2 Maritime transport, shipping and ports

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Currently, more than 80% of global trade (by volume) is transported by sea, accounting for 11.1 billion tonnes of goods in 2019 (+0.5% vs. 2018) (UNCTAD 2020, UNCTADSTAT). The economic and social disruptions caused by COVID-19 negatively impacted world trade in 2020 with an average decline in value of 9%. The greatest negative impact was recorded in the first half of 2020 with a 15% value reduction. From the third quarter onwards, world trade started to recover, mainly due to the increase in trade in goods, while trade in services remains far below average (Pallis et al. 2021, UNCTAD 2021a, UNCTAD 2021b). In the first quarter of 2021, total world trade was already at a higher level (+3%) than in the same quarter of 2019 (i.e. before the crisis), mainly driven by the strong export performance of the East Asian economies (UNCTAD 2021b).

In early 2020, the world merchant fleet consisted of 98,140 commercial vessels with a gross tonnage of more than 100 GT, equaling a total of of 2.1 billion DWT (dead-weight tonnage) (UNCTAD 2020). The top three countries in terms of ship ownership within the world merchant fleet (in DWT) are Greece (17.8%), Japan (11.4%) and China (11.2%). The main flag states are Panama, Liberia and the Marshall Islands, together accounting for 42.0% of the global DWT. Belgium had 301 seagoing vessels in 2020 accounting for 1.5% of global DWT, of which 188 were sailing under a foreign flag (UNCTAD 2020; see also list Belgian seagoing ships). The evolution of the Belgian merchant fleet is also covered in the triennial study of the Royal Belgian Shipowners' Association (RBSA 2017).

The Belgian seaports are situated along one of the busiest shipping routes in the world. The total cargo throughput in the Le Havre - Hamburg range[1] amounted to 1.2 billion tonnes in 2019. The share of the Flemish seaports amounted to 318.0 million tonnes (26.1%), of which Antwerp accounted for 238.5 million tonnes (Merckx 2020).

Maritime transport and shipping in the Belgian part of the North Sea (BNS) are discussed in detail below. For ports, only seaports (mainly for handling sea-going vessels) are considered in the current thematic chapter, whereas fishing ports (berths for fishing vessels, see thematic chapter **Fisheries**) and marinas (berths for recreational boats, see thematic chapter **Tourism and recreation**) are not considered (Port jargon Mobility Council).

2.1 Policy context

The United Nations Convention on the law of the sea (UNCLOS 1982) is of primary importance for the policy context for maritime transport, shipping and ports. This convention is considered as the constitution of the sea, discussing the general rights and obligations of nations (flag states, coastal states and port states). On an international level, shipping and maritime transport are covered by several international treaties and resolutions of the International Maritime Organization (IMO, Brochure IMO 2013). Those instruments deal with safety and security at sea, traffic regulations, the training of crew members and pollution prevention (accidental as well as operational discharges) (see IMO website). Some of these conventions are discussed further under **2.5 Sustainable use** and are explained in more detail in Verleye et al. (2018).

The Paris Memorandum of Understanding on Port State Control (MoU Paris 1982) states that each authority shall maintain an effective port state control system so that foreign seagoing vessels calling at its ports comply with the standards set out in the international conventions referred to above and the European Directive on Port State Control (Directive 2009/16/EG).

On a European level, the Directorate-General for Mobility and Transport (DG MOVE) is competent for maritime transport and ports. In December 2020, the European Commission published its Strategy for sustainable and smart mobility (COM (2020) 789) which focuses on greenhouse gas emission reductions, connectivity and digitalisation. The level of ambition of the emission reduction targets is mainly driven by the provisions within the European Green Deal (COM (2019) 640). Furthermore, the European Maritime Safety Agency (EMSA) is of relevance in the context of maritime transport and shipping. This agency aims to reduce the risk of maritime incidents, pollution from ships and the loss of life at sea. An overview of European regulations and policies relevant to ports and maritime transport is given, among others, in Merckx et al. (2012) and Verleye et al. (2018).

In Belgium, maritime transport is a federal matter, covered by the FPS Mobility, Directorate-General of Maritime Transport (other federal actors are listed in table 1). DG Shipping ensures that vessels sailing under a Belgian flag, or vessels entering Belgian ports, comply with the international maritime standards concerning shipping safety, such as the construction and equipment standards, but also the crew standards and the environmental regulations, both technically and administratively. DG Shipping represents Belgium within the IMO. The regulations with which the vessels must comply are briefly listed on the website of the FPS Mobility and Transport. The Belgian

[1] Le Havre - Hamburg range: includes the seaports between Hamburg and Le Havre. France: Le Havre, Dunkirk. Flanders: Antwerp, Zeebrugge, North Sea Port Flanders (Ghent), Ostend. The Netherlands: Amsterdam, Rotterdam. Germany: Hamburg, Bremen.

Shipping Code ('*Belgisch Scheepvaartwetboek*') of 8 May 2019 codifies Belgian maritime and inland navigation law. Strengthening 'blue shipping' is one of the central pillars of the North Sea Policy Statement 2020 (Van Quickenborne 2020) in which the reduction of greenhouse gas emissions and air pollution, waste management and the improvement of working conditions and safety on board are the main focus areas.

The Special Law of 8 August 1980 on the institutional reform defines that waterways and their appurtenances, ports and their appurtenances, pilotage services, coastal defence and beaconing services to and from the ports, as well as rescue and towing services at sea fall under the competence of the Flemish Region within the policy area of Mobility and Public Works (MOW, Policy paper MOW 2019-2024) (see overview of Flemish actors in table 1). The legislative framework regarding the Flemish ports[2] is covered by the Port Decree (2 March 1999, as amended) which forms the basis for the current port policy. The most important basic principles, as included in the Port Decree, are greater autonomy for the port authorities, uniform operating conditions, a more flexible personnel policy, compulsory legal personality for the port authorities, a clear definition of the roles of the ports and the Government of Flanders and an objectification of the financing policy. In December 2020, the Concept paper on the Flemish Port Strategy was presented to the Government of Flanders in the form of a communication. The concept note lays down the mission of the Government of Flanders with regard to the Flemish seaports and describes the overall strategic objectives and priorities of the Flemish port policy. These objectives are grouped around three basic themes: (1) maintaining the competitive position of the ports, (2) achieving sustainable growth and (3) increasing the added value of the port sector. Because ports and the logistics sector are facing important new challenges (digitalisation, green transition, unmanned shipping, etc.), the concept exceeds the intentions of an infrastructure strategy. The new port strategy does not question the current legal frameworks, but mainly aims to complement and strengthen the individual strategies of the ports, and to bring the strategy of the individual ports in line with the Flemish policy on these challenges. Another fundamental development in the Flemish port landscape is the tendency to cooperate extensively and, through increases in scale and the development of synergies, to make the ports more resilient and give them new opportunities for development. In this context, reference can be made to the cross-border merger between the port of Ghent and Zeeland Seaports (North Sea Port) in 2018 and the planned merger (early 2022) between ports of Antwerp and Zeebrugge (Port of Antwerp-Bruges).

The coordination and the consultation between the competent federal and Flemish services (table 1) and the gourvernor of the province of West Flanders is carried out by the Coast Guard (cooperation agreement of 8 July 2005). The organisational structure of the Coast Guard consists of a policy-making body, a consultation body and a secretariat. The policy-making body coordinates the collaboration between the different partners and advises the responsible ministers (article 6 of the cooperation agreement of 8 July 2005). The consultation body of the Coast Guard investigates certain files and gathers information for the policy-making body (article 12 of the cooperation agreement of 8 July 2005). The consultation body is chaired by the Governor of the Province of West Flanders who also manages the coordination of the General Emergency and Intervention Plan (ANIP) North Sea (see Belgian official journal of 20 October 2016). The Coast Guard cooperation agreement also includes the creation of the Coast Guard Centre.

The Coast Guard Centre is the operational section of the Coast Guard and consists of two services, which collaborate intensively: the Maritime Rescue and Coordination Centre (MRCC) in Ostend (acting as the national IMO Coastal Station, the first point of contact for vessels in distress and in charge of the coordination of rescue operations) and the Maritime Security Centre Belgium (MIK) in Zeebrugge (cooperation between the Naval Component, the Shipping Police, Border control and the DG Shipping to ensure compliance with the laws applicable on the BNS). Their tasks were laid down in the Decree of 16 June 2006, the Decision of the Government of Flanders of 26 October 2007 and the RD of 6 February 2009.

Other relevant organisations and clusters that were not included in table 1 are:

- The Mobility Council of Flanders (MORA) is the strategic advisory council for the policy domain of Mobility and Public Works (MOW). In March 2019, the operations of the Flemish Ports Commission (VHC), which until then had an advisory and informative function with regard to the socio-economic aspects of ports and port policy, were integrated into the MORA.
- The Environment and Nature Council of Flanders (Minaraad) is a strategic advisory council for the policy area Environment of the Government of Flanders. The advices of the Minaraad sometimes include port- and shipping-related topics.

[2] The Flemish ports include the ports of Antwerp, Ghent, Zeebrugge and Ostend. Since December 2017, the port of Ghent has merged with Zeeland Seaports (Terneuzen and Vlissingen) to form North Sea Port. The Ghent part is referred to as North Sea Port Flanders.

An overview of the legislation related to shipping and ports is also given in the Codex Coastal Zone, themes Shipping and Port and Industry. The environmental legal context of port policy, management and operation is outlined in detail in Van Hooydonk et al. (2003).

