outline per sector is given below.

Overview table - update socio-economic analysis BNS (reference period 2011-2015)

	Gross Value added (million Euro)	Year	Employed persons (FTEs)	Year	Development in production value or other relevant data on trends between first and second initial Assessment (million Euro)	Year	Data sources
Fisheries and aquaculture[1]	50,6	2016	363	2016	81,815	2015	Department Landbouw en Visserij 2016
Shipping[2]	2298	2013	8710	2013	Not available		Royal Belgian Shipowners Association 2014
Ports[3]	16532	2015	114773	2015	400	2010	NBB 2016
Offshore Energy[4]	1000	2015	15000-16000	2010-2030	2560	2017	Belgian offshore platform 2017
Aggregate extraction	Not available		124	2016	16,151	2016	FPS Economy, Zeegra
Dredging/dumping at sea[5]	Not available		240-560		Not available		Zeegra
Tourism[6]	335,814	2007	27000	2013	2803,5	2014	Compendium Kust & Zee 2015 Westtoer 2013
Recreational fisheries[7]	Not available		Not available		Not available		VLIZ

1: The data is obtained from the NBB and include aquaculture on land. Aquaculture at sea is currently absent in the BNS.
2: Specific data for the reference period is not available for Development in Production Value. These data are not made available by the ship owners for strategic reasons.
3: The figures provided in the table include the 4 Belgian maritime ports: Ostend, Zeebrugge, Ghent and Antwerp.
4: The values in the table are estimated values provided by the sector.
5: The values in the table are estimated values provided by the sector.
6: Gross added value for the tourism sector: only data for 2007 are available.
7. Data on recreative fisheries are collected in the framework of the VLIZ project 'Recreatieve Zeevisserij' and will become available in 2018.

The cost of degradation for the Belgian North Sea (BNS) has been summarized in the next table, based on the available data. This is done by calculating both the current cost of existing measures that avoid (reduce or minimize) degradation, and the cost of new/additional measures proposed by Belgium under MSFD to reach a Good Environmental Status by 2020 (considered as restoration cost). It should be noted that next to these costs, a large share of costs is related to several (high cost) land-based measures, such as sewage treatment. Since they not solely affect the North Sea environment and in principle are reported under the Water Framework Directive (WFD), they have not been considered under this study. A further outline of the cost of degradation per measure and per sector is given below.

Overview table – estimate of the annual cost of measures to avoid degradation of the BNS

Existing measure	Targeted sectors	Public authority	Personnel (FTE)	Working budget	Info
Permitting (incl. Environmental Impact Assessment (EIA) and Appropriate Assessments (AA))	Aquaculture (note 1), offshore energy, aggregate extraction	DMM	4	200.000	Info: DMM Joint budget and personnel across all activities and sectors
Definition of conservation targets and development of management plans/policy plans for marine protected areas.	n.a.				
Conditions and restrictions wind parks and cables	Offshore energy				
Conditions and restrictions wind parks and cables	Offshore energy	BMM	n.a.	n.a.	
Conditions and restrictions sand extraction	Aggregate extraction	Dienst Continentaal Plat	3	305.000	Info: FOD Economie – Dienst Continentaal Plat
Conditions and restrictions sand extraction (meetdienst Oostende)	Aggregate extraction	KBIN/BMM		101.000	
Conditions and restrictions sand extraction (monitoring)	Aggregate extraction	KBIN/BMM		411.000	
Conditions and restrictions sand extraction (monitoring)	Aggregate extraction	ILVO		411.000	
Condition and restrictions dumping of dredged sediments:	Dredging and dumping	n.a.	n.a.		
Spatial measures integrated in the marine spatial plan (2014-2020) linked to wind energy sector	Offshore energy	DMM	3	100.000	Info: DMM
Prohibited activities within SPAs and user agreements	Commercial fisheries, recreational fisheries	DMM	0,5		Info: DMM Joint budget and personnel across all activities and sectors
Prohibition shellfish fisheries					
Prohibition intentional (except with permit) and unintentional introduction of non-indigenous organisms via ballast water	Shipping				
Implementation of the Common	Commercial	Dienst Zeevisserij	5		Info: Dienst

Existing measure	Targeted sectors	Public authority	Personnel (FTE)	Working budget	Info
Fisheries Policy (CFP) measures	fisheries				Zeevisserij
Prohibition shellfish fisheries					
Implementation of the Common Fisheries Policy (CFP) measures	Commercial fisheries	Defense (Navy)		302.184	Info: Dienst Zeevisserij, Defense (Belgian Navy) Note 2
Implementation of the Common Fisheries Policy (CFP) measures	Commercial fisheries	ILVO	n.a.	n.a.	
Introduction of sumwings and roller shoes	Commercial fisheries	ILVO	0	0	Info: ILVO (note 3)
Implementation of the Common Fisheries Policy (CFP) measures	Commercial fisheries	OD-Nature		71.000	Info: Dienst Zeevisserij
Prohibition shellfish fisheries	Commercial fisheries				
Prohibition gillnet fisheries	Recreational fisheries		n.a.	n.a.	
Prohibition of ship activity in or near wind parks	Shipping, commercial fisheries, tourism		n.a.	n.a.	
Measures related to fouling	Shipping		n.a.	n.a.	
Land-based measures (policy and guidelines)		DMM	1	100.000	Info:DMM
Land-based measures (sensitization)		OVAM		36.000	Info: OVAM
Environmental monitoring		BMM	n.a.	n.a.	
Measures prevention and pollution control	All sectors	DMM	3	400.000	Info: DMM
Ship waste	Shipping	Port authorities	0	0	Info: port authorities Note 4
Seafood legislation	Commercial fisheries	FAVV			
Monitoring marine litter cfr. OSPAR		BMM			
Fishing for litter	Commercial fisheries	DMM	0,5	10.000	Info: DMM
Total			**21**	**2.447.184**	

Note 1: There are no marine aquaculture (mariculture) projects so far in the BNS, only pilot projects.

Note 2: This cost is the cost for surveillance by the Navy in 2015. It is calculated as follows: 18 days x 16.788 Euro/day. Important: the surveillance includes surveillance on other marine users as well: recreation, shipping etc.

Note 3: The pilot tests and research on sum wings and roller shoes have been carried out but this activity is finished now. The sum wings and roller shoes are now applied by the fishing vessel operators and the cost is born by the ship operators.

Note 4: There is no cost involved for ports, costs for waste collection are borne by the shipping companies. The waste collection is carried out by the private sector.

Additional measures	Average cost per year (Euro) (min-max)
Commercial fisheries	84.633-90.466
Shipping	10.625
Tourism	9.000-13.500
Recreational fisheries	98.499-108.499
Total (average per year):	**202.757-223.090**

Commercial fisheries

The Belgian waters are fished by the Belgian commercial fishing vessels, as well as fishing vessels from neighbouring countries (The Netherlands, France). The Belgian commercial fishing fleet deploys its activities to a large extent outside the Belgian continental Shelf, activities in the Belgian part of the North Sea are rather limited. The socio-economic data are, as a result, not restricted to the Belgian part of the North Sea. The Belgian commercial fishing fleet consisted of 76 fishing vessels in 2015, and the fleet has strongly declined in the past decades. The reasons for this decline are the declining fish stocks and limitations to quota. There was a total of 363 active fishermen in 2016. Development in production value of the sector amounted to 81.815 million Euro in 2015. The Gross added value was 50,6 million Euro in 2015.

It is expected that possibilities for commercial fisheries activities in the Belgian marine waters will largely remain the same in future (2020, 2030 or 2050). Alternative fishing techniques with reduced impact on the environment will be promoted further in future. It is expected that demand for fish will continue to rise in future due to the expected population growth (+13% by 2100). Increases in production will only be possible within the limits of the Total Allowable Catch (TAC). In future, the trend towards more sustainable fisheries practices, high quality products and short chain to clients is expected to remain (Long-Term Vision North Sea 2050).

The current costs of degradation can be estimated by the cost for the responsible authorities to implement and follow up the costs of enforcement spatial measures related to fisheries in the marine spatial plan (2014-2020), enforcement of the Common Fisheries Policy, enforcement prohibition of shellfish fisheries, seafood legislation and coordination between Flemish and federal administrations in Belgium. Restoration costs include costs for improved consultation structures, stricter enforcement in gravel zones, wind parks, soil conservation areas, sensitization on oil spills and waste management, stimulation of alternative to fishing lead and shark and ray protection.

Marine aquaculture

Commercial marine aquaculture is currently absent in the Belgian marine waters. The current marine spatial plan allows sustainable marine aquaculture in a multi-use context within 2 zones for renewable energy, but this opportunity is not being used so far (except for pilot project in a research context, e.g. EDULIS). Future marine spatial planning (2020-2030) foresees multiple-use of aquaculture and wind farms in the new zones for renewable energy.

As there is no actual mariculture activity, there is no current cost of degradation yet. Future aquaculture activities will require a permit, an EIA and an Appropriate Assessments (when relevant).

Shipping

The Belgian part of the North Sea (BNS) is crossed by over 150.000 ships per year and is considered as one of the busiest seas worldwide. The merchant fleet under Belgian flag has shown a growing trend in the past years with 162 ships in 2015 representing a total gross tonnage of more than 5 million tons. A total of 8.710 persons were employed directly in the shipping cluster in Belgium in 2013. The Belgium linked shipping industry and maritime cluster employs more than 12.100 persons and creates an annual revenue of 4.204 million Euro. This included merchant shipping, towage and dredging. Data on the total turnover of the shipping sector are currently not available. In 2013 the gross value added of the shipping cluster (merchant shipping, towage and dredging) amounted to € 2.298 million.

The shipping sector and supporting navigation channels will largely remain the same in the near future (2020-2030), with some optimizations in terms of safety. Possibilities for new emergency refuge areas, a tug station and multiple spatial use are being examined. In future (2050), there is trend towards larger and more energy-efficient ships. This represents a challenge in relation to the accessibility of the Belgian ports.

The current costs of degradation related to shipping are the costs for enforcement of measures relating to introduction of non-indigenous organisms via ballast water, measures related to fouling, pollution control, shipping waste, underwater noise. In the future, additional ship and boat control will also be needed in the new spatial zones for renewable energy and/or other commercial activities.

Ports

There are four ports in Belgium, with Ostend and Zeebrugge situated along the coast, and Ghent and Antwerp situated inland and connected to the North Sea via a canal and the river Scheldt respectively. These four ports constitute the Belgian North Sea ports cluster. These act as one of the most important bridgeheads for maritime trade links between all the continents worldwide and the European hinterland. In 2014, a total of nearly 269 million tons of goods were loaded or unloaded within this cluster. This amounted to 274 million tons in 2015.

The port of Antwerp is the second largest port in Europe and hosts the largest oil- and chemical industry cluster in Europe. The port of Zeebrugge is the market leader in trade of new cars and employs over 20.000 people. This port is also important for its LNG terminal and RO/RO traffic to and from Scandinavia, the UK and Spain/Portugal. The port of Ostend is focusing on offshore activities and renewable energy (wind parks) since 2008. The port of Ghent is an industrial port with steel industry and car factories. The traded goods consist of iron ore, coal, grain, building materials and oils. The port of Ghent has recently (2017) undergone a fusion with the port of Terneuzen under the name North Sea Port.

Direct and indirect employment in the Belgian North Sea Cluster amounted to a total of 114.647 persons (FTEs) in 2015. Together with the indirect employment this amounts to 252.394 FTEs or almost 6% of the working population in Belgium. The turnover of the ports amounted to approximately 400 million Euro in 2010. More recent data are not available, but the total amount of goods shipped via the ports can be used as a proxy and amounted to 282.535 thousand tons in 2016. The direct added value of the Belgian maritime ports amounted to 16.532 million Euro in 2014. In 2015, the gross added value amounted over 18 billion Euro. Together with the indirect added value this increases up to 33 billion euro, or circa. 8% of the GDP.

The current marine spatial plan safeguards the possibilities for further extension of the ports of Zeebrugge and Oostende by the designation of reservation zones. No significant changes are expected in the near future (2030) related to port development. Long-term projections indicate a trend towards automatization and robotization of the logistic chains in the ports, and the development of a ‘maritime logistic cloud’ to collect nautical and logistic data.

The current costs of degradation include the costs related to permitting and planning (incl. EIA and Appropriate Assessments) for port developments, bunker companies and port reception facilities. Waste from ships entering Belgian ports is collected by private companies in the harbours (no extra cost involved for the port authorities). Additional or new measures will include waste delivery from fishing vessels.

Offshore energy

To date, nine projects have been granted permits to build and operate wind and/or energy parks in the Belgian part of the North Sea. There are plans to build between 409 and 433 turbines in the wind turbine area by 2020, yielding a total capacity of 2,230 to 2,280 MW, accounting for around 10 % of total Belgian electricity generation. The investment value of the sector amounts to 8 billion Euro.

The offshore wind energy sector currently accounts for 1.400 jobs (FTEs) for exploitation. The employment for planned parks amount to circa 500 per year (man-years), with an exploitation period of 20 years. It is estimated that the total employment will amount to 15.000-16.000 jobs in the Belgian offshore wind energy sector between 2010 and 2030. The electricity price is fluctuating from year to year: ca. 70 EUR/MWh in 2008, 32 EUR/MWh in 2017. This amounts to a production value of 2.560 million Euro in 2017. The added value of the sector is estimated at 1 billion Euro/year (local and export) (Belgian offshore platform 2017).

Current costs for offshore energy are related to planning and permitting (incl. EIA, Appropriate Assessments), to guarantee safety at sea (enforcement), to electricity transmission to the land (e.g. 'Plug at sea"), to monitoring environmental impact, etc. By 2030 further extension of the European energy grid will take place, including installation of additional cables (and pipelines) preferably in the foreseen cable corridors. In future, multiple use of the zones for renewable energy will be examined and stimulated, e.g. testing of alternative renewable energy systems, marine aquaculture, passive fisheries in wind parks. Further costs of dismantling including restoration costs of the wind park sites, discarding and recycling costs, will need to be considered.

Aggregate extraction

Sand extraction is an important activity in the Belgian part of the North Sea (BNS) and takes place in four control zones, divided into sectors, for which concessions / permits are granted. Federal public Service Economy (Continentaal Plat), in cooperation with the research institutes ILVO and MUMM, are responsible for the sustainable management of the aggregate extraction on the Belgian Continental shelf (BCS) (permitting, monitoring).

Extracted sand is used for construction, beach supplements (coastal defence) and for land reclamation. Historically, a rise in sand extraction was observed from 29.000 m^3 in 1976 to 5,5 million m^3 in 2015. Until 1988 extraction was constant at ca. 0,5 million m^3, increasing steadily since. Peaks may be observed after severe storm events (coastal defence) (e.g. in spring 2014, winter 2017).

The aggregate extraction sector employed a total of 262 persons in 2016, including activities outside the BNS. The employment in activities in the BNS accounted for 124 FTE. The total production of marine aggregates in the BCS was 1.341.486 ton in 2016. The total turnover of the sector was 16.151.209 Euro (including production outside the BNS). Information on Gross added value was not available for the reference period. It is expected that the yearly demand for sand will increase with 6% up to 2050 (Long-Term Vision North Sea 2050).

The current marine spatial plan (2020) includes a.o. the partial closure of the Kwintebank for sand extraction, a redefinition of sectors for nautical safety and nature protection, inclusion of the Appropriate Assessment procedure in new concessions within the Natura2000 area 'Flemish Banks', a gradual reduction of extracted volumes in the SPZ 'Flemish Banks' and evaluation of multiple use of the sand extraction zones. By 2030 an additional zone will be demarcated in the northern part of the BNS, besides some optimizations of the existing zones.

The current costs of degradation include therefore costs related to permitting (incl. Environmental Impact Assessment (EIA) and Appropriate Assessments (AA)), costs related to monitoring, costs related to inspection of extraction activities and governance costs.

Dredging and dumping at sea

The maintenance of the entrance to the ports of Ostend, Zeebrugge and the smaller ports of Nieuwpoort and Blankenberge, and the shipping routes requires regular maintenance dredging (Flemish authority). In addition, there are also capital dredging activities for construction, deepening and broadening of ports. Most of the dredged material is dumped back at sea at specific dumping sites or re-used for beach nourishment if the quality allows. The management of dredging and dumping operations (including authorizations, monitoring environmental impact) falls under the responsibility of the federal government, in line with international requirements (e.g. sediment quality criteria).

The current employment is estimated to be 240 FTE or 560 FTE depending on the source. Dredging activities will largely remain the same by 2030, further considering safe nautical access and evolutions in ship technology. Some optimization of dumping sites may occur by 2030 related to nature conservation and will be further enlarged with a reservation area near Zeebrugge.

The current cost of degradation includes enforcement of conditions and restrictions for dumping of dredged sediments, enforcement of prohibited activities and user agreements. Dredging operators have to bear a

number of costs related to environmental impacts: anti-turbidity systems, authorizations for dumping dredged material at sea.

Tourism

Tourism is an important economic sector along the Belgian coast, with over 5 million arrivals and 28,4 million overnight stays in 2013. The tourism sector requires an extensive infrastructure and exerts a significant influence on urbanization and infrastructure in the coastal zones. Marinas have been built in Nieuwpoort and Blankenberge. The marina of Nieuwpoort holds berthing places for approximately 2000 boats and is the largest in northern Europe.

The tourism sector along the Belgian coast is important with an estimated 27.000 direct jobs (data 2013) and a total turnover of 2803,5 million Euro in 2014. No recent data are available for the tourism sector on gross added value. Data from 2007 showed that this amounted to 335,814 million Euro.

No significant changes are expected in the touristic and recreational possibilities in the Belgian coastal and marine area by 2020/2030. Further investments and diversification will be required in longer term for beach and sport clubs (Long-Term Vision North Sea 2050).

The current costs of degradation include awareness raising on the problem of marine litter and the importance of beach cleaning actions, further sensitization on waste management and oil pollution from pleasure crafts (especially in marinas). Some tourism activities might be subject to Appropriate Assessment procedures, in case of potential impact on marine protected areas (e.g. for sport activities),

Recreational fisheries

In total, 778 recreative fisheries boats were estimated in 2015, located in the harbours of Nieuwpoort, Zeebrugge, Oostende and Blankenberge. The total number of fishing trips by the recreative fisheries fleet amounts to 10.735 days. Most of the activities take place within the 3-nm zone.

There is very few information available on the economic importance of recreative fisheries in terms of direct employment, production value and value-added. A first estimate by the ICES Working Group on Recreational Fisheries (WGRFS), based upon a participation rate of 0,22%, stated an average expense of 1,372 Euro/fishermen/year (ILVO). Based upon this estimate, the total expenses of recreational fishermen amount to 33 Million Euro per year (Persoon 2015, Hyder et al. 2016). The ongoing project ‘Recreatieve Zeevisserij’ of the Flanders Marine Institute will generate more accurate data, which will become available in 2018. There are currently no accurate estimations of the number of recreational fishermen in Belgium (Verleye et al. 2015).

Currently, recreational bottom disturbing fisheries is generally prohibited in the entire special protection area ‘Flemish Banks’, with some exceptions for fishing on horse, by foot and for recreational fishermen already active (can have a permit to go out fishing for 10 times/year). Recreational gill net fisheries in the ‘Flemish Banks’ area is prohibited. This is expected to remain the same by 2030.

The current costs of degradation based upon existing measures include costs of management and enforcement of measures to restrict recreational fisheries in the SPA ‘Flemish Banks’ and to prohibit recreational fisheries in the wind parks, prohibition of shellfish fisheries and use of gillnets. New measures include measures to reduce bycatch of marine mammals, raising supervision on recreational fisheries, monitoring of the size of the sector, stimulation discussion on conversion of recreational fisheries to commercial fishing, and stimulating alternatives to fishing lead.

Other uses of the Belgian part of the North Sea

Following activities also take place in the BNS, but are less important in socio-economic terms: research, military operations, the Paardenmarkt as historical ammunition dump, anchorage areas and places of refuge, telecom cables and gas pipelines, wrecks and coastal defence. A brief description is included in the report.

Initial steps towards an Ecosystem services approach for the Belgian marine waters

Considering the increased attention for ecosystem-based approach in Europe (Biodiversity Strategy, MSFD) and at OSPAR level, Belgium has started to elaborate the ecosystem-based approach for its marine waters. It is expected that the ecosystem service approach, including monetary valuation of ecosystem services, will provide new insights for policy makers and contribute towards better decision-making. Ecosystem services are defined as goods and services - the benefits- that people obtain from ecosystems, and the direct and indirect contributions of ecosystems to human well-being.

The ecosystem services approach gives information on the value of the difference in ecosystem goods and services that would be provided in case of Good Environmental Status (GES), compared to the Business as Usual (BAU) scenario. The following steps characterize the approach and has been illustrated for the case study 'Flemish Banks', more in specific for the sector aggregate extraction.

1. Scoping of the marine ecosystem and abiotic services for the BNS: Based on the MAES classification for MSFD reporting 2018 (WG Dike, 2017), further elaborated to account for abiotic services, an overview of ecosystem services was produced. Prioritizing these flows (ecosystem and abiotic services) considering its relevance for the Belgian part of the North Sea (BNS) resulted in 16 ecosystem services to be further considered in the assessment: 3 provisioning services (P) (seafood, raw materials, renewable energy), 7 regulating services (R) (coastal erosion control, accessibility navigation, flood protection, maintaining nursery populations and habitats, pest and disease control, maintaining reef-building communities, water quality) and 6 cultural services (C) (experience value, environmental/aesthetic value, scientific, educational, heritage/cultural, entertainment).

2. Development of the assessment framework presenting the expected qualitative effect of the anthropogenic pressures on different ecosystem and abiotic services for the Belgian marine waters. The 3 main groups of pressures considered were physical disturbance, biological disturbance and disturbance due to input of substances, litter and energy in the marine environment.

3. Assessment of the condition of the marine ecosystem has been illustrated for the case study 'Flemish Banks' by comparing 2 scenarios: the current status 2016 (based on partially implemented MSP (2014-2020) and existing measures) and the expected status (2020) (based on fully implemented MSP (2014-2020) and additional new measure to reach GES). The major changes in activities and pressures are expected to have the strongest impact on the following ecosystem services for the Flemish Banks area: Seafood (P1), Raw materials (P2), Coastal erosion (R1)/Flood protection (R3), Maintaining nursery populations & habitats (R4), Maintaining reef-building communities (R6) and Pest & disease control (R5). A qualitative assessment has further been illustrated for the aggregate sector showing the results of a gradual reduction of extraction in the Flemish Banks area towards 2020. More data is needed to allow for a quantitative assessment.

4. Economic valuation of ecosystem services describing the consequences to human well-being of degradation of the marine environment in monetary terms. Building further on the example of aggregate extraction a preliminary flow diagram has been worked out to illustrate potential changes in raw material input, employment and economic return. More data is needed to allow for a detailed monetary valuation.

Recommendations

The following recommendations may be considered to further elaborate the socio-economic assessment of the Belgian part of the North Sea:

- the development of uniform descriptions of some economic activities (e.g. recreation and tourism), as it is not yet possible to collect the relevant data in a uniform manner due to lack of NACE codes.
- It is recommended to include data on the fishing efforts of the foreign fleet (especially Dutch vessels, considering their fishing effort in the BNS) in the overview.

In terms of the applicability of the ecosystem services approach concept, it is concluded that the methodology and empirical application are not mature enough yet to be applied within the current reporting cycle of the Marine Strategy Framework Directive. On longer term Belgium may use this approach for official reporting under the MSFD. Following recommendations may be considered to further elaborate the approach.

- Stakeholder involvement to prioritize the ecosystem and abiotic services for the Belgian marine waters, to verify the BAU scenarios, to support and validate data collection.
- Increased knowledge on the functioning of the marine ecosystem to identify the relevant relations between biotic, abiotic and economic processes.
- Increased knowledge to define ecosystem services at Good Environmental Status (GES) to allow comparison with the BAU scenarios
- Further modelling and research to allow quantification of the ecosystem services. An ecosystem services model based upon GIS and quantitative data (e.g. MarineInvest) to be worked out at BNS-scale to allow the testing of different scenarios on future developments in the BNS.
- Increased efforts on socio-economic data collection to allow economic valuation of ecosystem services and exploring the potential of the natural capital protocol for the Belgian marine waters.
- A widely accepted vision on monetary valuation of non-market goods to be worked out.

1 INTRODUCTION

1.1 Background and goals

This assignment complies with the obligations arising from the European Marine Strategy Framework Directive 2008/56 / EC (MSFD). The directive establishes a framework for achieving or maintaining a good environmental status (GES) of the marine environment by the EU Member States by 2020. A good environmental status of the waters means that there is an optimum condition regarding biological diversity, the presence of non-native species, the state of health of fish stocks, food chains, eutrophication, change of hydrographic conditions and concentration of contaminants, the amount of waste or noise pollution. To achieve this state, national marine strategies are developed and implemented.

As required by Article 8 of the MSFD, Belgium made an initial assessment of the marine environmental status of the waters in 2012 (Belgische Staat, 2012). This initial assessment includes: 1) Analysis of the current environmental status (Art 8.1.a) and 2) Analysis of the predominant pressures and impacts including human activities affecting the environmental status of marine waters (Art 8.1.b) as well as 3) the economic and social analysis of the use of those waters and the costs associated with the degradation of the marine environment (Art 8.1c).

According to article 17(2) of the Marine Strategy Framework Directive (MSFD), Member States (MS) have to update their marine strategies every six years. This requires articles 8 (initial assessment), 9 (determination of the Good Environmental Status) and 10 (establishment of targets) to be updated by 15 July 2018 and notified to the European Commission by 15 October 2018 at the latest. Considering this timeline, Belgium will organize its public consultation on the updated Art. 8, 9, 10 reports during April-June 2018. A reporting guidance has been developed with the aim of assisting and facilitating this 2018 reporting obligation by MS in their implementation of the Directive (European Commission Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment).

The objectives of this study are to update Art. 8.1c respecting the interdependence between the MSFD articles, considering the progress & recommendations made at EU level (since 2012) and regional level (OSPAR). To facilitate this work, participation and follow-up of the work under EU working group POMESA is provided.

1.2 Interdependence between environmental assessment, GES & targets

The interdependence between the main steps within the MSFD remains crucial. Improved GES definitions (Article 9) will form the basis for the revision of environmental assessment (Article 8) and the environmental objectives (Article 10). The well-known DPSIR (Driver-Pressure-State-Impact-Response) approach was adapted to better reflect the multiple relationships between the three parts of the initial assessment (Art.8) and to include the concept of ecosystem services. The modified DPSIR, graphically presented below in Figure 1, has been described by Working Group GES in the cross-cutting technical background paper (WG GES, 2015). An evaluation of the current state of the environment (Article 8.1a, ~ State) is in fact an assessment of the state of the environment that reflects the environmental impact (securities), including cumulative effects. These effects are, in turn, caused by the pressure (Article 8.1b, ~ Pressures) that is exerted on the environment by human activities (Article 8.1c, ~ Drivers, Human Activities). They rely on their turn on the ecosystem services provided by the marine environment, which depend on the state of the environment.

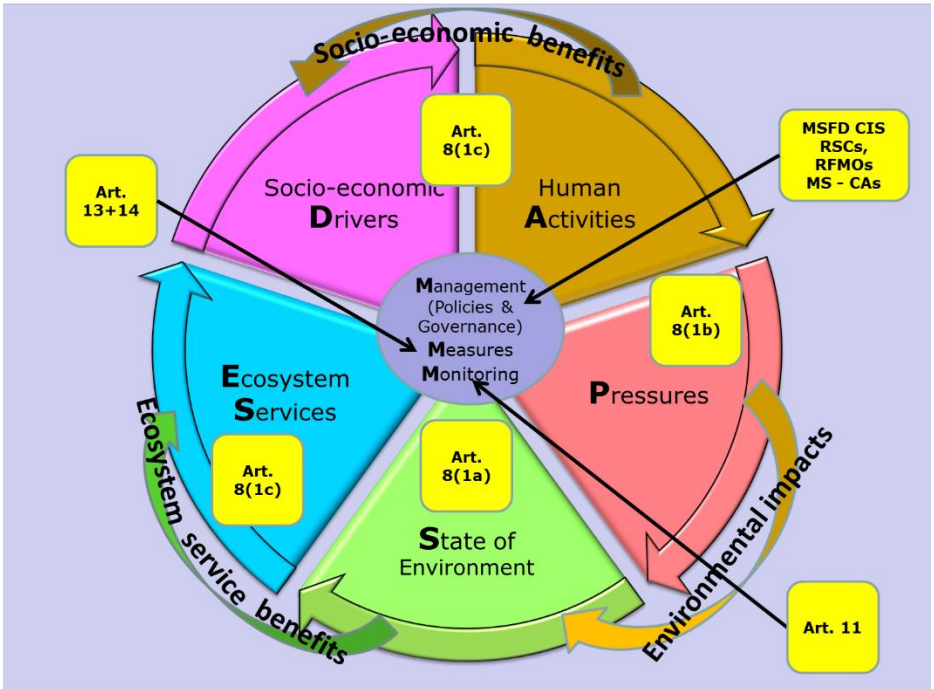


Figure 1: Modified DPSIR framework, showing links to relevant MSFD articles. CIS=Common Implementation Strategy, RSC=Regional Sea Convention, RFMO=Regional Fisheries Management Organization; MS-CA=Member State Competent Authority (based on DG Environment, MSCG 11-2013-16)

1.3 Progress and recommendations at EU level since 2012

The preparation of articles 8, 9 and 10 in 2012 provided the basis and starting point for the Member State's marine strategies, upon which the monitoring programmes (art. 11) and the programmes of measures (PoM) (art. 13) were built in 2014 and 2015 respectively. The information reported on these three articles in the first cycle of the MSFD needs to be updated in 2018, taking account of progress made since the last reporting in 2012, including:

- The outcomes of the EC's assessment of the 2012 reports;
- Establishment of monitoring programmes (article 11) in 2014 which aim, inter alia, to collect data and information to assess progress towards achieving GES and targets;
- Commission Decision (EU) 2017/848 on GES criteria and methodological standards, which replaces Decision 2010/477/EU. This revised Decision provides the basis for updating the determinations of GES and for assessing the extent to which GES is being achieved[1];
- Commission Directive (EU) 2017/845 which amends the MSFD by replacing its Annex III[2];
- Relevant assessments undertaken under other EU policies and international conventions;
- Advancements in scientific and technical knowledge and in methods for assessment.

Following findings and recommendations formulated by the European Commission in its report on the implementation of the MSFD (COM (2014) 97)[3], and by Joint Research Centre (JRC) for Belgium (Palialexis *et al*., 2014) need to be considered:

- Enhancing and coordinating the methodology for the socio-economic analysis in order to assess the degradation- and restoration costs and the cost/benefits of the implementation of the MSFD.

[1] Commission Decision laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU. http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1495097018132&uri=CELEX:32017D0848.
[2] Commission Directive amending Directive 2008/56/EC of the European Parliament and of the Council as regards the indicative lists of elements to be taken into account for the preparation of marine strategies. http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1495097018132&uri=CELEX:32017L0845.
[3] Report from the Commission to the council and the European Parliament. The first phase of implementation of the Marine Strategy Framework Directive (2008/56/EC). The European Commission's assessment and guidance {SWD(2014) 49 final}

- Further development of the methodologies to assess the effects of important pressures, in order to improve the assessment in 2018.
- Improved and more ambitious GES and environmental targets for some descriptors, through regional cooperation (synergies with OSPAR), and considering quantitative aspects and baselines to make them measurable and sufficiently ambitious to reach the goals of MSFD.

1.4 Alignment at regional sea level (OSPAR)

OSPAR decided in 2015 to re-establish the Intersessional correspondence group on Economic and Social Analysis (ICG-ESA) working group to ensure that the data gathered for the next EU MSFD initial assessment on the economic analysis of the use of the marine environment was as coordinated as practicable, and that this would contribute to the Intermediate Assessment 2017 (OSPAR, 2017).

The ICG-ESA has developed a list of socio-economic indicators that could be used to prepare a more coherent economic analysis of the use of the marine environment as part of the update of the Initial Assessment (focusing only on the least common denominator). This includes a list of sectors (fisheries and aquaculture, shipping, ports, oil and gas industry, and offshore wind energy), which most OSPAR member states presented as part of the data they produced for the economic analyses performed for the first round of the Initial Assessment and/or they intend to collect for the update of the Initial Assessment. This contributes to a more coherent economic analysis at the OSPAR level afterwards, based on those data, as well as a more coherent overview of the economic benefits derived from the marine environment. The data will be collected from Contracting Parties in 2018.

To allow future economic and social analysis of uses of the OSPAR Maritime Area there is a need to:

- quantify the relationship between economic activities and pressures on the marine environment, and determine how these impact the benefits we can derive from the ocean in terms of ecosystem services.
- develop a uniform description of the economic activity ‘recreation and tourism’. This is an important activity both because of the economic relevance and because of its dependency on the marine ecosystem, but since it not has a separate NACE code, it is not yet possible to collect the relevant data in a uniform manner.

1.5 Outline report

This report begins by describing the method used in Chapter 2. The actualisation of the use and cost of degradation is based on the previous methodologies used in the first reporting cycle of MSFD. Further, the initial steps for an ecosystem-based approach are described. The results of this update of socio-economic use and cost of degradation is presented in Chapter 3. Results are presented in terms of value added, production value and employment for the relevant activities at the Belgian North Sea. Chapter 4 demonstrates the initial steps of an ecosystem services approach for the Belgian marine waters for the case of ‘Flemish Banks’ (focus aggregate extraction). Finally, some recommendations for future action are given in Chapter 5.

2 METHODOLOGY

The update of Art. 8.1c considers the 2018 EU reporting obligations and includes the:

- Updating and supplementing the socio-economic analysis for Belgian marine waters based on the first MSFD Art. 8.1c report from 2012;
- Further elaboration of the estimate of the cost of degradation of the marine environment based on an overview of current costs associated with the protection and / or minimization of commercial activities in the marine environment, with increased attention for the recovery costs;
- Addition of the existing database with the most recent socio-economic information;
- Special attention to the relationship between the various environmental functions (ecosystem services) and the environmental quality.

2.1 Socio-economic analysis of the use of marine waters

European context

The Marine Strategy Framework Directive (MSFD) requires that EU member states submit an Initial Assessment of the environmental status of their marine waters, including a socio-economic analysis (Art.8.1c). The Guidance document of The European Commission (European Commission 2010) describes two different approaches to perform this socio-economic analysis: the Ecosystem services approach and the Marine water accounts approach of the use of marine waters.

Belgium has applied the Marine water accounts approach in the first cycle of the MSFD. The Marine water accounts approach captures only direct use, making use of data available in national accounts. The Ecosystem services approach has a higher ambition level (and hence data requirements) as this approach takes into account ‘use values’ as well as ‘non-use values’ of the marine waters. The Ecosystem services approach starts by identifying the ecosystem services of marine waters.

The analysis of the use of the Belgian waters in the first cycle contained the following socio-economic sectors: commercial (sea) fisheries, mariculture, wind parks, aggregate extraction, dredging and dredged material disposal, commercial shipping, tourism, other activities (incl. research, military exercises, ammunition zones, anchorage, cables and pipelines, wrecks).

Belgium will apply for the same **Marine water accounts approach** for the second cycle of the MSFD.

Regional context

Assessments on the state of the marine environment are being produced by OSPAR on a regular basis, using coherent datasets and methodologies across contracting parties. Until recently, there was no coherent approach for socio-economic data. The ICG ESA working group of OSPAR has developed a first attempt to come to a coherent socio-economic description of the use of the marine environment for the entire OSPAR area (a set of common indicators to quantify the socio-economic use for a common set of sectors, table 1 and 2), and to relate this to data and assessments on the state of the marine environment. As many OSPAR countries use more or less the same approach for the economic description of the use of the marine environment, makes this economic description a logical starting point to start adopting a more coherent economic analysis at OSPAR level, by aligning the data that will be collected for the socio-economic description of the use of the marine environment, before next steps (e.g. assessing the costs of degradation) are considered. By aligning as much as possible the type of data that will be asked from the statistical offices, as part of each country’s preparation for the socio-economic analysis required as part of the update of the MSFD Initial Assessment, it will be possible to finally arrive at a more uniform set of data for the whole OSPAR area. Since not all data will be relevant for all countries, and some countries might want to retrieve more data than others, therefore an attempt was made to come to a minimum set of indicators that the various countries are likely to present at both the national and OSPAR level. The ICG-ESA set of indicators is applied in this report for quantifying the use value.

The WG ICG ESA identified the following minimum set of sectors for the socio-economic description of the use of the marine environment in the intermediate assessment of OSPAR, to be described and analysed by

each OSPAR member state (Table 1). For statistical data on the sectors, NACE[4] codes were used to exactly define the sectors.

It must be noted that in some cases the NACE codes often do not allow to identify the specific maritime part of the economic sector, e.g. for aggregate extraction. It is therefore difficult to assess the economic impact of these sectors.

Table 1 : Sectors for the socio-economic description of the use of the marine environment, identified by the WG ICG ESA (OSPAR).

Sector	NACE code
Fisheries and aquaculture	03 (03.1 fisheries + 03.2 aquaculture) - excluding fish processing industry
Shipping (or maritime transport)	05.1 Sea and coastal passenger water transport + 05.2 Sea and coastal freight water transport) - excluding inland transport
Ports	30.1 Manufacturing (building ships and boats) 46.7 Wholesale Trade (other specialized wholesale) 42 Construction (civil engineering; construction of buildings excluded) 52.1 Transportation and storage (Warehousing for transportation)
Oil and Gas	06 Extraction of crude petroleum and natural gas (06.1 Extraction of crude petroleum + 06.2 Extraction of natural gas) Excluding processing industry
Offshore Wind Energy	No NACE code: use own publication(s)

Oil and gas extraction does not take place in the Belgian part of the North Sea (BNS). This activity is not further considered in this report.

In addition, Belgium will also include the following sectors, for reasons of relevance for the Belgian part of the North Sea:

- Aggregate extraction
- Dredging and dumping at sea
- Tourism
- Recreational fisheries
- Other sectors or spatial uses[5]

The WG ICG ESA identified the following common indicators to describe the use of the marine environment by the various economic sectors (Table 2):

Table 2 : Indicators (WG ICG ESA)

Indicator	**Unit**
Gross value added	Million EUR
Employed persons	X 1000 FTE
Production value	Million EUR

For this report, the reference period is 2011-2015, with a preference for 2014-2015. If no data are available for this period (2011-2015), the most recent datasets were used.

[4] NACE= Nomenclature statistique des Activités économiques dans la Communauté Européenne
[5] Other uses as reported in the first cycle or suggested by the steering group.