Table 2. Overview of the Flemish and federal partners of the Coast Guard structure.

Flemish partners of the Coast Guard	Federal partners of the Coast Guard
Strategy, International Policy and Animal Welfare Department	FPS Home Affairs (Civil Protection, Crisis Centre and Maritime Police)
Fisheries service	FPS Foreign Affairs
AMSC (*MDK*) - Coastal division	FPS Economy, SMEs, Self-employed and Energy
AMSC (*MDK*) - Shipping Assistance division	FPS Finance (Customs and Excises)
AMSC (*MDK*) - Pilotage	FPS Mobility and Transport (DG Shipping)
AMSC (*MDK*) - Fleet	FPS Public Health, Safety of the food Chain and Environment (Marine Environment division)
MOW - Department of Policy	Ministry of Defence
MOW - Maritime Access Department	Federal Institute for Sustainable Development
	POD Science Policy (Management Unit Mathematical Model of the North Sea (MUMM))

2.2 Spatial use

2.2.1 Offshore

In the marine spatial plan (MSP 2020-2026, RD of 22 May 2019, see also Verhalle and Van de Velde 2020), the most important shipping routes to reach the Belgian ports and the Scheldt ports are legally demarcated (figure 1). Within these areas, shipping has priority over other activities, but vessels are not obliged to follow these routes. The current navigational routes in Belgian and Dutch waters have been applied since 1 June 2017, and are mainly necessary for the safety of the Belgian offshore wind farms on, and in the surroundings of, the Thornton Bank (no access for vessels) and to promote the safety of shipping and to limit the risk of collisions with possible environmental pollution as a result (figure 1). The shipping routes also consider the offshore wind farms in Dutch waters (including Borssele). Other activities may be allowed within these demarcated zones, as long as they do not hinder shipping. For a number of these routes, a routeing system (ship's routeing, IMO) has been adopted within the IMO:

- Traffic separation scheme Noordhinder South;
- Precautionary area (where vessels have to navigate carefully) Noordhinder Junction;
- Traffic separation scheme Westhinder;
- Precautionary area Westhinder;
- Area to avoid Westhinder;
- Deepwater route (specifically for vessels with a limited maneuverability due to their draught) for approaching the Western Scheldt;
- Precautionary area north of the Deepwater route;
- Traffic flow Westpit, along the southern side of the zone delineated by the domain concession for the windmills in east-western direction.

In addition to the frequently used routes for which IMO has created routeing systems, other important and frequently used shipping routes towards the ports or the Scheldt area exist in the BNS. These routes are used by vessels because they are marked and/or dredged, guaranteeing a safe water depth for shipping. Most of these routes within the territorial sea are also pilotage routes (most merchant ships are subject to compulsory pilotage). Furthermore, a precautionary area is defined around the zone reserved for the construction and operation of renewable energy production facilities. A safety zone of 500 m is established around individual fixed structures, which will be counted from the boundaries of the concession zones as the offshore wind farm becomes operational cf. RD of 4 February 2020 (see also thematic chapter **Energy (including cables and pipes)**). The anchor areas Oostdyck and Westhinder are also delineated in the MSP 2020-2026.

The provisions and information concerning navigation in the BNS are communicated via the Notices to Mariners (NtM, more information: general provisions NtM 2020 nr. 1).

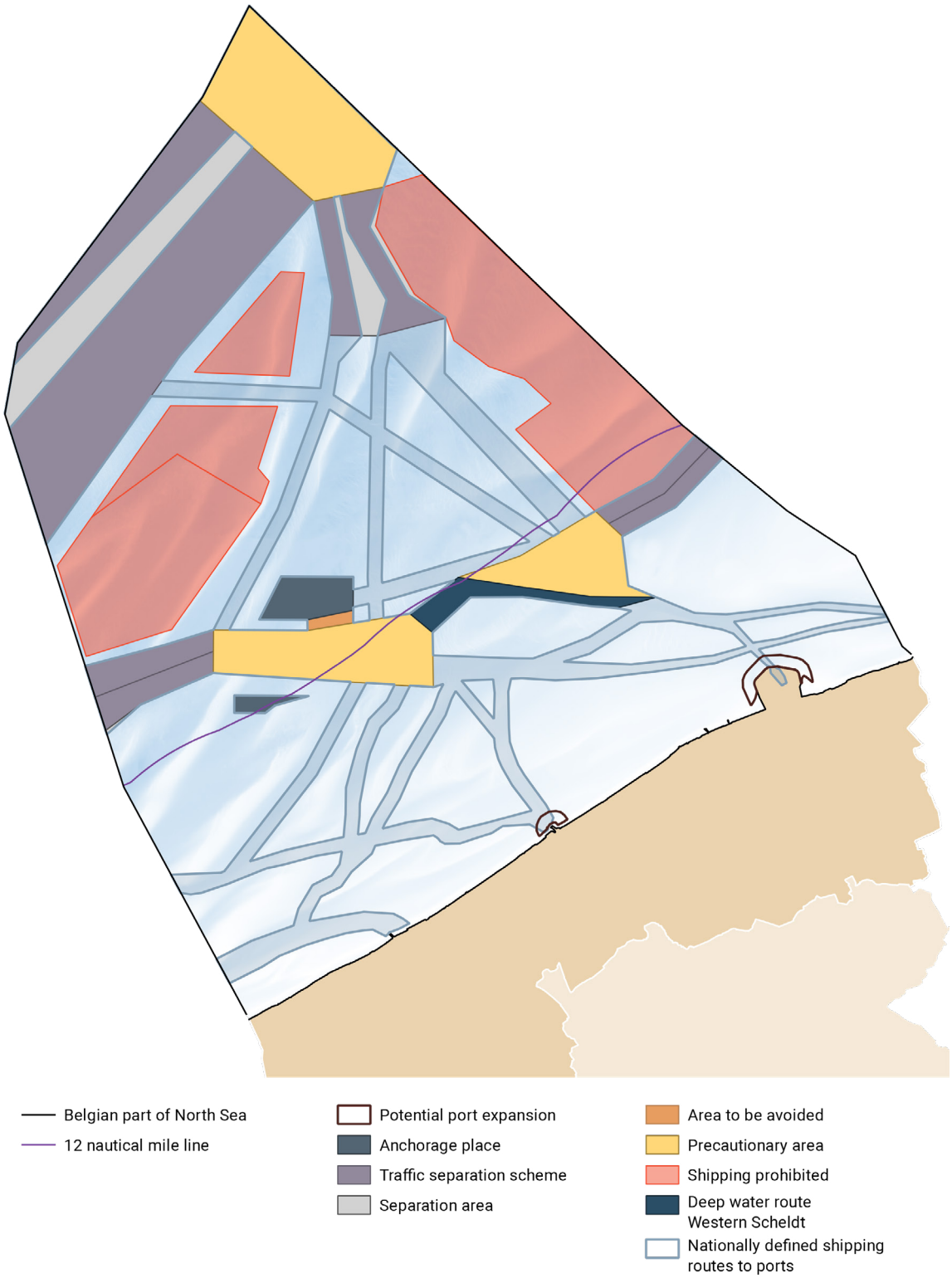

Figure 1. Indication of IMO shipping routes, anchorage areas, areas to be avoided and potential port expansions (Source: RBINS, MarineAtlas.be (based on the RD of 22 May 2019 (MSP 2020-2026)), Coastal Portal).

2.2.2 Port zones

In accordance with the provisions in the Spatial Structure Plan for Flanders (*Ruimtelijk Structuurplan Vlaanderen*; RSV), the Port Decree and consecutive coalition agreements, every Flemish seaport should have a strategic plan (including environmental impact assessments (plan-EIA) (see also **2.4 Impact**) and spatial safety reports) in which it is investigated how the economic interests can be sustainably aligned with other societal interests when the port area is further developed. This plan is the basis of the demarcation of seaports in a regional spatial implementation plan (RSIP): RSIP Ghent Seaport (2005), Ghent Seaport Phase 2 (2012), Zeebrugge (2009), Ostend (2013) and Antwerp (2013). The spatial development and accessibility of seaports is also addressed in Groenboek Vlaanderen 2050: mensenmaat in een metropool (2012), the White Paper Beleidsplan ruimte Vlaanderen (2017) and the Strategische visie beleidsplan ruimte Vlanderen (2018).

When the port development causes a loss of natural sites, this will usually be compensated by the creation and establishment of new natural sites in other areas. These nature compensation areas are delineated in agreement with the Flemish Land Agency (VLM) and are inter alia located in the area behind the Port of Zeebrugge (website VLM) and in the basin of the Scheldt estuary, as stipulated in the Sigmaplan.

The demarcation of the different port zones has been stipulated in the RD of 2 February 1993 and in the Decision of the Government of Flanders of 13 July 2001. The total surface and the water surface of the Flemish seaports are presented in table 2.

Ports are not only dealt with in spatial planning on land. For example, the MSP 2020-2026 (RD of 22 May 2019, see also Verhalle and Van de Velde 2020) provides space on the seaside to further expand the ports of Zeebrugge and Ostend.

Table 2. Overview of the Flemish seaports and their total surface and water area (Merckx 2020).