2.2 Business-As-Usual scenario

The Business-As-Usual (BAU) scenario describes how environmental status may change over time in response to existing drivers of change in the absence of MSFD implementation.

Further projections that will be looked at in this report are:

- BAU 2020: predicted evolution of use of the marine space by the different sectors due to implementation of the current marine spatial plan for the Belgian part of the North Sea (MRP) in the period 2014-2020.
- BAU 2030: predicted evolution of use of the marine space by the different sectors due to implementation of the revised marine spatial plan for Belgian part of the North Sea in the period 2020-2030[6].

2.3 Socio-economic analysis of the cost of degradation of the marine environment

European context

Besides the use of marine waters, Art. 8.1c of the MSFD demands an economic and social analysis of the cost of degradation of the marine environment. Three different approaches have been provided in the Guidance document of The European Commission (European Commission 2010) to perform this socio-economic analysis: the Ecosystem services approach, the Thematic approach and the Cost-based approach.

Belgian has applied for the **Thematic approach** in the first cycle of the MSFD, although it might align more to the Cost-based approach. The Thematic approach considers both the costs of the actual measures and the restoration costs needed to reach a good environmental status. In theory, Belgium has analysed the current costs related to the degradation of the marine environment categorized in prevention costs, mitigation costs, governance costs and opportunity costs. Strictly speaking, no restoration costs were considered (as also reported by the EC assessment) and therefore the methodology presented corresponds more to the Cost-based approach.

Belgian will enhance its methodology for the socio-economic analysis of the cost of degradation by considering the restoration costs related to the measures needed to reach GES. In this way, Belgium will continue to apply for the **Thematic approach in the second cycle** of the MSFD. In practice, the current costs based on the existing measures (~ cost-based approach) will be considered, besides the restoration costs based on the new measures to reach GES, as reported under the programme of measures by Belgium (March 2016).

As Belgium would like to apply for an **ecosystem services approach on longer term** (next MSFD cycles), further steps will be taken to develop a conceptual framework and to test it based on a case studies. More details may be found in Chapter 4.

Regional context

While the Intermediate Assessment report produced by OSPAR has made efforts in harmonizing the description of the use of marine waters, no common approach was presented to describe the cost of degradation of the marine environment. It should be noted however that a chapter has been included to link the economic sectors and the ecosystem services showing the importance of an ecosystem-based approach at regional level.

[6] Source of information for this prediction are the MRP 2020-2026 and included drivers, and the LTV 2050. These will be added when they become available.

2.4 Ecosystem Services Approach

2.4.1 Introduction

Economic sectors described in this report may put various pressures on marine ecosystems that can lead to the degradation of the marine environment and ultimately to the loss of marine ecosystems and their goods and services. Ecosystem services are defined as the benefits that people obtain from ecosystems (MEA 2005a), and the direct and indirect contributions of ecosystems to human well-being (TEEB 2010; Grizzetti *et al.* 2016). In a simple description, the concept of ecosystem goods and services explains how economic and social welfare link with ecosystem health through the flow of goods (e.g. amount of fish) and pressures (e.g. loss of habitats) that affect ecosystems and their functioning (Figure 2).

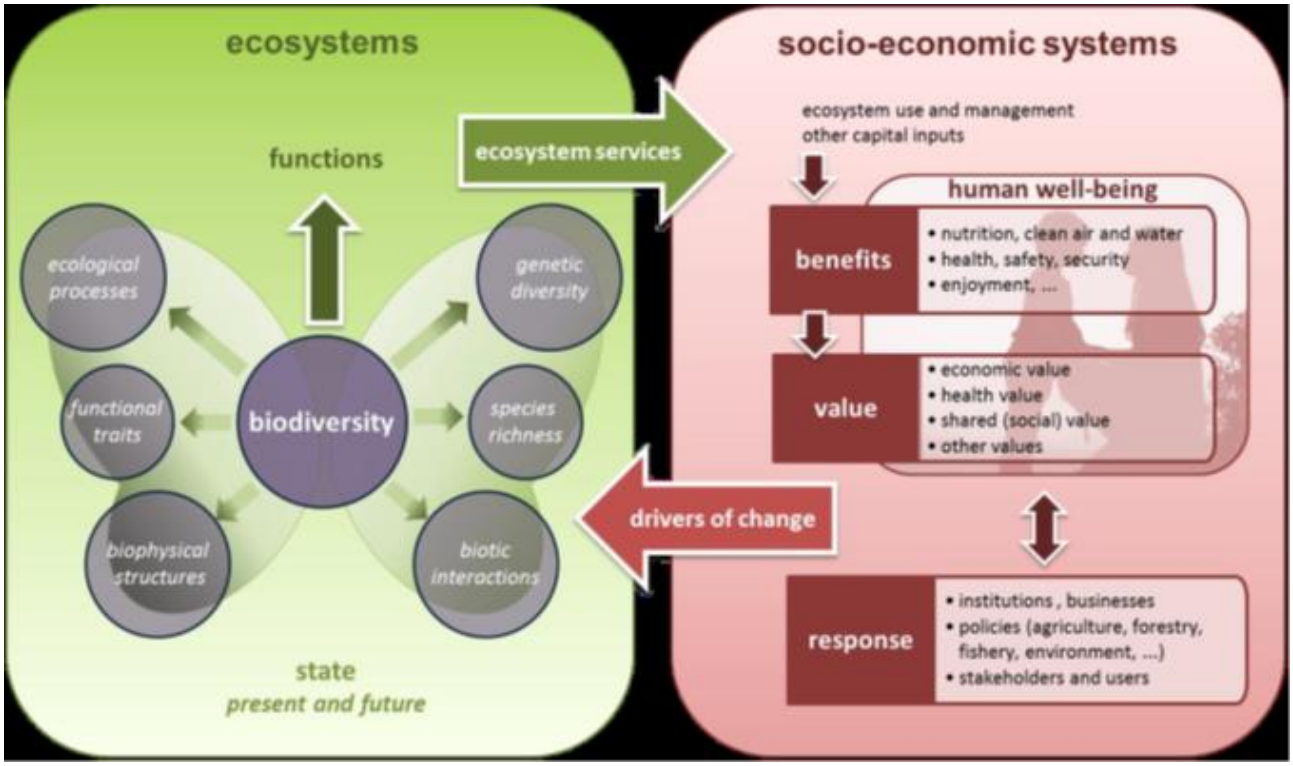


Figure 2 : Conceptual framework for EU wide ecosystem assessments (Maes 2013)

Drivers of the ecosystem services concept

An import driver for the implementation of the concept of ecosystem services is Action 5 of the **EU Biodiversity Strategy**, which foresees that Member States will, with the assistance of the Commission, map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020. The Working Group on Mapping and Assessment on Ecosystems and their Services (MAES) is mandated to co-ordinate and oversee Action 5. A ***conceptual framework*** has been developed to be implied by the EU linking biodiversity, ecosystem condition and ecosystem services to human well-being and was adopted in 2013. Following this adoption, the Working Group MAES decided to test it in six thematic pilots, including one on marine ecosystems (transitional waters and marine inlets, coastal ecosystems, the shelf, the open ocean). This resulted in a table with ***Indicators for ecosystem services*** delivered by marine ecosystems (MAES 2014) (see Annex). Furthermore, stock-taking was done on the progress and challenges in mapping and assessing the condition of Europe's ecosystems. The work carried out by working group MAES is important for the advancement of biodiversity objectives, and also to inform the development and streamline reporting under related policies, on water, marine, climate, agriculture, forest, regional planning.

In terms of marine policy, further support within this context is given by the **Marine Strategy Framework Directive (MSFD)** that amongst others aims at securing the capacity for the marine ecosystems to support the provision of goods and services. Marine strategies shall apply an ***ecosystem-based approach*** to the

management of human activities, ensuring that the collective pressures of such activities are kept within levels compatible with the achievement of good environmental status (GES) and that the capacity of marine ecosystems to respond to human-induced changes is not compromised, while enabling the sustainable use of marine goods and services by present and future generations (Art. 1). This relationship between human activities, their pressures and the consequent state of the environment is encompassed within the well-established DPSIR (Drivers-Pressure-State-Impact-Response) framework for environmental management, modified to address ambiguities in use of the terms 'driver' and 'impact' and to accommodate the concept of ecosystem services more explicitly. This model can be closely associated with the different main steps of MSFD implementation and thus follow much of the established understanding of how to improve environmental quality (see Figure 1).

In addition, **OSPAR's North East Atlantic Environment Strategy**, which has implemented the ecosystem approach as one of its main objectives, is another driver for this work. The Strategy commits OSPAR countries to continue to progressively implement the Ecosystem Approach to the management of human activities to reduce impacts on the marine environment, taking into account all pressures from human activities on the marine environment. One of the main strategic directions under this objective is to develop methodologies, including social and economic analysis of the use of the OSPAR maritime area, to support evaluations whether the North-East Atlantic is used sustainably. Ecosystem goods and services is one such tool that will need to be further developed in a regional context.

Despite an increasing interest in the topic, the application of the ecosystem services concepts for water management has been hampered by the lack of practical definitions and methodologies. Based on experience of the MAES pilot, linking multiple pressures, ecological status and the delivery of ecosystem services have been the subject of recent EU projects (e.g. OPERA (2015), OpenNESS (2015), DEVOTES (2016)) and national projects (e.g. Turner *et al*. 2014, Börger *et al*. 2016, Van der Biest *et al.* 2017).

Ecosystem services classification systems

Three international classification systems are available to classify ecosystem services: the Millennium Ecosystem Assessment (MA), the Economics of Ecosystems and Biodiversity (TEEB) and the Common International Classification of Ecosystem Services (CICES). In essence, they relate to a large extent to each other; all three include provisioning (e.g. drinking water and food), regulating (e.g. flood risk protection, climate regulation) and cultural services (e.g. tourism and nature watching, aesthetic benefits). They differ mainly in the interpretation/use of the supporting services (e.g. nutrient cycling, primary production) (Figure 3). Each classification has its own advantages and disadvantages due to the specific context within which they were developed. A further distinction can be made between intermediate and final ecosystem services providing goods/benefits to the society.

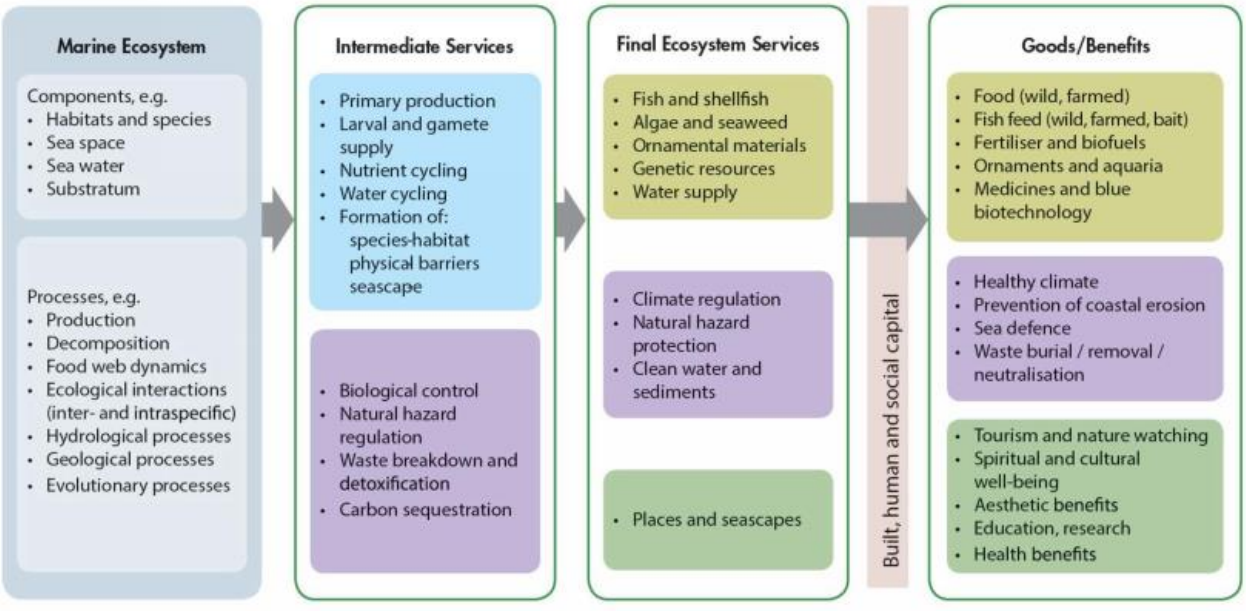


Figure 3: Ecosystem service classification (Turner et al., 2014) (Provisioning (Light green); Regulating (Purple); Cultural (Dark green); Supporting (Blue))

The **Working group MAES** promotes the CICES v4.3 classification for ecosystem services to ensure a coherent approach across EU Member States, building on the existing classifications but focusing on the ecosystem services dimension. This classification serves as the basis for MSFD reporting, as provided in the guidance document by the MSFD Technical group on Data, Information, and Knowledge Exchange (WG DIKE) (2017). For the purposes of CICES, ecosystem services are defined as the contributions that ecosystems make to human well-being. They are seen as arising from living organisms (biota) or the interaction of biotic and abiotic processes and refer specifically to the 'final' outputs or products from ecological systems. That is, the things directly consumed, used or enjoyed by people. Following common usage, the classification recognizes these outputs to be provisioning, regulating and cultural services, but it does not cover the so-called 'supporting services' originally defined in the MA. The supporting services (e.g. habitats for species) are treated as part of the ecosystem processes and ecosystem functions that characterize ecosystems. Since they are only indirectly consumed or used and may simultaneously facilitate the output of many 'final outputs' (e.g. the ecosystem service 'habitats for species' supports provisioning of food, wood, etc.), it was considered that they were best dealt within environmental accounts, in other ways.

The **Natural Capital protocol** introduced in 2016 by the Natural Capital Coalition is a standardized framework for business to measure and value its direct and indirect impacts and dependencies on natural capital. It starts from the natural capital concept referring to the stock of renewable and non-renewable natural resources on earth (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits or services to people (Figure 4). These flows can be ecosystem services and abiotic services, which provide value to business and to society. Besides the ecosystem services defined by WG MAES, also **abiotic services** are considered here defined as the benefits to people that do not depend on ecological processes but arise from fundamental geological processes and include the supply of minerals, metals, and oil and gas, as well as geothermal heat, wind tides, and the annual seasons. Biodiversity is critical to the health and stability of natural capital as it provides resilience to shocks like floods and droughts, and it supports fundamental processes such as the carbon and water cycles as well as soil formation. Therefore, biodiversity is both a part of natural capital and also underpins ecosystem services.

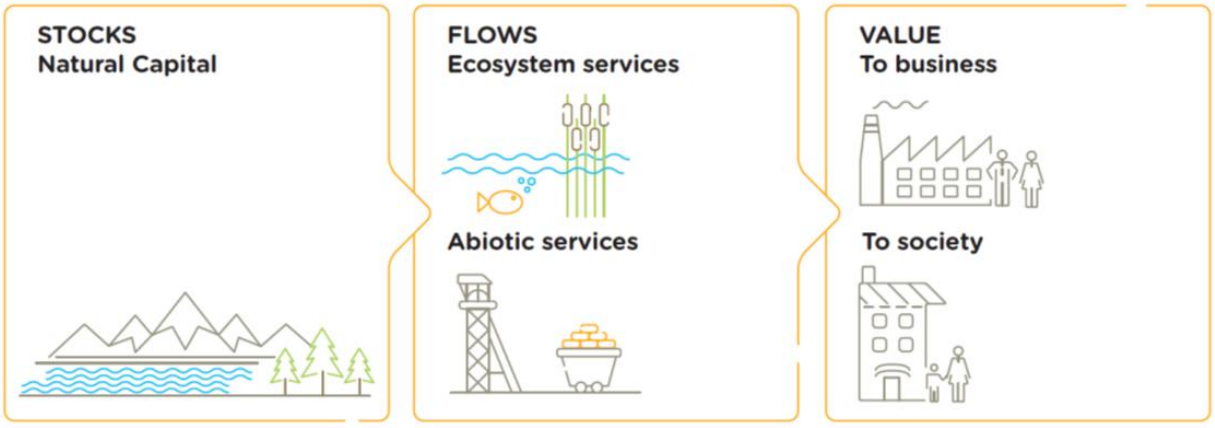


Figure 4: Natural capital stocks, flows and values (Natural Capital Coalition, 2016)

2.4.2 Ecosystem services approach Belgian marine waters

A 4-step approach has been proposed:

- Scoping of the marine ecosystem
- Development of the assessment framework (relations between pressures, ecological status and delivery of ecosystem services)
- Assessment of the condition of the marine ecosystem (biophysical assessment of ecosystem services
- Economic valuation of ecosystem services

1. Scoping of the marine ecosystem

For the assessment, the identification of the relevant ecosystem services is the first step. A large variety of ecosystem services have been addressed by assessments such as Millennium Ecosystem Assessment (MEA 2005a), the Economics of Ecosystems and Biodiversity (TEEB, 2010), MAES (Maes *et al.* 2016), and national assessments (e.g. UK NEA, 2011, Van der Biest *et al.* 2017).

We propose a simplified classification of ecosystem services based on the Common International Classification of Ecosystem Services Version 4.3 (CICES, 2015), which is the framework adopted by the common implementation of the ecosystem assessment approach in the EU, and has been transposed in the reporting guidance document on the 2018 update of articles 8, 9 & 10 for the Marine Strategy Framework Directive version 4.1 (WG DIKE, 2017). The guidance document gives an overview of ecosystem services relevant for the marine waters. The provisioning, regulating and cultural services relevant for the BNS will be identified. As mentioned before, the supporting services are not considered separately, but are treated as part of the ecosystem processes and ecosystem functions that characterize ecosystems amongst others to minimize double counting.

The framework of ecosystem services as presented by WG DIKE, will be slightly elaborated to consider also relevant abiotic services of the Belgian marine waters as defined by the Natural Capital protocol. This may include the supply of raw materials (like sand) or processes related to wind or tides.

2. Development of the assessment framework – linking pressures, ecological status and ecosystem services

Understanding the relationship between anthropogenic pressures and ecological status is the basis of the MSFD, to devise cost-effective measures to achieve a good ecological status for marine waters. For sound marine management, it is necessary to consider the complex links between pressures combinations and the ecological response of marine systems, as multiple pressures may have additive, synergetic or antagonistic effects. Although the importance of these interlinkages, knowledge of the extent of these cumulative effects is in general missing, which has also been brought to the attention by the working groups of the long-term vision 2050 for the Belgian marine waters (Degraer, 2017).

To support the analysis of the linkages, a conceptual framework for integrated assessment of marine water related services will be developed for the Belgian marine waters, focusing on the major significant pressures. An example of such framework is given in *Figure 5*.(Grizetti et al., 2016). The purpose of this framework is to support the users in describing the relationships between pressures and ecosystem services and design a conceptual scheme of the assessment and scenario analysis. The arrows are examples. Each user can select the relationships under analysis and complete and adapt the framework to the specific case under study. The Commission Directive 2017/845 amending the Directive 2008/56/EC and Annex III laying down the indicative list of ecosystem elements, anthropogenic pressures and human activities relevant to marine waters will serve as basis for developing this conceptual scheme. One step further, is to translate the expected effects of pressures on different ecosystem services in a qualitative way (high, medium, low) (Figure 6), and to include to the extent possible results from existing studies (e.g. Ecosysteemvisie Vlaamse Kust) for this quantification.

Input for the Belgian conceptual framework will come from previous and ongoing work related to Art. 8.1a (State) and Art. 8.1b (Pressures) under MSFD, environmental impact assessments for offshore activities, information collected under the recently developed long term vision 2050 BNS (Degraer 2017, Verreet 2017, Maes 2017) and the ecosystem vision Flemish coast (Van der Biest *et al.,* 2017).

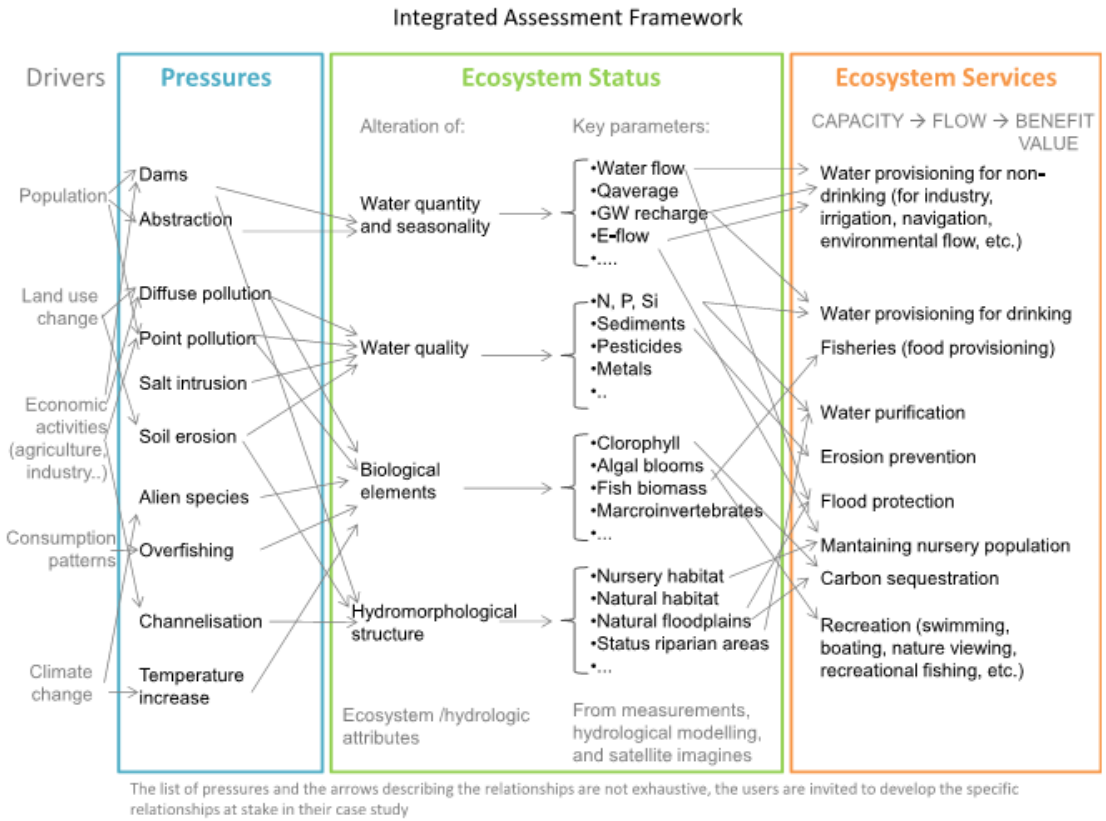


Figure 5: Integrated assessment framework for analysing the links between pressures, ecosystem status and ecosystem services. (Grizetti et al. 2016)

	Ecosystem services	Flow modifications	Diffuse and point pollution	Groundwater salinization	Erosion/ Brownification	Hydromorphological alterations	Alien species	Overfishing
Provisioning	Fisheries and aquaculture	●	●	○	●	◉	●	●
	Water for drinking	●	●	●	●	◉	○	○
	Raw (biotic) materials	◉	●	○	◉	●	●	◉
	Water for non-drinking purposes	●	●	●	●	◉	○	○
	Raw materials for energy	●	●	○	○	●	◉	○
Regulation & Maintenance	Water purification	●	●	◉	●	●	◉	○
	Air quality regulation	●	●	○	○	◉	○	○
	Erosion prevention	●	○	○	○	●	◉	○
	Flood protection	●	○	○	○	●	◉	○
	Maintaining populations and habitats	●	●	○	◉	●	●	●
	Pest and disease control	●	●	○	◉	●	●	●
	Soil formation and composition	●	◉	○	●	●	○	○
	Carbon sequestration	◉	○	○	◉	●	◉	○
	Local climate regulation	●	○	○	○	●	○	○
Cultural	Recreation	●	●	○	●	●	◉	●
	Intellectual and aesthetic appreciation	●	●	●	●	●	●	●
	Spiritual and symbolic appreciation	●	●	●	●	●	●	●

Legend: Expected impact of each pressure over the ecosystem service: ● high, ◉ medium, ○ low.

Figure 6: Expected qualitative effect of pressures on different ecosystem services (Grizetti et al. 2016)

3. Assessment of the condition of the ecosystem

Several approaches to assess and map ecosystem services are available in the literature, from GIS maps combined with scoring factors, to specific ecosystem service models based on ecological production functions (e.g. MarineINVEST 2015), and decision support tools. These tools usually combine ecology and economics, considering the spatial dimension. We suggest the selection of some suitable indicators or proxies of ecosystem services that are directly related to marine waters, as a flexible and handy approach to measure ecosystem services. This approach was also used by Maes *et al.* (2014).

Starting with the framework, a range of ecosystem service indicators will be identified for each element of the framework. These indicators reflect state and/or performance within the marine system and in the case of performance indicators will require a set of associated targets to be established. All of the indicators identified are expressed in natural science units or units with more anthropocentric relevance; indicators measured in monetary units are discussed in Section 'Economic valuation of ecosystem services' (see further).

The indicators for marine ecosystem services proposed by Maes et al. (2014) were each evaluated according to 2 criteria: i) data availability and ii) ability to convey information to the policy making and implementation processes (Maes et al. 2014). A score (colour) was assigned for each indicator.

- (green) available indicator to measure the condition of an ecosystem, or the quantity of an ecosystem service at a given CICES level for which harmonised, spatially-explicit data at European scale is available and which is easily understood by policy makers or non-technical audiences.
- (yellow) available indicator to measure the condition of an ecosystem, or the quantity of an ecosystem service at a given CICES level but for which either harmonised, spatially-explicit data at European scale is unavailable or which is used more than once in an ecosystem assessment, which possibly results in different interpretations by the user. This is typically the case for indicators that are used to measure ecosystem condition, which are reused to assess particular ecosystem services. This colour also includes indicators that capture partially the ecosystem service assessed.
- (red) available indicator to measure the condition of an ecosystem, or the quantity of an ecosystem service at a given CICES level but for which no harmonised, spatially-explicit data at European scale is available and which only provides information at aggregated level and requires additional clarification to non-technical audiences. This category includes indicators with limited usability for an ecosystem assessment due to either high data uncertainty or a limited conceptual understanding of how ecosystems deliver certain services or how ecosystem condition can be measured. The ability to convey information to end-users is limited and further refined and/or local level assessments should be used for verifying the information provided by this type of indicators.
- (grey) unknown availability of reliable data and/or unknown ability to convey information to the policy making and implementation processes.

This list of indicators will be revised, complemented with indicators relevant for the Belgian marine waters and evaluated at national scale according to the 2 criteria presented above. This step builds further on the previous step and will consider indicators used for the description of the status of the Belgian waters under Art. 8.1a and 8.1b, as well as other indicators identified in relevant studies for Belgium. In addition, marine models (e.g. MarineInvest) and related indicators will be further exploited on their relevance for the Belgian case.

4. Economic valuation of ecosystem services

Several methods are available in the literature to estimate economic values of ecosystem services (see for instance Koundouri *et al.* 2015). Overall, there are three categories of approaches: cost-based, revealed preferences and stated preferences approaches. Cost-based approaches consider the costs that arise in relation to the provision of services. Revealed preferences approaches refer to techniques that use actual data regarding individual's preferences for a marketable good which includes environmental attributes. Stated preferences approaches refer to methods based on structured surveys to elicit individuals' preferences for non-market environmental goods. Another practical way to value ecosystem services under non-availability of site specific data or funding constraints is the benefit transfer approach. This approach consists of using economic estimates from previous studies to value services provided by the ecosystem of interest (Navrud and Ready 2007, Grizetti *et al.* 2016).

For the economic assessment, the first step consists of identifying the benefits provided by the ecosystem service to be valued. To avoid double counting in the valuation exercise, only the services that have a direct impact on welfare are valued. The spatial scale of the assessment is also relevant for the selection of the method.

The choice of the primary valuation method depends on the ecosystem service to be valued and on the beneficiary population. One of the main difficulties in the economic valuation is to decide on the size of the benefiting population (beneficiaries). Aggregate benefits depend on estimates of both individual benefits and of the number of beneficiaries (Hanley *et al.* 2003). As a general rule, the beneficiaries should be the households/persons aggregated at the relevant geographic scale and should include both users and non-users impacted by the ecosystem service considered (except for services of only local importance). In addition, for some services (for example recreational services), when spatially aggregating individual benefits, it is usually considered that the willingness to pay (WTP) decreases with the distance from water body providing ecosystem services, as the opportunities of the ecosystem service provision are expected to decrease with the distance, and concurrently the existence of possible substitutes is assumed to increase (Bateman and Langford 1997; Georgiou *et al.* 2000; Jørgensen *et al*. 2013). Generally, a distance decay function is adopted to take into account the decrease of the willingness to pay with the distance from the water body providing the ecosystem services (Bateman *et al.* 2006). This distance determines the boundaries of the geographical area, or so-called economic jurisdiction, over which the individual WTP-values can be aggregated over the population of beneficiaries to calculate the total economic value of a proposed scenario of environmental change (Schaafsma *et al.* 2012). However, the specification of the distance decay relations has been highly debated among economists. A number of studies have examined in particular how the distance decay relation differs between users and non-users of the ecosystem service (Hanley *et al*. 2003; Bateman *et al*. 2006).

Case study Belgium

Considering the increased attention for ecosystem-based approach, Belgium will further elaborate the ecosystem-based approach for its marine waters and illustrate the approach for 1 case study (use: aggregate extraction in the Flemish Banks' area, and its impact on ecosystem services). On longer term Belgium may use this approach for official reporting under the MSFD (in addition to or replacing the thematic approach).

The first two steps described above will be worked out on the general level of the Belgian marine waters, while the assessment steps will be further illustrated for a Belgian case study.

The selection of the case will partly be based on the outcomes of the previous steps considering the importance of pressures and their impact on ecosystem services related to a specific case and the availability of data as a basis for the assessments.

The selection will further consider following criteria:

- Defined/demarcated area located in the Belgian marine waters
- Multiple activities taking place within the area
- Potential to define alternatives in an MSFD context illustrating changes in pressures, status and ecosystem services
- Data availability to assess the ecosystem services

3 UPDATE SOCIO-ECONOMIC ANALYSIS BELGIAN MARINE WATERS

For the second cycle, Belgium has applied the Marine water accounts approach for the analysis of the use of marine waters and the thematic approach related to the cost of degradation. The results have been presented for the sectors relevant for the Belgian part of the North Sea, aligned to the extent possible to the regional context (OSPAR). Per sector a general description is given of the activity, its key drivers, the forecasting of its socio-economic use for the period 2020/2030 and the cost of degradation expressed in costs of actual measures (existing) and new measures needed to reach GES as reported by Belgium in its Programme of Measures (2014). For this report, the reference period is 2011-2015, with a preference for data from 2014-2015.

3.1 Commercial fisheries

3.1.1 Description

The Belgian commercial fisheries activities take to a large extent place outside the Belgian continental Shelf and the commercial fisheries activities situated within the Belgian part of the North Sea are limited. Therefore, the socio-economic data on commercial fisheries go beyond the Belgian part of the North Sea (BNS) and are not representative for this area. The BNS is therefore of lesser importance for Belgian commercial fisheries because less than 10% of the total catch is derived from the BNS. Furthermore, fishing vessels from neighbouring countries (i.e. The Netherlands and France) exploit the BNS as well, but these data are not included here. The report of Pecceu *et al*. (2014) contains a detailed overview of fishing activities of the foreign and Belgian fleet in the BNS. Finally, it should be noted that the data presented only include commercial fisheries activities. Recreational fisheries are described under Section 3.9.

The Belgian fishing territory covers 3.478 km², of which 1.430 km² is territorial sea. Fishing grounds are historically dispersed as well as remotely located: North Sea, English Channel, Bay of Biscay, Western Waters, Celtic and Irish Sea. The fishing territory is remotely located from Belgian harbours.

Belgian vessels have exclusive fishing rights in the Belgian Territorial Sea up to 3 nautical miles (NM). According to the BENELUX-treaty, Dutch vessels have the same rights. Between 3 and 12 NM of the BNS, Dutch vessels can fish all fish species, whereas French vessels are only allowed to catch herring. This treaty allows Belgian vessels to fish unrestrictedly in the Dutch Territorial Sea. Beyond 12 nautical miles the principle of equal access fully applies with respect to other member States. Third States have no fishing rights in this zone, unless the European Community gives permission.

End 2017, the Belgian commercial fishing fleet consisted of 71 fishing vessels, with a total engine power of 45.051 kW and a gross tonnage of 13.712 BT. The number of fishing vessels is strongly declining in the last decades (e.g. 76 vessels in 2015 compared to 457 in 1950), while the engine power remained stable. The average age of the fishing vessels is relatively high (25 years), with 52 vessels (68%) being older than 20 years.

The importance of commercial fisheries has declined significantly in the past century. Decline in fish stocks and EU quota to allow recovery of collapsed stocks can be named as the most important factors. The most important commercial fish and shellfish species are European plaice, Common sole, Cod, Scallop and Brown shrimp. Beam trawling is the most commonly used technique by commercial fisheries in Belgium.

Further relevant information on fisheries efforts and fish landings per vessel type can be found in Devogel & Velghe (2016) and the VIRA (2016).

3.1.2 Key drivers

- **Economic growth** - The population growth in Belgium (+13% by 2100) is expected to lead to an increased demand for fish, as is also observed elsewhere. However, less than 5% of local consumption is actually provided by Belgian fisheries, and of these 5% only a fraction is derived from the BNS, the impact will be limited.

- **Technological innovation** – A general trend can be observed towards increasing engine power of fishing vessels, linked to increased fishing capacity. Technological advancements in equipment lead to more efficiency and more sustainable fishing.
- **Legislation and governance** - The imposed quota by Europe through the Common Fisheries Policy to allow recovery of overfished stocks is an important factor that contributed to the reduction in commercial fisheries in Belgium and that will further regulate the stocks in the Belgian waters.
- **Climate change** – The effects of climate change on commercial fisheries is complex to assess. It is expected that primary productivity in the North Sea will lead to increased fish stocks of certain species, while certain cold-adapted species (e.g. Cod) are expected to retreat further north. On the other hand, some species adapted to warm water will increase their extent. Ocean acidification can lead to a reduction of calcifying organisms such as mussels and scallops. Overall, climate change may lead to a change of the existing fish communities in the North Sea, including commercial species.

3.1.3 Forecasting socio-economic use 2020/2030

Baseline (2015)

- **Employed persons**: There is a total of 363 persons employed in the fisheries sector in 2016 (as registered fishermen, FTE's). A strong decline is observed over the past years (e.g. 541 registered fishermen in 2013).
- **Development in production value:** The total turnover of the fisheries sector (Belgian fishing vessels) increased from 68,367 million Euro in 2009 to 81,815 million Euro in 2015 (+ 20 %) (Figure 7). This amount includes both the fish landings in Belgian ports as well as in foreign ports of the Belgian commercial fishing fleet. This figure exceeds the borders of the Belgian Continental Shelf. Only a fraction of this amount (mainly coastal fisheries) concerns the BNS.

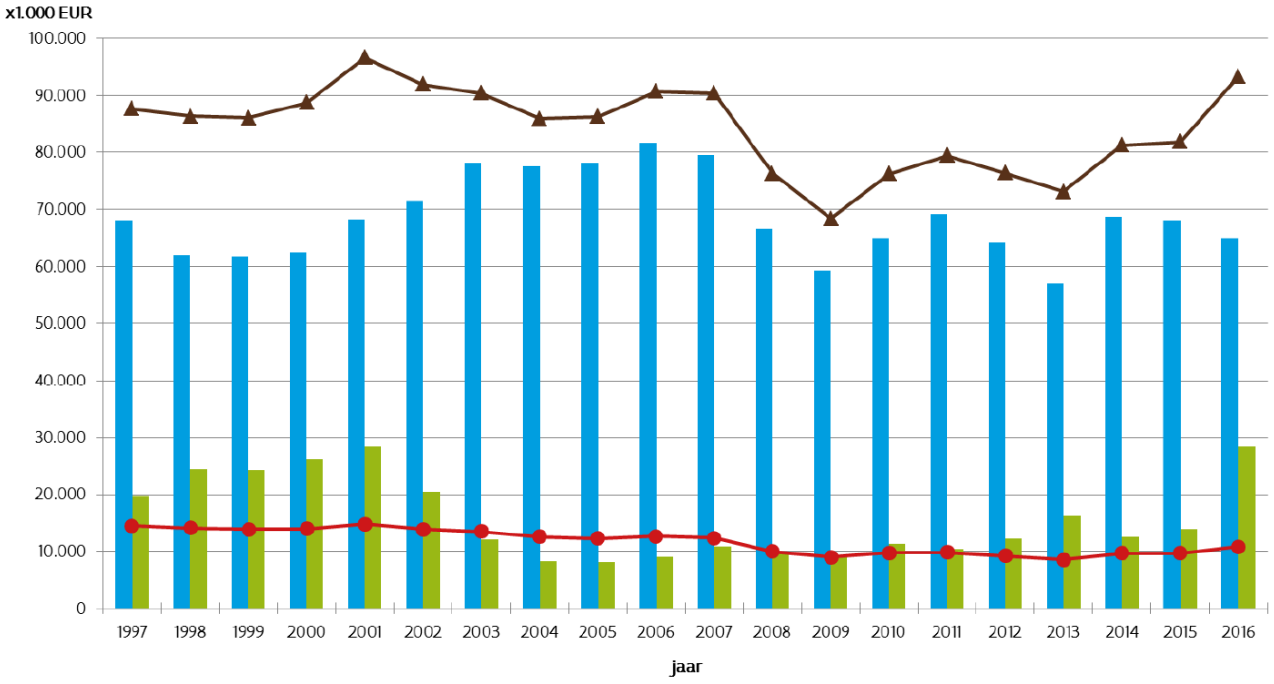


Figure 7 : Yearly total turnover, turnover fish landings Belgian ports, turnover fish landing foreign ports of the Belgian commercial fishing fleet (1995-2016) (Departement Landbouw en Visserij, 2016)

- **Gross added value:** The impact of the fisheries sector on the national economy of Belgium is limited with a gross value-added of maximal 50,6 million euro in 2015 (data NBB Belgium)7. This figure includes the aquaculture sector as well.

BAU (2020)

[7] http://stat.nbb.be/Index.aspx?DataSetCode=QNA&lang=nl#

The current marine spatial plan includes the following elements to guarantee the sustainability and viability of commercial fisheries (MRP 2014, Annex II):

- The existing fishery grounds are maintained, except for wind concession zones and infrastructure related to coastal defence.
- The Belgian fishing ports remain accessible for fishing vessels.
- Alternative and sustainable fisheries are promoted in parts of the Habitat Directive area 'Flemish Banks'. Four zones are demarcated to allow the transition towards passive and alternative fishing techniques, each defined by their own restrictions.
- CFP measures will be implemented including the prohibition of fishing vessels > 70 BT within the 3 NM, TACs and quota, minimum landing size, management plans, increased control, ban discards, etc.
- Actions are taken to raise the awareness of fishermen for sharks and rays.