Port	Total surface area	Water surface
Port Oostende	658 ha	199 ha
Port of Ghent (North Sea Port Flanders)	4,648 ha	623 ha
Port of Zeebrugge	2,857 ha	986 ha
Port of Antwerp	11,246 ha	2,028.4 ha

2.3 Societal interest

2.3.1 Corona pandemic and Brexit

In recent years, disruptive events, such as the Corona pandemic and the Brexit, have caused profound changes in the maritime sector. For example, the Corona pandemic and the associated lockdown period in 2020 resulted in a significant decrease in vessel movements (see **2.3.4 Vessel movements**), goods transhipment (see **2.3.5 Transshipment of goods**) and passenger traffic (see **2.3.6 Passenger traffic**) to the Flemish ports.

Additionally, the Brexit has been a fact since 1 January 2021. Belgium is one of the four main trade partners with the UK (besides the Netherlands, Germany and France). Currently, UK-based companies mainly use accompanied trucks and ferries for transport (Port of Antwerp 2020). In order to facilitate smooth customs handling and reduce transit times, companies are advised to consider alternative transport modes, such as short-sea shipping (SSS). SSS is the movement of cargo mainly by sea along a coast, without crossing an ocean. It includes the unaccompanied movements of liquid and dry bulk cargo, containers and conventional cargo, lifted on board of a cargo vessel by cranes. These recommendations were published in a Brexit white paper (2020) by the Port of Antwerp.

The Port of Zeebrugge is a hub for UK traffic, with about 70 vessels a week connecting the port with various regions in the UK. With an annual volume of 16.4 million tonnes (2020), 35% of the total handled volume in the Port of Zeebrugge, the UK is the port's largest trading partner (70% export, 30% import), of which the bulk (14.8 million tonnes) concerns roll-on/roll-off traffic (Port of Zeebrugge). Flanders Investment and Trade has developed a roadmap for the export of goods to the UK after the Brexit. The development of the Port of Zeebrugge as a Brexit-proof logistical gateway, by setting up a customs help desk, is also one of the objectives of the West

Flanders Fund for Regional Reconversion (WVFR) that was set up by the West Flanders Development Agency, together with the social partners, the federations, the sector funds and Flanders Investment and Trade.

2.3.2 Employment

Total employment in the Flemish seaports in 2019 was 239,049 full-time equivalents (FTE), of which 108,542 were direct FTE (Figure 2). Antwerp is the leading Flemish port in terms of direct employment with 64,121 direct jobs (59,1%). This is followed by North Sea Port Flanders (29,112 FTE; 26.8%), Zeebrugge (10,031 FTE; 9.2%) and Port Oostende (5,278 FTE; 4.9%). This difference in employment is partly linked to the nature of the industry and the goods traffic in the different ports (see below).

At sector level, more than one third of the personnel is employed in the maritime sector[3]. The total employment (direct + indirect) in the ports accounted for 5.9% of the total Flemish employment in 2019 (including the self-employed) (Rubbrecht et al. 2021).

The ports of Liège and Brussels together accounted for a total direct employment of 11,856 FTE. This brings the total direct employment for Belgium to 120,398 FTE of which Liege and Brussels jointly account for 9.8%. The total Belgian employment (direct + indirect) amounts to 250,905 FTE (Rubbrecht et al. 2021).

The workforce in Belgian ports has remained relatively unchanged for several years and concerns mainly male employees (83%). Blue collar workers make up the majority of the port workforce with a 52% share in 2015, followed by white collar workers (44%) and other staff (4%) (Mathys 2017).

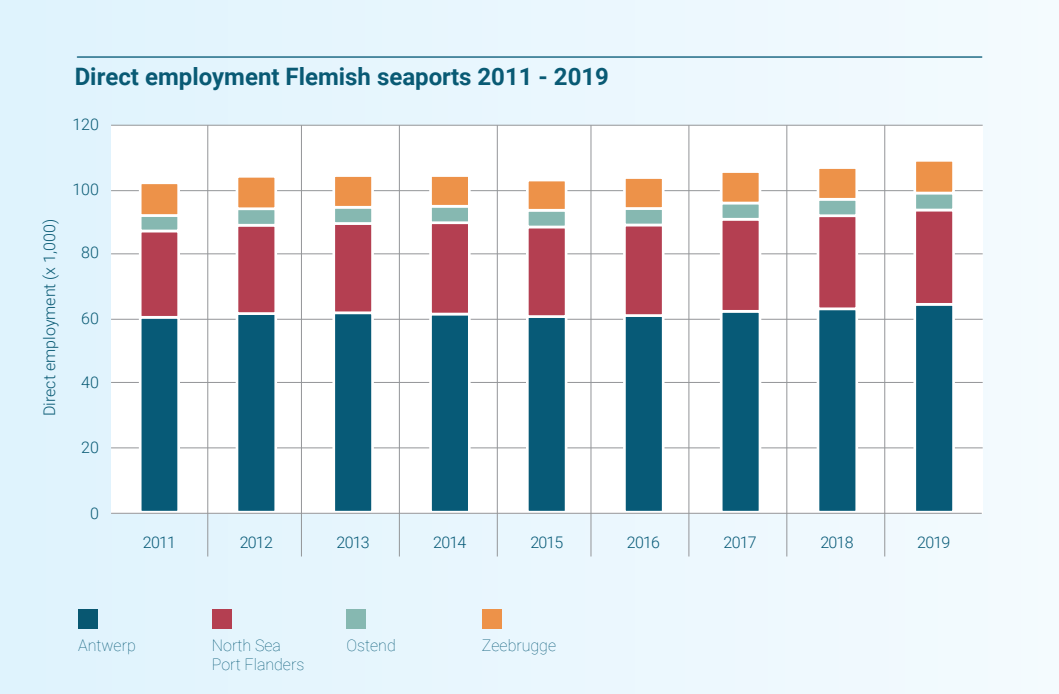

Figure 2. Direct employment in the Flemish seaports in FTEs (Source: Merckx 2020, *figures 2019 pers. comm.*, Rubbrecht et al. 2021).

2.3.3 Added value

The total added value of the Flemish ports in 2019 was 30.4 billion euro, of which 17.4 billion euro was direct added value (figure 3). Between 2013 and 2019, the direct added value of the ports increased by 18.4%. The Port of Antwerp generates the highest direct added value and accounts for 11.2 billion euro (64.5%), followed by North

[3] The maritime sector comprises those branches of industry that are specific to ports and whose existence is essential to them. Maritime branches of activity are shipping companies, shipping agents and forwarders, cargo handling, storage, shipbuilding and repair, port construction, dredging, fishing, maritime and pilotage services, locks, etc.

Sea Port Flanders (4.5 billion euro; 25.8%), Zeebrugge (1.1 billion euro; 6.2%) and Port Oostende (0.6 billion euro; 3.5%) (Merckx 2020; *figures 2019 pers. comm.*).

The ports of Liège and Brussels have a direct added value of 1.0 billion euro and 0.8 billion euro, respectively, and thus have a relative share of 9.8% of the total of Belgian ports (Rubbrecht et al. 2021).

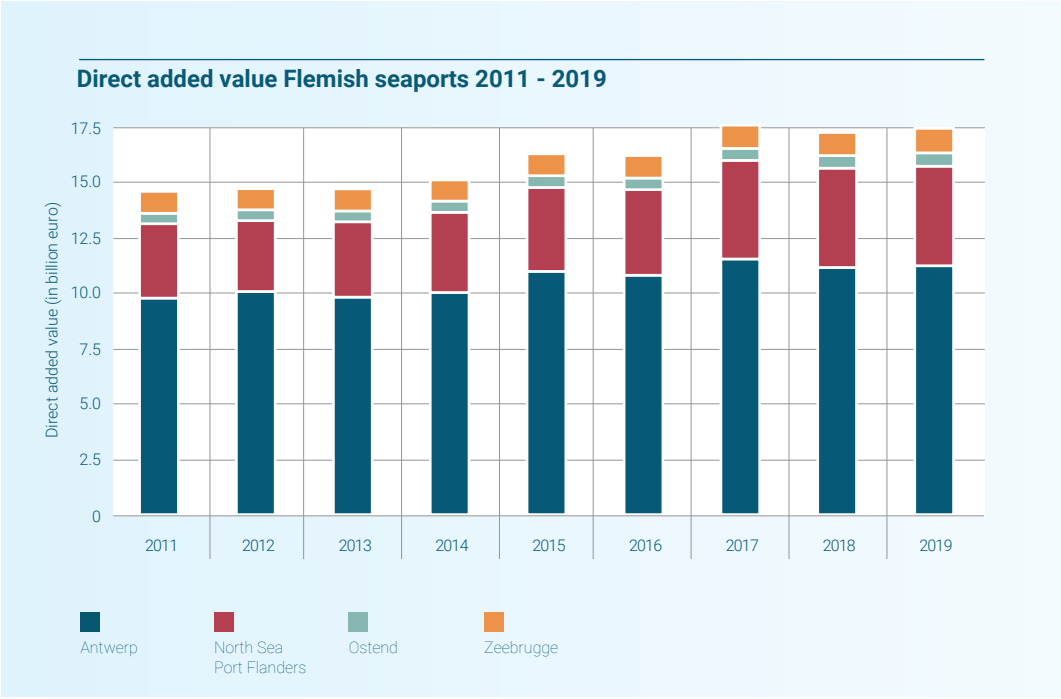

Figure 3. Direct added value in the Flemish seaports in million euro (Source: Merckx 2020, *figures 2019 pers. comm.*).

2.3.4 Vessel movements

In 2020, 30,163 seagoing vessels visited a Flemish seaport (-4.1% compared to 2019), accounting for a total of 636.9 million GT (-6.6% compared to 2019). The decrease compared to 2019 can be attributed to the corona pandemic (see also Verleye et al. 2020). In addition, the number of seagoing vessels calling at a Flemish seaport on an annual basis has been characterised by a decrease over the past four decades (-17.9% since 1980). This decline is however compensated by the increasing size of vessels, as a result of which the total Gross Tonnage (GT) today exceeds the amount from 1980 by more than 3.5 times (figure 4). At the level of individual vessels, this means an average increase from 5,237 GT to 21,115 GT (Merckx 2020; *figures 2020 pers. comm.*).

The average GT per vessel varied considerably between ports in 2020, with the average GT of vessels calling at Zeebrugge (29,840 GT) and Antwerp (28,850 GT) being remarkably higher than those calling at North Sea Port Flanders (11,322 GT) and Port Oostende (984 GT) (Merckx 2020; *figures 2020 pers. comm.*).

2.3.5 Transshipment of goods

The total maritime traffic in the Flemish ports has been characterised by a gradual increase over the past decades. Since the year 2000, only four setbacks have been recorded compared to the previous year. The main decrease in maritime traffic (-14.3% compared to the previous year) occurred in 2009, as a result of the global financial and economic crisis. In 2010, this decline was almost completely compensated (+13.6%), but the total traffic in the Flemish ports remained almost unchanged until 2015 compared to the 2008 level. It was only after 2015 that strong growth rates returned, but this upward trend was abruptly interrupted by the outbreak of the Corona pandemic in 2020, and the associated global measures and lockdowns (see also Verleye et al. 2020). In 2020, 308.6 million tonnes of goods were handled in the Flemish seaports, a drop of 3,0% compared with 2019 (figure 5). Antwerp comes out on top with 231.0 million tonnes (74.8%), followed by Zeebrugge (47.0 million tonnes; 15.2%), North Sea Port Flanders (29.1 million tonnes; 9.4%) and Ostend (1.5 million tonnes; 0.5%) (Merckx 2020; *figures 2020 pers. comm.*).

In terms of volume, the Port of Antwerp is the leading Flemish port for liquid bulk (69.0 million tonnes; 80.1%), containers (139.1 million tonnes; 88.4%) and conventional general cargo (6.6 million tonnes; 62.8%). Zeebrugge is the leading port for roll-on roll-off (14.2 million tonnes; 68.2%) while North Sea Port Flanders handles the largest amount of dry bulk (19.1 million tonnes; 56.8%) (Merckx 2020; *figures 2020 pers. comm.*).

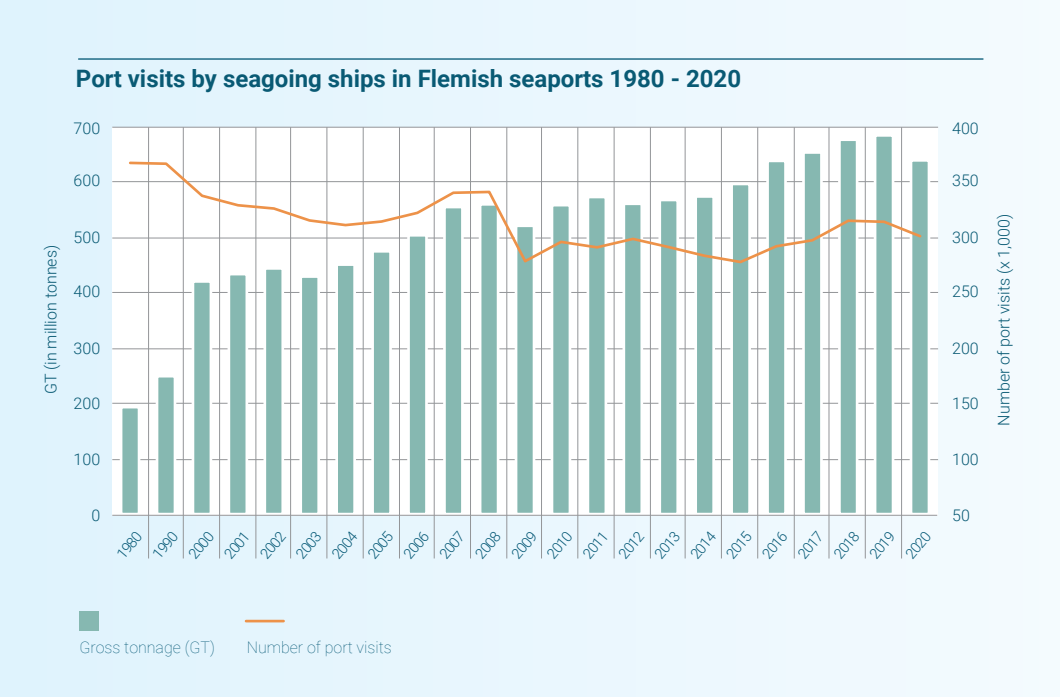

Figure 4. The number of port calls by seagoing vessels and the associated total gross tonnage (GT) (Source: Merckx 2020, *figures 2020 pers. comm.*).

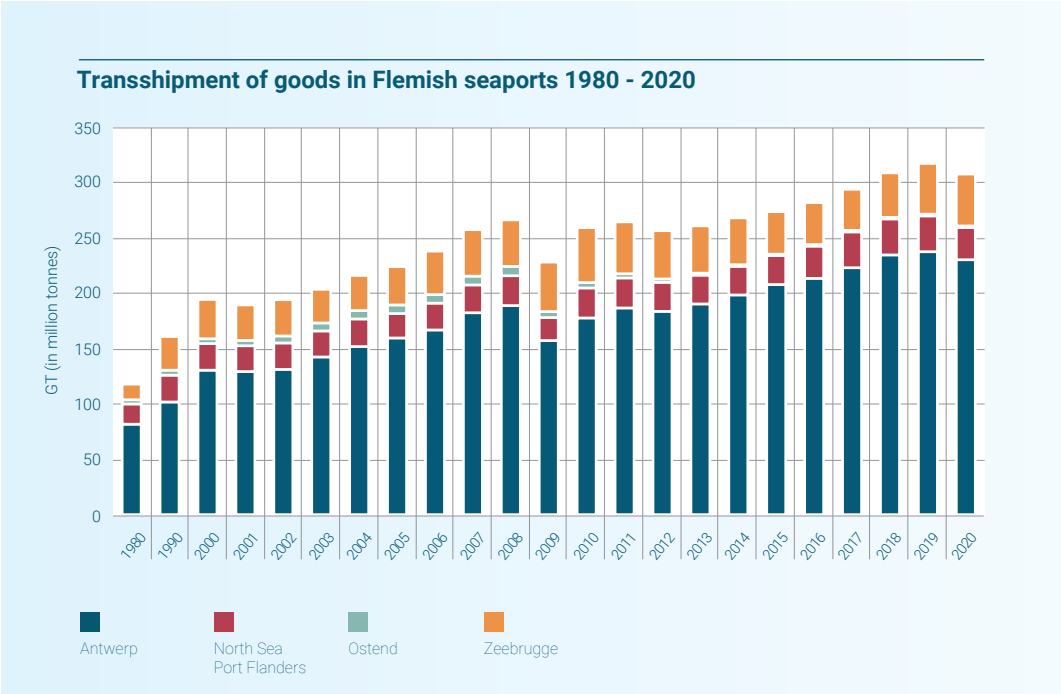

Figure 5. Transshipment of goods in the Flemish seaports (tonnes) (Source: Merckx 2020, *figures 2020 pers. comm.*).

2.3.6 Passenger traffic

Passenger traffic from and to the Flemish ports experienced a sharp decline between 1980 (over 5 million passengers) and 2004 (816,516 passengers) as a result of the opening of the Channel Tunnel, the cessation of the *Regie voor Maritiem Transport* (RMT), a company that provided a ferry connection between Ostend and the UK, and the termination of certain ferry lines to the UK (Notteboom 2004). In 2020, passenger traffic suffered greatly from the corona crisis and decreased by 93.6% compared to 2019 (figure 6). Only 66,303 people embarked or disembarked in a Flemish seaport, compared with over 1 million in 2019 (Merckx 2020; *figures 2020 pers. comm.*). In addition, on 1 January 2021, the ferry line between Zeebrugge and Hull was scrapped.

Passenger traffic in 2020 was almost entirely attributable to Zeebrugge (64,816 passengers; 97.8%). Until 2001, Port Oostende represented more than half of the passenger traffic to and from the Flemish ports, which has now fallen to 0.0% (Merckx 2020; *figures 2020 pers. comm.*).