It can be concluded that the possibilities for commercial fisheries in the BNS will largely remain the same by 2020. Alternative fishing techniques for a more sustainable fisheries sector with reduced impact on the environment will be promoted.

BAU (2030)

On the demand side, it can be expected that the demand for fish will increase in future due to the expected population growth (+13% by 2100). Increases in production are only possible if the catches are within the limits of the Total Allowable Catch (TAC). The current overall catch is currently estimated at 76,9 % of TAC (Rederscentrale, 2015).

The draft marine spatial plan for the period 2020-2026 foresees a maximal safeguarding of fishing grounds in the BNS, in function of sustainability of the fisheries sector. No fishing grounds will be closed with the purpose of nature protection, but measures related to sustainable fisheries methods will be implemented in special protection areas. Passive fisheries will be allowed in the new designated zones for wind energy (as will aquaculture). The ports of Nieuwpoort, Ostend and Zeebrugge remain accessible for fishing vessels.

Other trends up to 2050 defined by the Long-Term Vision North Sea 2050 (De Backer, 2017) related to fisheries include continued efforts for sustainable fisheries focusing on high quality fish products, investigating technological possibilities to short chain to clients (Visserij op bestelling), use of common data integration and modelling.

3.1.4 Cost of degradation

Current costs based on the existing measures

By public sector

Table 3 : Existing measures related to 'Commercial fisheries and cost for the authorities

Existing measures 'Commercial fisheries'	Personnel and cost (Euro)
Spatial measures integrated in the marine spatial plan (2014-2020) linked to fisheries sector: - Demarcation of 4 zones within SBZ-H 'Flemish Banks' to preserve bottom integrity (restricted for soil-disturbing fisheries) and to stimulate alternative sustainable fisheries + Monitoring (included in the monitoring programme of the MSFD) - Prohibition on fisheries in the wind parks	Dienst Marien Milieu: 3 FTE, 100.000
Implementation of the Common Fisheries Policy (CFP) measures including: - National prohibition on fisheries activities with vessels > 70 BT within the 3 NM-zone - TACs and quota - Minimum landing size - Multi-annual recovery and management plans for certain stocks	Dienst Zeevisserij: 5 FTE Belgian Navy: 302.184

- Inspection/monitoring/control fisheries - ICES coordination: quota and stock analysis - Removal of discards (in renewed CFP) - Obligatory pursuit of MSY (in renewed CFP) - Multispecies-quota and –management (in renewed CFP) - Data Collection Framework + Data Collection Multi-Annual Programmes	
Prohibition shellfish fisheries (Royal Decree)	OD-Natuur: 71.000
Other measures related to fisheries such as seafood legislation (control and monitoring by the FAVV (professional fisheries)), Fishing for Litter, etc.	Dienst Marien Milieu: 0,5 FTE, 10.000
Consultation between Flemish and Federal administrations concerning the fisheries policy	

Commercial fisheries are not subject to environmental impact assessment procedures. The current cost for permitting (incl. EIA, AA) by the authorities is therefore not relevant here.

By private sector

The measure on sumwings and roller shoes is borne by the private sector (fishing vessels). The total investment cost for the sector is not known.

Table 4 Existing measures related to 'Commercial fisheries and cost for the private sector

Existing measures 'Commercial fisheries'	Personnel and cost (Euro)
Introduction of sum wings and roller shoes for fishing boats	Private sector investment: - set of roller shoes per boat (shrimp trawlers): 16.800 - sum wings for beam trawlers: 48.000 – 52.000

Restoration costs based on additional/new measures to reach GES

The following additional measures that relate to the driver 'Commercial fisheries' have been identified in the POM (in Dutch) with cost estimates in Euro (when available) (Table 5) (DMM 2016):

Table 5 : Additional measures related to 'Commercial fisheries' and cost for the authorities

	2016	2017	2018	2019	2020	2021
23A. Better consultation structure necessary between Flemish and Federal governments in relation to the Fisheries policy						
25A. Prohibition of removal of stones/gravel						
26A. Stricter enforcement of the sailing prohibition within the area for the production of wind energy				16.250	16.250	16.250
26B. Supervision of the fishing	8.850	8.850	8.850	8.850	8.850	8.850

	2016	2017	2018	2019	2020	2021
restrictions within the soil conservation area						
26C. Monitoring of the soil conservation areas		59.550			100.000	100.000
28A. Sensitization for preventing spills when bunkering fishing vessels and pleasure crafts in harbours			15.000-22.500		15.000-22.500	
29A. Improving delivery of waste from fishing vessel						
29B. Research and sensitization on recycling, deposit, tagging of fishing nets			30.000-50.000			
29D. Stimulating alternatives to fishing lead (fishing sinkers)						
32 – Species specific approach for sharks and rays	3798,88		20.000-30.000		20.000-30.000	

3.2 Marine Aquaculture

3.2.1 Description

Aquaculture in Belgium is a rather small sector and is predominantly focusing on freshwater species and based in aquaculture facilities on land. Oyster culture was more important in the past in the Belgian coastal area, but is currently restricted to the Spuikom in Ostend, with a traditional culture of oysters. The Spuikom is a semi-closed seawater basin, located in the coastal zone near Ostend. Two species are cultivated: *Ostrea edulis* and *Crassostrea gigas*. The activities take place in 2 zones with a total surface of 9 ha. As this area is located outside the BNS, this is not further discussed here.

Mariculture (marine aquaculture) in the Belgian part of the North Sea is quasi absent to date. However, the current Marine Spatial Plan for the BNS (RD 20/03/2014) includes zones for mariculture within the wind farm area. In 2005, a permit was granted by ministerial decree for the cultivation of bivalve molluscs in four zones of the North Sea. In the period 2006-2009 SDVO (Stichting voor Duurzame Visserijontwikkeling) started the offshore cultivation of mussels, with financial support from the Belgian government, European support by FIOV/FIVA and scientific assistance from ILVO. The objective was the commercialization of the Belgian suspended cultivation of mussels. This project has not been continued.

Examples of ongoing and past research projects include the restocking with Turbot (Delbare *et al.* 2015), the Value@Sea project (2017, involving oysters, seaweed and clams) in front of the coast of Nieuwpoort and the EDULIS project (2017) in the C-Power and Belwind wind parks, involving mussels.

3.2.2 Key drivers

- **Economic growth** – Due to the population growth worldwide, an increase in demand of seafood from mariculture is expected.
- **Technological innovation** – In Belgium, aquaculture is still in its infancy, with some test projects to assess its viability. Further research on the technical feasibility of aquaculture in the North Sea will stimulate the potential for this new blue economy sector.
- **Legislation and governance** – Environmental impact assessment is needed for new aquaculture projects, which may only take place in the designated zones in the Belgian marine waters.
- **Climate change** – Depletion of wild fish stocks lead to an increased demand of fish and seafood from mariculture, as an alternative source.

3.2.3 Forecasting socio-economic use 2020/2030

Baseline (2015)

There are currently no mariculture activities of significance in the BNS (only test projects).

BAU (2020)

The current marine spatial plan includes the following elements on marine aquaculture (MRP 2014, Annex II):

- Only sustainable marine aquaculture methods are allowed, in a multi-use context. The zones where marine aquaculture is allowed are restricted to the zones for renewable energy, more specifically the Belwind I and C-Power zones.

It can be concluded that possibilities for commercial fisheries in the BNS are enlarged due to the designation of zones for marine aquaculture within the designated wind parks. To date, marine aquaculture is only taking place as research projects (e.g. EDULIS project (2017) in the C-power and Belwind wind parks.

BAU (2030)

The growing demand for seafood and fish will stimulate mariculture.

The draft marine spatial plan for the period 2020-2026 foresees an expansion of aquaculture development: aquaculture will be allowed in the entire existing zone for renewable energy, as well as in the new zones that will be designated for renewable energy.

The Long-Term Vision North Sea 2050 (De Backer, 2017) emphasizes the multiple use of aquaculture with other existing functions.

3.2.4 Cost of degradation

Current costs based on the existing measures

By public sector

Table 6 : Existing measures related to 'Marine aquaculture' (DMM 2014) and cost for the authorities

Existing measures 'Marine aquaculture'	Personnel and cost (Euro)
Permitting (incl. EIA and Appropriate Assessment)	4 FTE, 200.000

The current cost related to the granting of permits (incl. EIA, AA) by the federal authority is given as an overall cost (in Euro), applying for several activities in the BNS including mariculture. As there is no actual mariculture activity, there is no current cost of degradation yet. Future aquaculture activities will require a permit, an EIA and an Appropriate Assessments (when relevant).

By private sector

Costs related to Environmental Impact Assessment (EIA) and Appropriate Assessments (when relevant) need to be carried by the private sector.

Restoration costs based on additional/new measures to reach GES

No new measures defined by Belgium in Programme of Measures (2014) linked to mariculture.

3.3 Shipping

3.3.1 Description

With over 150.000 ships per year crossing, the Belgian part of the North Sea (BNS) may be considered as one of the busiest seas worldwide. Commercial shipping along the Belgian coast and towards the ports of Ostend, Zeebrugge, Ghent and Antwerp is bound to specific routing systems:

- **Noordhinder Traffic Separation Scheme**: used by ships travelling from and to European ports in the southern part of the North Sea and the Baltic Sea, entering or leaving the North Sea via the English Channel.
- **Westhinder Traffic Separation Scheme**: used by ships travelling from and to ports in Belgium and ports along the Westerscheldt estuary. This main shipping lane is situated north of the Oostdyck sublittoral sandbank and covers a refuge area in the north. The TSS finds its origin at the end of the Strait of Dover, adjacent to Dunkirk, and leads all the way into the Belgian territorial sea. 91 % of the voyages head towards the Scheldt (or opposite direction). Other destinations are the harbour of Ostend and Zeebrugge.
- The new tow-way **Westpit route** is active since the 1th of June 2017. This relates to a reduction of the precautionary area in the vicinity of Thornton and Bligh Banks and is necessary due to the presence of the dumping site S1, direct south of the Westpit route.
- **Shortsea shipping** (south of the Westhinder TSS) and **cross channel shipping** (incl. ferry traffic) between Belgian ports and the UK. Fishing boats or recreational vessels are not considered under this category.

The merchant fleet under Belgian flag is growing: 162 ships in 2015 with a total gross tonnage more than 5 million. The ranking for the Belgian controlled fleet is well within the top 25 of maritime nations with a total DWT of over 12,5 million i.e. 1,08% of the world seaborne trade capacity. The flag state-linked industry and maritime cluster employs more than 12.100 people and creates an annual revenue of 4.204 million Euro (FPS Mobility and Transport, 2015)[8].

3.3.2 Key drivers

- **Economic growth -** The most important single influence on the demand for sea transport is the world economy. The relationship is however not simple or direct and is determined by the business cycle and the trade development.
- **Technological innovation** – The growing demand for energy-efficient, clean and larger ships will steer the technological development in this sector, and the impact of shipping traffic on the marine environment.
- **Legislation and governance** – The international legal framework such as IMO, MARPOL are the driving forces with regard to maritime safety, the protection of the marine environment, etc. They will further influence the future development of the sector.
- **Climate change – C**limate change may affect shipping transport at the North Sea e.g. through increased storm frequencies.

3.3.3 Forecasting socio-economic use 2020/2030

Baseline (2013)

Data on employment, development in production value and gross added value are made available in the study 'Update 2013 Economic Impact Study (EIS) for the Belgian shipping cluster. Study Policy Research' from the Royal Belgian Shipowners Association.

Employed persons: A total of 8710 persons were employed in the shipping cluster in Belgium in 2013. This included merchant shipping, towage and dredging (Royal Belgian Shipowners Association, 2014).

[8] Press release FPS Mobility and Transport 09/09/2015

Development in production value: Data on the total turnover of the shipping sector are currently not available.

Gross added value: In 2013 the direct value added of the shipping cluster (merchant shipping, towage and dredging) amounted to € 2 298 million (Royal Belgian Shipowners Association, 2014).

More detailed / recent socio-economic data (e.g. production value, gross added value) on the commercial shipping sector were requested to the FPS Mobility and Transport but were not available. Commercial ship owners are reluctant to make such data public for commercial reasons.

BAU (2020)

The current marine spatial plan includes the following elements related to shipping (MRP 2014, Annex II):

- Research to potential additional routing systems and, if applicable, initiation of the procedure to announce this at the IMO.
- Safeguarding important shipping routes: the zone between the Vlakte van de Raan, Wielingen, Akkaertbank and Gootebank is designated as a traffic node.
- Safeguarding of sufficiently safe shipping routes between the Belgian coast and the UK.
- Safeguarding possibilities of temporarily refuge areas in the reservation area offshore.

It can be concluded that the shipping sector and relevant supporting spatial elements will largely remain the same by 2020, with the exception of some additional spatial provisions such as the Westpit route (installed in 2017). Possibilities for new emergency refuge areas, a tug station and multiple spatial use are being examined.

BAU (2030)

In the draft marine spatial plan for the period 2020-2026, the existing shipping routes are retained, including the new IMO routing systems: Westpit, Off Noordhinder traffic separation scheme and the Gootebank reservation zone (formerly designated as traffic node). The option regarding temporarily refuge areas is maintained. It can be concluded that no significant changes will occur related to zoning for shipping by 2030.

The Long-Term Vision North Sea 2050 (De Backer, 2017) further mentions the trend towards larger and more energy-efficient ships in relation to the accessibility of the Belgian harbors, the challenges related to estuary shipping to Zeebrugge.

3.3.4 Cost of degradation

Current costs based on the existing measures

By public sector

Table 7 : Existing measures related to ''Shipping' and cost for authorities

Existing measures 'Shipping'	Personnel and cost (Euro)
Spatial measures integrated in the marine spatial plan (2014-2020) linked to shipping sector: - Increased shipping safety via research on the possibility of additional shipping route systems (IMO), upgrading Westpit and a fixed tug boat station - Prohibition on sailing (including fisheries) in the wind parks	n.a.
Prohibition intentional (except with permit) and unintentional introduction of non-indigenous organisms via ballast water, (Law 20/01/1999 and Royal Decree KB 21/12/2001)	
Measures related to fouling: - Anti-fouling measures (guidance IMO) - Prohibition on use of TBT (IMO International	

Existing measures 'Shipping'	Personnel and cost (Euro)
Convention on the Control of Harmful Antifouling Systems, Directive 2002/62/EG, Ordnance 782/2003)	
Measures prevention and pollution control: - Measures in the framework of the national approach (pollution control equipment, aerial surveillance, satellite), MARPOL, OPRC, Bonn, European mechanisms (control at ports) - Prevention of pollution by shipping (o.a. double-walled tankers) (conform MARPOL) - Recognition bunker companies - Control flights by Defence, EMSA, BMM and Department of Marine Environment	Dienst Marien Milieu: 3 FTE, 400.000
Measures related to shipping waste: - Reception installations in ports (collection of MARPOL Annex I and V waste) - Waste management plans ports	

Shipping activities are not subject to environmental impact assessment procedures. The current cost for permitting (incl. EIA, AA) by the authorities is therefore not relevant here.

By private sector

Ships entering the ports pay a fee for waste collection by a private company. Data are not available on the amounts and total cost.

Restoration costs based on additional/new measures to reach GES

The following additional measures that relate to the driver 'Shipping' have been identified in the POM (in Dutch) with cost estimates in Euro (when available) (Table 8) (DMM 2016):

Table 8 : Additional measures related to 'Shipping' (DMM 2016) and cost for the authorities

	2016	2017	2018	2019	2020	2021
26A. Stricter enforcement of the sailing prohibition within the area for the production of wind energy				16.250	16.250	16.250
31 – Consultation and sensitization regarding measures within shipping limiting impact of underwater noise on cetaceans		5.000		10.000		

3.4 Ports

3.4.1 Description

Belgium considers itself fortunate to contribute substantially to worldwide seaborne trade with a very large volume of goods loaded and unloaded in its sea ports cluster. The ports of Antwerp, Ghent, Zeebrugge and Ostend constitute the Belgian North Sea ports cluster. Antwerp, Ghent, Zeebrugge and Ostend fall within a radius of 50 km, which provides one of the most important bridgeheads for maritime trade links between all the continents worldwide and the European hinterland. In 2014, a total of nearly 269 million tons of goods were loaded or unloaded within this cluster (NBB 2016). This amounted to 274 million tons in 2015.

The multi-continent nature of Belgian seaborne trade is illustrated by the following figures: in 2010 for the 2 largest Belgian ports, maritime traffic with Asia totalled 54 million tons, with N- & S-America over 40 million tons, with Africa over 16 million tons and with Oceania 1.25 million tons.

These volumes indicate that the Belgian North Sea ports cluster can be found within the top 10 seaports of the world. Furthermore, with a total container load of just over 11 million TEU in 2010, the cluster positions itself in the top 10 for developing seaborne trade. In short, the volume and the geographical spread of the goods handled through the Belgian ports demonstrate that Belgium is an important contributor to seaborne trade spanning all the continents worldwide.

The port of Antwerp has traded a total of over 208 million ton of goods in 2015 and is the second largest port in Europe. It is the most important trade port for coffee in the world. The port of Antwerp is important in terms of industry, with the largest oil- and chemical industry cluster in Europe.

The port of Zeebrugge is a relatively young harbour with a modern infrastructure. This port is the market leader in trade of new cars and employs over 20.000 people (direct and indirect employment). The port is also important for its LNG terminal and RO/RO traffic to and from Scandinavia, the UK and Spain/Portugal. The total volume of goods in 2015 was 38 million ton.

The port of Ostend is focusing on offshore activities and renewable energy (wind parks) since 2008.

The port of Ghent employs 60.000 people (direct and indirect employment). The total amount of traded goods amounted to 26 million ton in 2015. The port of Ghent is an industrial port with steel industry and car factories. The traded goods consist of iron ore, coal, grain, building materials and oils. The port of Ghent has recently (2017) undergone a fusion with the port of Terneuzen under the name North Sea Port.

3.4.2 Key drivers

- **Economic growth -** The most important single influence on the demand for sea transport is the world economy. The relationship is however not simple or direct and is determined by the business cycle and the trade development.
- **Technological innovation** – The growing demand for energy-efficient, clean and larger ships will steer the technological development in this sector, and the impact of shipping traffic on the marine environment. A potential shift toward more LNG ships will also demand the necessary adjustments of the port facilities.
- **Legislation and governance** – The international legal framework such as IMO, MARPOL are the driving forces with regard to maritime safety, the protection of the marine environment, etc. They will further influence the future development of the sector.
- **Climate change – C**limate change may affect the accessibility of the Belgian harbours e.g. through increased storm frequencies, or reduced time slots for accessing the harbour.

3.4.3 Forecasting socio-economic use 2020/2030

Baseline (2015)

- **Employed persons**: A total of 114.647 persons were employed in the maritime ports of Belgium sector in 2015 (direct employment, FTEs), together with indirect employment this adds up to 252.394 FTEs or almost 6% of the working population in Belgium (De Backer, 2017). There was a slight decline in employment from 2009 to 2015 (-0,9 %) (NBB 2016).

- **Development in production value**: The turnover in the different ports amounted to approximately 400 million Euro in 2010. More recent data are not available, but the total amount of goods shipped via the ports can be used as a proxy and amounts to 282.535 thousand tons in 2016.
- **Gross added value**: The direct added value of the Belgian maritime ports amounted to 16.532 million Euro in 2014. The direct added value increased from 2009 to 2014 by 1,9 % (NBB 2016). In 2015, the gross added value amounted over 18 billion Euro (De Backer, 2017). Together with the indirect added value this increases up to 33 billion euro, or circa. 8% of the BBP (De Backer, 2017).

BAU (2020)

The current marine spatial plan includes the following element related to ports (MRP 2014, Annex II):

- Safeguarding the possibilities for further extension of the ports of Zeebrugge, Oostende by the designation of reservation zones for these ports.

It can be concluded that no significant changes are expected by 2020 related to port development.

BAU (2030)

The draft marine spatial plan for the period 2020-2026 foresees that possibilities for further extension of the ports of Zeebrugge, Ostend, Nieuwpoort en Blankenberge remain open. It can be concluded that no further significant changes are expected by 2030 related to port development.

The Long-Term Vision North Sea 2050 (De Backer, 2017) further mentions the trend towards automatization and robotization of the logistic chains in the harbours, and the development of a 'maritime logistic cloud' to collect nautical and logistic data.

3.4.4 Cost of degradation

Current costs based on the existing measures

By public sector

Table 9: Existing measures related to 'Ports' and cost for the authorities

Existing measure 'Ports'	Personnel and cost (Euro)
Permitting (EIA and Appropriate Assessment)	Dienst Marien Milieu: 4 FTE, 200.000 Flemish authority: not available
Measures prevention and pollution control: - Recognition of bunker companies	n.a.
Measures related to shipping waste: - Port reception installations (Collection of MARPOL Annex I and V waste) - Waste management plans ports	n.a.

Port developments are subject to EIA and Appropriate Assessment procedures. Although they fall under Flemish authority, federal authorities will have an advisory role on their potential impact on the marine environment. Only cost estimates for federal authorities are available.

By private sector

Waste from ships entering Belgian ports is collected by private companies in the harbours. The ships pay a fee for this service. There is no extra cost involved for the port authorities.

Restoration costs based on additional/new measures to reach GES

The following additional measures that relate to the driver ‘Ports’ have been identified in the POM (in Dutch) with cost estimates in Euro (when available) (Table 10) (DMM 2016):

Table 10 : Additional/new measures related to ‘Ports’ (DMM 2016) and cost for the authorities

	2016	2017	2018	2019	2020	2021
29A. Improving delivery of waste from fishing vessels				n.a.		

3.5 Offshore energy

3.5.1 Description

The marine spatial plan of the BNS (RD 20/03/2014) includes a designated zone for offshore energy. To date, nine projects have been granted permits to build and operate wind and/or energy parks in the Belgian part of the North Sea. There are plans to build up to 500 turbines in the wind turbine area by 2020, yielding a total capacity of 2,230 to 2,280 MW (Degraer et al. 2017) This means that, in principle, wind farms will account for around 10 % of total Belgian electricity generation and will power close to half of the homes in Belgium. (webpage OD Nature, 2018)

The following table provides an overview of these concessions and their operationality to date (Table 11) (Compendium Kust & Zee 2015; webpage OD Nature, 2018).

Each project requires an environmental permit as well as a domain concession for the proposed project area, according to the law on the protection of the marine environment and two Royal Decrees. The Management Unit of the North Sea Mathematical Models (KBIN/MUMM) makes an environmental impact assessment (EIA), based on the environmental impact study (EIS), submitted by the applicant. Based on the EIA and on the results of the public consultation, the KBIN/MUMM advises the federal Minister responsible for the marine environment, who decides whether the environmental permit should be granted. Requests for the domain concession are submitted to the CREG (Commission for the Regulation of the Electricity and the Gas), advising the Minister of Energy. The concession is not valid until the environmental permit is granted. There is also a permit procedure for the installation of the cables (Royal Decree 12 March 2002). Requests are submitted to the FPS for Economic Affairs, who advises the Minister of Energy.

Table 11 : Overview of concessions and status of operationality to date

Park	Status	Number of turbines	Total capacity	Surface area
Norther (SE of Thornton Bank)	Environmental permit granted Construction in 2017-2018	45 (8,4 MW)	378 MW	44 km²
C-Power (Thornton Bank)	Operational since 2009, fully operational since 2013	6 (5MW-GBF) 48 (6,15 MW – JF)	325 MW	19,5 km²
Rentel (between Lodewijk and Thornton Bank)	Environmental permit granted Construction on-going	42 (7,35 MW)	309 MW	23 km²
Northwind (Lodewijk bank)	Operational since 2015	72 (3MW – MP)	216 MW	13,8 km²
Seastar (NW Lodewijk bank)	Construction planned by 2018	41 (6 MW)	246 MW	18,4 km²
Belwind/Nobelwind (Bligh Bank)	Phase 1: operational since 2010 (Belwind I) Phase 2: operational Dec 2017 (Nobelwind)	56 (3 MW – MP) + Alstom turbine (6 MW) 50 (3,3 MW – MP)	171 MW 165 MW	17 km² 19,8 km²
Northwester 2 (NW Bligh Bank, below Mermaid)	Environmental permit granted	22-32 (6 – 8,5 MW)	217-227 MW	15,2 km²
Mermaid (NW of Bligh Bank)	Environmental permit granted	27-41 (6 – 8,5 MW) Wave E convertors	232-266 MW 5 MW wave energy	16,3 km²

Operational farms

C-Power is located on the Thornton bank, 27 km off the coast of Zeebrugge, covering a surface of 18 km². In 2009, 6 turbines (with gravity base foundations) of 5,15 MW became operational. In the summer of 2013, in addition 48 Repower turbines of 6,15 MW or 295 MW were installed. The total capacity of 54 turbines amounts to 325 MW, providing green energy for 300,000 homes. The annual energy production amounts to 986,1 GWH or approximately 1 TWh.

C-Power was followed by **Belwind**. In September 2009, Belwind began the construction of 55 wind turbines on Bligh Bank, 46 kilometers off the coast of Zeebrugge. This farm became the world's furthest from the shoreline. The foundations were made from monopiles, driven 35 m into the sea bed. The Belwind wind farm came online in December 2010. With 55 wind turbines, each with an output of 3 MW, and an Alstom Haliade test turbine of 6 MW, this offers a capacity of 171 MW, which provides green energy for about 160,000 Belgian homes a year.

Northwind the third operational wind farm, lies 38 km off the coast of Zeebrugge on Lodewijk Bank. This park has been in operation since May 2014 and has 72 turbines each with an output of 3 MW. It offers a capacity of 216 MW. This wind farm supplies more green power for 250,000 Belgian homes.

On 7 October 2015 Belwind NV's environmental permit to build and operate an offshore wind farm was partially transferred to **Nobelwind** NV and the conditions of transfer were set. As a result, Nobelwind received an environmental permit to build and operate an offshore wind farm of 50 turbines of a capacity of 3.3 MW on Bligh Bank some 47 kilometres from the coastline. With a capacity of 165 MW, this farm will provide green energy for some 160.000 Belgian homes. The construction has been completed in December 2017.

Planned wind farms

By 2020, a further 5 wind farms will be built in the area set aside for renewable energy in the Belgian North Sea. The 5 wind projects, which are already licensed, have reached various pre-construction stages.

On 18 January 2012 (amended on 19 October 2012, 28 March 2013 and 26 August 2014) NV **Norther** was granted an environmental permit to build and operate its offshore wind farm in the south east of Thornton Bank, 21 kilometres off the coast of Zeebrugge. A total capacity of 378 MW is planned for the Norther farm, based on 45 wind turbines with an output of 8.4 MW. This farm will provide green energy for some 350,000 homes.

On 15 February 2013 (amended on 3 December 2015) **Rentel** NV was granted an environmental permit to build and operate its offshore wind farm in the north west of Thornton Bank and the south east of Lodewijk Bank at a distance of 31 km from the coastline. The Rentel farm will have a total capacity of 309 MW provided by 42 turbines, each with a capacity of 7,35 MW. This farm will provide green energy for around 280,000 Belgian homes.

On 13 April 2015, THV **Mermaid** was granted an environmental permit to build and operate an offshore energy farm in the north west of Bligh Bank, at a distance of 50 km from the coastline. Mermaid is therefore the furthest licensed wind project from the shoreline. The Mermaid farm will have a total capacity of 232 to 266 MW provided by 27-41 wind turbines. This farm will provide green energy for 250,000 to 290,000 Belgian homes. The THV Mermaid was also granted an environmental permit to build and operate a pilot project involving wave energy converters with a total capacity of no more than 5 MW. A permit has been granted for one test field, at which one or more wave energy converters can be placed in the space between the wind turbines.

On 18 December 2015, NV **Northwester 2** was granted an environmental permit to build and operate an offshore wind farm in the north west of Bligh Bank, 51 kilometres from the coastline. Between 22 and 32 wind turbines are planned for the Northwester wind farm, giving a total capacity of 217 to 227 MW. This farm will provide green energy for 240,000 to 250,000 Belgian homes.

On 7 February 2014 NV **Seastar** was granted an environmental permit to build and operate an offshore wind farm to the north west of Lodewijk Bank and the south east of Bligh Bank at a distance of 41 kilometres from the coastline. A total capacity of 246 MW is planned for the Seastar wind farm, which will have 41 wind turbines. The wind farm will produce green energy for 270,000 Belgian homes.

3.5.2 Key drivers

- **Economic growth** - The offshore renewables sector has been identified by Europe as one of the most important blue economy sectors that will grow over the next decades. They have to provide a sustainable alternative for the traditional energy.
- **Technological innovation** – Technological evolution has increased the capacity of the wind turbines and the cables, making the investment more efficient and more profitable. More efficient turbines make it possible to install less wind turbines. A “plug” at sea gives the possibility to use less cables to land (instead of one cable per wind park), offering environmental and economic benefits. Elia currently develops such plug at sea, referred to as the ‘Modular Offshore Grid’ (MOG).
- **Legislation and governance** – Policy towards sustainability: In 1998, Belgium committed in the burden sharing treaty to decrease greenhouse gasses by 7,5 % in 2008–2012, compared to the emission level in 1990. To achieve the targets, the Federal Plan in Sustainable Development has been drawn up, stating that in 2010 3 % of the energy needs to come from renewable energy sources, and 27 % by 2030. Flanders opted to gain energy by wind, using offshore wind turbines. In 2008 the European Commission set for Belgium a target of 13 % energy production from renewable energy sources by 2020.
- **International cooperation** - The North Sea Offshore Grid, officially the North Seas Countries Offshore Grid Initiative (NSCOGI), is a collaboration between EU member states and Norway to create an integrated offshore energy grid which links wind parks and other renewable energy sources across the northern seas of Europe.
- **Climate change** – Renewable energy production contributes significantly to the decrease of greenhouse gas emissions (see also legislation and governance).
- **Financial issues** - Producers of renewable energy have the opportunity to receive renewable energy certificates from the Flemish Regulator of the Electricity and Gas market (VREG). The certificates represent 1.000 kWh renewable energy. Producers of renewable energy sources can choose to sell renewable energy certificates to the electricity operator ELIA for a legally required minimum price (107 €/MWh for electricity up to 216 MW; 90 €/MWh for electricity above 216 MW of the installed capacity). Government support for green power was reduced in 2015. The federal government made an agreement with the last 3 planned offshore wind parks operators to reduce further the government subsidies. It is unclear how the market will further evolve if the financial support is further reduced or stopped.

3.5.3 Forecasting socio-economic use 2020/2030

Baseline (2015)

- **Employed persons**: The available estimations consist of direct and indirect employment estimates in the Belgian offshore energy sector and include both local offshore energy and export of products. It is estimated that the total employment will amount to 15.000-16.000 jobs by deployment of the Belgian offshore wind energy sector between 2010 and 2030. The offshore employment consists of the construction phase and exploitation phase: the construction phase (including all research and development activities) lasts several years, the exploitation phase of a wind park lasts minimum 20 years. De Backer (2017) states that the offshore wind energy sector currently accounts for 1.400 FTEs. The FTE man-years for planned parks amount to circa 500 per year, with an exploitation period of 20 years.
- **Development in production value**: The investment value of the sector amounts to 8 billion Euro. To date (end 2017), 877 MW has been installed. The electricity price is fluctuating from year to year: ca. 70 EUR/MWh in 2008, 32 EUR/MWh in 2017. This amounts to a production value of 2.560 million Euro in 2017.
- **Gross added value**: The added value of the sector is estimated at 1 billion Euro/year (Belgian offshore platform 2017) (local and export).

BAU (2020)

The current marine spatial plan includes the following elements related to offshore energy (MRP 2014, Annex II):

- An additional concession zone for a ‘Plug at sea” is included.
- The existing zone for renewable energy is kept and is not being enlarged in the marine spatial plan. The aim is to operationalize the existing zone to a maximal extent within the current planning period.

- New concession zones for an energy atoll at the coast in front of Blankenberge-De Haan and east of the harbour of Zeebrugge.
- The existing safety perimeters are being maintained.
- Options for multiple spatial use are being investigated: the high voltage station can have an additional nature function or function as tug boat station, the energy atols can have a nature function.
- The zone for renewable energy is also being used as a zone for alternative forms of sustainable energy, marine aquaculture and research on offensive nature protection measures (artificial reefs and resting places for seals).
- A visitor centre can be allowed within the high voltage stations and the zones for energy storage.

The total installed capacity of the Belgian offshore wind energy sector by 2020 will reach 2200-2300 MW. Taking into account the 232 currently operational wind turbines, this means that the amount of electricity generated by wind farms will increase threefold, and that between 2.2 and 2.3 million Belgian homes will be using green 'North Sea Energy' by 2020. This generates a production of 8 TW electricity per year (Belgian offshore platform 2017).

The zones for an energy atoll will not be used.

BAU (2030)

The area for renewable energy is currently 2.100 km². Considering that the designated area would be converted to a wind farm with a capacity density of 10 MW/km², this would result in an installed wind energy capacity of 21 GW.

The draft marine spatial plan for the period 2020-2026 foresees that new cables and pipelines related to energy are installed to a maximum extent in the existing cable- and pipeline corridors. Additional cables and high voltage stations will be installed according to the construction of a European energy grid.

The existing zones for renewable energy are retained and new zones will be installed in function of energy – and climate objectives. Existing safety perimeters are retained. Multiple use of the zones for renewable energy will be examined and stimulated, e.g. testing of alternative renewable energy systems, marine aquaculture, passive fisheries.

Other trends up to 2050 defined by the Long-Term Vision North Sea 2050 (De Backer, 2017) related to renewable energy include:

- Demand for offshore test zones
- Increase in scale and combination between wind, tides and wave energy
- Increased international cooperation / North Sea grid
- Demand for high voltage offshore platform
- Demand for offshore AC/DC – conversion stations

3.5.4 Cost of degradation

Current costs based on the existing measures

By public sector

Table 12 : Existing measures related to 'Offshore energy' and cost for the authorities

Existing measure 'Offshore energy'	Personnel and cost (Euro)
Permitting (incl. EIA and Appropriate Assessments)	Dienst Marien Milieu: 4 FTE, 200.000 (for both measures)
Conditions and restrictions wind parks and cables (only those with a direct link to MSFD descriptors) - Zonation: Delineation of a zone for wind parks - Condition in the permit: Maximal limitation of introduction of hard substrates - Condition in the permit related to erosion protection (cables) - Condition in the permit to avoid oil pollution	

- Condition in the permit to limit under water noise during construction Monitoring during construction and exploitation (introduction hard substrates, underwater noise, benthos…)	
Spatial measures integrated in the marine spatial plan (2014-2020) linked to wind energy sector: - Prohibition on sailing (including fisheries) in the wind parks	Dienst Marien Milieu: 3 FTE, 100.000

Costs related to the granting of permits (incl. EIA, AA) by the federal authority (FPS Environment, in collaboration with KBIN/MUMM) is given as an overall cost (in EURO), applying for several activities in the BNS including offshore wind farms. The cost for the environmental impact assessment (~retribution cost) varies between 60.000 – 120.000 € depending on the complexity of the dossier,

Other governance costs by the public sector (FPS Environment/KBIN/MUMM) comprises the management of concessions, monitoring programmes, enhancement and control.

Costs related to the monitoring of potential environmental impacts is coordinated by KBIN and funded by fees paid by the concessionaires.

By private sector

Table 13 Existing measures related to 'Offshore energy' and cost for the private sector

Existing measures 'Commercial fisheries'	Personnel and cost (Euro)
Environmental Impact Assessment (EIA) and Environmental permits	- EIA: 40.000-100.000 - Environmental permit: 10.000-40.000
Monitoring costs (fees paid by private sector, carried out by BMM)	- Estimation (2015): 1.250.500 for all wind parks
Cost of dismantling	- Estimation: 4% of the total cost of the wind park

The **costs related to Environmental Impact Assessment (EIA)** are born by the private sector (not included in the table above). This includes the cost for the Environmental report (between 40.000 - 100.000 €) and as well as the costs related for obtaining the necessary permit applications (between 10.000 – 40.000 €).

Costs related to the monitoring (see above) are funded by fees paid by the concessionaires (Article 24 of the KB of 9 September 2003[9]). This fee is used to fund the ongoing research on the impact of exploitation and exploration activities on the marine environment and the seabed. The monitoring programme and environmental research is determined by the specificities of the project. The cost for the monitoring consists of 2 parts: an administrative cost per man-day (yearly indexation, e.g. 500,20 Euro, index 2015) and the costs for the monitoring programmes, environmental impact studies and environmental assessments.

The monitoring of the full wind park zone in the BNS by BMM requires an equivalent of 2500 man-day per year until 2022 (estimation, BMM 2015). The involved costs are divided pro rata among by the concessionaires of the wind parks. There is a maximal contribution of each concessionaire of the equivalent of 5357 man-days from the start until the end of 2022. Provisions after 2022 will be defined when necessary. Based upon this information, the administrative cost for monitoring borne by the concessionaires of the Belgian wind parks amounts to 1250500 Euro.

Costs of dismantling: After the concession period, the concession site needs to be restored to its original state. So, the wind turbines need to be dismantled, discarded and recycled. The cables need to be removed

[9] Koninklijk besluit houdende de regels betreffende de milieu-effectenbeoordeling in toepassing van de wet van 20 januari 1999 ter bescherming van het marinemilieu in de zeegebieden onder de rechtsbevoegdheid van België

and the foundation piles cut off at a depth of 3 meters. The cost of dismantling equals 4 % of the total cost (including investment, exploitation, maintenance and revision costs).

Restoration costs based on additional/new measures to reach GES

No additional/new measures were defined.

3.6 Aggregate extraction

3.6.1 Description

Only sand extraction is carried out in the Belgian Continental Shelf, no gravel extraction. According to the law of June 13, 1969, amended by the law of January 20, 1999 and the law of April 22, 1999, the exploration and exploitation of sand and gravel is restricted to certain areas. Four control zones have been defined, divided into sectors, for which a concession can be granted (Table 14).

Table 14 : Overview of the different control areas for sand- and gravel extraction in the BNS (Van Lancker et al. 2015)

Control zone	Sector	Location	Access
1	a	Thorntonbank	Open, except area THBREF
2	kb	Kwintebank	Open, except KBMA and KBMB
	br	Buiten Ratel	The central part of 2br is closed from 2015 onwards (BRMC)
	od	Oostdyck	Open
3	a	Sierra Ventana	Open
	b	Sierra Ventana	Closed as long as sector is being used to deposit dredged sediments
4	a	Noordhinder	Open
	b	Oosthinder-noord	Open
	c	Oosthinder-zuid	Open
	d	Westhinder	Open

Extracted sand is used for three purposes: construction (concrete), as beach supplements to suppress erosion of the Belgian coast (coastal defence) and for land reclamation.

Figure 8 shows the evolution of aggregate extraction in the BNS for the period 1976 to 2016 (Roche et al. 2017). Because of the depletion of existing sand quarries on land, an increasing demand for sea sand is noticed. Moreover, the increase is due to a growing interest and demand in sand, as its varied usage purposes. Compared to other European countries, the extraction of marine aggregates is rather modest.

In 1976 29.000 m³ sand and gravel was extracted, increasing to ca. 5,5 million m³ in 2014 (Van Lancker *et al.* 2015). Until 1988 extraction was constant at ca. 0,5 million m³, increasing steadily since. In 1997 almost 3,9 million m³ was extracted, due to the installation of new gas pipelines Interconnector and NorFra in the BNS. The peak in 1991 was also due to the construction of submarine pipelines for gas. There was a peak of sand extraction in the period fall 2013-spring 2014 for beach nourishment. The beaches of Westende, Middelkerke, Raversijde, Mariakerke, Ostend, Bredene, Wenduine, Blankenberge and Knokke-Heist were prioritized, partly due to a severe storm event on the 5th and 6th of December 2013 (Van Quickelborne 2014). More recently, a severe storm ‘Dieter’ on the 14th of January 2017 washed away 1,5 million m³ of sand from beaches along the Belgian coast.

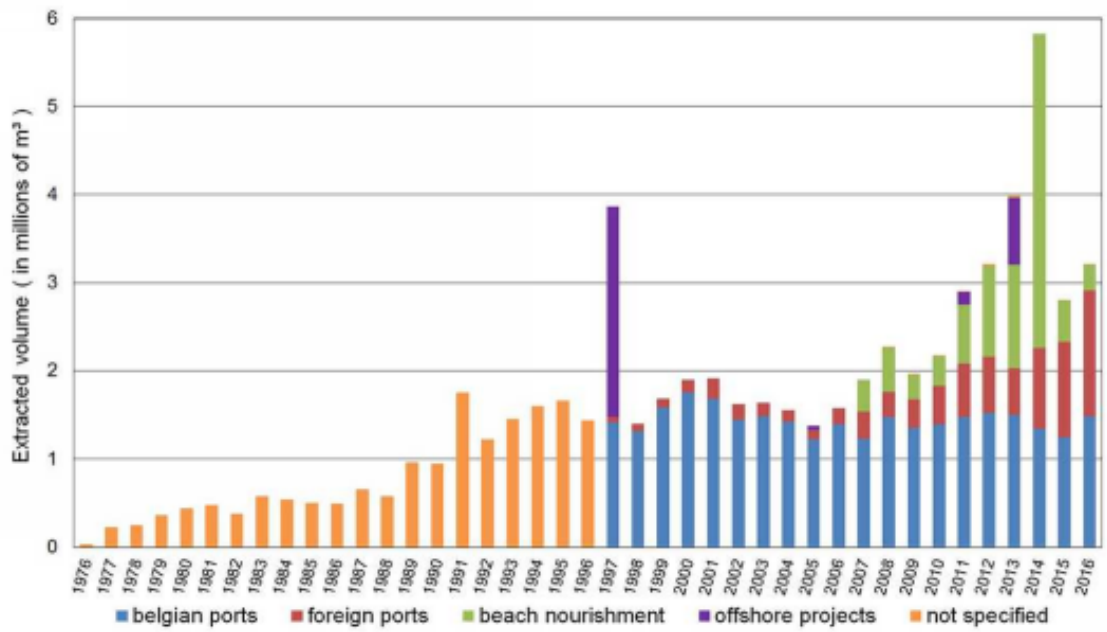


Figure 8 : Evolution of the extraction of sand in the BNS between 1976 and 2016. Data source: FPS Economy, Department Continental Shelf. The graph has been extracted from Roche et al. (2017).

Division 'Continentaal Plat' from the federal public service Economy is responsible for a sustainable management of aggregate extraction on the Belgian Continental shelf. Permits need to be obtained to exploit sand, by submitting a concession demand and an Environmental Impact Study (EIS). The concession demand needs to be directed to the public service Continentaal Plat, who is responsible for the treatment of concession demands. Meanwhile, the EIS needs to be handed in by the Management Unit of the North Sea Mathematical Models (KBIN/MUMM), who makes an evaluation of the activity on the marine environment. KBIN/MUMM transmits an EIA to the Minister of marine environment, which informs the Minister of Economic Affairs of his legally binding decision.

Extraction activities as well as the environmental consequences are monitored. To determine whether the conditions of the concession are respected, each vessel needs to be equipped with a black box, and registers need to be filled in. The monitoring is performed by the public service Continentaal Plat, in cooperation with the Institute of Agricultural and Fisheries research ILVO and KBIN/MUMM.

3.6.2 Key drivers

- **Economic growth** - Besides coastal defence, there is also a demand for sand due to large infrastructural and/or land reclamation projects. According to stakeholders there are no alternatives for sand extracted from sea. So, they do not expect a shift to other materials.
- **Legislation and governance** – The 'Masterplan Coastal Safety' is the main instrument developed by Afdeling Kust and being implemented in phases since 2011. The aim of the plan is to protect the whole Belgian coast against storms and floods (reference: a 1000-year storm). The supply of sand for beach nourishment is a well-known 'soft' measure for coastal protection. A total of 15-20 million m³ of sand is required in this framework. There is a continuing demand for sand for coastal defence purposes, partly due to more frequent storm events.
- **Technological innovation** – Innovative concepts have been developed over the last decades to protect our coasts, including sand motors, islands barriers, etc., all linked to a medium to high sand demand. A central element in many of these technological developments is the concept of 'working with nature'. Some concepts also promote the multi-purpose function of coastal defence. The viability of these ideas for the Belgian coast will be further investigated within the project Coastal Vision (Maritime Access Division), taking into account the sand availability at the Belgian part of the North Sea.
- **Climate change** – The link between climate change and coastal protection is straightforward. Climate change will result in higher storm frequencies, waves, etc., and there is growing evidence that these changes will happen with a higher speed then first expected.

3.6.3 Forecasting socio-economic use 2020/2030

Baseline (2015)

The data was made available by the Department Continental Shelf (FPS Economy) and by members of the Zeegra association.

- **Employed persons**: A total of 262 persons was employed in the aggregate extraction sector in 2016 (FTE's, Belgium and rest of Europe). The employment in activities in the BNS accounted for 124 FTE.
- **Development in production value**: The total production of marine aggregates in the Belgian Continental Shelf was 1.341.486 ton in 2016. The total turnover of the sector was 16.151.209 Euro. It should be noted that this amount consists of aggregates from the BNS and outside the BNS.
- **Gross added value**: No information available for the reference period.

BAU (2020)

The current marine spatial plan includes the following elements related to sand and gravel extraction (MRP 2014, Annex II):

- The existing four extraction areas are maintained, with maintenance of partially closure of Kwintebank.
- Redefinition of the sectors of zone 2 in function of nautical safety and nature protection. Gravel extraction remains forbidden in zone 2.
- Appropriate assessments as a part of the procedure on new concessions within the Natura 2000 area 'Flemish Banks'.
- The maximum extraction volumes are maintained, with a gradual reduction of extraction in the special protection zone 'Flemish Banks'.
- Possibilities for combinations with other activities in the extraction zone are possible, considering the temporary nature of sand- and gravel extraction.

It can be concluded that importance of sand and gravel extraction will increase in future due to the increasing demand (Marine Spatial Plan, 2014) but that the activities of the offshore sand and gravel extraction sector will largely remain the same by 2020, with some provisions to reduce the impact in the special protection area 'Flemish Banks'.

BAU (2030)

It is expected that the demand for sand will increase, both for coastal defence and for commercial purposes. The extraction volumes take into consideration required volumes for the construction sector and beach nourishment. Required volumes related to other measures of coastal defence are not included in the total extractable volume.

The draft marine spatial plan 2020-2026 therefore needs to foresee sufficient space for sand extraction. A new exploration zone has been indicated in the northern Part of the BNS. The current extraction zones are retained, with some redefinitions for zones 4c (related to zone for renewable energy) and 1a (related to cable corridors). A new extraction zone is planned on the Bligh Bank to compensate for the redefinition of zone 1a. The control zone for monitoring purposes (located in zone 1a) remains active until 2023; afterwards a new zone will be opened. A reference area for calibration purposes and evaluation is delineated between the Kwintebank and the Buiten Ratel.

Combination of sand extraction with other uses remains possible, taking into consideration the temporarily nature of sand and gravel extraction activities.

Within the Long-Term Vision North Sea 2050 (De Backer, 2017) it has been estimated that considering a yearly increase of sand demand with 6% up to 2050, 8.75 million m^3 sand per year will be needed (without exceptional demands). Increased knowledge on sediment dynamics and sand balances could optimize the current extraction strategies.

3.6.4 Cost of degradation

Current costs based on the existing measures

By public sector

Table 15 : Existing measures related to 'Aggregate extraction'

Existing measure	Personnel and cost (Euro)
Permitting (incl. EIA and Appropriate Assessment)	4 FTE, 200.000
Conditions and restriction sand extraction: - Zonation: delineation of zones for extraction activities - Periodic closure zones - Condition permit: allowed maximum volumes - Yearly compensation for monitoring activities (depending on material and extracted volumes) - Monitoring and inspection	Dienst Continentaal Plat: 305.000 ILVO: 411.000 KBIN/Meetdienst Oostende: 101.000 KBIN/BMM: 411.000

Costs related to the granting of permits (incl. EIA, AA) by the federal authority (FPS Environment) is given as an overall cost (in EURO), applying for several activities in the BNS including aggregate extraction.

Other governance costs are born by the public sector Service Continental Shelf (FPS Economy). The cost comprises the management of concessions (processing extraction requests, determining extraction volumes and authorizing the prolongation of concessions).

Costs related to the monitoring of potential environmental impacts is executed by Continentaal Plat, ILVO and the Management Unit of the North Sea Mathematical Models (KBIN/MUMM). The Continentaal Plat monitors the shape of the sea bed and the composition of sediments Continentaal Plat has a contract with ILVO for monitoring the effects on benthos. This cost is born by the public sector, Continentaal Plat from the federal public service Economy and does not consider costs incurred by KBIN/MUMM, representing ca. 70% of the total monitoring cost. The costs are funded by fees paid by the concessionaires with fees being dependent on extracted volumes. This fee is used to fund the ongoing research on the impact of exploitation and exploration activities on the marine environment and the seabed.

Inspection of extraction activities: Processing data from the black boxes is performed by KBIN/MUMM. The cost is born by Continentaal Plat.

By private sector

Costs related to Environmental Impact Assessment (EIA) are born by the private sector (Zeegra) (for commercial use) and/or public sector (for coastal defence). This includes the cost for the Environmental report (between 40.000 - 900.000 €).

- 2004 – 2005 regarding zone 1, 2 and 3: 66.278 € born by the private sector Zeegra, and 20.000 was financed by the public sector;
- 2008 - 2010 regarding zone 4: 900.000 €. This cost was born by the public sector.
- 2015-2016 regarding zone 1, 2 and 3: 40.000 € born by the private sector Zeegra

Costs related to the monitoring (see above) are funded by fees paid by the concessionaires with fees being dependent on extracted volumes. This fee is used to fund the ongoing research on the impact of exploitation and exploration activities on the marine environment and the seabed.

Restoration costs based on additional/new measures to reach GES

There are no additional/new measures that relate to aggregate extraction.

3.7 Dredging and dumping at sea

3.7.1 Description

Two types of dredging activities exist: capital dredging activities for construction, deepening and broadening of ports and secondly maintenance dredging to maintain the required depth to maritime access routes and Flemish coastal ports (Zeebrugge, Ostend, Nieuwpoort and Blankenberge). Maintenance dredging is executed all year long by 3 to 4 trailing suction hopper dredgers. Maintenance dredging in fishing harbours and marinas is taking place before and just after the coastal tourist period. Dredging in the BNS is the responsibility of the Flemish Region (Maritime Access Division).

Dredging activities are carried out in the following locations: Pas van het Zand, Central part of the new outer harbour of Zeebrugge, Harbour and outer harbour of Zeebrugge, Scheur Oost, Scheur West, Access channel to Oostende, Harbour of Oostende, Access channel to Blankenberge. Figure 9 shows the evolution of dumping of dredged sediments for the period 1997-2014 (Van den Eynde et al. 2015). In 2015, the amount of dredged material is 13.173.189 ton (Lauwaert *et al.* 2016).

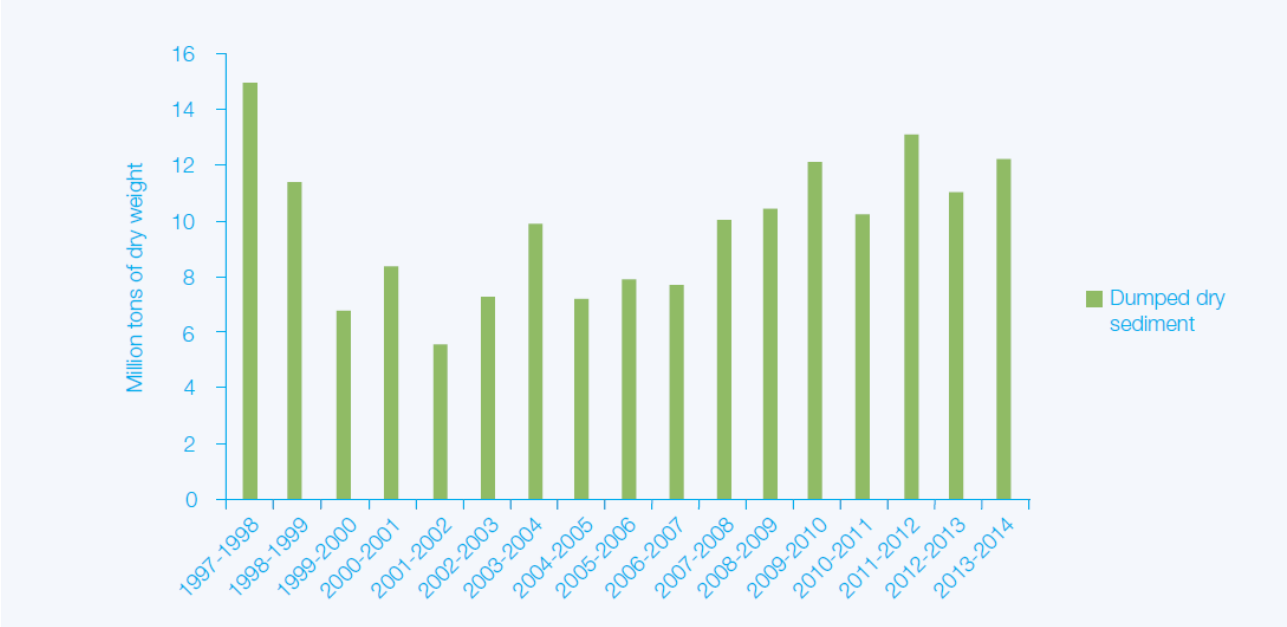


Figure 9 : Evolution of dumping of dredged sediments (in million tons of dry weight).

Most of the dredged material is dumped back at sea at specific dumping sites: S1, S2, Bruggen en Wegen Zeebrugge, Bruggen en Wegen Oostende, Nieuwpoort. When the dredged material contains mainly sand (50.000 – 100.000 TDS per year), the sand can be used for beach nourishment, i.e. —beneficial use.

The federal government is responsible for the monitoring of the effects of dumped dredged material. On 12 June 1990, a cooperation agreement was signed between the Belgian State and the Flemish Region in order to safeguard the North Sea from the environmental effects of dumping dredged material at sea. The management of dredged material is fully in line with international obligations, as a result of the (regional) OSPAR Convention and her worldwide equivalent, the London Convention (Lauwaert et al. 2015).

In accordance with the law of January 20, 1999, authorization is required to dump dredging material at sea. The procedure to obtain authorization for dumping dredged material from activities undertaken by the Flemish Region at sea is laid down in the Royal Decree of March 12, 2000 defining the procedure for authorizing the dumping of certain substances and materials in the North Sea. The Management Unit of the North Sea Mathematical Models (KBIN/MUMM) is authorized to reach out dumping permits in the BNS. At the moment, there are five authorizations for dumping dredged material at sea in force. Dumping permits are issued for a period of two years. Dredged material to be dumped at sea must fulfil the sediment quality criteria (SQC) defined in the permits.

3.7.2 Key drivers

- **Economic growth –** Dredging and dumping activities in the North Sea are determined by shipping patterns, as their main purpose is to guarantee the accessibility of the navigation channels and entrances to the ports. The average dredged quantity for maintenance purposes is 8 million TDS per year. It may be expected that due to more and larger container ships, the dredging efforts to maintain the access channels will increase. There are no concrete plans for capital dredging.
- **Technological innovation** – Potential technological developments may be linked to larger dredgers, increasing time-efficiency of dredging activities.
- **Legislation and governance** – Environmental impact assessment is needed for new concessions, which may only take place in the designated zones in the Belgian marine waters.
- **Climate change – C**limate change may affect mass flow patterns at the North Sea resulting in increasing erosion rates of the navigation channels.

3.7.3 Forecasting socio-economic use 2020/2030

Baseline (2015)

There are few socio-economic data available for the dredging sector.

- **Employed persons**: Only estimates are available. A survey showed that the dredging companies have approximately 240 employees. Other estimates, based upon the yearly budgets show an employment of approximately 560 employees.
- **Development in production value**: No data are available for the reference period.
- **Gross added value**: No data are available for the reference period.

BAU (2020)

The current marine spatial plan includes the following elements related to dredging and dumping at sea (MRP 2014, Annex II):

- Dredging locations are kept in function of safe nautical access and in relation to evolutions in ship technology.
- Dumping locations are maintained and enlarged with a reservation area near Zeebrugge, in function of efficiency of dumping and taking into consideration operational needs.

It can be expected that the dredging and dumping activities will largely remain the same by 2020.

BAU (2030)

The draft marine spatial plan 2020-2026 foresees that existing dredging locations are retained, in function of safe nautical access to ports and in function of evolution in ship sizes. Dumping locations will be updated in function of nature conservation (outside the Flemish Banks area) and capacity. Additional zones have been indicated to (possibly) replace existing dumping sites: 2 zones in the vicinity of S1 and 1 zone near Zeebrugge (the former reservation zone near Zeebrugge).

It is not expected that significant changes will occur by 2030 as a result of the new marine spatial plan.

3.7.4 Cost of degradation

Current costs based on the existing measures

By public sector

Table 16 : Existing measures related to 'Dredging and dumping at sea' (DMM 2014)

Existing measure 'Dredging and dumping at sea'	Personnel and cost (Euro)
Authorization (incl. EIA and Appropriate Assessment) – for new concessions	Dienst Marien Milieu: 4 FTE, 200.000
Spatial measures integrated in the marine spatial plan (2014-2020) linked to the sector: - Delineation of zones for dumping of dredged sediments - Indication reservation zone near Zeebrugge for dumping dredging sediments	Dienst Marien Milieu: 3 FTE, 100.000
Condition and restrictions dumping of dredged sediments: - Dredged sediments that are dumped in sea are required to fulfil sediment quality criteria (SQC's)	
Prohibited activities within SPAs and user agreements: - Dumping of dredged sediments and inert materials of natural origin within the former zone 'Trapegeer Stroombank'	

Strictly speaking, no permit is needed for dredging and dumping activities, only an authorization. On a voluntary basis, environmental notes have been drafted by the Flemish authority (responsible for the maintenance/accessibility of the navigation channels) to be evaluated by the Federal authority. Therefore, the current cost related to the granting of permits (incl. EIA, AA) by the federal authority given as an overall cost (in EURO) has been included in the table.

Monitoring and research programmes: authorizations are granted with the condition of carrying out monitoring and research programmes. The cost of monitoring and research is paid by aMT and carried out by KBIN/MUMMs. KBIN/MUMMs research focuses on the sediment dynamics, the identification of environmental changes in the Belgian nearshore area and the implementation of monitoring strategies to identify environmental changes induced by dumping activities. The environmental monitoring programme of ILVO focuses on the effects of changes in the contaminants in the sediment and fauna at the dumping sites, the effects of the dumping activity on the benthic organisms and the effect of the influx of organisms from the dredging areas on the native fauna and the disposal sites. Besides these continuous research and monitoring programmes, every ten years, a large monitoring programme is set up to evaluate the quality of the material to be dredged: samples are taken from all areas in which dredging is taking place.

By private sector

There are a number of **costs for dredging operators to reduce/mitigate the environmental impacts** like anti-turbidity systems. These systems reduce the amount of air entrained in hopper dredge effluent. The system reduces the dispersion of turbid water following a dredging operation.

Restoration costs based on additional/new measures to reach GES

There are no additional/new measures that relate to dredging and dumping at sea.

3.8 Tourism

3.8.1 Description

The Belgian coastline offers housing, restaurants, shopping, attractions and musea, soft recreation (walking, (mountain) biking, horse riding), golf and MICE (meetings, incentives, conferences, and exhibitions)-tourism and facilities for water sport. Long-term stays in coastal tourism generated 5 million arrivals and 28,4 overnight stays in 2013. Between 16 and 19 million-day tourists visited the coast per year (Westtoer trendrapport Kust 2012-2013). The airport of Ostend and the ports of Ostend and Zeebrugge are important for arrivals of foreign tourists.

The tourism sector requires an extensive infrastructure and exerts a significant influence on urbanization and infrastructure in the coastal zones. Marinas have been built in Nieuwpoort and Blankenberge. The marina of Nieuwpoort holds berthing places for approximately 2000 boats and is the largest in northern Europe.

3.8.2 Key drivers

- **Economic growth** - According to UNEP (2009) the growth of tourism in general, and in coastal areas in particular, is related to three main factors: 1. increased personal incomes and leisure time; 2. improvements in transportation systems; 3. Greater public awareness of world destinations due to improved communications. Today 's tourists seek a variety of experiences including cultural and natural attractions, gastronomy, sports, etc. all this in a well-preserved and distinctive natural environment. At the same time, people living in traditional tourist destinations are increasingly aware of and concerned about their natural, historic and cultural heritage. Water sports will remain important, with a constant and continuous availability of water sport materials. It is expected that beach- and sport clubs in the coastal zone will invest further and will diversify further.
- **Sustainability trends** – It is expected that tourism in future will be more demanding in terms of sustainability, e.g. local products, healthy food and sustainable activities in a high-quality environment. There is also a trend to spend more regular but shorter holidays at the coast. Tourist destinations will have to evolve to all-year round destinations. It can be expected that the coast will accept a more constant flow of tourists.
- **Health and food trends** – more awareness on health benefits (clean air, more sun, open space), food culture: unique food products with closer link to nature (catch of the day, etc.)
- **Technological innovations**: smarter ways of transportation, improved safety measures, unique tourist experiences (drones, diving, etc.), improved distribution of information/communication tools.
- **Climate change** – Climate change may affect tourist destinations both in a positive (e.g. better temperature conditions) and in a negative (e.g. decrease of beach area due to increased coastal erosion) way.

3.8.3 Forecasting socio-economic use 2020/2030

Baseline (2015)

- **Employed persons**: Estimation: 27.000 direct employment in 2013 (Westtoer 2013)
- **Development in production value**: The total turnover of the tourism (calculated as expenses of tourists visiting the coast) amounted to 2803,5 million Euro in 2014(Compendium Kust & Zee, 2015).
- **Gross added value**: No data for the period 2014-2015 was available for the tourism sector. The gross added value for 2007 amounted to 335,814 million Euro.

BAU (2020)

The current marine spatial plan includes the following elements related to tourism (MRP 2014, Annex II):

- The current touristic and recreational possibilities are being maintained as much as possible within the BNS.

BAU (2030)

The draft marine spatial plan 2020-2026 foresees that possibilities for tourism and recreation are retained as much as possible in the BNS and no significant changes are expected by 2030 as a result of this.

The Long-Term Vision North Sea 2050 (De Backer, 2017) notes further that beach and sport clubs will have to invest and diversify to maintain its clientele.

3.8.4 Cost of degradation

Current costs based on the existing measures

By public sector

Table 17 : Existing measures related to 'Tourism'

Existing measure	Personnel and cost (Euro)
Appropriate Assessment	4 FTE, 200.000
Prohibited activities within SPAs and user agreements: - Prohibition of passage of high speed vessels and exercises with helicopters at an altitude of less than 500 feet in the zones SBZ-V1 and SBZ-V2 in the period from 1 December until 15 March - Prohibition water sport competitions in SBZ-V1 and SBZ-V2 - Prohibition activities related to civil engineering/construction, industrial activities and activities of publicity and commercial enterprises within all SPAs - Applying the relevant legislation under European Waste Directive, Water Framework Directive, Directive Urban wastewater, Framework directive packaging, Policy plan Flemish government, Waste policy coastal municipalities	
Land-related measures (awareness raising marine litter): - awareness raising campaigns OVAM - Clean Beach actions (beach cleaning)	36.000

Recreational activities are not bound to permit conditions, except that appropriate assessments are required when a recreational (e.g. sports) activity takes place with a potential impact on Natura2000 areas. The current **cost related to the granting of permits (incl. EIA, AA)** by the federal authority is given as an overall cost (in EURO), applying for several activities in the BNS.

Other governance costs by the public sector comprises enhancement and control of marine protected areas in relation to recreational activities, and awareness raising regarding the problem of marine litter.

Coastal communities organize additional cleaning up actions of the beaches in the summer period. Besides, several actions are organized by the coastal communities to clean up the beach. Examples are communication and awareness raising campaigns, educative games, expositions, workshops as brochures. An example of a yearly awareness raising action is the Eneco beach cleanup[10].

Awareness raising campaigns of OVAM (e.g. Mooimakers[11]) have a focus that goes beyond the coast (Flanders). There are a number of initiatives by OVAM that focus on the coast and beach litter. OVAM cooperated with Westtoer on garbage bins and awareness raising on the beach (cost: 25000 euro). OVAM placed 32 waste bins for beach litter along the coast (waste collection function as well as awareness raising) (cost: 11000 euro).

By private sector

There is no information on measures by the private sector.

[10] https://enecocleanbeachcup.be
[11] http://mooimakers.be

Restoration costs based on additional/new measures to reach GES

The following additional measures that relate to the driver 'Tourism – Recreational boating' have been identified in the POM (in Dutch) with cost estimates in Euro (when available) (Table 18) (DMM 2016):

Table 18 : Additional measures related to 'Tourism – Recreational boating' (DMM 2016)

	2016	2017	2018	2019	2020	2021
28A. Sensitization for preventing spills when bunkering fishing vessels and pleasure crafts in harbour			15.000-22.500		15.000-22.500	
28B. Sensitization on waste management in harbours for pleasure crafts			12.000-18.000		12.000-18.000	

3.9 Recreational fisheries

3.9.1 Description

Verleye et al. (2016) has estimated that Belgium counted a total of 778 recreative fisheries boats in 2015. These are mainly situated in the harbours of Nieuwpoort, Zeebrugge, Oostende and Blankenberge. Some key figures of the Belgian recreative fisheries:

- Over 631 recreative fishing boats.
- 72 % of the boats are between 6 and 8 meters.
- Estimated total number of fishing trips by the recreative fisheries fleet: 10.735 days.
- Estimated total number of fishing trips by individual fishermen: 25.765.
- Most of the activities take place within the 3-nm zone.

3.9.2 Key drivers

- **Economic growth -** The population growth in Belgium (+13% by 2100) is expected to lead to an increased demand for recreational activities, including recreational fisheries.
- **Legislation and governance –** Up to now, recreational fisheries are not obliged to register their catches, but discussions are on-going to which extent recreational fisheries need to be regulated, as their impact may be significantly. Bag restrictions on seabass (EU Directive 2015/104, and 2015/523) in addition to existing national limitations (Ministerial Degree 18 December 2014) potentially also influences the recreational fisheries activity.
- **Climate change** – The effects of climate change on commercial fisheries is complex to assess. It is expected that primary productivity in the North Sea will lead to increased fish stocks of certain species, while certain cold-adapted species (e.g. Cod) are expected to retreat further north. On the other hand, some species adapted to warm water will increase their extent. Ocean acidification can lead to a reduction of calcifying organisms such as mussels and scallops. Overall, climate change may lead to a change of the existing fish communities in the North Sea, including commercial species.
- **Financial issue** - Fuel costs influence significantly the number of active recreational (trawling) boats, as was observed during recent years after the prohibition of red gasoil as boat fuel.

3.9.3 Forecasting socio-economic use 2020/2030

Baseline (2015)

There is very few information available on the economic importance of recreative fisheries in terms of direct employment, production value and value-added. A first estimate was calculated by the ICES Working Group on Recreational Fisheries (WGRFS), based upon a participation rate of 0,22% and an average expense of 1,372 Euro/fishermen/year (ILVO). Based upon this estimate, the total expenses of recreational fishermen amount to 33 Million Euro per year (Persoon 2015, Hyder *et al.* 2016). At the European scale, it is estimated that direct expenses related to recreational fisheries amount to 6 Billion Euro per year (Hyder *et al*. 2016). The ongoing project 'Recreatieve Zeevisserij' of the Flanders Marine Institute will generate more accurate data, which will become available in 2018[12].

There are currently no accurate estimations of the number of recreational fishermen in Belgium (Verleye *et al.* 2015).

BAU (2020)

The current marine spatial plan includes the following elements related to recreational fisheries (MRP 2014, Annex II):

- Prohibition of recreational bottom disturbing fisheries in the entire special protection area 'Flemish Banks', except for fishing on horse, by foot and for recreational fishermen already active (can have a permit to go out fishing for 10 times/year) (also mentioned in the previous chapter).
- Prohibition of recreational gill net fisheries in the 'Flemish Banks' area.

[12] http://www.recreatievezeevisserij.be

BAU (2030)

The same restrictions regarding recreational fisheries are valid in the new marine spatial plan 2020-2026.

3.9.4 Cost of degradation

Current costs based on the existing measures

By public sector

Table 19 : Existing measures related to 'Recreational fisheries'

Existing measure	Personnel and cost (Euro)
Spatial measures integrated in the marine spatial plan (2014-2020) linked to fisheries sector: - Prohibition of recreational bottom disturbing fisheries in the Flemish Banks, with exceptions: a. exceptions fishing on horse, by foot (allowed) b. recreational fishermen already active (can have a permit to go out fishing for 10 times/year) - Prohibition on fisheries in the wind parks	3 FTE, 100.000
Prohibition shellfish fisheries (Royal Decree)	5 FTE
Prohibition gillnet fisheries: - Prohibition recreational gillnet fisheries at sea (species protection KB 21/12/2001) - Prohibition beach gill nets in the full Flemish beach zone - Prohibition catch and bycatch cetaceans and seals, obligatory release of living and unwounded animals and reporting obligation (Law marine environment)	

Recreational fisheries are not subject to environmental impact assessment procedures. The current cost for permitting (incl. EIA, AA) by the authorities is therefore not relevant here.

Governance costs by the public sector comprises mainly enhancement and control of recreational fisheries activities in the BNS.

By private sector

There is no information available on measures taken by the private sector.

Restoration costs based on additional/new measures to reach GES

The following additional measures that relate to the driver 'Recreational fisheries' have been identified in the POM (in Dutch) with cost estimates in Euro (when available) (Table 20) (DMM 2016):

Table 20 : Additional measures related to the driver 'Recreational fisheries (DMM 2016).

	2016	2017	2018	2019	2020	2021
24 - Measures to reduce by-catch of marine mammals in gillnets: supervision on prohibition of recreational gillnetting on the beach	32.500	32.500	32.500	32.500	32.500	32.500
27A. Raising supervision on recreational fisheries		50.000	50.000	50.000	50.000	50.000

27B. Monitoring size of recreational fisheries	34.000	32.000	25.000-35.000	25.000-35.000	25.000-35.000	25.000-35.000
27C. Stimulating discussion on simplifying conversion of recreational fishing to commercial fishing						
29D. Stimulating alternatives to fishing lead (fishing sinkers)						30.000-50.000

3.10 Other activities at sea

To be complete, the following activities take also place in the BNS, but they are of a lesser importance (environmental impact, extent in time and place) compared to the socio-economic activities described in the previous chapters. A summary is given, without going into further detail.

3.10.1 Research

The Belgian marine research landscape was mapped by Mees *et al*. (2015) in the 'Compendium Kust & Zee' and by Pirlet et al. (2017). In total, 99 marine research groups were active in Belgium within research institutes and universities in 2015. This increased to 117 marine research groups in 2017. There is an increase in recent years because several research groups have expanded their research domain towards the marine environment. The number of active researchers was 1.373 in 2015.

Additional to these marine research groups there are approximately 28 entities operational as international or European institutes (IODE Project Office, Marine Board, …), as NGO 's or intergovernmental cooperation programmes in the field of marine and coastal research and support, with educational purposes. Moreover, 16 formal courses such as Maritime Sciences, Maritime Academy, and more than 60 private companies operate in this field. Operational support for research is provided by two research vessels: the R/V Belgica and the R/V Simon Stevin.

3.10.2 Military operations

Military exercises are held on land (beach) and at sea, covering a large part of the BNS. The exercises can be categorized into different sub-uses according to the zone in which they are executed and to the military component that is responsible for them. The most important military exercises taking place in the marine environment are (Wouters *et al.* 2015):

- Shooting exercises direct seawards from land (responsible authority: Army) in Nieuwpoort – Lombardsijde. These exercises comprise testing new ammunition or weapons and second, training staff by simulating air attacks. (no limitations on the number of shooting exercises per year; not in the summer school holiday and in weekends, reducing the maximum shooting days to 175).
- Shooting exercises at sea at floating targets (responsible authority: Navy) executed from the southern limit in northern direction, during day or night. (used all year long).
- Amphibian exercises to train survival performance of Air Force Pilots, dropped at sea (responsible authority: Army/Navy/Air Force). (on average 3 times per year, with a maximum of 5 times per year)
- Detonation of war ammunitions (mining exercises) (responsible authority: Navy) north of the anchor area Westhinder (since 2001). (no limitations on the number of detonations per year; used all year long). After exercising, mines are swept. Mining exercises can be divided into two categories:
  a. Defensive mining, simulating a war situation whereby a strategic place needs to be defended against enemies.
  b. Offensive mining, simulating a war situation whereby enemies try to put mines by the enemy. Mines can also be dropped by aircraft of small fishing boats.
  c. Once per 2 years NATO holds extensive international large-scale naval exercises. The defensive or offensive mining exercises consist of placing mines and in a second stage, locating and sweeping mines.

3.10.3 Historical ammunition dump

In 1919, after the First World War, the Belgian Government decided to dump ca. 35.000-ton German military ammunition in the BNS. For a period of 6 months, the ammunition was disposed on a daily basis on the sand flat 'the Paardenmarkt', circa 1 km offshore, near Duinbergen. Since '70 it is forbidden to fish or to anchor in this area, first corresponding to 1,5 km² and then to 3 km² in '80 when the area was enlarged.

The number of toxic ammunitions, containing yperite (60 %), (di)phosgene (20 %) and clark (11 %), is estimated at 20 to 30 %. Most of the ammunition is buried under sediment, mainly due to the construction of the outer port of Zeebrugge, and does not pose a danger. Therefore, the Government has decided that the ammunition will remain at place.

3.10.4 Anchorage areas and places of refuge

Places of anchorage are designated places where ships are able to anchor, while waiting for a pilot or a permission to enter a port. Places of refuge are areas where ships can refuge in case of heavy storms at sea or in case of leakage (Maes, Frank et al. 2005). At the BNS, the Westhinder Anchorage area and the Oostdyck Anchorage area have been determined as the places of refuge. NE Akkaert Anchorage and AZ Anchorage are emergency anchorage areas, in case Westhinder anchorage would not be available.

Ostend en Zeebrugge are two ports of refuge. These ports can only welcome smaller vessels without significant damage, due to the limited capacity, without dry docks and given its limited depth. Other destinations are Flushing, Dunkirk or Rotterdam.

3.10.5 Cables and pipelines

Cables are used for telecommunication and energy purposes and pipelines for gas transportation. The total length of telecommunication cables is 914 km: 16 cables are operational (718 km), while 11 cables are no longer in use (196 km).

There are 3 gas pipelines on the BNS with a total length of 163 km:
- Interconnector: between Bacton on the southern coast of the United Kingdom and Zeebrugge;
- Zeepipe: between the Sleipner area on the Norwegian continental shelf and the Distrigaz terminal in Zeebrugge;
- Norfra or Franpipe: between the Norwegian continental shelf and Dunkirk on the northern coast of France.

There is a demand for more electricity cables in the BNS, to export electricity from the wind parks towards the coast and to interconnect national grids in countries along the North Sea (e.g. between UK and Belgium, NEMO Link). To the extent possible, the cables are grouped in cable corridors.

Table 21 : Existing measures related to 'Cables and pipelines (DMM 2014)

Existing measure	Personnel and cost (Euro)
Permitting (incl. EIA and Appropriate Assessment	Dienst Marien Milieu: 4 FTE, 200.000
Spatial measures integrated in the marine spatial plan (2014-2020) linked to the sector: - - Maximum bundling of cables and pipes in corridors	Dienst Marien Milieu: 3 FTE, 100.000
Restrictions and conditions wind parks and cables: - Condition in permit related to erosion protection (cable laying) - Conditions in permit to restrict under water noise during construction - Monitoring during construction and exploitation (introduction hard substrates, underwater noise, benthos…)	
Prohibited activities within SPAs and user agreements: - Prohibition activities related to civil engineering/construction, industrial activities and activities of publicity and commercial enterprises within all SPAs'	

3.10.6 Wrecks

Ship wrecks, other vessel wrecks and sunk loads spread along the entire Belgian part of the North Sea, because of shipping accidents and other disasters at sea and their removal. The BNS counts many ship

wrecks (http://www.vlaamsehydrografie.be/wrakkendatabank.htm) and there is a likelihood that shipping accidents may occur in the future. The wrecks are an important hotspot for marine biodiversity.

There are over 280 known wrecks in the BNS. 8 historical wrecks have been protected as historical cultural heritage. Additional protection measures can be installed for these wrecks[13].