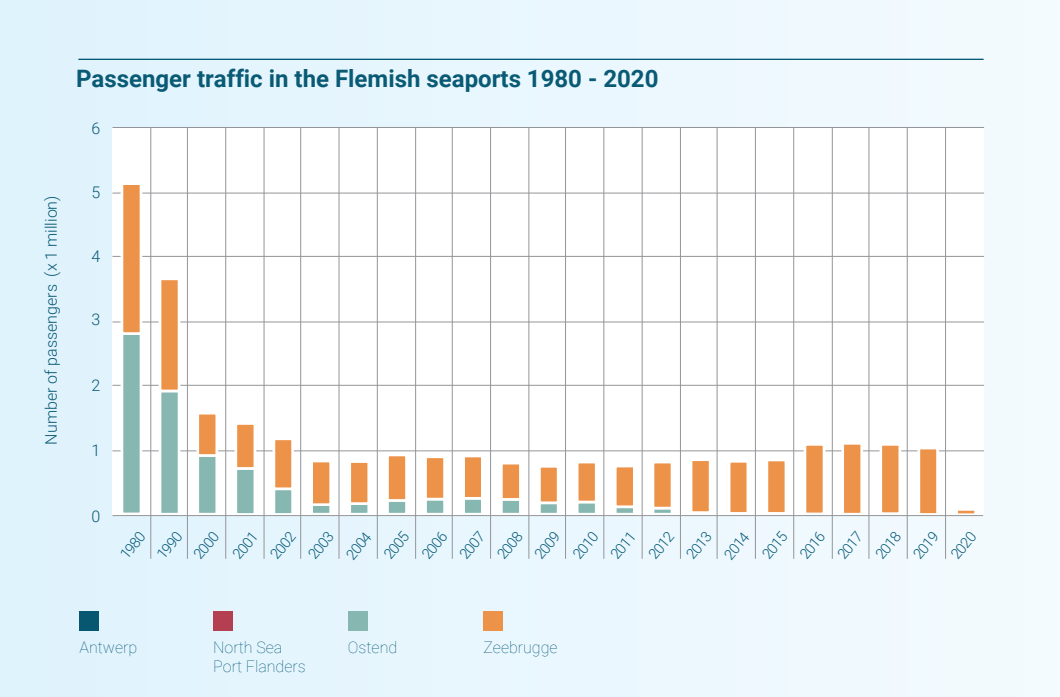

Figure 6. Passenger traffic in the Flemish seaports (Source: Merckx 2020, *figures 2020 pers. comm.*).

2.3.7 Inland navigation to and from Flemish seaports

In 2020, 125.1 million tonnes of goods were loaded and unloaded into and from inland vessels in the Flemish seaports, a decline of 0.5% compared to 2019. This represents 73.5% of the total cargo traffic by inland navigation in Flanders (170.2 million tonnes). Antwerp (101.0 million tonnes) and North Sea Port Flanders (22.9 million tonnes) together account for 72.8% of the total Flemish goods traffic by inland navigation and represent 99.0% of the share of the seaports (figure 7) (Merckx 2020; *figures 2020 pers. comm.*). The accessibility of Zeebrugge for inland navigation remains problematic, but is partly compensated by the development of the estuary shipping[4] via the Scheldt to the hinterland.

2.3.8 Investments

In 2019, direct investments in the Flemish seaports amounted to 4.5 billion euro, an increase of 45.7% since 2013, but a decrease of 23.6% compared to 2018 (figure 8). The high investment volume in 2018 (especially for Antwerp) results from a merger among shipping companies. The Port of Antwerp accounts for 72.6% of total investments in 2019, accounting for 3.3 billion euro. This is followed by North Sea Port Flanders (802.2 million euro; 17.8%), Zeebrugge (315.9 million euro; 7.0%) and Port Oostende (111.3 million euro; 2.5%) (Rubbrecht et al. 2021).

[4] Estuary shipping is sailing with reinforced inland navigation vessels at sea along the coastline, between the mouth of the Scheldt and the Port of Zeebrugge. This special mode of transport is the solution for a better connection of the Port of Zeebrugge.

Investments in the ports of Liège and Brussels amounted to 205.4 million and 102.8 million euro, respectively, in 2019. Together, they represent 6.4% of the total investments in Belgian ports (4.8 billion euro) (Rubbrecht et al. 2021).

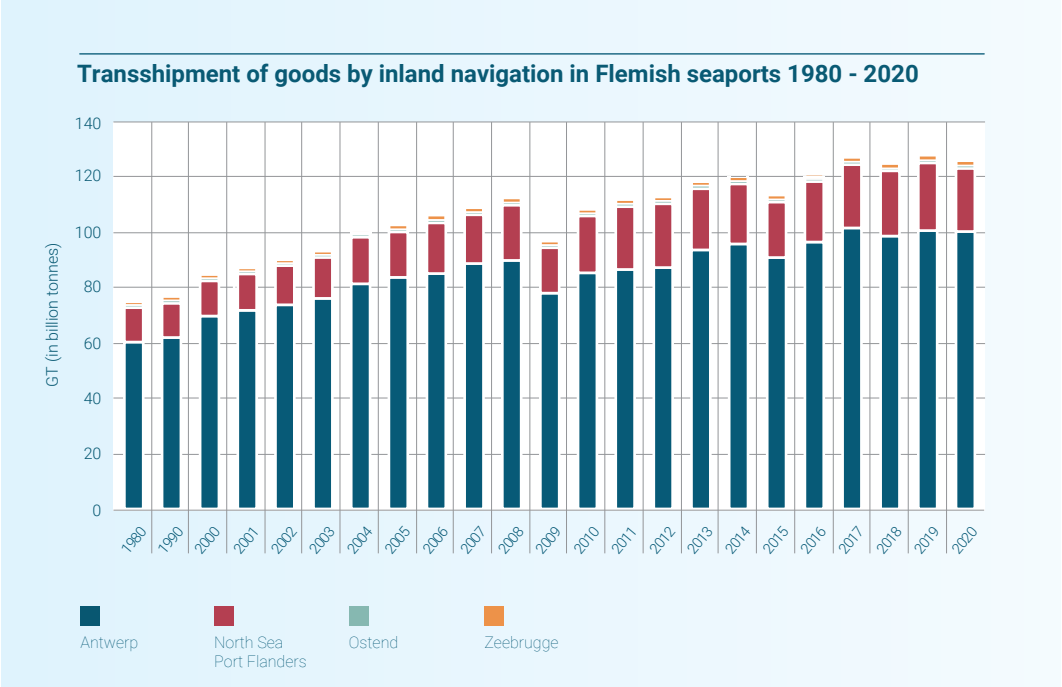

Figure 7. Transhipment of goods by inland navigation in the Flemish seaports (Source: Merckx 2020, *figures 2020 pers. comm.*).

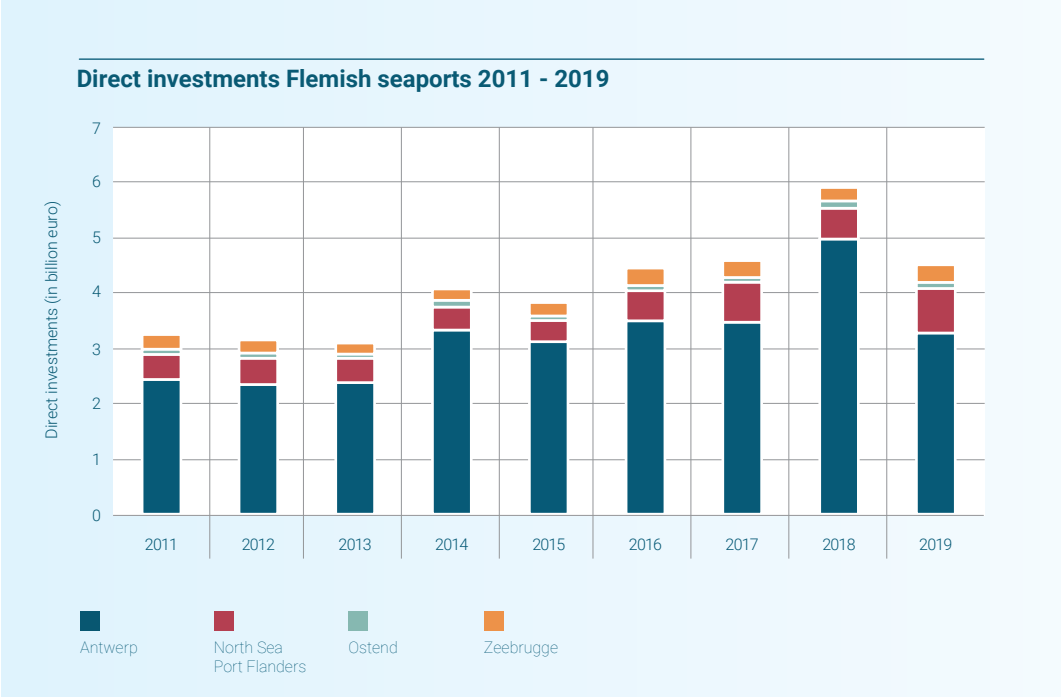

Figure 8. Direct investments in the Flemish seaports in million euro (Source: Merckx 2020 (*figures 2019 pers. comm.*), Rubbrecht et al. 2021).

2.3.9 Government expenditure

Total public spending on the Flemish seaports amounted to 462.2 million euro in 2020. 'Maritime access', with its 256.0 million euro, immediately accounts for 55.4% of total public spending. This includes maintenance dredging at sea and on the Western Scheldt, various deepening programmes, wreck removal, vessel traffic services (VTS) and sludge processing. Among the port-related expenditures (185.7 million euro), the largest budget was provided for the Port of Antwerp (149.3 million euro), followed by Zeebrugge (30.3 million euro), Port Oostende (3.2 million euro) and North Sea Port Flanders (2.9 million euro) (figure 9) (Merckx 2020; *figures 2020 pers. comm.*).