Table 22 : List of wrecks in the BNS protected as historical cultural heritage and protection measures

Wreck name	Protection measures
HMS Wakefull	No specific protection measures
Westhinder	No angling/fishing, anchoring, dredging within a circle with radius of 15 m No fishing with nets within a circle with radius of 40 meter
Wreck of wooden ship in in front of Ostend (19th century)	No anchoring, dredging within a circle with radius of 20 m
Wreck site Buiten Ratel Zandbank (year: 1741)	No anchoring, dredging within a circle with radius of 12,5 m
Wreck site 't Vliegend Hart (year: 1735)	No anchoring, dredging within a circle with radius of 15 m
Wreck site SS Kilmore (year: 1906)	No angling/fishing, anchoring, dredging within a circle with radius of 45 m
Wreck site U-11 (year: 1914)	No angling/fishing, anchoring, dredging within a circle with radius of 30 m No fishing with nets within a circle with radius of 30m
Wreck site HMS Brilliant (year: 1918)	No angling/fishing, anchoring, dredging within a circle with radius of 35 m

3.10.7 Coastal defense

The Master Plan Coastal Safety of the Flemish Government is considered as main instrument to protect the Belgian coast the sea's violence, against storm surge and flooding. The implementation started since 2011. A lot of work has already been completed in various coastal municipalities. Other actions under the Master Plan Coastal Safety are still planned in the coming years (up to 2020). An overview of the state of play is given in an information leaflet published by Afdeling Kust (2017).

Other trends up to 2050 defined by the Long-Term Vision North Sea 2050 (De Backer, 2017) related to coastal defence concentrate on developing a vision for coastal safety for the future (up to 2100), with attention for multiple use. Several (on-going) initiatives are set up to increase the knowledge related to coastal processes to support such a vision, and to help in preparing the marine and coastal area against the increased effects of climate change (e.g. Quest4D (2007-2011), 4Shore project (2013-2016), CREST project (2015-2019), Complex project kustvisie (2017-2020), as well as demonstration projects and calculation of costs of inundation (Verwaest *et al.* 2015).

[13] http://www.vondsteninzee.be

3.11 Summary socio-economic use of BNS

To summarize, Table 23 gives an overview of the economic key figures for the Belgian North Sea Economy for the reference period 2011-2015, based on the available data for the sectors. For the marine activities, a distinction has been made between the sectors of the OSPAR common approach, and the other relevant activities for the BNS (research). Besides marine activities, the study considers sectors in the coastal area with a strong and clear link to the North Sea including tourism and recreational activities and ports. Activities representing a spatial use, but without economic indicators (military zones, historical ammunition dumps, anchorage areas, wrecks and coastal defense) have not been included in the table. Data on recreational fisheries have not been included as accurate data will only become available in 2018 (VLIZ).

Table 23 : Overview table socio-economic use of BNS (reference period 2011-2015)

	NACE codes	Contracting Party	Gross Value dated (million Euro)	Year	Employed persons (FTEs)	Year	Development in production value or other relevant data on trends between first and second initial Assessment (million Euro)	Year	Scale: OSPAR area, national, other	Comments	Data scources
Sectors - OSPAR common approach											
Fisheries and aquaculture	03 (03.1 fisheries 03.2 aquaculture* (excl. fish processing industry	Belgium	50,6	2016	363	2016	81,815	2015	Other	Note 1	Department Landbouw en Visserij 2016
Shipping	05.1 Sea and coastal passenger water transport Excluding inland transport	Belgium	2298	2013	8710	2013	n.a.	n.a.	National	Note 2	Royal Belgian Shipowners Association 2014

	NACE codes	Contracting Party	Gross Value dated (million Euro)	Year	Employed persons (FTEs)	Year	Development in production value or other relevant data on trends between first and second initial Assessment (million Euro)	Year	Scale: OSPAR area, national, other	Comments	Data scources
Ports	30.1 Manufacturing (building ships and boats) 46.7 Wholesale Trade (other specialized wholesale) 42 Construction (civil engineering; construction of buildings excluded) 52.1 Transportation and storage (Warehousing for transportation	Belgium	16532	2015	114773	2015	400	2010	National	Note 2	NBB 2016
Oil and gas	06 Extraction of crude petroleum and natural gas	Belgium	n.a.		n.a.		n.a.	n.a.	National		
Offshore Wind Energy		Belgium	1000	2015	15000-16000	2010-2030	2560	2017	National	Note 4, 5, 6	
Other relevant sectors BNS (specific for Belgium)											

	NACE codes	Contracting Party	Gross Value dated (million Euro)	Year	Employed persons (FTEs)	Year	Development in production value or other relevant data on trends between first and second initial Assessment (million Euro)	Year	Scale: OSPAR area, national, other	Comments	Data scources
Research		Belgium	n.a.		1375	2015	n.a.		National		Mees *et al.* (2015), Pirlet *et al.* (2017)

Note 1: Mariculture (NACE 03.2) is absent in the BNS and is therefore not included in the figures.

Note 2: Specific data for the reference period is not available for Development in Production Value. These data are not made available by the ship owners for strategic reasons (sensitivity).

Note 3: The figures provided in the table include the 4 Belgian maritime ports: Ostend, Zeebrugge, Ghent and Antwerp.

Note 4: Estimated value

Note 5: The figure on employment in the Offshore wind energy sector is an estimation and includes both direct and indirect employment. The estimation is based upon the Input/ Output multiplicator methodology, which is also applied by the Federal Planning Bureau of Belgium. The figure also includes employment in production of wind power plants and export.

Note 6: The total installed capacity of the Belgian offshore wind energy sector is 2200 MW. This generates a production of 8-Terawatt electricity per year. The electricity price is fluctuating from year to year: ca. 70 EUR/MWh in 2008, 32 EUR/MWh in 2017. This amounts to a production value of 2560 Million Euro in 2017.

3.12 Summary cost of degradation of BNS

To summarize, the cost of degradation for the Belgian North Sea (BNS) has been presented in Table 24Table 24, based on the available data on existing measures. This is done by calculating both the current cost of existing measures that avoid (reduce or minimize) degradation, and the cost of new/additional measures proposed by Belgium under MSFD to reach a Good Environmental Status by 2020 (considered as restoration cost). It should be noted that next to these costs, a large share of costs is related to several (high cost) land-based measures, such as sewage treatment. Since they not solely affect the North Sea environment and in principle are reported under the Water Framework Directive (WFD), they have not been considered under this study. A further outline of the cost of degradation per sector is given below.

It has to be noted that the costs of measures mentioned in Table 24 represent the 'certain' part of the actual cost of degradation of the BNS. The 'not certain' part of the costs concerns 1) costs of current measures where data was unavailable and 2) hypothetical additional measures that may fully prevent degradation. The cost total therefore represents a minimum.

The cost of new/additional measures is provided as a summary of the average total cost per year per activity. The details are provided in the chapters on the activities.

Table 24: Overview table estimated annual cost of measures to avoid degradation of the BNS

Existing measure	Targeted sectors	Public authority	Personnel (FTE)	Working budget	Info
Permitting (incl. Environmental Impact Assessment (EIA) and Appropriate Assessments (AA))	Aquaculture (note 1), offshore energy, aggregate extraction	DMM	4	200.000	Info: DMM Joint budget and personnel across all activities and sectors
Definition of conservation targets and development of management plans/policy plans for marine protected areas.	n.a.				
Conditions and restrictions wind parks and cables	Offshore energy				
Conditions and restrictions wind parks and cables	Offshore energy	BMM	n.a.	n.a.	
Conditions and restrictions sand extraction	Aggregate extraction	Dienst Continentaal Plat	3	305.000	Info: FOD Economie – Dienst Continentaal Plat
Conditions and restrictions sand extraction (meetdienst Oostende-	Aggregate extraction	KBIN/BMM		101.000	
Conditions and restrictions sand extraction (monitoring)	Aggregate extraction	KBIN/BMM		411.000	

Existing measure	Targeted sectors	Public authority	Personnel (FTE)	Working budget	Info
Conditions and restrictions sand extraction (monitoring)	Aggregate extraction	ILVO		411.000	
Condition and restrictions dumping of dredged sediments:	Dredging and dumping	n.a.	n.a.		
Spatial measures integrated in the marine spatial plan (2014-2020) linked to wind energy sector	Offshore energy	DMM	3	100.000	Info: DMM
Prohibited activities within SPAs and user agreements	Commercial fisheries, recreational fisheries	DMM	0,5		Info: DMM Joint budget and personnel across all activities and sectors
Prohibition shellfish fisheries					
Prohibition intentional (except with permit) and unintentional introduction of non-indigenous organisms via ballast water	Shipping				
Implementation of the Common Fisheries Policy (CFP) measures	Commercial fisheries	Dienst Zeevisserij	5		Info: Dienst Zeevisserij
Prohibition shellfish fisheries					
Implementation of the Common Fisheries Policy (CFP) measures	Commercial fisheries	Defense (Navy)		302.184	Info: Dienst Zeevisserij, Defense (Belgian Navy) Note 2
Implementation of the Common Fisheries Policy (CFP) measures	Commercial fisheries	ILVO	n.a.	n.a.	
Introduction of sumwings and roller shoes	Commercial fisheries	ILVO	0	0	Info: ILVO (note 3)
Implementation of the Common Fisheries Policy (CFP) measures	Commercial fisheries	OD-Nature		71.000	Info: Dienst Zeevisserij
Prohibition shellfish fisheries	Commercial fisheries				

Existing measure	Targeted sectors	Public authority	Personnel (FTE)	Working budget	Info
Prohibition gillnet fisheries	Recreational fisheries		n.a.	n.a.	
Prohibition of ship activity in or near wind parks	Shipping, commercial fisheries, tourism		n.a.	n.a.	
Measures related to fouling	Shipping		n.a.	n.a.	
Land-based measures (policy and guidelines)		DMM	1	100.000	Info:DMM
Land-based measures (sensitization)		OVAM		36.000	Info: OVAM
Environmental monitoring		BMM	n.a.	n.a.	
Measures prevention and pollution control	All sectors	DMM	3	400.000	Info: DMM
Ship waste	Shipping	Port authorities	0	0	Info: port authorities Note 4
Seafood legislation	Commercial fisheries	FAVV			
Monitoring marine litter cfr. OSPAR		BMM			
Fishing for litter	Commercial fisheries	DMM	0,5	10.000	Info: DMM
Total			**21**	**2.447.184**	

Note 1: There are no marine aquaculture (mariculture) projects so far in the BNS, only pilot projects.

Note 2: This cost is the cost for surveillance by the Navy in 2015. It is calculated as follows: 18 days x 16.788 Euro/day. Important: the surveillance includes surveillance on other marine users as well: recreation, shipping etc.

Note 3: The pilot tests and research on sumwings and rollershoes have been carried out but this activity is finished now. The sumwings and roller shoes are now applied by the fishing vessel operators and the cost is born by the ship operators.

Note 4: There is no netto cost involved for ports, costs for waste collection are borne by the shipping companies. The waste collection is carried out by the private sector.

Additional measures	Average cost per year (Euro) (min-max)
Commercial fisheries	84.633-90.466
Shipping	10.625
Tourism	9.000-13.500
Recreational fisheries	98.499-108.499
Total (average per year):	**202.757-223.090**

4 INITIAL STEPS TOWARDS AN ECOSYSTEM SERVICES APPROACH FOR THE BELGIAN MARINE WATERS

For the second cycle of the MSFD, Belgium has applied the thematic approach related to the cost of degradation, as illustrated above. Considering the importance of the ecosystem-based approach in marine policy context, Belgium decided to start elaborating this approach for the Belgian marine waters. The results of a 4-step ecosystem services approach are presented below, including:

- Scoping of the marine ecosystem
- Development of the assessment framework (relations between pressures, ecological status and delivery of ecosystem services)
- Assessment of the condition of the marine ecosystem (biophysical assessment of ecosystem services
- Economic valuation of ecosystem services

The first two steps have been worked out on the general level of the Belgian marine waters, while the assessment steps have been further illustrated using a case study.

The draft results of these steps have been presented and discussed during an interactive work session with the steering group (14th of November 2017) and further adjusted to reflect their feedback.

It is important to note that these initial steps taken by Belgium towards using an ecosystem services approach for the BNS, may not be considered as mature yet for official reporting under MSFD. The main goal is to illustrate the conceptual framework linking pressures, ecological status and ecosystem services for the Belgian marine waters, considering the interdependence of other steps within an MSFD context and opening the debate for further improvements which may result in a more detailed ecosystem-based approach that may be used for further MSFD reporting cycles.

4.1 Scoping of the marine ecosystem

To identify the provisioning, regulating and cultural services relevant for the BNS following actions were taken:

- Starting from the ecosystem services presented by the guidance for reporting on the 2018 update of articles 8, 9 & 10 for the Marine Strategy Framework Directive (WG DIKE, 2017) a detailed description/interpretation of the ecosystem services for the Belgian marine waters was developed;
- Elaboration of the list of ecosystem services with abiotic services relevant for the Belgian marine waters including the provision of raw materials (sand, gravel) and abiotic energy sources (wind, tidal).
- Prioritizing these flows (ecosystem and abiotic services) considering its relevance for the Belgian part of the North Sea (BNS) using a semi-quantitative scale (high (1) or low (2) priority for further assessments, (3) not considered as relevant for BNS). Prioritization was done on expert judgement considering the extent and importance of the service for the BNS as criteria.

Ecosystem and abiotic services identified for the Belgian marine waters

The list of ecosystem services and abiotic services identified for the Belgian part of the North Sea (BNS), including their prioritization scale is given in Annex 1. The list considers work done in previous studies on ecosystem services in Belgium (o.a. Van der Biest *et al.* (2017), further elaborated to fit the purpose of MSFD reporting. The list contains a complete overview of services based upon the MAES classification for MSFD reporting. As a first step, a clear description of these listed ecosystem services for the BNS was needed.

According to the MAES classification, provision of abiotic products and abiotic energy are not considered as an ecosystem service, as they do not strictly arise from living organisms (biota) or the interaction of biotic and abiotic processes. However, considering the importance of sand extraction and renewable energy (wind) in the BNS, it was decided to consider these abiotic services, next to the strictly defined ecosystem services by WG MAES, for further consideration in this study. In this way, the Natural Capital framework was followed. For further reporting under this study, the term ecosystem services will be used to refer to both the ecosystem services *sensu strictu* and the abiotic services.

Relevance of the ecosystem services for Belgium is scored on a 1 to 3 scale (1: high relevance BNS, 2: low relevance BNS, ES with a potential high relevance in future are given this score as well, 3: not relevant or

minimal in the BNS). The prioritisation of the ecosystem services has taken into account the outcomes of related studies (a.o. Van der Biest *et al.* (2017), Ivarsson *et al.* (2017)), further adjusted towards the MSFD reporting framework. The prioritization was presented and further discussed on the interactive work session with the steering committee and adjusted where needed.

Ecosystem services examined in this study have an importance and are determined by processes at the local BNS scale. Aspects of ecosystem services that are determined by global processes (such as climate change), for which long-term impacts (e.g. acidification) will become more significant in the future, are not considered for the purpose of this study (time horizon study 2030). It is recommended to take them into account in the further development of the ecosystem-based.

The most relevant services (score 1 or 2 for relevance) identified for the BNS are summarized below. For the further steps in the ecosystem-based approach only the highly relevant ES (score 1) have been further considered: in total 16 ecosystem services (marked ***in bold, italic***).

Provisioning services

Theme	Feature	Short name ES BNS	Code
Nutrition	***Wild animals and their output*** ***Algal Seafood from aquaculture*** ***Animals from in situ aquaculture***	***Seafood***	***P1***
Materials	***Raw materials (e.g. sand)***	***Raw materials***	***P2***
Materials	Materials from plants, algae and animals for agricultural use		
Energy	***Abiotic energy (wind, waves, tides)***	***Renewable energy***	***P3***

Regulating services

Theme	Feature	Short name ES BNS	Code
Mediation of waste, toxics and other nuisances	Bio-remediation by micro-organisms, algae, plants, and animals		
	Filtration/sequestration/storage/accumulation by ecosystems Mediation of smell/visual impact by ecosystems		
Mediation of flows	***Mass stabilisation and control of erosion rates***	***Coastal erosion control***	***R1***
	Buffering and attenuation of mass flows	***Accessibility (navigation channels)***	***R2***
	Flood protection (liquid flows)	***Flood protection***	***R3***
	Ventilation and transpiration (gaseous/air flows)		
Maintenance of physical, chemical and biological conditions	***Maintaining nursery populations and habitats***	***Maintaining nursery populations and habitats***	***R4***
	Gene pool protection		
	Pest control/ Disease control	***Pest and disease control***	***R5***
	Decomposition and fixing processes	***Maintaining reef-building communities***	***R6***
	Chemical condition of salt waters	***Water quality***	***R7***

Theme	Feature	Short name ES BNS	Code
	Global climate regulation by reduction of greenhouse and gas concentrations		

Cultural services

Theme	Feature	Short name ES BNS	Code
Underpinning and/or enhancing physical and intellectual interactions	***Experiential use of plants, animals and land-/seascapes in different environmental settings***	***Experience value***	***C1***
	Physical use of land-/seascapes in different environmental settings Aesthetic	***Environmental value/ Aesthetic***	***C2***
	Scientific	***Scientific***	***C3***
	Educational	***Educational***	***C4***
	Heritage, cultural	***Heritage, cultural***	***C5***
	Entertainment	***Entertainment***	***C6***
Underpinning and/or enhancing spiritual, symbolic and other interactions	Symbolic		
	Sacred and/or religious		
	Existence		
	Bequest		

4.2 Development of the assessment framework – linking pressures, ecological status and ecosystem services

To develop the assessment framework for the BNS following actions were taken:

1) Starting from the Commission Directive 2017/845 amending the Directive 2008/56/EC and Annex III, the uses and human activities in or affecting the Belgian marine waters have been selected (see Table 2b of the revised Directive);
2) The link was further made with the environmental pressures on the marine environment, categorized in physical, biological and substances, litter and energy (according to Table 2a of the revised Annex III of the Commission Directive 2017/845).
3) The anthropogenic pressures were then linked to the prioritized ecosystem and abiotic services as defined under step 1 (scoping).
4) Combining this information resulted in an overview table presenting the expected qualitative effect of the anthropogenic pressures on different ecosystem and abiotic services for the Belgian marine waters. This table was presented and discussed at the interactive work session with the steering committee and adjusted where needed.

Human activities relevant to the Belgian marine waters (step 1)

A description of human activities relevant for the Belgian marine waters is given in Chapter 3, with specific reference to the subparagraph 'Description'. They have been categorized according to the structure of revised Annex III of the Commission Directive 2017/845 amending the Directive 2008/56/EC.

Theme	Activity	Reference Chapter 3
Physical restructuring of coastline or seabed	Coastal defence and flood protection	Section 3.10.7 (Coastal defence)
	Offshore structures (other than for oil/gas/renewables)	This include e.g. monitoring stations (fixed platforms). This is not described as marine use under Chapter 3.
	Restructuring of seabed morphology, including dredging and depositing of materials	Sections 3.7. (Dredging and dumping at sea)
Extraction of non-living resources	Extraction of minerals	Section 3.6. (Aggregate extraction)
	Extraction of water	This include the use of water for cooling purposes for LNG terminal. Section 3.4 (Ports)
Production of energy	Renewable energy generation (incl. infra)	Section 3.5. (Offshore energy)
	Transmission of electricity and communications (cables)	Section 3.10.5. (Cables and pipelines)
Extraction of living resources	Fish and shellfish harvesting (professional, recreational)	Section 3.1. (Commercial fisheries) Section 3.9. (Recreational fisheries)
Cultivation of living resources	Aquaculture – marine (incl. infra)	Section 3.2. (Marine Aquaculture)
Transport	Transport infrastructure	Section 3.4 (Ports) Section 3.10.4 (Anchorage areas and places of refuge)
	Transport - shipping	Section 3.3. (Shipping)
Tourism and leisure	Tourism and leisure infrastructure	Section 3.8 (Tourism)
	Tourism and leisure activities	Section 3.8. (Tourism) Section 3.10.6 (Wrecks)
Security/defence	Military operations	Section 3.10.2. (Military operations) Section 3.10.3. (Historical ammunition dump: Paardenmarkt)
Education and research	Research, survey and educational activities	Section 3.10.1. (Research)

Note 1: Urban and industrial uses including waste treatment have an (indirect) effect on the Belgian marine waters (a.o. through riverine input). They are defined as land-based sources and not further considered in this study.

Note 2: Though it concerns a land-based activity, there's still a eutrophication problem in the BNS (OSPAR, IA, 2017).

Linking human activities to environmental pressures (step 2)

The impact these relevant activities have on the Belgian marine waters are assessed in a semi-quantitative way based on expert judgements considering previous work done under MSFD and within an MSP perspective. An important background document is the GAUFRE report (Maes 2005) that made a first estimate of the pressures related to the activities at the BNS. The results have been used as a starting point, further refined according to the MSFD categorisation of pressures from the revised Annex III of the Commission Directive 2017/845.

The pressures are categorised in (1) high, (2) medium (or high, but local), (3) low and (4) almost no effect on the Belgian marine waters. The impact table (Annex 2) has been presented in the interactive working session with the steering committee and adjusted where needed based on their feedback.

A summary of the main pressures on the Belgian marine environment is given below (in thematic groups):

Physical

- Physical loss is considered as one of the main pressures at the BNS caused by extraction of minerals (if extraction depth is too deep; exposing layers with different texture), restructuring of coastline (hard measures) and seabed (dredging and dumping), development of renewable energy. This may on its turn result in changes in hydrological conditions due to changes in flow patterns and sediment plumes (light penetration). Consequently, also certain species will be killed or disturbed.
- Physical disturbance of the seabed (temporary, reversible) caused by bottom trawling activities is also important to consider in the BNS. Both recreational and commercial fisheries have an important biological impact through fish catch, fish injuries (discards) and impacts on sea mammals (caught in nets, etc.).
- Installation of offshore aquaculture installations require anchoring, and this can disturb the seabed. Aquaculture installations are placed in natural habitat and take up this space. They may contribute to an increased input of nutrients. This may result in a loss/change of natural biological communities due to the cultivation of animal and/or plant species. Overall extent of future aquaculture facilities will probably be limited in the next decade.

Pollution

- All ship-related activities pose a certain threat to oil pollution. Small oil spills might occur during bunkering of oil in ports. The highest risk on oil pollution is however expected due to the collision with wind parks. Fuel dumping above sea might occur in case of emergencies with airplanes (e.g. emergency landing).
- Several activities like dredging and dumping, extraction activities might cause an input of nutrients, and other substances in the water column, but this is not considered an issue in the BNS as sediment quality is controlled and considered sufficient to good in the BNS.
- The problem of marine litter is a growing concern, with as main contributors' tourism and leisure activities, fisheries (lost fishing gear) and shipping (cargo losses).

Biodiversity

- Fisheries activities also attract scavenging seabirds due to dumping of discards and fish waste. Populations of some species can increase as a result of this.
- Behaviour of marine species can be affected by the presence of wind parks, leading to avoidance or attracting of species. Wind parks lead to increased mortality of seabirds and bats due to collision.
- Both shipping and renewable energy play a role in the input/spread of non-indigenous species, which may take over natural occurring communities. Wind farm development introduced hard substrates (foundations, erosion protection) which may offer suitable substrate for the settlement of NIS. Ballast water of ships is known to be an important vector for spread of NIS. Aquaculture might become important to consider regarding non-indigenous species and/or microbial pathogens.
- Cables and pipelines are buried in the seabed and application of hard substrates is limited. Effects on spread of NIS or seabed habitats are therefore limited. Effects of electromagnetic fields are expected to be very limited or non-existent, as cables are buried. Some increased noise levels can occur during construction of cables and pipeline networks.
- Beaches that are frequented by tourists undergo trampling and soil disturbance (digging etc.). Recreational boats can be a vector for spread of NIS. Microbial pathogens (e.g. E. coli) in seawater occur after sewage spills in periods of heavy rainfall.
- In general, all ship-related activities will contribute to an increased anthropogenic ambient noise due to the shipping and specific operational activities. Two activities will have a significant impact on anthropogenic impulsive sound due to pile driving activities (wind parks) and detonation exercises

(military activities). Due to the intensive shipping traffic on the Belgian part of the North Sea many species are disturbed during feeding, resting and sometimes breeding.

- Seawater is extracted for cooling purposed at the LNG terminal in the port of Zeebrugge. This might cause temperature effects for marine species in the area, although limited data exists on this phenomenon. In addition, marine organisms (fish, invertebrates) might be killed due to intake of cooling water from the sea. The port of Zeebrugge is located in SPA 3 (Zeebrugge, 57 km²) which is of special importance as breeding site for *Sterna sandvicensis* and *Sterna hirundo* (April to August).
- Fisheries may contribute to the input of organic matter, as part of their fish cleaning activities, fish discards or by throwing overboard kitchen waste. Aquaculture may potentially also contribute to organic input. Organic waste and wastewater from ships can be substantial in case of cruise liners/ferries.
- Fish discards and pulse fisheries might lead to fish injuries.

Linking environmental pressures to priority ecosystem services (step 3)

Annex 3 presents the expected qualitative effect of the environmental pressures on the most relevant ecosystem services identified for the BNS (see scoping). Some key points are summarized below:

- While the provisioning services are straightforward to assess, more overlap may be found in some of the regulating services (e.g. coastal erosion control versus flood protection) and the cultural services. Critical review is needed to avoid double counting in a quantification process.
- Physical disturbance: Especially physical loss due to permanent change and extraction, is affecting the majority of the identified ES (14 of 16). This can either be in a negative way a.o. decrease of seafood (P1) and availability of sand (P2), or negatively affecting nursery populations/habitats (R4) and reef-building communities (R6). However, also some positive changes may occur e.g. the introduction of hard structures (wind parks) may on its turn work disseminate wave energy, affecting flood protection (R3); create new habitats or less disturbed areas attracting new species and acting as new nursery habitats (R4). The related changes in hydrological conditions will have its impact on raw materials (P2), coastal erosion control (R1), accessibility (navigation channels) (R2) and flood protection (R3).
- Biological disturbance: This shift towards hard substrate (permanent change seabed) may on its turn also stimulate the introduction of NIS and influence the ES ‘pest and disease control’ (R5) or having a negative impact on the wild seafood populations (P1). A second major pressure relation is the extraction/killing of wild species (mainly by recreational/commercial fishing) will directly affect the ES ‘Seafood’ (P1), and especially in the shallow waters have a negative impact on the ES ‘Maintenance nursery populations and habitats’ (R4). The latter ES (R4) also links to all human activities causing disturbance of species (breed, rest, feed) in these sensitive nursery areas.
- Substances, litter and energy: The input of nutrients and organic matter will predominantly affect the coastal waters. An increase will result in higher production (thus positive for ES ‘Seafood’) (P1), but may also result in blooms (algae, jelly fish) (R5) negatively affecting several cultural values (experience value (C1), environmental/aesthetic value (C2), entertainment/recreation and leisure (C6)). The same cultural values are also impacted by an increase of marine litter coming from land and sea-based sources and by the problem of oil pollution.
- The ES ‘Scientific’ (C3) has been interpreted as the importance of that pressure in on-going or planned research and monitoring programmes. The ES ‘Educational’ (C4) has been based on focus theme for awareness campaigns or voluntary community actions. Elements as the creation of new habitats with new species, the introduction of NIS, the disappearance of certain marine species and the issue of marine litter has been selected as (potential) themes of interest for the public.

In addition, some additions were made to the table of relationships that might be less visible at first sight:

- The pressure ‘Input microbial pathogens’ can have an effect on the ES ‘Seafood’ (P1). E.g. European oysters have been affected by pathogens (viruses and bacteria).
- The pressure ‘Changes in hydrological conditions’ can affect the ES ‘Seafood’ (P1). This is related to long term changes in seawater temperature due to climate change and it is unclear (positive or negative effects are possible’. E.g. northwards retreat of Cod from the North Sea and appearance of new fish species with a more southern distribution.
- The pressure ‘Input/spread non-indigenous species’ can have an impact on the ES ‘Entertainment/Recreation and leisure’ (C6). Examples are the massive growth of invasive bivalves (e.g. *Ensis directus*) covering tourist beaches after storms.
- The pressure ‘Input other substances’ can have a serious effect on the ES ‘Environmental value/Aesthetic’ (C2). Oil pollution on beaches is an example where the aesthetic value is affected.

4.3 Belgian case illustrating ecosystem-based approach

Selection of case study Belgian marine waters

The following criteria were used to select a case study to illustrate the ecosystem-based approach:

- Defined/demarcated area located in the Belgian marine waters
- Multiple activities taking place within the area
- Potential to define alternatives in an MSFD context illustrating changes in pressures, status and ecosystem services
- Data availability to assess the ecosystem services

Based on these criteria two potential case studies have initially been defined:

- Flemish banks area
- Concession area wind parks

The final choice went out to the Natura 2000-area 'Flemish Banks' as the number and diversity of activities taking place within the area is higher, being a better basis to illustrate the ecosystem services approach.

Description of alternatives - case study 'Flemish Banks'

The 'Flemish Banks' (1.100 km²), located in the western part of the Belgian marine waters, has been designated as special area of conservation (SAC) under Natura 2000 (RD 27/10/2016, amending RD 14/10/2005). The 'Flemish Banks' is an extension of the 'Trapegeer-Stroombank' SAC (181 km²) and has 4 subzones characterized by specific habitat types (Figure 10):

- A. complex of sandbanks with dominance of the Abra alba biotope = habitat type 'permanent sandbanks covered with seawater' (1110) and *Lanice conchilega* aggregations = habitat type 'Reefs' (1170)
- B. Sandbanks with dominance of the *Nephtys cirrosa* and *Ophelia limacina* biotopes (1110)
- C. Complex of sandbanks with dominance of the *Nephtys cirrosa* and *Ophelia limacina* biotopes (1110) and gravel beds (1170)
- D. Sandbanks with dominance of the *Ophelia limacina* and *Nephtys cirrosa* biotopes (1110)

The 'Flemish Banks' overlap with two other nature protection areas, namely the Special Protection Areas designated under the Birds Directive: SPA 1 (Nieuwpoort, 110 km²) and SPA 2 (Ostend, 145 km²), notified for the following 4 species: Fuut *Podiceps cristatus*, Dwergmeeuw *Hydrocoloeus minutus*, Grote Stern *Sterna sandvicensis* and Visdief *Sterna hirundo*. For the species present in the bird directive areas, conservation of the current surface and quality of the habitat is sufficient.

The case 'Flemish Banks' consisting of a reference scenario and a planning scenario is used to illustrate the steps in the methodology. In the reference scenario (zero alternative) the existing measures (implemented by end 2016) as reported by Belgium under the MSFD were considered. The planning scenario (MSFD alternative) is based on the Marine Spatial Plan (2014-2020), as adopted by RD 20/03/2014, in which all defined measures have been fully implemented. The MSFD alternative takes further into account all new measures reported under MSFD by Belgium, which have been / will be implemented since beginning of 2017 (up to plan horizon 2020). A description of both scenarios for the different activities taking place in the Belgian marine waters may be found in Table 25.

The refence and planning scenario are used to illustrate how the methodology put forward can be used to elaborate the causal chain from changes in maritime activities to changes in environmental pressure and consequently, impact on quality and provision of ecosystem services.

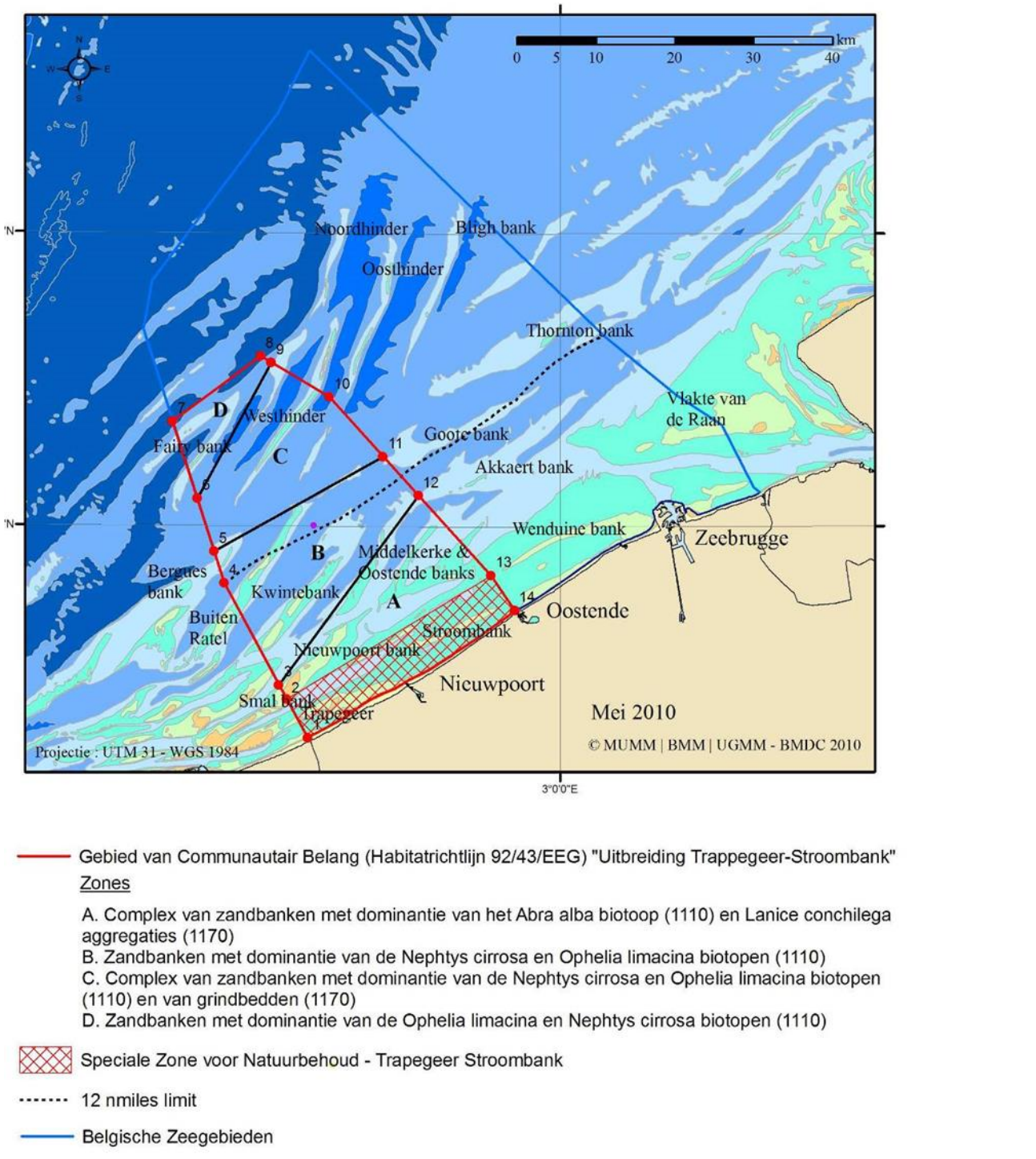


Figure 10: Special Area of Conservation 'Flemish Banks', with subdivision in 4 subzones (Source: BMM, May 2010)

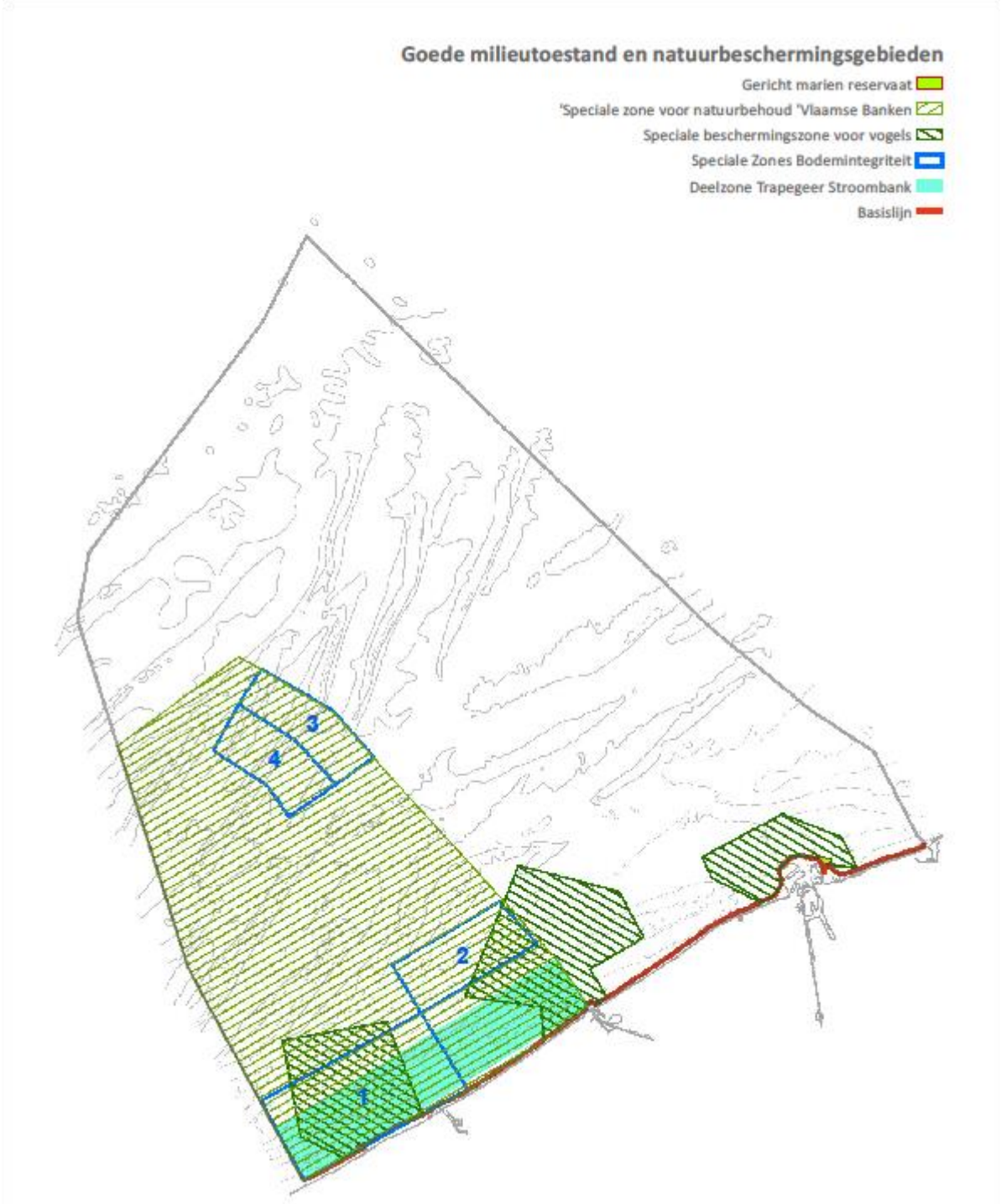


Figure 11: Natura 2000 areas: Habitat Directive -SAC 'Flemish Banks' and Bird Directive - SPAs 'Nieuwpoort', Ostend', 'Zeebrugge' (Source: MRP (2014-2020) (Note: revision needed based on the ongoing revision MRP (2020-2026) – still confidential).

Table 25: Description of alternatives – Case study 'Flemish Banks'

	REFERENCE Scenario (ZERO ALTERNATIVE) *Status 2016* *Based on partially implemented MSP (2014-2020) (current state)* *Based on existing measures of PoM (2015) (implemented by end 2016)*	**PLANNING scenario (MSFD alternative)** *Status 2020* *Based on fully implemented MSP (2014-2020) (expected state)* *Based on new measures of PoM (2015) ((to be) implemented since/ from 2017 onwards)*
Nature protection	Contours of nature protection areas as defined by RD 20/03/2014 (Nature protection areas relevant for case study: Habitat Directive_Flemish Banks (incl. Trapegeer-Stroombank), Birds Directive_SPA-1 (Nieuwpoort), SPA-2 (Ostend))	Similar as zero alternative
		Implementation of general and specific nature protection measures. Specific measures 'Flemish Banks' are: * improved application of procedure appropriate assessments for plans/projects with potential impact on Natura-2000 (e.g. sand extraction, water sports events) * bottom protection measures in the identified zones (1-4) for commercial fisheries (see further under fisheries) * prohibition of recreational bottom disturbing fisheries in the Flemish Banks, with exceptions (see further under fisheries) * restauration gravel beds
	Further alignment measures with nearby nature conservation areas in France and on land	Similar as zero alternative
Coastal defence and flood protection	Maintenance sufficient extraction zones related to soft coastal protection	Similar as zero alternative
	Partial implementation Master Plan Coastal Defence (focus West coast including suppletion De Panne - Koksijde (2011), Westende-Middelkerke (2013-15) and Oostende-Raversijde (2013-14); Oostende centre Zeeheldenplein (incl. storm surge) (2012), Oostende harbour Oosteroever - start storm surge (2014-...)	Master Plan Coastal Defence fully implemented (Relevance case Flemish Banks: additional measures West coast include suppletion Lombardsijde (2017), harbour Nieuwpoort storm surge barrier (planned))
	No in-situ experiments coastal defence; only model studies Broersbank	Location for experiments new methods coastal defence at Broersbank (subject to appropriate assessment)
Extraction of minerals (sand)	Redefined sectors of zone 2 in function of natural protection (excluding gravel beds) and nautical safety (excluding anchorage zone)	Similar as zero alternative
	Maintenance partially closure of Kwintebank	Similar as zero alternative
	Current max. permitted extraction volume (as permitted)	Similar as zero alternative
	Gradual reduction of extraction volume with yearly 1% (time horizon 2014-2016)	Continued gradual reduction of extraction volume with yearly 1% (time horizon 2017-2020)
Transmission of electricity and communications (cables, pipelines)	Construction cable and pipes preferably within pre-defined cable and pipeline corridors	Similar as zero alternative
	Concession zone for interconnector UK-BE (Nemo)	Expansion of European energy grid by construction HVDC interconnector UK - BE (Nemo project)

	REFERENCE Scenario (ZERO ALTERNATIVE)	PLANNING scenario (MSFD alternative)
	Safety perimeters around cables and pipelines	Similar as zero alternative
Fish and shellfish harvesting (professional)	Maintenance existing fishery grounds, except wind concession zone and infrastructure related to coastal defence	Similar as zero alternative
	Maintenance accessibility Belgian fisheries harbors	Similar as zero alternative
		Demarcation of 4 zones within SAC 'Flemish Banks' to preserve bottom integrity (restricted for soil-disturbing fisheries) and to stimulate alternative sustainable fisheries (Figure 11)
		ZONE 1: all fishing vessels currently present in the area may continue their activities on condition that beams with wheels ("roller shoes") are incorporated into the fishing equipment. For shrimp fishing a sieving net is obligatory. Existing vessels may be replaced. New vessels are allowed to fish in the area using non-seabed-disturbing fishing techniques. This means that vessels that were up until now not active in this area cannot use seabed-impacting techniques.
		ZONE 2: only non-seabed-impacting fishing gear is allowed. Moreover, testing of alternative seabed-impacting fishing gear is allowed under a permit system. A three-year transition period is established during which existing fishing techniques in the area are still allowed.
		ZONE 3: only non-seabed-impacting fishing techniques are allowed
		ZONE 4: only non-seabed-disturbing fishing techniques and testing of alternative seabed-impacting fishing techniques are permitted
	Implementation of the CFP measures including prohibition fishing vessels > 70 BT within 3 NM, TACs and quota, min. Landing size, management plans, inspection/monitoring/control, ban discards, MSY, etc.	Fishing within an area of 4.5 nautical miles (NM) offshore is prohibited for fishing vessels having a gross tonnage of more than 70 or a total length exceeding 20m
		Other new measures such as
		* Improvement of waste disposal by fishing vessels
	* prohibition removal stones/gravel	Similar as zero alternative
		* improved control/monitoring
		* awareness to prevent discharges of bunkering of fishing vessels and pleasure crafts in ports
	* species specific approach for sharks and ray to raise awareness fishermen (identification fiches)	* continued species-specific approach for sharks and ray to raise awareness fishermen (other instruments)
	Other measures related to fisheries such as seafood legislation (control/monitoring FAVV), fishing for litter, etc.	Similar as zero alternative
	No marine aquaculture foreseen in Flemish Banks area	Similar as zero alternative
	Fishery activities defined prior to Brexit	Changing fisheries landscape under Brexit (expected implementation March 2019)

	REFERENCE Scenario (ZERO ALTERNATIVE)	PLANNING scenario (MSFD alternative)
Fish and shellfish harvesting (recreational)	Existing recreational fishery grounds in Flemish Banks area	Prohibition of recreational bottom disturbing fisheries in the Flemish Banks, with exceptions: * exceptions fishing on horse, by foot (allowed) * recreational fishermen already active (can have a permit to go out fishing for 10 times/year)
	Prohibition recreational gill net fisheries	Prohibition recreational gill net fisheries, but increased control
Transport - infrastructure	Demarcation reservation zones for harbour extension Zeebrugge and Oostende (not for Nieuwpoort)	Similar as zero alternative
Transport - shipping	Shipping lanes crossing Flemish Banks: Westhinder (IMO) Traffic to/from harbour Nieuwpoort, Oostende (priority given to shipping in these lanes; other activities allowed if no conflicts with shipping activities)	Similar as zero alternative
	Anchorage areas in (vicinity of) Flemish Banks: Oostduyck, Westhinder (priority given to shipping in these lanes; other activities allowed if no conflicts with shipping activities)	Similar as zero alternative
	Maintenance dumping locations. Relevant Flemish Banks: B & W Nieuwpoort (other activities prohibited if conflicts with dumping activities)	Similar as zero alternative
Tourism and leisure infrastructure	Marina Nieuwpoort, Oostende	Similar as zero alternative or extra protection measures Masterplan Coastal Defence
Tourism and leisure activities	Tourism and leisure is allowed in entire BNS, respecting conditions and exceptions	Similar as zero alternative
	Water sport matches forbidden in SBZ-1 and SBZ-2 during period 1 December until 15 March	Improved control appropriate assessment water sports events
		Recreational fisheries (see above)
Military operations	Zone for military exercises Nieuwpoort (shooting exercises)	Similar as zero alternative
Research, survey and educational activities	Research is allowed in entire BNS, except otherwise specified	Permit construction and exploitation of temporary test platform for tidal energy near port of Oostende (NEMOS GmbH, 13/06/2017)
		Test research cases near Flemish Banks: 1) Aquaculture - Value@Sea (oysters, algae, scallops) nearby the coat of Nieuwpoort; 2) Coastal defence - "Coastbusters - Development of ecosystem-based protection against coastal erosion" (Research related to coastal resilience by using innovative bio-stabilization methods) in-situ test location, at the coastline off Nieuwpoort

Scoping – ecosystem and abiotic services identified in Flemish Banks area

The 16 ecosystem services identified for the Belgian marine waters, except P3 (renewable energy) are provided by the Flemish Banks area for the time horizon considered in this study (2014-2020).

Framework – linking pressures, ecological status and ecosystem services in Flemish Banks area

The pressures relevant for the Flemish banks area have been categorised in the same semi-quantitative way as done for the Belgian marine waters: (1) high, (2) medium (or high, but local), (3) low and (4) almost no effect. The impact table describing the Flemish Banks area is presented in Annex 4.

A summary of the main pressures is given below, focusing on the expected change comparing the reference and planning scenario of the case study 'Flemish Banks'. The major changes in activities are related to:

- Coastal defence and flood protection, where the Master Plan Coastal Defence will be further implemented. At the west coast a suppletion is foreseen for Lombardsijde, which will result in a temporary disturbance of the seabed. The major change will however come from the construction of a storm surge barrier at Nieuwpoort, resulting in a permanent loss/change of the seabed with resulting changes in hydrological conditions due to changes in flow patterns and sediment plumes (light penetration). Consequently, also certain species will be killed or disturbed.
- Extraction of minerals, where a continued gradual reduction of extraction volume with yearly 1% (2017-2020) will be further implemented. Together, with the maintenance of the partially closure of the Kwintebank, this will further reduce the number of benthic species extracted in the area, having an overall positive effect on the prevailing habitat communities (sand banks).
- The construction of the interconnector between the UK and Belgium, the NEMO link, planned for 2018-2019. However, the environmental impacts regarding the NEMO link projects are considered to be local and are described in more detail in the environmental impact report (Arcadis, 2016).
- Extraction of living sources, where the demarcation of 4 zones within SAC 'Flemish Banks' to preserve bottom integrity (restricted for soil-disturbing fisheries) and to stimulate alternative sustainable fisheries will reduce the physical disturbance/loss in the area. Combined with further restrictions of certain fishing vessels (> 70 GT or > 20 m) in the 4.5 NM and prohibition of recreational fisheries (bottom disturbing + gill net fisheries), with some exceptions, the impact on benthic habitats and their species communities will decrease. In addition to the already implemented CFP measures, other measures related to improved waste disposal, awareness raising for bunkering practices, species specific approaches towards sharks/rays, etc. will have a positive impact on the wild species in the area and on the introduction of substances (e.g. oil) and litter in the marine environment.
- Shipping: in general, no change is expected in shipping patterns/traffic, but due to new legislation (e.g. ballast water) and more control (e.g. TBT, waste, pollution) positive effects may be expected related to the input/spread of non-indigenous species and to the introduction of substances, litter and energy in the marine environment.

Other activities taking place in the Flemish Banks area like tourism and leisure activities (beach/water recreation), dredging/dumping activities (B&W Nieuwpoort), military operations (shooting exercises Nieuwpoort), research activities, etc. will continue. There is however no change expected (intensity, location, etc.) compared to the on-going situation (reference scenario), and therefore the pressure on the marine environment will remain the same for these activities.

The major changes in activities and pressures as described above will have its strongest impact on the following ecosystem services for the Flemish Banks area:

P1 - Seafood
P2 – Raw materials (sand)
R1 – Coastal erosion / R3 – Flood protection
R4 – Maintaining nursery populations and habitats
R6 – Maintaining reef-building communities
R5 – Pest & disease control

The linkages between pressures, ecological status and ecosystem services will be further elaborated for the example of extraction of minerals to illustrate in more detail the ecosystem-based approach.

Assessment of the condition of the ecosystem – example of aggregate extraction

The schematic representation below (Figure 12) shows the relationships between drivers, the aggregate extraction activity in the Vlaamse Banken area, the pressures that are related to aggregate extraction, status of the ecosystem components, related ecosystem services and benefits for society derived from aggregate extraction and seafood.

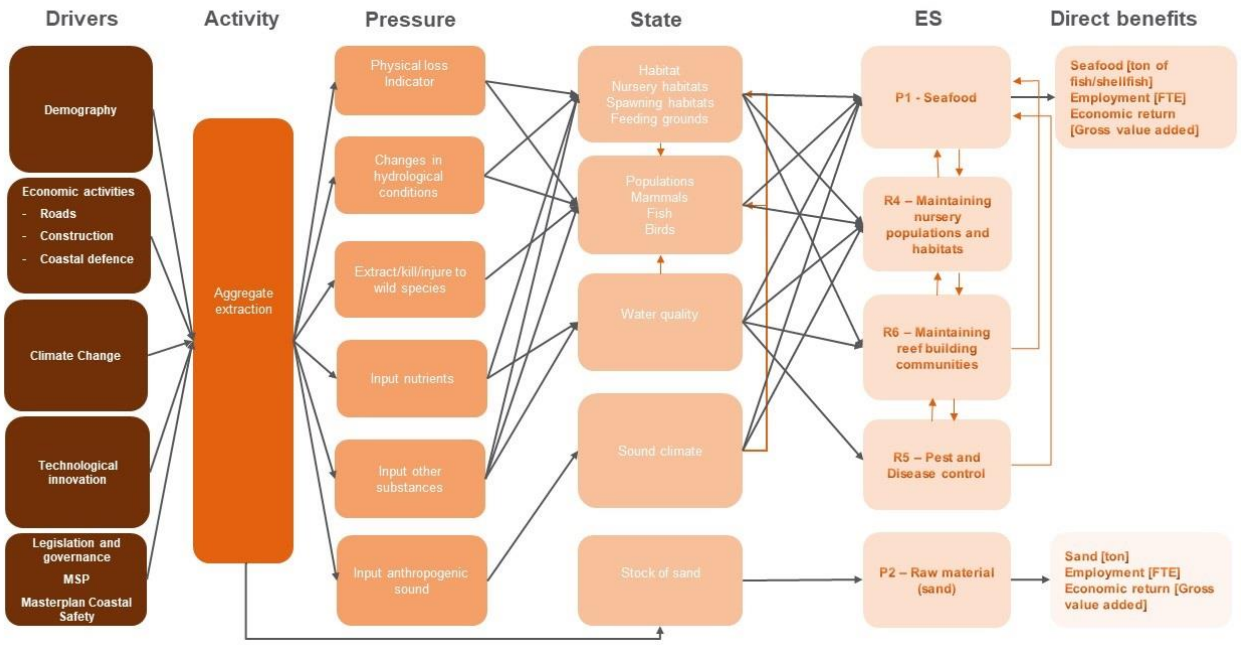


Figure 12 Schematic representation of relationships between drivers, aggregate extraction activity, pressures from aggregate extraction, ecosystem status, related ecosystem services and benefits with examples for seafood and raw materials worked out.

Figure 13 shows the qualitative changes that occur because of the decreasing sand extraction according to the MRP 2014-2020 (see MRP 2014, Annex II). A full description is provided under 3.6.3. According to this scenario, there will be a gradual reduction of extraction in the special area of conservation 'Vlaamse Banken'. There will be a continued gradual reduction of extraction volumes with yearly 1% (2017-2020) and maintenance of the partially closure of the Kwintebank.

A gradual reduction of sand extraction in the Vlaamse Banken area will diminish some of the pressures associated with the sand extraction activity, e.g. physical loss, changes in hydrological conditions and extraction/killing/injuring of marine species. As there will be less ship and extraction activity, the overall anthropogenic sound levels will diminish. Input of nutrients and contaminants due to sand extraction are absent or negligible (Zeegra 2016).

The gradual reduction in pressures will have a positive impact on the state of the ecosystem components habitat, populations and sound climate. Water quality will not be affected, as the impact of extraction activities on nutrient and contaminant levels is quasi absent. It is obvious that the stock of sand remains the same and will be depleted more slowly in the area.

These causal chains will have positive effects on the following ecosystem services: seafood, maintenance of nursery populations and habitats, maintenance of reef building communities. No direct effect is expected on pest and disease control.

Provision of sand from the Vlaamse Banken area will diminish in the future, leading to less economic return, lower extracted volumes and less employment.

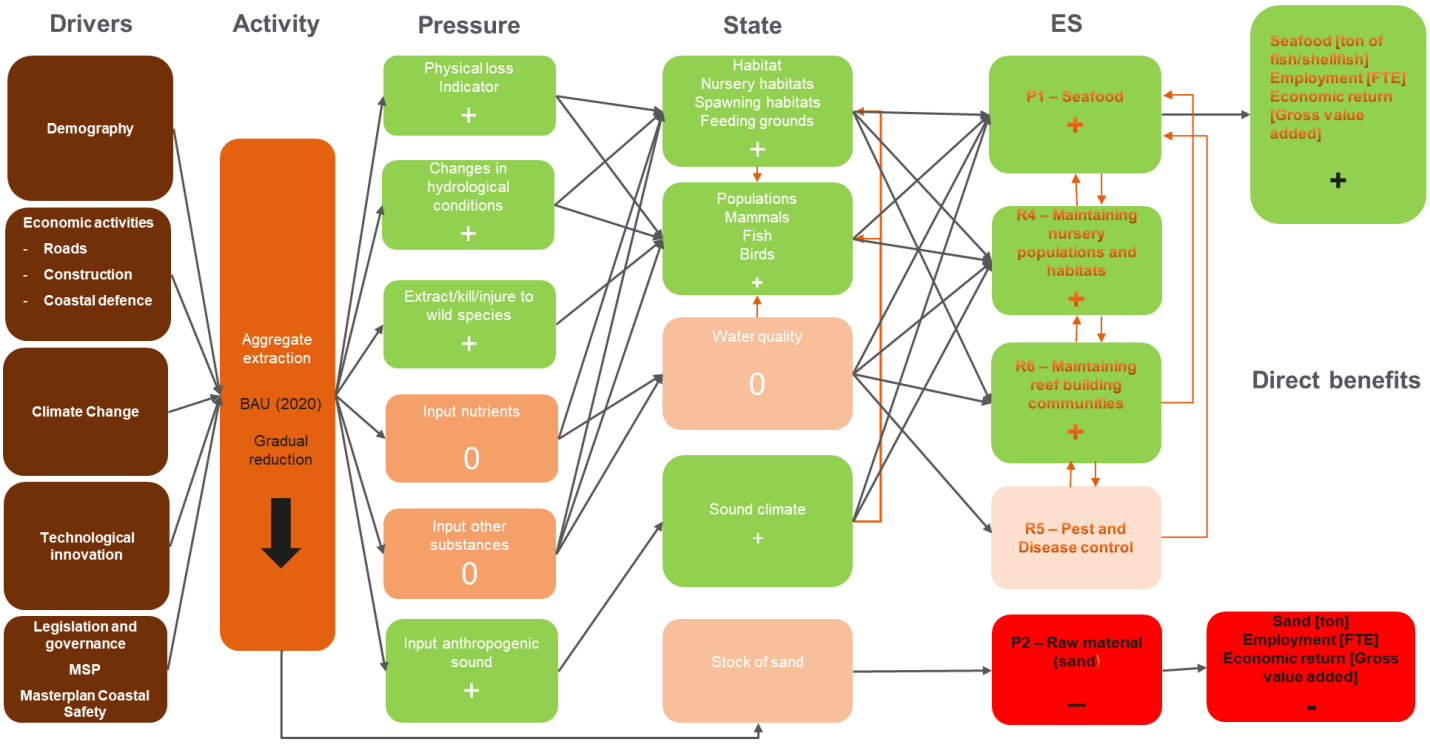


Figure 13 Qualitative changes in pressures, state, ecosystem services and direct benefits that are expected in the BAU (2020) scenario in the Vlaamse Banken area. Green: positive effect, Red: negative effect.

Indicators for the above described activity, pressure, state, ecosystem services and direct benefits have been obtained from the EIA for aggregate extraction (Zeegra 2016) and include:

Activity

- Aggregate extraction: volume per year (million m³/y), extraction activity (h/year)

Pressure

- Physical loss: area of habitat lost (km²/y), seabed morphology (height of sandbanks in m), sediment grain size distribution (µm)
- Changes in hydrological conditions: turbidity, area affected by sedimentation plume (km²)
- Extract/kill/injure species: number of individuals affected (n), habitat lost or affected (km²)
- Input nutrients: changes in concentration of nutrients (µg/l), total amount of nutrients due to the activity (kg)
- Input contaminants: changes in concentration of contaminants (µg/l), total amount of contaminants due to the activity (kg)
- Input anthropogenic sound: underwater noise (dB)

State

- Habitat: area of habitat important in life history (nursery, spawning, feeding): km²
- Population: population size (n)
- Water quality: concentration of water quality parameters (µg/l, % oxygen saturation, etc.)
- Sound climate: average sound levels (Db)
- Stock of sand: volume (million m³)

Ecosystem service (direct benefits)

- Seafood: amount harvested (ton/y), employment (FTE), economic return (euro/y)
- Raw material (sand): volume extracted (ton/y), employment (FTE), economic return (euro/y)

Economic valuation of ecosystem services – example of aggregate extraction

The following illustrative example describes the economic valuation of the ecosystem service 'Raw materials', more specifically sand extracted in the BNS for coastal defence and construction. It has to be noted that sand is a non-renewable resource and is not considered to be an ecosystem service according to TEEB, Maes *et al*. (2014) and Böhnke-Henrichs *et al.* (2013). Non-living resources such as minerals (sand) are considered here to be an ecosystem service like the approach in Ivarsson *et al.* (2017).

In the following case a flow-diagram was developed that links the ecosystem service, indicators for the ecosystem service and benefits for society.

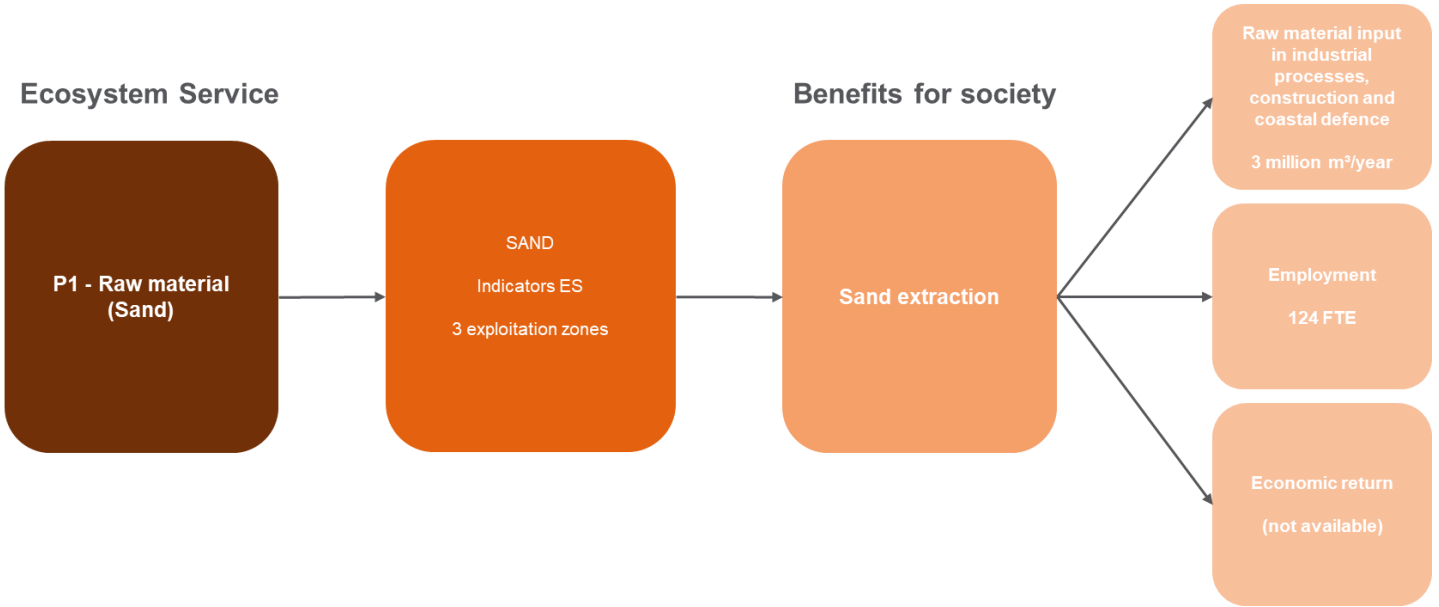
Ecosystem service 'P2 - Raw material – sand'.

The importance of sand extraction in the BNS is described under Chapter 3.6 Aggregate extraction. The extraction takes place in 3 zones in the BNS. On average, a total of circa 3 million m³ is extracted in the BNS per year.

Indicators for this ecosystem service: The total stock of sand available for extraction in the BNS is determined by the areas open for extraction (map under 3.6 Aggregate extraction) under the current marine spatial plan.

Benefits for society for 'P2 - Raw material (sand)' include:

- Raw material (sand) input in industrial processes, construction and coastal defence (indicator: 3 million m³/year)
- Employment generated by sand extraction activities (indicator: 124 FTE for extraction activities in the BNS)
- Economic return (indicator: profit, gross value added in Euro, not available)



5 RECOMMENDATIONS FOR FUTURE ACTIONS

5.1 Recommendations on the socio-economic assessment for BNS

The following recommendations may be considered to further elaborate the socio-economic assessment of the Belgian part of the North Sea:

- develop a uniform description of some economic activities (e.g. recreation and tourism), as it is not yet possible to collect the relevant data in a uniform manner due to lack of NACE codes.
- Fishing vessels from neighbouring countries (i.e. The Netherlands and France) exploit the BNS as well, but these data are not included so far. It is recommended to include data on the fishing efforts of the foreign fleet (especially Dutch vessels, considering their fishing effort in the BNS) in the overview.

5.2 Recommendations on the ecosystem-based assessment framework for BNS

In terms of the applicability of the ecosystem services approach concept, it is concluded that the methodology and empirical application are not mature enough yet to be applied within the current reporting cycle of the Marine Strategy Framework Directive. On longer term Belgium may use this approach for official reporting under the MSFD.

Following recommendations may be considered to further elaborate the approach.

- Stakeholder involvement to prioritize the ecosystem and abiotic services for the Belgian marine waters, to verify the BAU scenarios, to support and validate data collection.
- Increased knowledge on the functioning of the marine ecosystem to identify the relevant relations between biotic, abiotic and economic processes.
- Increased knowledge to define ecosystem services at Good Environmental Status (GES) to allow comparison with the BAU scenarios
- Further modelling and research to allow quantification of the ecosystem services. An ecosystem services model based upon GIS and quantitative data (e.g. MarineInvest) to be worked out at BNS-scale to allow the testing of different scenarios on future developments in the BNS.
- Increased efforts on socio-economic data collection to allow economic valuation of ecosystem services and exploring the potential of the natural capital protocol for the Belgian marine waters.
- A widely accepted vision on monetary valuation of non-market goods to be worked out.

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7 ANNEXES

7.1 Annex 1: List of ecosystem services and abiotic services identified for the Belgian marine waters, including their prioritization scale (PS)

Priority Scale: (1) high relevance BNS; (2) low relevance BNS, ES with a potential high relevance in future are given this score as well; (3) not relevant or minimal in the BNS

ES	Theme	Sub-theme	Feature		Short name ES BNS	PS	Feature description Belgian marine waters
Provisioning services	**Nutrition**	**Biomass**	Wild plants, algae and their outputs	**P1**	Seafood	3	This is not being done on a (large) commercial scale in the BNS (e.g. collection for use in restaurants). There is some anecdotical evidence of collection on a small scale. This ES is not considered further.
			Wild animals and their outputs			1	Seafood collected by commercial fisheries activities in the BNS; mainly fish and crustaceans.
			Algal seafood from aquaculture			2	There are currently no commercial aquaculture activities in the BNS. It is expected that this will become more important in future. Some projects aim(ed) to explore this potential: At~Sea project aimed at the development of advanced technical textiles in order to demonstrate the technical and economic feasibility of open sea cultivation of macroalgae (seaweed). The Value@Sea project aims to explore the potential of scallops, oyster and seaweed aquaculture. This is an ecosystem service with a potential high importance in future.
			Animals from in-situ aquaculture			2	Pilot projects have been developed to evaluate the potential: Value@Sea, EDULIS project (mussels in offshore wind parks).
	Materials	**Biomass**	Raw materials (e.g. sand)	**P2**	Raw materials	1	Non-renewable raw materials are not considered as ecosystem services s.s. according to the MAES classification, but as an abiotic service under the Natural Capital Protocol (considered as a stock). Given the importance of sand reserves and sand extraction in the BNS it is decided to treat this as an ecosystem service in this study.
			Fibres and other materials from plants, algae and animals for direct use or processing		Materials for direct use or processing (cosmetic/medicinal/ornamental)	3	Production of medicinal or cosmetic products from marine organisms or abiotic substances in the BNS is currently very limited to nonexistent. There is a potential overlap with the ES 'Genetic resources'. Potential products in this category include alginates and food supplements. Other material may include ornamental resources.
			Materials from plants, algae and animals for agricultural use		Materials for agricultural use	2	Potential products include fishmeal as a protein source in fish food (aquaculture) or animal food, calcium carbonate from bivalve shells, etc.
			Genetic materials from all biota			3	This ES includes the use of genetic information derived from marine organisms for use in e.g. production of pharmaceuticals. This could also include marine nutraceuticals, marine organism-derived anti-foulants and adhesives. Currently no marine genetic resources from the BNS are being used. Note: approximately 60 marine species are found only in the BNS. This ES is not considered further.
	Energy	**Abiotic energy**	Abiotic energy (wind, waves, tides)	**P3**	Renewable energy	1	Abiotic energy sources (wind, waves, tides) are not considered as an ES according to MAES and other classifications, but as an abiotic service within the Natural Capital Protocol (considered as a stock). Considering the importance of renewable energy production (wind) in the BNS, this is considered as an ES in this study.
		Biomass-based energy sources	Plant-based resources			3	Energy production from biomass is non-existent in the BNS and is not expected to be relevant or important in future. Reference is made to the AquaValue project: marine products will be used for applications with the highest added value. Energy production from biomass ranks third on this scale after food production and industrial applications. This activity is not considered further.
Regulating services	**Mediation of waste, toxics and other nuisance**	**Mediation by biota**	Bio-remediation by micro-organisms, algae, plants, and animals			2	This ecosystem service relates a.o. to the detoxification of pollutants (e.g. hazardous substances, toxics, oil pollution) by organisms. An example is the breakdown of hydrocarbon pollutions by micro-organisms in the marine environment.
			Filtration/sequestration /storage/accumulation by micro-organisms, algae, plants, and animals			3	This ecosystem service relates a.o. to sequestration and to the uptake of carbon dioxide by the water column contributing to acidification in the long term. This is a global process and it will not be considered further in this study.
		Mediation by ecosystems	Filtration/sequestration /storage/accumulation by ecosystems			2	Mediation by ecosystems relate to e.g. uptake of carbon dioxide in the water column. This also leads to acidification. Studies on the impact of acidification in Galicia are relevant in this sense. The CAMP project (Comprehensive Atmospheric Monitoring Programme) provides data on atmospheric deposition in the North Sea.
			Mediation of smell/visual impact			2	Mediation by ecosystems of smell, visual impacts by water medium. The mediation of noise disturbance could be added under this category for the BNS. There is a potential overlap with the cultural services (aesthetic).
	Mediation of flows	**Mass flows**	Mass stabilisation and control of erosion rates	**R1**	Coastal erosion control	1	This ecosystem service relates to sediment processes, coastal erosion control at the BNS. Several research programmes (a.o. on-going CREST) contains useful data relating to hydro-morphological flows (incl. mobility of sand dunes). Due to the mobility of the upper layers of soil (sand) in the BNS, cables for example need to be buried deeper to be in a stable and non-erodible soil layers. Coastal erosion is an important element related to coastal protection (flood protection), and overlap may exist with the ES 'Flood protection'.

ES	Theme	Sub-theme	Feature		Short name ES BNS	PS	Feature description Belgian marine waters
Cultural services	Maintenance of physical, chemical, biological conditions		Buffering and attenuation of mass flows	R2	Accessibility (navigation channels)	1	This ecosystem service has been interpreted as buffering mass flows (sediment /water) in order to maintain the shipping lanes at the BNS. Maritime transport (Sea water as medium) is not considered as an ecosystem service in the MAES classification system, as it does not depend on ecological processes. Considering the importance of this activity in the BNS, it has been considered under this ES.
		Liquid flows	Flood protection	R3	Flood protection	1	This ecosystem service relates to hydrological processes, flood protection from sea (storm frequencies, waves). 'Masterplan Coastal Safety' (2011) aims to protect the coastal area up to 2050. Coastal protection up to 2100 is currently under consideration within the ongoing study 'Complex Project Coastal Vision'. Several other research programmes (a.o. on-going CREST) contains useful data relating to flood protection (incl. CREST). Some overlap may exist with the ES 'Coastal erosion control).
		Gaseous / air flows	Ventilation and transpiration			2	This ecosystem service has been defined for the BNS as to the cooling effect for industrial activities; e.g. LNG terminal in Zeebrugge makes use of cooling by seawater in its facilities. The cooling effect of the sea in general (e.g. climate difference coast versus inland, during heatwaves, milder winter temperatures) has been considered as part of the cultural services 'Experience value of the coast' (to avoid double counting).
		Lifecycle maintenance, habitat and gene pool protection	Pollination and seed dispersal			3	This ES relates a.o. to seed dispersal from seagrasses, etc., but is considered as not relevant for the BNS. This ecosystem service is not considered further.
			Maintaining Nursery Populations and Habitats	R4	Maintaining Nursery Populations and Habitats	1	This ecosystem service relates to the maintenance of nursery populations, nursery grounds, spawning habitats, etc. at the BNS.
			Gene pool protection			2	The OBIS database shows that approximately 60 marine species are unique (so far) to het BNS. A relevant study in this sense is the ongoing project on connectivity of MPAs in the BNS (Flemish Banks) by Ecoast. This ES is considered as a supporting service and includes also the intrinsic value of biological richness. This involves aspects of the functioning as stepping stones for marine organisms.
		Pest and disease control	Pest control	R5	Pest and disease control	1	Relevant species to consider for pest control in the BNS include algal blooms (*Phaeocystis*), blooms of jellyfish and invasive species like *Ensis directus* (Du: Amerikaanse zwaardschede), *Crassostrea gigas* (Du: Japanse oester), the Asian shore crab *Hemigrapsus sanguineus* (Du: blaasjeskrab).
			Disease control			2	This ecosystem service relates to disease control (e.g. healthy populations sea mammals/fish). It further relates to e.g. outbreaks of E. Coli in coastal waters (often after sewage spills) affecting the swimming water quality and leading to diseases. Other: poisoning of shellfish (mussels) by algae and toxic compounds. Information to be found at the Flanders Marine Institute.
		Soil formation and composition	Decomposition and fixing processes	R6	Maintaining reef-building communities	1	This ecosystem service includes aspects of soil formation/composition. Relevant for the BNS are the reef-building communities (e.g. *Lanice*, oysters), and is considered as a supporting service. Another relevant issue to consider for the BNS is the silting of gravel beds in the northern part of the Flemish Banks area. This phenomenon is not yet fully understood.
		Water conditions	Chemical condition of salt waters	R7	Water quality	1	This ecosystem service relates to water quality incl. denitrification, N, P, storage, etc. and is considered as a supporting service.
		Atmospheric composition and climate regulation	Global climate regulation by reduction of greenhouse gas concentrations			2	Climate regulation including carbon storage. Carbon sequestration rates in the BNS are low (on average 1,2 kg C/ha/Y by benthic communities) compared to e.g. saltmarsh and seagrass habitats.
	Underpinning and/or enhancing physical and intellectual interactions	**Physical and experiential interactions**	Experiential use of plants, animals and land-/seascapes in different environmental settings	C1	Experience value	1	This ES has been defined as the experience value of the coast (kustbelevingswaarde) linked to health aspects, stress, wellness. A relevant article is published in the Zeekrant (Zit er een luchtje aan de zee?) on air quality at the coast and health aspects of coast and sea.
			Physical use of land-/seascapes in different environmental settings	C2	Environmental value	1	This ES has been defined as the environmental value (omgevingswaarde) linked to the appreciation of the coastal zone, expressed in attractiveness of the area for living and as tourist destination
		Intellectual and representative interactions	Scientific	C3	Scientific	1	This ES relates to the sea as a subject for marine research and environmental monitoring.
			Educational	C4	Educational	1	This ES relates to the educational value incl. school activities, beach cleaning activities, training programmes, etc.
			Heritage, cultural	C5	Cultural heritage & identity	1	Cultural heritage relevant for the BNS include the shrimp fishermen on horse/foot in Oostduinkerke, protected wreck sites, paleo-landscapes. An important aspect is also the cultural identity of fishermen communities.
			Entertainment	C6	Entertainment	1	This ES relates to the recreational and leisure value of the BNS, including both beach and water recreation.
			Aesthetic	C2	Aesthetic	1	This ES relates to the seascape (blue horizon) and potential impact on it. Overlap may be seen with the cultural service 'Environmental value'. They will be considered together to avoid double counting.
	Underpinning and/or enhancing spiritual, symbolic and other interactions	**Spiritual and/or emblematic**	Symbolic			2	The symbolic value of the coast relates to the emblematic use of coast and sea. As these aspects are relatively fuzzy, there is a risk of double counting.
			Sacred and/or religious			2	The sacred and/or religious value of the coastal and sea, is often described as the spiritual value, as a source of inspiration. They may also relate to ash scattering at sea (Du: asverstrooiing), sea ordination (Du: zeewijding), etc.
		Other cultural outputs	Existence			2	This ES relates to the non-use value of the sea, the existence value (Du: bestaanswaarde). Although of importance, difficult to value in terms of ES.

ES	Theme	Sub-theme	Feature		Short name ES BNS	PS	Feature description Belgian marine waters
			Bequest			2	This ES relates to the non-use value of the sea, the bequest value (Du: optionele waarde). Although of importance, difficult to value in terms of ES.