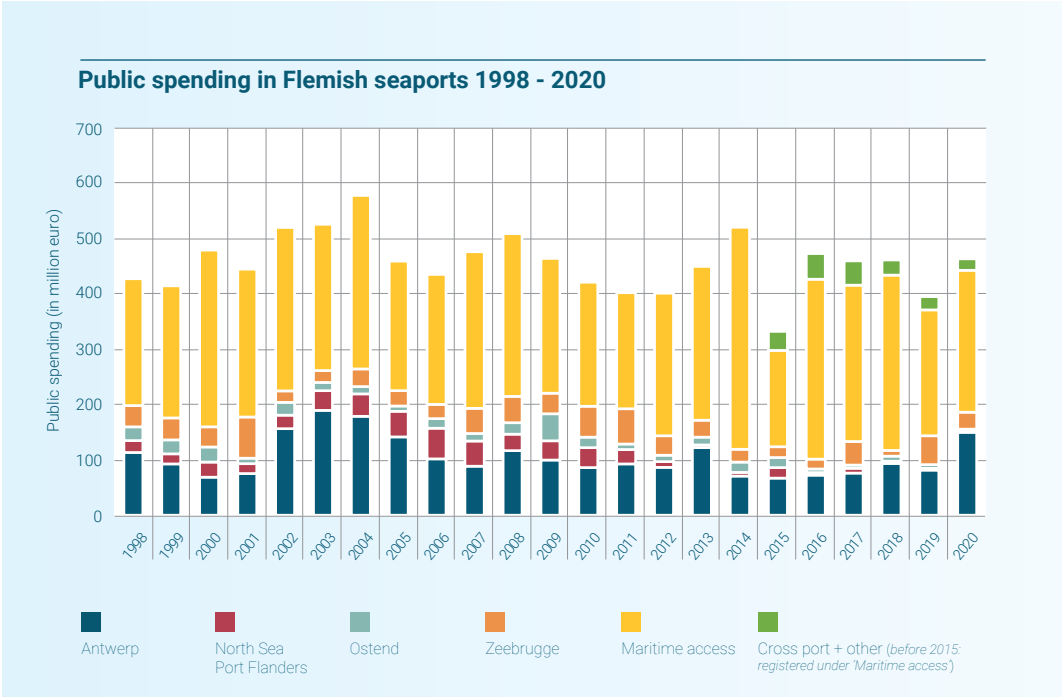

Figure 9. Public expenditure in the Flemish seaports (in million euro) (Source: Merckx 2020. *figures 2020 pers. comm.*).

2.4 Impact

Shipping has a series of effects on the marine environment. Table 3 gives an overview of the possible impacts and the relevant literature.

In addition, the port locations and operations also have an impact on the environment. These effects are listed in the (plan-) environmental impact assessments (EIAs) of the ports' strategic plans (table 4, non-exhaustive list, see also EIA file database, Department of Environment and Spatial Development).

2.5 Sustainable use

2.5.1 Roadmap towards a sustainable EU maritime transport

COM (2009) 8 developed strategic objectives and recommendations for the EU's maritime transport policy until 2018, followed by the Resolution 2009/2095(INI) of 5 May 2010 in which the European Parliament called on the Commission to take further action against the misuse of flags of convenience, to draw up new rules on state aid, to propose guidelines for ports, to take more account of maritime transport in the context of the Trans-European Transport Networks (TEN-Ts), to reduce emissions form vessels, and to develop European maritime transport within a common maritime space. Following the White Paper 'Roadmap to a Single European Transport Area' (COM (2011) 144), which proposed 40 concrete initiatives to achieve a competitive and resource efficient European transport system, the Resolution 2011/2096(INI) was adopted at the end of 2011. Specifically for maritime transport, the European Parliament called in this resolution, among other things, for the introduction of a European policy for short and medium distance shipping and a proposal for the development of a European maritime space without barriers (the so-called 'Blue Belt'). The latter was followed up by COM (2013) 510 which

aims to simplify customs formalities in order to reduce costs and facilitate trade. Regulation (EU) 1315/2013 provides guidelines for the establishment of a long-term strategy for the development of a TEN-T by road, rail, air and water. Through the Connecting Europe Facility for Transport (CEF Transport) financing channel, TEN-T projects can be financed to remove bottlenecks in this network. 'Motorways of the Sea', with Shortsea Shipping (SSS; see also **2.3.1 Corona pandemic and Brexit**) as the main transport mode (COM (2004) 453), is the maritime component of TEN-T and contributes to the creation of a European transport area without barriers.

Table 3. Overview of the environmental impact related to shipping.

Impact	Literature
Pollution by oil and other harmful substances due to accidental, operational or illegal spills	Maes et al. 2004 (MARE-DASM project BELSPO), Schrijvers and Maes 2005 (GAUFRE project BELSPO), Le Roy et al. 2006 (RAMA project BELSPO), Volckaert et al. 2006 (MIMAC project BELSPO), Goffin et al. 2007, OSPAR QSR 2010, Dittman et al. 2012, Lagring et al. 2012, Maebe et al. 2012, Dulière et al. 2013 (OSERIT project BELSPO), Bonn Agreement 2014 (BE AWARE I Summary Report), Second Federal Environmental Report 2015, Hjorth et al. 2015 (BE AWARE II Summary Report), Schallier and Van Roy 2016, OSPAR IA 2017, Stienen et al. 2017, Third Federal Environmental Report part 1 (Belgian State 2018), Third Federal Environmental Report part 2 (Belgian State 2019)
Air pollution from the emission of particles in the exhaust gas of ship engines (NOx, SOx, CO_2, etc.)	Maes et al. 2004 (MARE-DASM project BELSPO), Schrijvers and Maes 2005 (GAUFRE project BELSPO), Goffin et al. 2007, Maes et al. 2007 (ECOSONOS project BELSPO), Gommers et al. 2007 (MOPSEA project BELSPO), OSPAR QSR 2010, Bencs et al. 2012 (SHIPFLUX project BELSPO), Van Roy and Scheldeman 2016
Accidental or illegal discharge of waste or material	Goffin et al. 2007, OSPAR QSR 2010, Claessens et al. 2013 (AS-MADE project BELSPO), Second Federal Environmental Report 2015, Devriese and Janssen 2017, Third Federal Environmental Report deel 1 (Belgian State 2018), Third Federal Environmental Report part 2 (Belgian State 2019)
Leaching of harmful antifouling substances (e.g. tributyltin (TBT))	Maes et al. 2004 (MARE-DASM project BELSPO), Schrijvers and Maes 2005 (GAUFRE project BELSPO), Goffin et al. 2007, OSPAR QSR 2010, OSPAR IA 2017
Introduction of non-indigenous species by attachment to the keel or discharge of ballast water	Maes et al. 2004 (MARE-DASM project BELSPO), Schrijvers and Maes 2005 (GAUFRE project BELSPO), Goffin et al. 2007, Kerckhof et al. (2007), OSPAR QSR 2010, Vandepitte et al. 2012, State of Europe's Seas 2015, Saelens and Verleye 2015, OSPAR IA 2017, Third Federal Environmental Report part 1 (Belgian State 2018), Third Federal Environmental Report part 2 (Belgian State 2019)
Pollution and physical impact due to loss of vessels and cargo	Le Roy et al. 2006 (RAMA project BELSPO), De Baere et al. 2010, OSPAR QSR 2010
Other possible physical impact including noise and collision with marine mammals	Maes et al. 2004 (MARE-DASM project BELSPO), OSPAR QSR 2010, State of Europe's Seas 2015, compilation national reports ASCOBANS, Jomopans project, Farcas et al. 2020
Impact on other users (safety, spatial impact, etc.)	Maes et al. 2004 (MARE-DASM project BELSPO), Schrijvers and Maes 2005 (GAUFRE project BELSPO), Le Roy et al. 2006 (RAMA project BELSPO), Volckaert et al. 2006 (MIMAC project BELSPO), Nilsson et al. 2018 (NorthSEE project Interreg)

Table 4. An overview of the documents relations to the EIAs of the various Flemish seaports.

Port	(Plan-)EIAs
Oostende	Plan EIA strategic plan for the Port of Oostende (notification memorandum) 2004 Plan EIA coastal defence and maritime accessibility Ostend 2007 Project EIA flooding measures rear port Ostend 2019
Antwerp	Notification of plan EIA Port of Antwerp Strategic Plan 2006 Plan EIA strategic plan Port of Antwerp (non-technical summary) 2008 Notification of widening of navigation channel in the Lower-Zeescheldt and Western Scheldt 2006 Interim strategic plan Port of Antwerp 2006 Project EIA excavations in the Zeeschelde to Wintam 2009 Project EIA deepening and construction of soil protection at the North Sea Terminal in Antwerp 2010 Project EIA renovation Royers Lock 2014 Alternatives study note Complex project "Realisation of additional container handling capacity in the Antwerp port area" 2017 Project EIA deepening Europa Terminal 2018 Project EIA new quay wall Canal Dock B2 - Insertion Dock (non-technical summary) 2020
Zeebrugge	Plan EIA strategic plan Port of Zeebrugge 2004 Notification project EIA of the strategic port infrastructure project (SHIP) in the western inner Port of Zeebrugge 2011 Strategic environmental assessment Improving nautical accessibility to the (inner) Port of Zeebrugge 2017 Plan EIA as part of the municipal RUP 'Vissershaven' in Zeebrugge (non-technical summary) 2018
North Sea Port Flanders	Project EIA design sea port site Langerbruggekaai/De Nest (non-technical summary) 2008 Regional spatial implementation plan 'Afbakening Zeehavengebied Gent - Fase 2 EIA New Lock Terneuzen 2015

As a follow-up to COM (2009) 8, the European Commission published its Strategy for sustainable and smart mobility (COM (2020) 789) in December 2020, in which greenhouse gas emission reductions, connectivity and digitalisation are central. The emission targets are to a large extent driven by the previously formulated ambitions within the European Green Deal (COM (2019) 640). Also in the area of connectivity, the European Commission will ensure that the TEN-T guidelines are in line with the European Green Deal and that infrastructure is adapted to climate change. To this end, a revision of Regulation (EU) 1315/2013 is also envisaged. The Commission will take the necessary measures to complete the transport corridor throughout the European continent by 2030, which will require a budget of 300 billion euro. In addition to the above objectives, in its new approach to a sustainable blue economy (COM (2021) 240), the EU proposes to set up a Blue Forum for maritime users to coordinate a dialogue between offshore operators and to encourage the use of EU funds for the greening of maritime transport by promoting SSS, upgrading the ship fleet to improve their energy efficiency and developing highly advanced production and technological capacity.