7.2 Annex 2: Links between activities and environmental pressures BNS

Scale: (1) high effect; (2) medium (or high, but local) effect; (3) low effect; (4) almost no effect in the BNS

Activities	Pressures	Physical			Biological						Substances, litter and energy						
		Disturbance seabed (temporary or reversible)	Physical loss due to permanent change seabed substrate or morphology and to extraction of seabed substrate	Changes hydrological conditions	Input/spread non-indigenous species	Input microbial pathogens	Input GM species, translocate of native species	Loss/change natural biological communities due to cultivation of animal and plant species	Disturbance of species (e.g. where they breed, rest, feed) due to human presence	Extract/kill/injure to wild species (by recreational fishing and other activities)	Input nutrients	Input organic matter	Input other substances (e.g. synthetic, non-synthetic, radionuclides)	Input litter	Input anthropogenic sound	Input other forms energy	Input water
Physical restructuring of coastline or seabed (water management)	Coastal defence and flood protection	2	2	2					2				3		3		
	Offshore structures (other than for oil/gas/renewables)		3	3					4				4		4		
	Restructuring of seabed morphology, including dredging and depositing of materials	3	2	1						3	3		3		3		
Extraction of non-living resources	Extraction of minerals (rock, metal ores, gravel, sand, shell)		1	2						2	3		3		3		
	Extraction of water								3	3						3	
Production of energy	Renewable energy generation incl. infra	2	1	1	2			2	2	2			2		1	3	
	Transmission of electricity and communications (cables)	3	4	3	4				3	4					3	3	
Extraction of living sources	Fish and shellfish harvesting (professional, recreational)	1		3		3			3	1		3	3	2	3		
Cultivation of living resources	Aquaculture - marine incl. infra	3	3		2	2	3	2	3		2	3	3	3			
Transport	Transport infrastructure		3	3					2					3	3		
	Transport - shipping	3			1	2			2			3	2	2	2		
	Transport - air												4				
Tourism and leisure	Tourism and leisure infrastructure		3	3										3			
	Tourism and leisure activities	3			3				3			4		1	3		
Defence and national security	Military operations	3											3	3	1	3	
Education and research	Research, survey and educational activities	3					4			4					3	4	

7.3 Annex 3: Links between environmental pressures and marine ecosystem services BNS

Scale: (dark) strong to medium effect; (light) low to almost no almost no effect in the BNS

		P1	P2	P3	R1	R2	R3	R4	R5	R6	R7	C1	C2	C3	C4	C5	C2
Pressure	**Pressure theme**	Seafood	Raw material	Renewable energy	Coastal erosion control	Accessibility (navigation channels)	Flood protection	Maintaining nursery populations & habitats	Pest and disease control	Maintaining reef-building communities	Water quality	Experience value	Environmental value/ Aesthetic	Scientific	Educational	Cultural heritage and identity	Recreation and leisure (entertainment)
Physical	Disturbance seabed (temporary or reversible)																
	Physical loss due to permanent change seabed substrate or morphology and to extraction of seabed substrate																
	Changes hydrological conditions																
Biological	Input/spread non-indigenous species																
	Input microbial pathogens																
	Input GM species, translocate of native species							?	?								
	Loss/change natural biological communities due to cultivation of animal and plant species	?															
	Disturbance of species (e.g. where they breed, rest, feed) due to human presence																
	Extract/kill/injure to wild species (by recreational fishing and other activities)																
Substances, litter and energy	Input nutrients																
	Input organic matter											?	?				?
	Input other substances (e.g. synthetic, non-synthetic, radionuclides)																
	Input litter																
	Input anthropogenic sound																
	Input other forms energy																
	Input water																

7.4 Annex 4: Link between activities and environmental pressures in the Flemish Banks area

Scale: (red) high effect; (yellow) medium (or high, but local) effect; (green) low effect; (white) (almost) no effect in Flemish Banks area

Activities	Pressures	Physical			Biological						Substances, litter and energy						
		Disturbance seabed (temporary or reversible)	Physical loss due to permanent change seabed substrate or morphology and to extraction of seabed substrate	Changes hydrological conditions	Input/spread non-indigenous species	Input microbial pathogens	Input GM species, translocate of native species	Loss/change natural biological communities due to cultivation of animal and plant species	Disturbance of species (e.g. where they breed, rest, feed) due to human presence	Extract/kill/injure to wild species (by recreational fishing and other activities)	Input nutrients	Input organic matter	Input other substances (e.g. synthetic, non-synthetic, radionuclides)	Input litter	Input anthropogenic sound	Input other forms energy	Input water
Physical restructuring of coastline or seabed (water management)	Coastal defence and flood protection																
	Restructuring of seabed morphology, including dredging and depositing of materials																
Extraction of non-living resources	Extraction of minerals (rock, metal ores, gravel, sand, shell)																
Production of energy	Transmission of electricity and communications (cables)																
Extraction of living sources	Fish and shellfish harvesting (professional, recreational)																
Transport	Transport infrastructure																
	Transport - shipping																
	Transport - air																
Tourism and leisure	Tourism and leisure infrastructure																
	Tourism and leisure activities																
Defence and national security	Military operations																
Education and research	Research, survey and educational activities																

COLOPHON

UPDATE SOCIO-ECONOMIC ANALYSIS OF THE USE OF THE BELGIAN MARINE WATERS AND OF THE COST OF DEGRADATION
MARINE STRATEGY FRAMEWORK DIRECTIVE - ART. 8.1.C

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Samenvatting van de socio-economische analyse van het gebruik van de Belgische mariene wateren en van de door de aantasting van het mariene milieu verbonden kosten[1]

Kaderrichtlijn Mariene Strategie – Art 8, lid 1c

1. Beknopte samenvatting

De Europese Kaderrichtlijn Mariene Strategie 2008/56/EG (KRMS) stelt een kader vast voor het bereiken of handhaven van een goede milieutoestand van het mariene milieu door de EU-lidstaten tegen 2020. In 2012 werd er een eerste beoordeling gemaakt van de toestand van de mariene wateren in België, zoals vereist door de KRMS. Deze beoordeling omvatte een economische en sociale analyse van het gebruik van de Belgische wateren en de kosten in verband met de aantasting van het mariene milieu.

De studie biedt een update en uitbreiding van de economische en sociale analyse van 2012 volgens de Marine Water Accounts-aanpak (Europese Commissie, 2010), waarbij verder wordt gekeken naar de vooruitgang en aanbevelingen op EU- en OSPAR-niveau. De studie legt resultaten voor de OSPAR-gemeenschappelijke socio-economische indicatoren voor: Bruto toegevoegde waarde (eenheid: Miljoen EUR), Werknemers (eenheid: VTE), Productiewaarde (eenheid: Miljoen EUR). Naast de sectoren die onder de gemeenschappelijke OSPAR-aanpak vallen (visserij en aquacultuur, scheepvaart (of zeevervoer), havens, olie en gas, offshore windenergie), houdt de studie rekening met socio-economische sectoren en gebruiken die specifiek zijn voor de Belgische context (bijvoorbeeld zandwinning, toerisme). De referentieperiode is 2011-2015, met een voorkeur voor 2014-2015. Waar mogelijk werden intern beschikbare gegevens van autoriteiten gebruikt en aangevuld met externe gegevens van belanghebbenden. De aanpak berust over het algemeen op het verkrijgen van geschikte verdeelsleutels om de economische statistieken op te splitsen. Als er geen gegevens beschikbaar zijn voor deze periode, werden de meest recente gegevens gebruikt.

Dit rapport biedt verder inzicht in de kosten van de aantasting van het mariene milieu van het Belgische deel van de Noordzee aan de hand van een schatting van de jaarlijkse kosten op basis van de huidige kost van de bestaande maatregelen om aantasting te vermijden (te verminderen of tot een minimum te beperken) en de herstelkosten op basis van aanvullende/nieuwe maatregelen om een Goede Milieutoestand (GMT) te bereiken. Deze methode wordt beschreven als de thematische benadering binnen het Europese richtsnoer (Europese Commissie, 2010). Gezien de gehanteerde veronderstellingen en rekening houdend met de maatregelen waarvoor geen gegevens beschikbaar zijn, werden de totale kosten van maatregelen die aantasting van het Belgische Noordzeegebied voorkomen, berekend als zijnde minstens 2.447.184 € per jaar. Een groot deel van

[1] Het volledige rapport van de socio-economische analyse van het gebruik van de Belgische mariene wateren en van de door de aantasting van het mariene milieu verbonden kosten is beschikbaar in annex.

deze totale kosten heeft betrekking op het monitoren van de impact van aggregaat extractie.

Daarnaast wordt inzicht verschaft in de potentiële toepasbaarheid van de ecosysteemdiensten-benadering om de ecosysteemvoordelen te berekenen die worden verkregen wanneer een Goede Milieutoestand wordt bereikt. Wat betreft de toepasbaarheid van deze benadering, luidde de conclusie dat de methodologie en de empirische toepassing nog niet rijp genoeg zijn om te worden toegepast binnen de huidige rapportagecyclus van de Kaderrichtlijn Mariene Strategie. Er moet verdere vooruitgang worden geboekt om deze methode volledig toe te passen binnen een KRMS-context.

Sleutelwoorden: *Kaderrichtlijn Mariene Strategie, kosten, Noordzee, ecosysteembenadering*

2. Update van de sociaaleconomische analyse van de Belgische mariene wateren en van de door de aantasting van het marine milieu verbonden kosten

In Tabel 1 worden samenvattende resultaten weergegeven, die een overzicht geven van de economische kerncijfers voor de Belgische Noordzee (BNZ) economie voor de referentieperiode 2011-2015, op basis van de beschikbare gegevens. Naast mariene activiteiten, wordt in de studie ook gekeken naar sectoren in het kustgebied (op het land) met een sterke en duidelijke verbinding met de Noordzee, waaronder toerisme en recreatieve activiteiten en havens. Een verdere beschrijving per sector wordt hieronder gegeven.

Tabel 1: ***Overzichtstabel - update socio-economische analyse BNZ (referentieperiode 2011-2015)***

	Gedateerde brutowaarde (miljoen euro)	Jaar	Werknemers (VTE's)	Jaar	Ontwikkeling in productiewaarde of andere relevante gegevens over trends tussen eerste en tweede initiële	Jaar	Gegevensbronnen
Visserij en aquacultuur[1]	50,6	2016	363	2016	81.815	2015	Afdeling Landbouw en Visserij 2016
Scheepvaart[2]	2298	2013	8710	2013	Niet beschikbaar		Koninklijke Belgische Redersvereniging 2014
Havens[3]	16532	2015	114773	2015	400	2010	NBB 2016
Offshore Energie[4]	1000	2015	15000-16000	2010-2030	2560	2017	Belgisch offshore platform 2017
Aggregaat[5] extractie	Niet beschikbaar		124	2016	16.151	2016	FOD Economie, Zeegra
Baggeren/dumpen op zee[6]	Niet beschikbaar		240-560		Niet beschikbaar		
Toerisme[7]	335.814	2007	27000	2013	2803,5	2014	Compendium Kust & Zee 2015 Westtoer 2013
Recreatieve visserij[8]	Niet beschikbaar		Niet beschikbaar		Niet beschikbaar		

1: De gegevens worden verkregen van de NBB en omvatten aquacultuur op het land. Aquacultuur op zee is momenteel afwezig in het

BNZ.

2: Specifieke gegevens voor de referentieperiode zijn niet beschikbaar voor Ontwikkeling in productiewaarde. Deze gegevens worden om strategische redenen niet beschikbaar gesteld door de reders.

3: De cijfers in de tabel omvatten de 4 Belgische zeehavens: Oostende, Zeebrugge, Gent en Antwerpen.

4: De waarden in de tabel zijn geschatte waarden afkomstig van de sector.

5. De waarden in de tabel zijn geschatte waarden afkomstig van de sector.

6: Geschatte waarden

7: Bruto toegevoegde waarde voor de toeristische sector: alleen gegevens voor 2007 zijn beschikbaar.

8. Gegevens met betrekking tot recreatieve visserij worden verzameld in het kader van het VLIZ project 'Recreatieve zeevisserij' en zullen beschikbaar worden in 2018

De kosten van degradatie voor de Belgische Noordzee (BNZ) zijn samengevat in Tabel 2, op basis van de beschikbare gegevens. Hiervoor worden zowel de huidige kosten berekend van bestaande maatregelen die degradatie voorkomen (verminderen of minimaliseren) als de kosten van nieuwe / aanvullende maatregelen voorgesteld door België onder de KRMS om tegen 2020 een goede milieutoestand te bereiken (beschouwd als herstelkosten). Opgemerkt moet worden dat naast deze kosten, ook een groot deel kosten gerelateerd zijn aan verschillende landgebonden maatregelen, zoals rioolwaterzuivering. Aangezien ze niet alleen van invloed zijn op het milieu in de Noordzee en in principe worden gerapporteerd onder de Kaderrichtlijn Water (KRW), zijn ze in deze studie niet behandeld. Een verdere beschrijving van de kosten van degradatie per sector wordt hieronder gegeven.

Tabel 2: ***Overzichtstabel - schatting van de minimale jaarlijkse kosten van maatregelen om aantasting van het BNZ te voorkomen (op basis van beschikbare gegevens van de federale overheden)***

Overzichtstabel – schatting van de jaarlijkse kost van maatregelen om degradatie van de BNZ te voorkomen.	Doel-sectoren	Publieke authoriteit	Personeel (FTE)	Werkings-budget	Info
MilieuEffectRapportage (MER) en Passende Beoordeling (PB) (algemene maatregel voor alle descriptoren)	Aquacultuur (nota 1), offshore energie, aggregaat extractie	DMM	4	200.000	Info: DMM Gezamenlijk budget en personeel voor alle activiteiten en sectoren
Definiëren instandhoudings-doelstellingen en opmaak beheerplannen/beleids-plannen voor de mariene beschermde gebieden	n.a.				
Voorwaarden en beperkingen	Offshore energie				

windparken en kabels					
Voorwaarden en beperkingen windparken en kabels	Offshore energie	BMM	n.a.	n.a.	
Voorwaarden en beperkingen zandwinning	Aggregaat extractie	Dienst Continentaal Plat	3	305.000	Info: FOD Economie – Dienst Continentaal Plat
Voorwaarden en beperkingen zandwinning (meetdienst Oostende)	Aggregaat extractie	KBIN/BMM		101.000	
Voorwaarden en beperkingen zandwinning (monitoring)	Aggregaat extractie	KBIN/BMM		411.000	
Voorwaarden en beperkingen zandwinning (monitoring)	Aggregaat extractie	ILVO		411.000	
Voorwaarden en beperkingen storten baggerspecie	Dredging and dumping	n.a.	n.a.		
Maatregelen uit het Marien Ruimtelijk Plan (2014-2020) in verband met wind energy sector	Offshore energie	DMM	3	100.000	Info: DMM
Verboden activiteiten binnen SBZ's en gebruiksovereen-komsten	Commerciële en recreatieve visserij	DMM	0,5		Info: DMM Personeel voor alle activiteiten en sectoren
Verbod bevissen schelpdierbestanden					
Verbod opzettelijke (tenzij vergunning) en onopzettelijke introductie van niet-inheemse organismen via ballastwater	Scheepvaart				
Implementatie van maatregelen uit het Gemeenschappelijk Visserijbeleid (GVB)	Commerciële visserij	Dienst Zeevisserij	5		Info: Dienst Zeevisserij
Verbod op schelpdiervisserij					
Implementatie van maatregelen uit het Gemeenschappelijk Visserijbeleid (GVB)	Commerciële visserij	Defensie (Marine)		302.184	Info: Dienst Zeevisserij, Defensie (Belgian Navy) Note 2
Gemeenschappelijk Visserij	Commerciële	ILVO	Niet	Niet	

Beleid en hernieuwd Gemeenschappelijk Visserij Beleid	visserij		beschikbaar	beschikbaar	
Introductie van sumwing vleugelprofielen en rolsloffen.	Commerciële visserij	ILVO	0	0	Info: ILVO (note 3)
Gemeenschappelijk Visserij Beleid en hernieuwd Gemeenschappelijk Visserij Beleid	Commerciële visserij	OD-Nature		71.000	Info: Dienst Zeevisserij
Verbod bevissen schelpdierbestanden	Commerciële visserij				
Verbod bevissen schelpdierbestanden	Recreatieve visserij		Niet beschikbaar	Niet beschikbaar	
Verbod scheepvaart in windmolenzone	Scheepvaart, commerciële visserij, recreatieve visserij, toerisme		Niet beschikbaar	Niet beschikbaar	
Fouling	Scheepvaart		Niet beschikbaar	Niet beschikbaar	
Land-gerelateerde maatregelen (beleid en richtlijnen)		DMM	1	100.000	Info:DMM
Land-gerelateerde maatregelen (sensibilisering))		OVAM		36.000	Info: OVAM
Monitoring kwaliteit marien milieu		BMM	Niet beschikbaar	Niet beschikbaar	
Maatregelen preventie en pollutiebestrijding	Alle sectoren	DMM	3	400.000	Info: DMM
Afval van scheepvaart	Scheepvaart	Haven-autoriteiten	0	0	Info: Haven-autoriteiten Nota 4
Seafood wetgeving	Commerciele visserij	FAVV			
Monitoring marien afval conf. OSPAR		BMM			
Fishing for litter	Commerciele visserij	DMM	0,5	10.000	Info: DMM
Totaal			**21**	**2.447.184**	

1: Er zijn momenteel geen commerciële aquacultuurprojecten in het Belgische deel van de Noordzee, enkel kleinschalige proefprojecten.

2: Deze kost omvat de kost voor bewaking door de marine in 2015. Deze is als volgt berekend: 18 dagen x 16.788 Euro/dag. Er wordt opgemerkt dat de bewaking niet enkel visserijactiviteiten omvat maar ook andere mariene gebruikers: scheepvaart, recreatie, ….

3: De piloottesten en het onderzoek in verband met sumwings en rolsloffen is uitgevoerd onder deze maatregel, maar was reeds afgelopen voorafgaand aan deze periode. De sumwings en rolsloffen worden momenteel toegepast door vissersvaartuigen en de kost hiervan wordt gedragen door de reders.

4: Aan afvalophaling van schepen die de havens binnenkomen is geen kost verbonden voor de havenautoriteiten. De kost wordt gedragen door de rederijen. De afvalophaling zelf wordt door private bedrijven uitgevoerd.

Bijkomende maatregelen in sector	Gemiddelde kost per jaar (EUR) (min-max)
Commerciële visserij	84.633-90.466
Scheepvaart	10.625
Toerisme	9.000-13.500
Recreatieve visserij	98.499-108.499

Commerciële visserij

De Belgische wateren worden bevist door de Belgische commerciële vissersvaartuigen, evenals door vissersvaartuigen uit de buurlanden (Nederland, Frankrijk). De Belgische commerciële vissersvloot zet zijn activiteiten grotendeels buiten het Belgisch continentaal plat in, de activiteiten in het Belgische deel van de Noordzee zijn eerder beperkt. De socio-economische gegevens zijn bijgevolg niet beperkt tot het Belgische deel van de Noordzee. De Belgische commerciële vissersvloot bestond in 2015 uit 76 vissersschepen en de vloot is in de afgelopen decennia sterk gekrompen. De redenen voor deze krimp zijn de dalende visbestanden en beperkingen van het quotum. Er waren in totaal 363 actieve vissers in 2016. De ontwikkeling in productiewaarde van de sector bedroeg 81.815 miljoen euro in 2015. De bruto toegevoegde waarde bedroeg 50,6 miljoen euro in 2015.

Verwacht wordt dat de mogelijkheden voor commerciële visserijactiviteiten in de Belgische mariene wateren grotendeels gelijk zullen blijven in de toekomst (2020, 2030 of 2050). In de toekomst zullen alternatieve vistechnieken met minder impact op het milieu verder worden gestimuleerd. Verwacht wordt dat de vraag naar vis in de toekomst zal blijven stijgen als gevolg van de verwachte bevolkingsgroei (13% tegen 2100). Productieverhogingen zijn alleen mogelijk binnen de grenzen van de Totale Toegestane Vangst (TTV). Naar verwachting zal de trend naar duurzamere visserijpraktijken, hoogwaardige producten en korte keten naar klanten in de toekomst blijven bestaan (Langetermijnvisie Noordzee 2050).

De werkelijke kosten van aantasting kunnen worden geschat op basis van de kosten voor de verantwoordelijke autoriteiten voor de uitvoering en follow-up van de kosten van handhaving van ruimtelijke maatregelen met betrekking tot de visserij in het mariene ruimtelijke plan (2014-2020), de handhaving van het Gemeenschappelijk Visserijbeleid, de handhaving van het verbod van schaaldiervisserij, de zeevisserijwetgeving en de coördinatie tussen Vlaamse en federale overheden in België. De herstelkosten omvatten kosten voor verbeterde overlegstructuren, een strengere handhaving in grintzones, windparken, bodembeschermingsgebieden, sensibilisering voor olieverlies en afvalbeheer, stimulering van alternatieven voor vislood en bescherming tegen haaien en roggen.

Mariene aquacultuur

Er is momenteel geen sprake van commerciële mariene aquacultuur in de Belgische mariene wateren. Het huidige mariene ruimtelijke plan maakt duurzame mariene aquacultuur mogelijk in een context van meervoudig gebruik binnen 2 zones voor hernieuwbare energie, maar deze mogelijkheid wordt tot nu toe niet benut (uitgezonderd een pilootproject in een onderzoekscontext, bijv. Edulis). De toekomstige mariene ruimtelijke planning (2020-2030) voorziet in een meervoudig gebruik van aquacultuur en windparken in de nieuwe zones voor hernieuwbare energie.

Omdat er geen sprake is van maricultuuractiviteit, zijn er nog geen huidige kosten van aantasting. Voor toekomstige aquacultuuractiviteiten zal een vergunning nodig zijn, een MER en een Passende Beoordeling (indien relevant).

Scheepvaart

Het Belgische deel van de Noordzee (BNZ) wordt jaarlijks doorkruist door meer dan 150.000 schepen en wordt beschouwd als een van de drukste zeeën ter wereld. De commerciële vloot onder Belgische vlag vertoonde de afgelopen jaren een groeiende trend met 162 schepen in 2015, goed voor een totaal brutotonnage van meer dan 5 miljoen ton. In 2013 waren er in België in totaal 8.710 personen rechtstreeks tewerkgesteld in de scheepvaartcluster. De Belgische scheepvaartsector met maritieme partners heeft meer dan 12.100 werknemers in dienst en realiseert een jaaromzet van 4.204 miljoen euro. Dit omvatte koopvaardij, slepen en baggeren. Gegevens over de totale omzet van de scheepvaartsector zijn momenteel niet beschikbaar. In 2013 bedroeg de bruto toegevoegde waarde van de scheepvaartsector (koopvaardijscheepvaart, slepen en baggeren) 2.298 miljoen euro.

De scheepvaartsector en ondersteunende navigatieroutes zullen in de nabije toekomst (2020-2030) grotendeels gelijk blijven, met enkele optimalisaties op het gebied van veiligheid. Mogelijkheden voor nieuwe noodopvanggebieden, een sleepstation en meerdere ruimtelijke toepassingen worden momenteel onderzocht. In de toekomst (2050) is er een trend naar grotere en energie-efficiëntere schepen. Dit vormt een uitdaging in verband met de bereikbaarheid van de Belgische havens.

De huidige kosten van aantasting gerelateerd aan scheepvaart zijn de kosten voor de handhaving van maatregelen met betrekking tot de invoering van niet-inheemse organismen via ballastwater, maatregelen met betrekking tot vervuiling, verontreinigingsbeheersing, scheepsafval, onderwatergeluid. In de toekomst zal een aanvullende controle van schepen en boten ook nodig zijn in de nieuwe ruimtelijke zones voor hernieuwbare energie en/of andere commerciële activiteiten.

Havens

Er zijn vier havens in België, met Oostende en Zeebrugge langs de kust, en Gent en Antwerpen in het binnenland die via respectievelijk een kanaal en de Schelde verbonden zijn met de Noordzee. Deze vier havens vormen de Belgische cluster van Noordzeehavens. Ze fungeren als een van de belangrijkste knooppunten voor maritieme handel tussen alle continenten wereldwijd en het Europese achterland. In 2014 werden in totaal bijna 269 miljoen ton goederen binnen deze cluster geladen of gelost. In 2015 was dat 274 miljoen ton.

De haven van Antwerpen is de op een na grootste haven van Europa en is de grootste olie- en chemische industriecluster in Europa. De haven van Zeebrugge is marktleider in de handel in nieuwe auto's en biedt werk aan meer dan 20.000 mensen. Deze haven is ook belangrijk voor haar LNG-terminal en RO/RO-verkeer van en naar Scandinavië, het Verenigd Koninkrijk en Spanje/Portugal. De haven van Oostende richt zich sinds 2008 op offshore-activiteiten en hernieuwbare energie (windparken). De haven van Gent is een industriële haven met staalindustrie en autofabrieken. De verhandelde goederen bestaan uit ijzererts, kolen, graan, bouwmaterialen en oliën. De haven van Gent ging onlangs (2017) een fusie aan met de haven van Terneuzen onder de naam Noordzeehaven.

De directe en indirecte werkgelegenheid in de Belgische Noordzeecluster bedroeg in totaal 114.647 personen (VTE's) in 2015. Samen met de indirecte werkgelegenheid bedraagt dit 252.394 VTE's of bijna 6% van de

beroepsbevolking in België. De omzet van de havens bedroeg in 2010 ongeveer 400 miljoen euro. Meer recente gegevens zijn niet beschikbaar, maar de totale hoeveelheid goederen die via de havens wordt verscheept, kan worden gebruikt als referentie en bedroeg in 2016 282.535 duizend ton. De directe toegevoegde waarde van de Belgische zeehavens bedroeg in 2014 16,532 miljoen euro. In 2015 bedroeg de bruto toegevoegde waarde meer dan 18 miljard euro. Samen met de indirecte toegevoegde waarde neemt dit toe tot 33 miljard euro, of circa 8% van het BBP.

Het huidige mariene ruimtelijke plan waarborgt de mogelijkheden voor verdere uitbreiding van de havens van Zeebrugge en Oostende door het aanwijzen van reserveringszones. Er worden in de nabije toekomst (2030) geen significante veranderingen verwacht met betrekking tot havenontwikkeling. Langetermijnprojecties wijzen op een trend naar automatisering en robotisering van de logistieke ketens in de havens, en de ontwikkeling van een 'maritieme logistieke cloud' om nautische en logistieke gegevens te verzamelen.

De huidige kosten van aantasting omvatten de kosten in verband met de nodige concessies/vergunningen (incl. MER en Passende Beoordelingen) voor havenontwikkelingen, bunkerbedrijven en havenontvangstfaciliteiten. Afval van schepen die Belgische havens binnenvaren wordt verzameld door particuliere bedrijven in de havens (geen extra kosten voor de havenautoriteiten). Aanvullende of nieuwe maatregelen omvatten het afgeven van afval door vissersvaartuigen.

Offshore energie

Tot op heden kregen negen projecten een vergunning voor de bouw en exploitatie van wind- en/of energieparken in het Belgische deel van de Noordzee. Er zijn plannen om tegen 2020 tussen 409 en 433 turbines in het windturbinegebied te bouwen, wat een totale capaciteit oplevert van 2.230 tot 2.280 MW, goed voor ongeveer 10% van de totale Belgische elektriciteitsproductie. De investeringswaarde van de sector bedraagt ca. 8 miljard euro.

De offshore windenergiesector is momenteel goed voor 1.400 banen (VTE's) voor exploitatie. De werkgelegenheid voor de geplande parken bedraagt ongeveer 500 per jaar (manjaren), met een exploitatieperiode van 20 jaar. Naar schatting zal de totale werkgelegenheid tussen 2010 en 2030 15.000-16.000 banen in de Belgische offshore windenergiesector opleveren. De elektriciteitsprijs schommelt van jaar tot jaar: ca. 70 EUR/MWh in 2008, 32 EUR/MWh in 2017. Dit komt neer op een productiewaarde van 2.560 miljoen euro in 2017. De toegevoegde waarde van de sector wordt geschat op 1 miljard euro/jaar (lokaal en export) (Belgisch offshore platform 2017).

De huidige kosten voor offshore energie hebben betrekking op de planning en vergunningen (incl. MER en Passende Beoordelingen) van wind-en/of energieparken, op het verzekeren van de veiligheid op zee (handhaving), op de elektriciteitstransmissie naar land (bijv. ‘Plug at sea'), de monitoring van de impact op het milieu, enz. Tegen 2030 zal het Europese energienetwerk nog verder uitgebreid worden, met inbegrip van de installatie van extra kabels (en pijpleidingen), bij voorkeur in de voorziene kabelcorridors. In de toekomst zal meervoudig gebruik van de zones voor hernieuwbare energie worden onderzocht en gestimuleerd, bijv. het testen van alternatieve duurzame energiesystemen, mariene aquacultuur, passieve visserij in windparken. Ook moet rekening worden gehouden met de verdere kosten van ontmanteling inclusief herstelkosten van de

windpark zones en de kosten voor de verwijdering en recycling van het materieel.

Aggregaat extractie

Zandwinning is een belangrijke activiteit in het Belgische deel van de Noordzee (BNZ) en vindt plaats in vier controlezones, verdeeld in sectoren, waarvoor concessies/vergunningen worden verleend. De Federale Overheidsdienst Economie (Dienst Continentaal Plat) is, in samenwerking met het Instituut voor Landbouw- en Visserijonderzoek (ILVO) en de Beheerseenheid Mathematisch Model voor de Noordzee (MUMM), verantwoordelijk voor het duurzame beheer van extractie activiteiten op het Belgisch Continentaal Plat (BCP) (vergunningen, monitoring).

Geëxtraheerd zand wordt gebruikt voor de bouw, strandsuppleties (kustverdediging) en voor landaanwinning. Historisch gezien zien we dat de zandwinning is toegenomen van 29.000 m^3 in 1976 tot 5,5 miljoen m^3 in 2015. Tot 1988 bleef de extractie constant op ca. 0,5 miljoen m^3, en is ze sindsdien gestaag toegenomen. Pieken kunnen worden waargenomen na zware stormen (kustverdediging) (bijv. in de lente van 2014, winter 2017).

De sector voor aggregaatextractie stelde in 2016 in totaal 262 personen te werk, inclusief activiteiten buiten het BNZ. De werkgelegenheid in het BNZ was goed voor 124 VTE. De totale productie van zeeaggregaten in het BDZ bedroeg 1.341.486 ton in 2016. De totale omzet van de sector bedroeg 16.151.209 Euro (inclusief productie buiten het BNZ). Informatie over de bruto toegevoegde waarde was niet beschikbaar voor de referentieperiode. Naar verwachting zal de jaarlijkse vraag naar zand met 6% toenemen tot 2050 (Langetermijnvisie Noordzee 2050).

Het huidige mariene ruimtelijke plan (2020) omvat onder andere de gedeeltelijke sluiting van de Kwintebank voor zandwinning, een herdefinitie van sectoren voor nautische veiligheid en natuurbescherming, opname van de Passende Beoordelingsprocedure in nieuwe concessies binnen het Natura 2000-gebied 'Vlaamse Banken', een geleidelijke vermindering van gewonnen volumes in de SBZ 'Vlaamse Banken' en de evaluatie van meervoudig gebruik van de zandwinningszones. Tegen 2030 zal een extra zone worden afgebakend in het noordelijke deel van het BNZ, naast enkele optimalisaties van de bestaande zones.

De huidige kosten van aantasting omvatten derhalve kosten in verband met vergunningen (incl. MER en Passende Beoordelingen), ook kosten in verband met monitoring, inspectie van winningsactiviteiten en bestuurskosten.

Baggeren en dumpen op zee

Het onderhoud van de toegang tot de havens van Oostende, Zeebrugge en de kleinere havens van Nieuwpoort en Blankenberge, en de scheepvaartroutes vereist regelmatig onderhoudsbaggerwerken (Vlaamse bevoegdheid). Daarnaast zijn er ook aanzienlijke baggeractiviteiten voor de aanleg, verdieping en verbreding van havens. Het grootste deel van het gebaggerde materiaal wordt op specifieke stortplaatsen op zee gedumpt of hergebruikt om stranden aan te vullen als de kwaliteit dit toelaat. Het beheer van bagger- en stortoperaties (incl. toekennen machtigingen, monitoring milieu-impact) valt onder de verantwoordelijkheid van de federale

overheid, in overeenstemming met internationale vereisten (bijv. criteria voor sedimentkwaliteit).

De huidige werkgelegenheid wordt geschat op 240 VTE of 560 VTE, afhankelijk van de bron. De baggeractiviteiten zullen grotendeels ongewijzigd blijven tegen 2030, rekening houdend met de veilige nautische toegang en evoluties in de scheepstechnologie. Tegen 2030 kunnen sommige stortplaatsen geoptimaliseerd worden in verband met natuurbehoud en ze zullen verder worden uitgebreid met een reserveringszone in de buurt van Zeebrugge.

De huidige kosten van aantasting omvatten het opleggen van voorwaarden en beperkingen voor het dumpen van opgebaggerde sedimenten, het controleren op activiteiten met een verbodsbepaling en op het nakomen van gebruikersovereenkomsten. Baggerbedrijven moeten een aantal kosten dragen die verband houden met het inperken van milieueffecten: anti-turbiditeitssystemen, machtiging voor het dumpen van opgebaggerd materiaal op zee.

Toerisme

Toerisme is een belangrijke economische sector langs de Belgische kust, met meer dan 5 miljoen bezoekers en 28,4 miljoen overnachtingen in 2013. De toeristische sector heeft een uitgebreide infrastructuur nodig en oefent een aanzienlijke invloed uit op verstedelijking en infrastructuur in de kustgebieden. Er werden jachthavens gebouwd in Nieuwpoort en Blankenberge. De jachthaven van Nieuwpoort heeft ligplaatsen voor ongeveer 2000 boten en is de grootste van Noord-Europa.

De toeristische sector langs de Belgische kust is belangrijk met naar schatting 27.000 directe banen (gegevens 2013) en een totale omzet van 2803,5 miljoen euro in 2014. Er zijn geen recente gegevens beschikbaar voor de toerismesector over de bruto toegevoegde waarde. Gegevens uit 2007 toonden aan dat deze 335,814 miljoen euro bedroeg.

Er worden geen significante veranderingen verwacht in de toeristische en recreatieve mogelijkheden in het Belgische kust- en zeegebied tegen 2030. Verdere investeringen en diversificatie zijn op langere termijn vereist voor strand- en sportclubs (Langetermijnvisie Noordzee 2050).

De huidige kosten van aantasting zijn onder meer gerelateerd met bewustmaking rond het probleem van zwerfvuil op zee en het belang van strandschoonmaakacties, verdere sensibilisering voor afvalbeheer en olievervuiling door pleziervaartuigen (vooral in jachthavens). Sommige toeristische activiteiten kunnen onderworpen zijn aan Passende Beoordelingsprocedures, in het geval van mogelijke gevolgen voor beschermde mariene gebieden (bijvoorbeeld voor sportwedstrijden),

Recreatieve visserij

In 2015 werd het totale aantal recreatieve vissersboten geschat op 778, gelegen in de havens van Nieuwpoort, Zeebrugge, Oostende en Blankenberge. Het totale aantal visreizen door de recreatieve visserijvloot bedraagt 10.735 dagen. De meeste activiteiten vinden plaats binnen de 3-nm-zone.

Er is zeer weinig informatie beschikbaar over het economische belang van de recreatieve visserij wat betreft directe werkgelegenheid, productiewaarde en toegevoegde waarde. Een eerste schatting van de ICES-Werkgroep voor Recreatieve Visserij (WGRFS), gebaseerd op een participatiegraad van 0,22%, vermeldde een gemiddelde uitgave van 1.372 Euro/visser/jaar (ILVO). Op basis van deze schatting bedragen de totale uitgaven van recreatieve vissers 33 miljoen euro per jaar (Persoon 2015, Hyder et al. 2016). Het lopende project 'Recreatieve Zeevisserij' van het Vlaams Instituut voor de Zee zal nauwkeurige gegevens genereren, die in 2018 beschikbaar zullen zijn.

Op dit moment is recreatieve bodemberoerende visserij over het algemeen verboden in de volledige speciale beschermingszone 'Vlaamse Banken', met enkele uitzonderingen voor het vissen te paard, te voet en voor recreatieve vissers die al langer actief zijn (kunnen een vergunning hebben om 10 keer per jaar te gaan vissen). Recreatieve warrelnetvisserij in het gebied van de 'Vlaamse Banken' is verboden. Dit zal naar verwachting hetzelfde blijven tegen 2030.

De huidige kosten van aantasting op basis van bestaande maatregelen omvatten kosten van beheer en handhaving van de maatregelen om de recreatieve visserij in de SBZ ‘Vlaamse Banken’ te beperken en om in windparken te verbieden, het naleven van een verbod op schaaldiervisserij en het gebruik van kieuwnetten. Nieuwe maatregelen omvatten maatregelen om de bijvangst van zeezoogdieren te verminderen, toezicht op de recreatieve visserij op te voeren, toezicht op de omvang van de sector, bevorderen van de conversie van recreatieve visserij naar commerciële visserij en stimulering van alternatieven voor de visvangst.

Andere toepassingen van het Belgische deel van de Noordzee

De volgende activiteiten vinden ook plaats in het BNZ, maar zijn minder belangrijk in socio-economisch opzicht: onderzoek, militaire operaties, de Paardenmarkt als historische munitiedump, ankergebieden en toevluchtsoorden, telecomkabels en gaspijpleidingen, scheepswrakken en kustverdediging. Een korte beschrijving is opgenomen in het rapport.

3. Initiële stappen naar een ecosysteembenadering voor de Belgische mariene wateren

Gezien de toegenomen aandacht voor een ecosysteemgerichte benadering in Europa (Biodiversiteitsstrategie, KRMS) en op OSPAR-niveau, is België begonnen met het uitwerken van de ecosysteembenadering voor zijn mariene wateren. Naar verwachting zal de ecosysteemdienstenbenadering, waaronder de monetaire waardering van ecosysteemdiensten, nieuwe inzichten voor beleidsmakers opleveren en bijdragen aan een betere besluitvorming. Ecosysteemdiensten worden gedefinieerd als goederen en diensten - de voordelen - die mensen verkrijgen van ecosystemen, en de directe en indirecte bijdragen van ecosystemen aan het menselijk welzijn.

De ecosysteemdienstenbenadering geeft informatie over de waarde van het verschil in ecosysteemgoederen en -diensten die zouden worden verstrekt in het geval van een Goede Milieutoestand (GMT) in vergelijking met het Business-as-Usual (BAU) -scenario. De volgende stappen zijn kenmerkend voor de aanpak en werden geïllustreerd voor de case 'Vlaamse Banken', meer specifiek voor de sector aggregaatextractie.

1. **Reikwijdte van het mariene ecosysteem en abiotische diensten voor het BNZ:** Op basis van de MAES-classificatie voor KRM-rapportage 2018 (WG Dijk, 2017), verder uitgewerkt om rekening te houden met abiotische diensten, werd een overzicht van ecosysteemdiensten gemaakt. Door prioriteit te geven aan deze ecosysteem- en abiotische diensten, rekening houdend met de relevantie ervan voor het Belgische deel van de Noordzee (BNS), zijn 16 ecosysteemdiensten verder meegenomen in de beoordeling: 3 voorzienende diensten (P) (voedsel uit de zee, grondstoffen, hernieuwbare energie), 7 regulerende diensten (R) (kusterosiebestrijding, toegankelijkheid van de navigatie, bescherming tegen overstromingen, het onderhouden van populaties en habitats voor kwekerijen, beheersing van ziekten en plagen, behoud van gemeenschappen voor het bouwen van riffen, waterkwaliteit) en 6 culturele diensten (C) (ervaringswaarde, milieu-/esthetische waarde, wetenschappelijk, educatief, erfgoed/cultureel, amusement).