On the Flemish level, Multimodaal.Vlaanderen was established in 2017 and acts as an independent advisory point for companies regarding the optimal transport mode choice (including SSS) per freight flow.

2.5.2 Safety at sea: construction, equipment and crew of seagoing vessels

There are many regulations governing maritime safety, the prevention of maritime disasters and the safety of human life at sea. Table 5 lists the most relevant international conventions, which are explained in more detail in Verleye et al. (2018). The principal convention on the safety of merchant vessels is the SOLAS Convention (Safety of Life at Sea). The first version of the convention was adopted in 1914 after the Titanic disaster. The current version dates from 1974. In 2004, the amendment providing for an International Ship and Port Facility Security Code (ISPS-code) came into force. The code defines the minimum requirements and responsibilities of governments, companies, vessel's personnel and port facility personnel for detecting security threats to vessels and port facilities involved in international trade and for taking preventive measures to avoid security incidents.

Table 5. Most relevant international conventions in the field of maritime safety.

Convention	Goals
LL 1966 (*Load Lines*)	This convention regulates the determination of the freeboards of ships, i.e. the distance from the top of the deck line to the top of the applicable line of the outfall mark.
TONNAGE 1969 (*Tonnage Measurement*)	The Tonnage Measurement Convention provides a universal tonnage measurement system for ships.
COLREG 1972 (*Collision Regulations*)	This convention provides guidelines for determining safe speeds, reducing the risk of collision and for escorting ships operating in, or in the vicinity of, traffic separation schemes.
SOLAS 1974 (*Safety of Life at Sea*)	The SOLAS Convention is considered to be the most important international convention relating to the safety of merchant ships. The main objective of the convention is to specify the minimum standards for the construction, equipment and operation of ships to ensure the safety of human life at sea.
STCW 1978 (*Standards of Training, Certification and Watchkeeping for Seafarers*)	The STCW Convention is an international convention that sets out the minimum requirements that seafarers must meet as regards training, certification and watchkeeping. The convention aims to protect the marine environment as well as to promote the safety of human life and property. The EU directives on the minimum level of training of seafarers are described in Directive 2008/105/EC.
SAR 1979 (*Search and Rescue*)	The International Convention on Maritime Search and Rescue aims to establish an international SAR-plan so that, wherever a person is in distress at sea, rescue operations are coordinated by an SAR-organisation. Today, there is also more emphasis on the regional approach and coordination between sea and airborne SAR-operations.
MLC 2006 (*Maritime Labour Convention*)	The Maritime Labour Convention brings together all existing maritime and other labour conventions of the International Labour Organisation (ILO).

At European level, the legal framework concerning ship and port facility security is provided by Regulation (EC) 725/2004, while Directive 2005/65/EC specifically focuses on enhancing port security. At national level, the aforementioned EU legislation is implemented via the Belgian Shipping Code of 8 May 2019.

The topic 'Safety requirements and safety certificates of seagoing vessels' is covered in Book 2, Title 2 – Chapter 3 of the Belgian Shipping Code of 8 May 2019. Title 4 relates to persons on board and Title 5 – Chapter 3 deals with prevention of pollution. DG Shipping (FPS Mobility and Transport) ensures that vessels sailing under the Belgian flag comply with international maritime regulations on shipping safety and the protection of the marine environment (via, among others, the Shipping Inspection Regulations - RD of 20 July 1973 and frequently amended).

Belgian Port State Control (FPS Mobility and Transport) inspects foreign-flagged vessels calling at Belgian ports to check whether they comply with the applicable international ILO (International Labour Organisation) and IMO standards. In case of infringements, departure from the port may be refused or conditions may be imposed, such as sailing to the nearest shipyard, if the deficiencies cannot be repaired in a Belgian port and are of such a nature that the safety of the ship and crew may be endangered. For more information on regional cooperation on port state control, see Memorandum of Understanding on Port State Control (MoU Paris) and the European Port State Control Directive (Directive 2009/16/EG).

The Shipping Assistance division (Agency for Maritime and Coastal Services, MDK) is responsible for the safe and smooth operation of shipping on the maritime access routes to and from the Belgian seaports by organising and offering Vessel Traffic Services (VTS). The Fleet and Pilotage Service (DABL) departments are responsible for piloting the routes to and from the Flemish ports that are subject to compulsory pilotage.

2.5.3 Preventing and combating pollution from shipping

There are numerous regulatory instruments to prevent and combat pollution of the marine environment from shipping. The UN Convention on the law of the sea (UNCLOS 1982) provides the general international legal framework addressing, *inter alia*, marine pollution (Part XII). The MARPOL Convention is the main international convention on accidental or operational pollution of the marine environment from shipping. In addition, there are a number of important treaties under the umbrella of the IMO (table 6, more detailed explanations of the relevant regulations in Verleye et al. 2018).

Table 6. Most relevant IMO-conventions on marine pollution.

Convention	Goals
CLC 1969/1992 (*Civil Liability for Oil Pollution Damage*)	This convention describes the civil liability for pollution damage caused by persistent oil.
FUND 1971/1992 (*Fund for Compensation for Oil Pollution Damage*)	This convention provides for the establishment of an international fund for the compensation of pollution damage cause by persistent oil.
MARPOL 1973/1978 (*Prevention of Pollution from Ships*)	The purpose of this convention is to prevent the voluntary and accidental discharges of oil, chemicals, noxious substances in packaged form, sewage and household wastes, and certain types of air pollution from ships, either directly by means of stringent operational discharge conditions or prohibition of discharge, emission conditions or indirectly by imposing technical measures on the construction and equipment of the ship.
LLMC 1976 (*Limitation of Liability for Maritime Claims*)	This conventions establishes a regime of limitation of liability for maritime claims.
OPRC 1990 (*Oil Pollution Preparedness, Response and Co-operation*)	The convention deals with oil pollution preparedness, response and cooperation.
OPRC-HNS protocol 2000 (*Preparedness, Response and Co-operation to pollution Incidents by Hazardous and Noxious Substances*)	The protocol covers preparation for, response to and cooperation in dealing with pollution incidents involving harmful and potentially dangerous substances.
AFS 2001 (*Anti-fouling Systems*)	The AFS Convention bans the use of harmful organotin in anti-fouling paints for ships and introduces a mechanism to prevent the future use of other harmful substances in anti-fouling systems.
BUNKER 2001 (*Bunker Oil Pollution Damage*)	This BUNKER Convention regulates the civil liability for bunker oil pollution damage.
BWM 2004 (*Ballast Water Management*)	The BWM Convention aims to prevent the further spread of invasive aquatic organisms from one region to another by introducing standards and procedures for the management and control of ballast water and sediments on board ships.
WRC 2007 (*Removal of Wrecks*)	This WRC Convention regulates the clearing of wrecks.
HNS 2010 (*Hazardous and Noxious Substances*)	The HNS Convention regulates liability and compensation for damage in connection with the carriage of hazardous and noxious substances by sea (not yet entered into force).

Other relevant international conventions and agreements that do not emanate from the IMO are the Bonn Agreement and the OSPAR Convention. The Bonn Agreement regulates the cooperation between the coastal states of the North Sea in detecting, reporting and combating pollution in the North Sea caused by oil and other harmful substances from vessels and offshore installations. Since 1991, aerial surveillance has been organised in the BNS under this agreement in order to detect illegal discharges by vessels and to provide evidence for a potential prosecution. The observation programme is carried out by the Management Unit of the North Sea Mathematical Models of the Royal Belgian Institute of Natural Sciences (RBINS-MUMM) in cooperation with the Ministry of Defence. The annual results of air monitoring are reported on the MUMM-website. Since the beginning of the aerial surveys in 1991, there has been a downward trend in the number of oil discharges and the estimated oil volume (figure 10), which shows that the measures taken within the European directive on port reception facilities (Directive 2019/833/EU) and MARPOL, as well as the increased monitoring, are having a positive effect (Lagring et al. 2012, MUMM). The number of operational discharges of hazardous substances other than oil remains a common problem and has even shown a slight upward trend since 2015 (MUMM). Within the Coast Guard, action was taken to address this by constructing a more detailed follow-up procedures in a MARPOL roadmap. The annual surveillance reports under the Bonn Agreement show that the increasing trend is also observed in the neighbouring countries (the Netherlands, France). This has led to an initiative by North Sea countries at the Marine Environment Protection Committee (MEPC), whereby a proposal for a new definition for so-called 'Persistent Floaters' within MARPOL Annex II was accepted. These are persistent floating liquids for which a new mandatory prewash procedure applies since 2021.