2. **Ontwikkeling van het beoordelingskader** dat het verwachte kwalitatieve effect van de antropogene druk op verschillende ecosysteem- en abiotische diensten voor de Belgische mariene wateren weergeeft. De 3 belangrijkste drukgroepen die onder de loep werden genomen, waren fysische verstoring, biologische verstoring en verstoring door inbreng van stoffen, afval en energie in het mariene milieu.

3. **De beoordeling van de toestand van het mariene ecosysteem** werd geïllustreerd voor de case 'Vlaamse Banken' door 2 scenario's te vergelijken: de huidige toestand 2016 (gebaseerd op gedeeltelijk geïmplementeerde MSP (2014-2020) en bestaande maatregelen) en de verwachte toestand (2020) (op basis van volledig geïmplementeerde MSP (2014-2020) en aanvullende nieuwe maatregelen nodig om GMT te bereiken). De belangrijkste veranderingen in activiteiten en druk zullen naar verwachting de grootste impact hebben op de volgende ecosysteemdiensten voor de Vlaamse Banken: voedsel uit de zee (P1), Grondstoffen (P2), Kusterosie (R1) / Bescherming tegen overstromingen (R3), Behoud van populaties in kwekerijen en habitats (R4), Onderhouden van rifbouwende gemeenschappen (R6) en Bestrijding van plagen en ziekten (R5). Daarnaast werd er een kwalitatieve beoordeling geïllustreerd voor de agregaatsector met de resultaten van een geleidelijke vermindering van de zandwinning in het Vlaamse Bankengebied tot 2020. Er zijn meer gegevens nodig om een kwantitatieve beoordeling mogelijk te maken.

4. **Economische waardering van ecosysteemdiensten** die de gevolgen voor het menselijk welzijn van de aantasting van het mariene milieu in monetaire termen beschrijft. Voortbouwend op het voorbeeld van aggregaat extractie werd er een preliminair stroomschema opgesteld om potentiële veranderingen in de input van grondstoffen, werkgelegenheid en economisch rendement te illustreren. Er zijn meer gegevens nodig om een gedetailleerde monetaire waardering mogelijk te maken.

Samenvatting van de socio-economische analyse van het gebruik van de Belgische mariene wateren en van de door de aantasting van het mariene milieu verbonden kosten[1]

Kaderrichtlijn Mariene Strategie – Art 8, lid 1c

1. Beknopte samenvatting

De Europese Kaderrichtlijn Mariene Strategie 2008/56/EG (KRMS) stelt een kader vast voor het bereiken of handhaven van een goede milieutoestand van het mariene milieu door de EU-lidstaten tegen 2020. In 2012 werd er een eerste beoordeling gemaakt van de toestand van de mariene wateren in België, zoals vereist door de KRMS. Deze beoordeling omvatte een economische en sociale analyse van het gebruik van de Belgische wateren en de kosten in verband met de aantasting van het mariene milieu.

De studie biedt een update en uitbreiding van de economische en sociale analyse van 2012 volgens de Marine Water Accounts-aanpak (Europese Commissie, 2010), waarbij verder wordt gekeken naar de vooruitgang en aanbevelingen op EU- en OSPAR-niveau. De studie legt resultaten voor de OSPAR-gemeenschappelijke socio-economische indicatoren voor: Bruto toegevoegde waarde (eenheid: Miljoen EUR), Werknemers (eenheid: VTE), Productiewaarde (eenheid: Miljoen EUR). Naast de sectoren die onder de gemeenschappelijke OSPAR-aanpak vallen (visserij en aquacultuur, scheepvaart (of zeevervoer), havens, olie en gas, offshore windenergie), houdt de studie rekening met socio-economische sectoren en gebruiken die specifiek zijn voor de Belgische context (bijvoorbeeld zandwinning, toerisme). De referentieperiode is 2011-2015, met een voorkeur voor 2014-2015. Waar mogelijk werden intern beschikbare gegevens van autoriteiten gebruikt en aangevuld met externe gegevens van belanghebbenden. De aanpak berust over het algemeen op het verkrijgen van geschikte verdeelsleutels om de economische statistieken op te splitsen. Als er geen gegevens beschikbaar zijn voor deze periode, werden de meest recente gegevens gebruikt.

Dit rapport biedt verder inzicht in de kosten van de aantasting van het mariene milieu van het Belgische deel van de Noordzee aan de hand van een schatting van de jaarlijkse kosten op basis van de huidige kost van de bestaande maatregelen om aantasting te vermijden (te verminderen of tot een minimum te beperken) en de herstelkosten op basis van aanvullende/nieuwe maatregelen om een Goede Milieutoestand (GMT) te bereiken. Deze methode wordt beschreven als de thematische benadering binnen het Europese richtsnoer (Europese Commissie, 2010). Gezien de gehanteerde veronderstellingen en rekening houdend met de maatregelen waarvoor geen gegevens beschikbaar zijn, werden de totale kosten van maatregelen die aantasting van het Belgische Noordzeegebied voorkomen, berekend als zijnde minstens 2.447.184 € per jaar. Een groot deel van

[1] Het volledige rapport van de socio-economische analyse van het gebruik van de Belgische mariene wateren en van de door de aantasting van het mariene milieu verbonden kosten is beschikbaar in annex.

deze totale kosten heeft betrekking op het monitoren van de impact van aggregaat extractie.

Daarnaast wordt inzicht verschaft in de potentiële toepasbaarheid van de ecosysteemdiensten-benadering om de ecosysteemvoordelen te berekenen die worden verkregen wanneer een Goede Milieutoestand wordt bereikt. Wat betreft de toepasbaarheid van deze benadering, luidde de conclusie dat de methodologie en de empirische toepassing nog niet rijp genoeg zijn om te worden toegepast binnen de huidige rapportagecyclus van de Kaderrichtlijn Mariene Strategie. Er moet verdere vooruitgang worden geboekt om deze methode volledig toe te passen binnen een KRMS-context.

Sleutelwoorden: *Kaderrichtlijn Mariene Strategie, kosten, Noordzee, ecosysteembenadering*

2. Update van de sociaaleconomische analyse van de Belgische mariene wateren en van de door de aantasting van het marine milieu verbonden kosten

In Tabel 1 worden samenvattende resultaten weergegeven, die een overzicht geven van de economische kerncijfers voor de Belgische Noordzee (BNZ) economie voor de referentieperiode 2011-2015, op basis van de beschikbare gegevens. Naast mariene activiteiten, wordt in de studie ook gekeken naar sectoren in het kustgebied (op het land) met een sterke en duidelijke verbinding met de Noordzee, waaronder toerisme en recreatieve activiteiten en havens. Een verdere beschrijving per sector wordt hieronder gegeven.

Tabel 1: ***Overzichtstabel - update socio-economische analyse BNZ (referentieperiode 2011-2015)***

	Gedateerde brutowaarde (miljoen euro)	Jaar	Werknemers (VTE's)	Jaar	Ontwikkeling in productiewaarde of andere relevante gegevens over trends tussen eerste en tweede initiële	Jaar	Gegevensbronnen
Visserij en aquacultuur[1]	50,6	2016	363	2016	81.815	2015	Afdeling Landbouw en Visserij 2016
Scheepvaart[2]	2298	2013	8710	2013	Niet beschikbaar		Koninklijke Belgische Redersvereniging 2014
Havens[3]	16532	2015	114773	2015	400	2010	NBB 2016
Offshore Energie[4]	1000	2015	15000-16000	2010-2030	2560	2017	Belgisch offshore platform 2017
Aggregaat[5] extractie	Niet beschikbaar		124	2016	16.151	2016	FOD Economie, Zeegra
Baggeren/dumpen op zee[6]	Niet beschikbaar		240-560		Niet beschikbaar		
Toerisme[7]	335.814	2007	27000	2013	2803,5	2014	Compendium Kust & Zee 2015 Westtoer 2013
Recreatieve visserij[8]	Niet beschikbaar		Niet beschikbaar		Niet beschikbaar		

1: De gegevens worden verkregen van de NBB en omvatten aquacultuur op het land. Aquacultuur op zee is momenteel afwezig in het

BNZ.

2: Specifieke gegevens voor de referentieperiode zijn niet beschikbaar voor Ontwikkeling in productiewaarde. Deze gegevens worden om strategische redenen niet beschikbaar gesteld door de reders.

3: De cijfers in de tabel omvatten de 4 Belgische zeehavens: Oostende, Zeebrugge, Gent en Antwerpen.

4: De waarden in de tabel zijn geschatte waarden afkomstig van de sector.

5. De waarden in de tabel zijn geschatte waarden afkomstig van de sector.

6: Geschatte waarden

7: Bruto toegevoegde waarde voor de toeristische sector: alleen gegevens voor 2007 zijn beschikbaar.

8. Gegevens met betrekking tot recreatieve visserij worden verzameld in het kader van het VLIZ project 'Recreatieve zeevisserij' en zullen beschikbaar worden in 2018

De kosten van degradatie voor de Belgische Noordzee (BNZ) zijn samengevat in Tabel 2, op basis van de beschikbare gegevens. Hiervoor worden zowel de huidige kosten berekend van bestaande maatregelen die degradatie voorkomen (verminderen of minimaliseren) als de kosten van nieuwe / aanvullende maatregelen voorgesteld door België onder de KRMS om tegen 2020 een goede milieutoestand te bereiken (beschouwd als herstelkosten). Opgemerkt moet worden dat naast deze kosten, ook een groot deel kosten gerelateerd zijn aan verschillende landgebonden maatregelen, zoals rioolwaterzuivering. Aangezien ze niet alleen van invloed zijn op het milieu in de Noordzee en in principe worden gerapporteerd onder de Kaderrichtlijn Water (KRW), zijn ze in deze studie niet behandeld. Een verdere beschrijving van de kosten van degradatie per sector wordt hieronder gegeven.

Tabel 2: ***Overzichtstabel - schatting van de minimale jaarlijkse kosten van maatregelen om aantasting van het BNZ te voorkomen (op basis van beschikbare gegevens van de federale overheden)***

Overzichtstabel – schatting van de jaarlijkse kost van maatregelen om degradatie van de BNZ te voorkomen.	Doel-sectoren	Publieke authoriteit	Personeel (FTE)	Werkings-budget	Info
MilieuEffectRapportage (MER) en Passende Beoordeling (PB) (algemene maatregel voor alle descriptoren)	Aquacultuur (nota 1), offshore energie, aggregaat extractie	DMM	4	200.000	Info: DMM Gezamenlijk budget en personeel voor alle activiteiten en sectoren
Definiëren instandhoudings-doelstellingen en opmaak beheerplannen/beleids-plannen voor de mariene beschermde gebieden	n.a.				
Voorwaarden en beperkingen	Offshore energie				

windparken en kabels					
Voorwaarden en beperkingen windparken en kabels	Offshore energie	BMM	n.a.	n.a.	
Voorwaarden en beperkingen zandwinning	Aggregaat extractie	Dienst Continentaal Plat	3	305.000	Info: FOD Economie – Dienst Continentaal Plat
Voorwaarden en beperkingen zandwinning (meetdienst Oostende)	Aggregaat extractie	KBIN/BMM		101.000	
Voorwaarden en beperkingen zandwinning (monitoring)	Aggregaat extractie	KBIN/BMM		411.000	
Voorwaarden en beperkingen zandwinning (monitoring)	Aggregaat extractie	ILVO		411.000	
Voorwaarden en beperkingen storten baggerspecie	Dredging and dumping	n.a.	n.a.		
Maatregelen uit het Marien Ruimtelijk Plan (2014-2020) in verband met wind energy sector	Offshore energie	DMM	3	100.000	Info: DMM
Verboden activiteiten binnen SBZ's en gebruiksovereen-komsten	Commerciële en recreatieve visserij	DMM	0,5		Info: DMM Personeel voor alle activiteiten en sectoren
Verbod bevissen schelpdierbestanden					
Verbod opzettelijke (tenzij vergunning) en onopzettelijke introductie van niet-inheemse organismen via ballastwater	Scheepvaart				
Implementatie van maatregelen uit het Gemeenschappelijk Visserijbeleid (GVB)	Commerciële visserij	Dienst Zeevisserij	5		Info: Dienst Zeevisserij
Verbod op schelpdiervisserij					
Implementatie van maatregelen uit het Gemeenschappelijk Visserijbeleid (GVB)	Commerciële visserij	Defensie (Marine)		302.184	Info: Dienst Zeevisserij, Defensie (Belgian Navy) Note 2
Gemeenschappelijk Visserij	Commerciële	ILVO	Niet	Niet	

Beleid en hernieuwd Gemeenschappelijk Visserij Beleid	visserij		beschikbaar	beschikbaar	
Introductie van sumwing vleugelprofielen en rolsloffen.	Commerciële visserij	ILVO	0	0	Info: ILVO (note 3)
Gemeenschappelijk Visserij Beleid en hernieuwd Gemeenschappelijk Visserij Beleid	Commerciële visserij	OD-Nature		71.000	Info: Dienst Zeevisserij
Verbod bevissen schelpdierbestanden	Commerciële visserij				
Verbod bevissen schelpdierbestanden	Recreatieve visserij		Niet beschikbaar	Niet beschikbaar	
Verbod scheepvaart in windmolenzone	Scheepvaart, commerciële visserij, recreatieve visserij, toerisme		Niet beschikbaar	Niet beschikbaar	
Fouling	Scheepvaart		Niet beschikbaar	Niet beschikbaar	
Land-gerelateerde maatregelen (beleid en richtlijnen)		DMM	1	100.000	Info:DMM
Land-gerelateerde maatregelen (sensibilisering))		OVAM		36.000	Info: OVAM
Monitoring kwaliteit marien milieu		BMM	Niet beschikbaar	Niet beschikbaar	
Maatregelen preventie en pollutiebestrijding	Alle sectoren	DMM	3	400.000	Info: DMM
Afval van scheepvaart	Scheepvaart	Haven-autoriteiten	0	0	Info: Haven-autoriteiten Nota 4
Seafood wetgeving	Commerciele visserij	FAVV			
Monitoring marien afval conf. OSPAR		BMM			
Fishing for litter	Commerciele visserij	DMM	0,5	10.000	Info: DMM
Totaal			**21**	**2.447.184**	

1: Er zijn momenteel geen commerciële aquacultuurprojecten in het Belgische deel van de Noordzee, enkel kleinschalige proefprojecten.

2: Deze kost omvat de kost voor bewaking door de marine in 2015. Deze is als volgt berekend: 18 dagen x 16.788 Euro/dag. Er wordt opgemerkt dat de bewaking niet enkel visserijactiviteiten omvat maar ook andere mariene gebruikers: scheepvaart, recreatie, ….

3: De piloottesten en het onderzoek in verband met sumwings en rolsloffen is uitgevoerd onder deze maatregel, maar was reeds afgelopen voorafgaand aan deze periode. De sumwings en rolsloffen worden momenteel toegepast door vissersvaartuigen en de kost hiervan wordt gedragen door de reders.

4: Aan afvalophaling van schepen die de havens binnenkomen is geen kost verbonden voor de havenautoriteiten. De kost wordt gedragen door de rederijen. De afvalophaling zelf wordt door private bedrijven uitgevoerd.

Bijkomende maatregelen in sector	Gemiddelde kost per jaar (EUR) (min-max)
Commerciële visserij	84.633-90.466
Scheepvaart	10.625
Toerisme	9.000-13.500
Recreatieve visserij	98.499-108.499

Commerciële visserij

De Belgische wateren worden bevist door de Belgische commerciële vissersvaartuigen, evenals door vissersvaartuigen uit de buurlanden (Nederland, Frankrijk). De Belgische commerciële vissersvloot zet zijn activiteiten grotendeels buiten het Belgisch continentaal plat in, de activiteiten in het Belgische deel van de Noordzee zijn eerder beperkt. De socio-economische gegevens zijn bijgevolg niet beperkt tot het Belgische deel van de Noordzee. De Belgische commerciële vissersvloot bestond in 2015 uit 76 vissersschepen en de vloot is in de afgelopen decennia sterk gekrompen. De redenen voor deze krimp zijn de dalende visbestanden en beperkingen van het quotum. Er waren in totaal 363 actieve vissers in 2016. De ontwikkeling in productiewaarde van de sector bedroeg 81.815 miljoen euro in 2015. De bruto toegevoegde waarde bedroeg 50,6 miljoen euro in 2015.

Verwacht wordt dat de mogelijkheden voor commerciële visserijactiviteiten in de Belgische mariene wateren grotendeels gelijk zullen blijven in de toekomst (2020, 2030 of 2050). In de toekomst zullen alternatieve vistechnieken met minder impact op het milieu verder worden gestimuleerd. Verwacht wordt dat de vraag naar vis in de toekomst zal blijven stijgen als gevolg van de verwachte bevolkingsgroei (13% tegen 2100). Productieverhogingen zijn alleen mogelijk binnen de grenzen van de Totale Toegestane Vangst (TTV). Naar verwachting zal de trend naar duurzamere visserijpraktijken, hoogwaardige producten en korte keten naar klanten in de toekomst blijven bestaan (Langetermijnvisie Noordzee 2050).

De werkelijke kosten van aantasting kunnen worden geschat op basis van de kosten voor de verantwoordelijke autoriteiten voor de uitvoering en follow-up van de kosten van handhaving van ruimtelijke maatregelen met betrekking tot de visserij in het mariene ruimtelijke plan (2014-2020), de handhaving van het Gemeenschappelijk Visserijbeleid, de handhaving van het verbod van schaaldiervisserij, de zeevisserijwetgeving en de coördinatie tussen Vlaamse en federale overheden in België. De herstelkosten omvatten kosten voor verbeterde overlegstructuren, een strengere handhaving in grintzones, windparken, bodembeschermingsgebieden, sensibilisering voor olieverlies en afvalbeheer, stimulering van alternatieven voor vislood en bescherming tegen haaien en roggen.

Mariene aquacultuur

Er is momenteel geen sprake van commerciële mariene aquacultuur in de Belgische mariene wateren. Het huidige mariene ruimtelijke plan maakt duurzame mariene aquacultuur mogelijk in een context van meervoudig gebruik binnen 2 zones voor hernieuwbare energie, maar deze mogelijkheid wordt tot nu toe niet benut (uitgezonderd een pilootproject in een onderzoekscontext, bijv. Edulis). De toekomstige mariene ruimtelijke planning (2020-2030) voorziet in een meervoudig gebruik van aquacultuur en windparken in de nieuwe zones voor hernieuwbare energie.

Omdat er geen sprake is van maricultuuractiviteit, zijn er nog geen huidige kosten van aantasting. Voor toekomstige aquacultuuractiviteiten zal een vergunning nodig zijn, een MER en een Passende Beoordeling (indien relevant).

Scheepvaart

Het Belgische deel van de Noordzee (BNZ) wordt jaarlijks doorkruist door meer dan 150.000 schepen en wordt beschouwd als een van de drukste zeeën ter wereld. De commerciële vloot onder Belgische vlag vertoonde de afgelopen jaren een groeiende trend met 162 schepen in 2015, goed voor een totaal brutotonnage van meer dan 5 miljoen ton. In 2013 waren er in België in totaal 8.710 personen rechtstreeks tewerkgesteld in de scheepvaartcluster. De Belgische scheepvaartsector met maritieme partners heeft meer dan 12.100 werknemers in dienst en realiseert een jaaromzet van 4.204 miljoen euro. Dit omvatte koopvaardij, slepen en baggeren. Gegevens over de totale omzet van de scheepvaartsector zijn momenteel niet beschikbaar. In 2013 bedroeg de bruto toegevoegde waarde van de scheepvaartsector (koopvaardijscheepvaart, slepen en baggeren) 2.298 miljoen euro.

De scheepvaartsector en ondersteunende navigatieroutes zullen in de nabije toekomst (2020-2030) grotendeels gelijk blijven, met enkele optimalisaties op het gebied van veiligheid. Mogelijkheden voor nieuwe noodopvanggebieden, een sleepstation en meerdere ruimtelijke toepassingen worden momenteel onderzocht. In de toekomst (2050) is er een trend naar grotere en energie-efficiëntere schepen. Dit vormt een uitdaging in verband met de bereikbaarheid van de Belgische havens.

De huidige kosten van aantasting gerelateerd aan scheepvaart zijn de kosten voor de handhaving van maatregelen met betrekking tot de invoering van niet-inheemse organismen via ballastwater, maatregelen met betrekking tot vervuiling, verontreinigingsbeheersing, scheepsafval, onderwatergeluid. In de toekomst zal een aanvullende controle van schepen en boten ook nodig zijn in de nieuwe ruimtelijke zones voor hernieuwbare energie en/of andere commerciële activiteiten.

Havens

Er zijn vier havens in België, met Oostende en Zeebrugge langs de kust, en Gent en Antwerpen in het binnenland die via respectievelijk een kanaal en de Schelde verbonden zijn met de Noordzee. Deze vier havens vormen de Belgische cluster van Noordzeehavens. Ze fungeren als een van de belangrijkste knooppunten voor maritieme handel tussen alle continenten wereldwijd en het Europese achterland. In 2014 werden in totaal bijna 269 miljoen ton goederen binnen deze cluster geladen of gelost. In 2015 was dat 274 miljoen ton.

De haven van Antwerpen is de op een na grootste haven van Europa en is de grootste olie- en chemische industriecluster in Europa. De haven van Zeebrugge is marktleider in de handel in nieuwe auto's en biedt werk aan meer dan 20.000 mensen. Deze haven is ook belangrijk voor haar LNG-terminal en RO/RO-verkeer van en naar Scandinavië, het Verenigd Koninkrijk en Spanje/Portugal. De haven van Oostende richt zich sinds 2008 op offshore-activiteiten en hernieuwbare energie (windparken). De haven van Gent is een industriële haven met staalindustrie en autofabrieken. De verhandelde goederen bestaan uit ijzererts, kolen, graan, bouwmaterialen en oliën. De haven van Gent ging onlangs (2017) een fusie aan met de haven van Terneuzen onder de naam Noordzeehaven.

De directe en indirecte werkgelegenheid in de Belgische Noordzeecluster bedroeg in totaal 114.647 personen (VTE's) in 2015. Samen met de indirecte werkgelegenheid bedraagt dit 252.394 VTE's of bijna 6% van de

beroepsbevolking in België. De omzet van de havens bedroeg in 2010 ongeveer 400 miljoen euro. Meer recente gegevens zijn niet beschikbaar, maar de totale hoeveelheid goederen die via de havens wordt verscheept, kan worden gebruikt als referentie en bedroeg in 2016 282.535 duizend ton. De directe toegevoegde waarde van de Belgische zeehavens bedroeg in 2014 16,532 miljoen euro. In 2015 bedroeg de bruto toegevoegde waarde meer dan 18 miljard euro. Samen met de indirecte toegevoegde waarde neemt dit toe tot 33 miljard euro, of circa 8% van het BBP.

Het huidige mariene ruimtelijke plan waarborgt de mogelijkheden voor verdere uitbreiding van de havens van Zeebrugge en Oostende door het aanwijzen van reserveringszones. Er worden in de nabije toekomst (2030) geen significante veranderingen verwacht met betrekking tot havenontwikkeling. Langetermijnprojecties wijzen op een trend naar automatisering en robotisering van de logistieke ketens in de havens, en de ontwikkeling van een 'maritieme logistieke cloud' om nautische en logistieke gegevens te verzamelen.

De huidige kosten van aantasting omvatten de kosten in verband met de nodige concessies/vergunningen (incl. MER en Passende Beoordelingen) voor havenontwikkelingen, bunkerbedrijven en havenontvangstfaciliteiten. Afval van schepen die Belgische havens binnenvaren wordt verzameld door particuliere bedrijven in de havens (geen extra kosten voor de havenautoriteiten). Aanvullende of nieuwe maatregelen omvatten het afgeven van afval door vissersvaartuigen.

Offshore energie

Tot op heden kregen negen projecten een vergunning voor de bouw en exploitatie van wind- en/of energieparken in het Belgische deel van de Noordzee. Er zijn plannen om tegen 2020 tussen 409 en 433 turbines in het windturbinegebied te bouwen, wat een totale capaciteit oplevert van 2.230 tot 2.280 MW, goed voor ongeveer 10% van de totale Belgische elektriciteitsproductie. De investeringswaarde van de sector bedraagt ca. 8 miljard euro.

De offshore windenergiesector is momenteel goed voor 1.400 banen (VTE's) voor exploitatie. De werkgelegenheid voor de geplande parken bedraagt ongeveer 500 per jaar (manjaren), met een exploitatieperiode van 20 jaar. Naar schatting zal de totale werkgelegenheid tussen 2010 en 2030 15.000-16.000 banen in de Belgische offshore windenergiesector opleveren. De elektriciteitsprijs schommelt van jaar tot jaar: ca. 70 EUR/MWh in 2008, 32 EUR/MWh in 2017. Dit komt neer op een productiewaarde van 2.560 miljoen euro in 2017. De toegevoegde waarde van de sector wordt geschat op 1 miljard euro/jaar (lokaal en export) (Belgisch offshore platform 2017).

De huidige kosten voor offshore energie hebben betrekking op de planning en vergunningen (incl. MER en Passende Beoordelingen) van wind-en/of energieparken, op het verzekeren van de veiligheid op zee (handhaving), op de elektriciteitstransmissie naar land (bijv. ‘Plug at sea'), de monitoring van de impact op het milieu, enz. Tegen 2030 zal het Europese energienetwerk nog verder uitgebreid worden, met inbegrip van de installatie van extra kabels (en pijpleidingen), bij voorkeur in de voorziene kabelcorridors. In de toekomst zal meervoudig gebruik van de zones voor hernieuwbare energie worden onderzocht en gestimuleerd, bijv. het testen van alternatieve duurzame energiesystemen, mariene aquacultuur, passieve visserij in windparken. Ook moet rekening worden gehouden met de verdere kosten van ontmanteling inclusief herstelkosten van de

windpark zones en de kosten voor de verwijdering en recycling van het materieel.

Aggregaat extractie

Zandwinning is een belangrijke activiteit in het Belgische deel van de Noordzee (BNZ) en vindt plaats in vier controlezones, verdeeld in sectoren, waarvoor concessies/vergunningen worden verleend. De Federale Overheidsdienst Economie (Dienst Continentaal Plat) is, in samenwerking met het Instituut voor Landbouw- en Visserijonderzoek (ILVO) en de Beheerseenheid Mathematisch Model voor de Noordzee (MUMM), verantwoordelijk voor het duurzame beheer van extractie activiteiten op het Belgisch Continentaal Plat (BCP) (vergunningen, monitoring).

Geëxtraheerd zand wordt gebruikt voor de bouw, strandsuppleties (kustverdediging) en voor landaanwinning. Historisch gezien zien we dat de zandwinning is toegenomen van 29.000 m^3 in 1976 tot 5,5 miljoen m^3 in 2015. Tot 1988 bleef de extractie constant op ca. 0,5 miljoen m^3, en is ze sindsdien gestaag toegenomen. Pieken kunnen worden waargenomen na zware stormen (kustverdediging) (bijv. in de lente van 2014, winter 2017).

De sector voor aggregaatextractie stelde in 2016 in totaal 262 personen te werk, inclusief activiteiten buiten het BNZ. De werkgelegenheid in het BNZ was goed voor 124 VTE. De totale productie van zeeaggregaten in het BDZ bedroeg 1.341.486 ton in 2016. De totale omzet van de sector bedroeg 16.151.209 Euro (inclusief productie buiten het BNZ). Informatie over de bruto toegevoegde waarde was niet beschikbaar voor de referentieperiode. Naar verwachting zal de jaarlijkse vraag naar zand met 6% toenemen tot 2050 (Langetermijnvisie Noordzee 2050).

Het huidige mariene ruimtelijke plan (2020) omvat onder andere de gedeeltelijke sluiting van de Kwintebank voor zandwinning, een herdefinitie van sectoren voor nautische veiligheid en natuurbescherming, opname van de Passende Beoordelingsprocedure in nieuwe concessies binnen het Natura 2000-gebied 'Vlaamse Banken', een geleidelijke vermindering van gewonnen volumes in de SBZ 'Vlaamse Banken' en de evaluatie van meervoudig gebruik van de zandwinningszones. Tegen 2030 zal een extra zone worden afgebakend in het noordelijke deel van het BNZ, naast enkele optimalisaties van de bestaande zones.

De huidige kosten van aantasting omvatten derhalve kosten in verband met vergunningen (incl. MER en Passende Beoordelingen), ook kosten in verband met monitoring, inspectie van winningsactiviteiten en bestuurskosten.

Baggeren en dumpen op zee

Het onderhoud van de toegang tot de havens van Oostende, Zeebrugge en de kleinere havens van Nieuwpoort en Blankenberge, en de scheepvaartroutes vereist regelmatig onderhoudsbaggerwerken (Vlaamse bevoegdheid). Daarnaast zijn er ook aanzienlijke baggeractiviteiten voor de aanleg, verdieping en verbreding van havens. Het grootste deel van het gebaggerde materiaal wordt op specifieke stortplaatsen op zee gedumpt of hergebruikt om stranden aan te vullen als de kwaliteit dit toelaat. Het beheer van bagger- en stortoperaties (incl. toekennen machtigingen, monitoring milieu-impact) valt onder de verantwoordelijkheid van de federale

overheid, in overeenstemming met internationale vereisten (bijv. criteria voor sedimentkwaliteit).

De huidige werkgelegenheid wordt geschat op 240 VTE of 560 VTE, afhankelijk van de bron. De baggeractiviteiten zullen grotendeels ongewijzigd blijven tegen 2030, rekening houdend met de veilige nautische toegang en evoluties in de scheepstechnologie. Tegen 2030 kunnen sommige stortplaatsen geoptimaliseerd worden in verband met natuurbehoud en ze zullen verder worden uitgebreid met een reserveringszone in de buurt van Zeebrugge.

De huidige kosten van aantasting omvatten het opleggen van voorwaarden en beperkingen voor het dumpen van opgebaggerde sedimenten, het controleren op activiteiten met een verbodsbepaling en op het nakomen van gebruikersovereenkomsten. Baggerbedrijven moeten een aantal kosten dragen die verband houden met het inperken van milieueffecten: anti-turbiditeitssystemen, machtiging voor het dumpen van opgebaggerd materiaal op zee.

Toerisme

Toerisme is een belangrijke economische sector langs de Belgische kust, met meer dan 5 miljoen bezoekers en 28,4 miljoen overnachtingen in 2013. De toeristische sector heeft een uitgebreide infrastructuur nodig en oefent een aanzienlijke invloed uit op verstedelijking en infrastructuur in de kustgebieden. Er werden jachthavens gebouwd in Nieuwpoort en Blankenberge. De jachthaven van Nieuwpoort heeft ligplaatsen voor ongeveer 2000 boten en is de grootste van Noord-Europa.

De toeristische sector langs de Belgische kust is belangrijk met naar schatting 27.000 directe banen (gegevens 2013) en een totale omzet van 2803,5 miljoen euro in 2014. Er zijn geen recente gegevens beschikbaar voor de toerismesector over de bruto toegevoegde waarde. Gegevens uit 2007 toonden aan dat deze 335,814 miljoen euro bedroeg.

Er worden geen significante veranderingen verwacht in de toeristische en recreatieve mogelijkheden in het Belgische kust- en zeegebied tegen 2030. Verdere investeringen en diversificatie zijn op langere termijn vereist voor strand- en sportclubs (Langetermijnvisie Noordzee 2050).

De huidige kosten van aantasting zijn onder meer gerelateerd met bewustmaking rond het probleem van zwerfvuil op zee en het belang van strandschoonmaakacties, verdere sensibilisering voor afvalbeheer en olievervuiling door pleziervaartuigen (vooral in jachthavens). Sommige toeristische activiteiten kunnen onderworpen zijn aan Passende Beoordelingsprocedures, in het geval van mogelijke gevolgen voor beschermde mariene gebieden (bijvoorbeeld voor sportwedstrijden),

Recreatieve visserij

In 2015 werd het totale aantal recreatieve vissersboten geschat op 778, gelegen in de havens van Nieuwpoort, Zeebrugge, Oostende en Blankenberge. Het totale aantal visreizen door de recreatieve visserijvloot bedraagt 10.735 dagen. De meeste activiteiten vinden plaats binnen de 3-nm-zone.

Er is zeer weinig informatie beschikbaar over het economische belang van de recreatieve visserij wat betreft directe werkgelegenheid, productiewaarde en toegevoegde waarde. Een eerste schatting van de ICES-Werkgroep voor Recreatieve Visserij (WGRFS), gebaseerd op een participatiegraad van 0,22%, vermeldde een gemiddelde uitgave van 1.372 Euro/visser/jaar (ILVO). Op basis van deze schatting bedragen de totale uitgaven van recreatieve vissers 33 miljoen euro per jaar (Persoon 2015, Hyder et al. 2016). Het lopende project 'Recreatieve Zeevisserij' van het Vlaams Instituut voor de Zee zal nauwkeurige gegevens genereren, die in 2018 beschikbaar zullen zijn.

Op dit moment is recreatieve bodemberoerende visserij over het algemeen verboden in de volledige speciale beschermingszone 'Vlaamse Banken', met enkele uitzonderingen voor het vissen te paard, te voet en voor recreatieve vissers die al langer actief zijn (kunnen een vergunning hebben om 10 keer per jaar te gaan vissen). Recreatieve warrelnetvisserij in het gebied van de 'Vlaamse Banken' is verboden. Dit zal naar verwachting hetzelfde blijven tegen 2030.

De huidige kosten van aantasting op basis van bestaande maatregelen omvatten kosten van beheer en handhaving van de maatregelen om de recreatieve visserij in de SBZ ‘Vlaamse Banken’ te beperken en om in windparken te verbieden, het naleven van een verbod op schaaldiervisserij en het gebruik van kieuwnetten. Nieuwe maatregelen omvatten maatregelen om de bijvangst van zeezoogdieren te verminderen, toezicht op de recreatieve visserij op te voeren, toezicht op de omvang van de sector, bevorderen van de conversie van recreatieve visserij naar commerciële visserij en stimulering van alternatieven voor de visvangst.

Andere toepassingen van het Belgische deel van de Noordzee

De volgende activiteiten vinden ook plaats in het BNZ, maar zijn minder belangrijk in socio-economisch opzicht: onderzoek, militaire operaties, de Paardenmarkt als historische munitiedump, ankergebieden en toevluchtsoorden, telecomkabels en gaspijpleidingen, scheepswrakken en kustverdediging. Een korte beschrijving is opgenomen in het rapport.

3. Initiële stappen naar een ecosysteembenadering voor de Belgische mariene wateren

Gezien de toegenomen aandacht voor een ecosysteemgerichte benadering in Europa (Biodiversiteitsstrategie, KRMS) en op OSPAR-niveau, is België begonnen met het uitwerken van de ecosysteembenadering voor zijn mariene wateren. Naar verwachting zal de ecosysteemdienstenbenadering, waaronder de monetaire waardering van ecosysteemdiensten, nieuwe inzichten voor beleidsmakers opleveren en bijdragen aan een betere besluitvorming. Ecosysteemdiensten worden gedefinieerd als goederen en diensten - de voordelen - die mensen verkrijgen van ecosystemen, en de directe en indirecte bijdragen van ecosystemen aan het menselijk welzijn.

De ecosysteemdienstenbenadering geeft informatie over de waarde van het verschil in ecosysteemgoederen en -diensten die zouden worden verstrekt in het geval van een Goede Milieutoestand (GMT) in vergelijking met het Business-as-Usual (BAU) -scenario. De volgende stappen zijn kenmerkend voor de aanpak en werden geïllustreerd voor de case 'Vlaamse Banken', meer specifiek voor de sector aggregaatextractie.

1. **Reikwijdte van het mariene ecosysteem en abiotische diensten voor het BNZ:** Op basis van de MAES-classificatie voor KRM-rapportage 2018 (WG Dijk, 2017), verder uitgewerkt om rekening te houden met abiotische diensten, werd een overzicht van ecosysteemdiensten gemaakt. Door prioriteit te geven aan deze ecosysteem- en abiotische diensten, rekening houdend met de relevantie ervan voor het Belgische deel van de Noordzee (BNS), zijn 16 ecosysteemdiensten verder meegenomen in de beoordeling: 3 voorzienende diensten (P) (voedsel uit de zee, grondstoffen, hernieuwbare energie), 7 regulerende diensten (R) (kusterosiebestrijding, toegankelijkheid van de navigatie, bescherming tegen overstromingen, het onderhouden van populaties en habitats voor kwekerijen, beheersing van ziekten en plagen, behoud van gemeenschappen voor het bouwen van riffen, waterkwaliteit) en 6 culturele diensten (C) (ervaringswaarde, milieu-/esthetische waarde, wetenschappelijk, educatief, erfgoed/cultureel, amusement).

2. **Ontwikkeling van het beoordelingskader** dat het verwachte kwalitatieve effect van de antropogene druk op verschillende ecosysteem- en abiotische diensten voor de Belgische mariene wateren weergeeft. De 3 belangrijkste drukgroepen die onder de loep werden genomen, waren fysische verstoring, biologische verstoring en verstoring door inbreng van stoffen, afval en energie in het mariene milieu.

3. **De beoordeling van de toestand van het mariene ecosysteem** werd geïllustreerd voor de case 'Vlaamse Banken' door 2 scenario's te vergelijken: de huidige toestand 2016 (gebaseerd op gedeeltelijk geïmplementeerde MSP (2014-2020) en bestaande maatregelen) en de verwachte toestand (2020) (op basis van volledig geïmplementeerde MSP (2014-2020) en aanvullende nieuwe maatregelen nodig om GMT te bereiken). De belangrijkste veranderingen in activiteiten en druk zullen naar verwachting de grootste impact hebben op de volgende ecosysteemdiensten voor de Vlaamse Banken: voedsel uit de zee (P1), Grondstoffen (P2), Kusterosie (R1) / Bescherming tegen overstromingen (R3), Behoud van populaties in kwekerijen en habitats (R4), Onderhouden van rifbouwende gemeenschappen (R6) en Bestrijding van plagen en ziekten (R5). Daarnaast werd er een kwalitatieve beoordeling geïllustreerd voor de agregaatsector met de resultaten van een geleidelijke vermindering van de zandwinning in het Vlaamse Bankengebied tot 2020. Er zijn meer gegevens nodig om een kwantitatieve beoordeling mogelijk te maken.

4. **Economische waardering van ecosysteemdiensten** die de gevolgen voor het menselijk welzijn van de aantasting van het mariene milieu in monetaire termen beschrijft. Voortbouwend op het voorbeeld van aggregaat extractie werd er een preliminair stroomschema opgesteld om potentiële veranderingen in de input van grondstoffen, werkgelegenheid en economisch rendement te illustreren. Er zijn meer gegevens nodig om een gedetailleerde monetaire waardering mogelijk te maken.