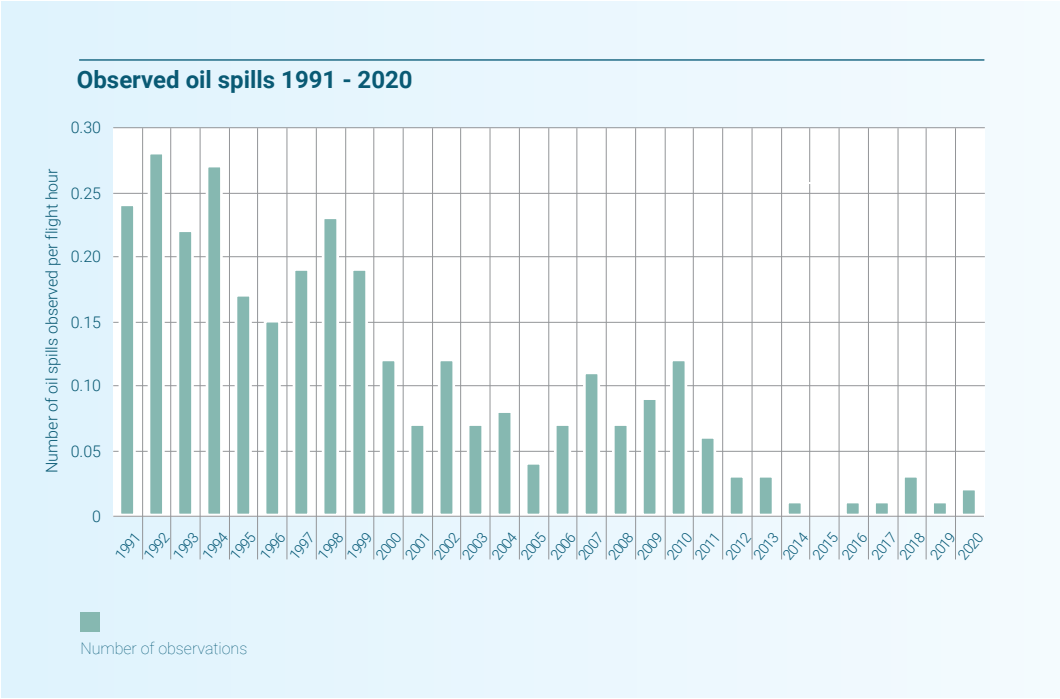

Figure 10. Number of observed oil spills per flight hour (RBINS-MUMM).

Under the OSPAR Convention (see also thematic chapter **Nature and environment**), which aims to protect the marine environment of the North-East Atlantic through international cooperation, the oil pollution rate of guillemots is recognised as an indicator of the degree of chronic oil pollution of the marine environment, a so-called EcoQO (Ecological Quality Objective). The oil pollution rate of the birds washed up on the Belgian beaches is reported by the Research Institute for Nature and Forest (INBO) (i.e. Stienen et al. 2014, Stienen et al. 2017) and can be consulted online on the website of bird victims. In the update of the initial assessment for the Belgian marine waters (Belgian State 2018), the oil pollution is evaluated (e.g. oil-covered guillemots, illegal oil discharges, acute oil pollution from the 'Flinterstar' incident in 2015) with regard to descriptor 8 of the Marine Strategy Framework Directive (MSFD, Directive 2008/56/EC). Furthermore, under the umbrella of OSPAR, operational discharges are dealt with by a network of police experts and prosecutors called NSN (North Sea Network of Prosecutors and Investigators).

After the Erika incident in 1999, a series of measures known as Erika I (COM (2000) 142), Erika II (COM (2000) 802) and Erika III (COM (2005) 585) were adopted by Europe in order to increase maritime safety. Several EU directives

and regulations implement these measures (table 7). In addition, the MSFD includes concentrations of pollutants as one of the descriptors for assessing good environmental status and identifies pollution from vessels as a pressure (more information: Law et al. 2010).

Table 7. Selection of European measures taken in the framework of the Erika initiatives.

Selection of measures	Goals
Directive 2002/59/EC	Establishment of a vessel traffic monitoring and information system to enhance the safety and efficiency of maritime traffic within the EU.
Directive 2005/35/EC	Introducing Community rules for the imposition of sanctions for discharges of oil or other polluting substances from ships in EU waters.
Framework Decision 2005/667/JBZ	Strengthening the criminal law framework for ship-source pollution response.
Directive 2009/15/EC	Formulating common rules and standards for ship inspection and survey organisations and for the relevant activities of maritime administrations.
Directive 2009/16/EC	Reforming port control mechanisms in order to efficiently verify that ships comply with the applicable regulations on maritime safety, maritime security, protection of the marine environment and living and working conditions.
Directive 2009/18/EC	Establishing fundamental principles governing the investigation of accidents in the maritime transport sector.
Directive 2009/20/EC	Insuring shipowners against maritime claims.
Directive 2009/21/EC	Compliance with flag State requirements.
Directive 2010/65/EU	Simplify and harmonise the different administrative procedures applicable to maritime transport through the introduction of electronic data transmission (by 1 June 2015) and the rationalisation of reporting formalities.
Directive (EU) 2019/883	Directive on port reception facilities for ship-generated waste and cargo residues.
Regulation (EC) 1406/2002	Establishment of a European Maritime Safety Agency (EMSA). This agency aims to reduce the risk of maritime accidents, pollution by ships and loss of life at sea. EMSA promotes initiatives such as SafeSeaNet (a centralised European information platform for the exchange of maritime data between competent authorities) and CleanSeaNet (satellite service to detect oil pollution from ships).
Regulation (EC) 391/2009	Establishment of common rules and standards for ship inspection and survey organisations.
Regulation (EC) 392/2009	Regulating the liability of carriers of passengers by sea in the event of accidents.
Regulation (EU) 530/2012	Establish an accelerated phasing-in scheme for the application of the double hull or equivalent design requirements of the MARPOL Convention to single hull oil tankers, with a deadline of 2015.

At Belgian level, the prevention of pollution from vessels is dealt with in Title 5 - Chapter 3 'Prevention of pollution' and Title 7 - Chapter 3 'Pollution caused by shipping accidents' of the Belgian Shipping Code of 8 May 2019. This Code provides the legal framework for the implementation of the MARPOL Convention. In case of a serious pollution in the BNS, the action is regulated by the General Emergency and Intervention Plan (ANIP) North Sea (see Belgian official journal of 20 October 2016) in accordance with the principles of the RD of 16 February 2006 on emergency and intervention plans.

The advanced 3D model OSERIT (Oil Spill Evaluation Response Integrated Tool, developed by MUMM) provides science-based support to decision-makers in the event of an oil spill. This integrated model provides an estimate of the environmental impact of oil pollution in the short term (1 to 5 days) and can be used to identify a polluter via backtracking (Dulière et al. 2013, OSERIT project BELSPO). This tool is made available to the Coast Guard 24/7. In addition, since the disaster with the Erika (1999), the Belgian government has a more extensive core of specific oil spill response resources at its disposal. It is the Enforcement Unit of the Marine Environment division (FPS Public Health, Food Chain Safety and Environment) that maintains and deploys this equipment in cooperation with the *Hulpverleningszone 1* and the Coast Guard partners. In case the response capacity of Belgium is insufficient, it can call on support from neighbouring countries via the Bonn Agreement (see also Verleye et al. 2018). In addition, through a specific European activation procedure, Belgium can also call on complementary stand-by oil-combating vessels and other anti-pollution services provided by EMSA. The application for additional resources is centralised in the European Commission's Common Emergency Communication and Information System (CECIS Marine Pollution) (European Civil Protection and Humanitarian Aid Operations).

In 2005 (updated in 2007), an intervention plan was also drawn up for the rescue and rehabilitation of birds affected by oil pollution at sea (Intervention plan Birds 2007). For the clearing of sea-based pollution on the beach, there is a roadmap '*Propere stranden*' that is currently being revised under the guidance of the cabinet of the Governor of West Flanders. This scenario describes the interventions in case oil or a sea mammal washes ashore on the beach and brings more structure to the actions of the public services involved, from the notification to the damage claim.

Ahead of MEPC 76, Belgium made an analyses (March 2021) on the potential impact of wash water discharges from flue gas cleaning systems (scrubbers) on the acidification of sea water in the southern North Sea. The study focused on the emission of sulphur oxides (SOx) in sea water from vessels using scrubbers and how this contributes to the decrease in pH of sea water. This study aims to support the evaluation and harmonisation of rules and guidelines for the discharge of wash water from flue gas cleaning systems into the aquatic environment.

2.5.4 Measures against the disposal of ship-generated waste

The MARPOL Convention is the main international convention for the prevention and control of marine pollution from shipping. In case of operational spills, the convention limits pollution by setting discharge standards (or prohibiting discharges). At EU level, the problem of ship-generated waste is addressed by the Directive on port reception facilities for ship-generated waste and cargo residues (Directive (EU) 2019/883/EC). This directive obliges the industry to ensure responsible delivery of ship-generated waste to ports. In the MSFD (Directive 2008/56/EC), marine litter is one of the descriptors for assessing good environmental status and has been identified as a physical disturbance to the environment. The criteria and methodological standards for the determination of good environmental status with regard to marine litter were established in Galgani et al. (2010) (see also thematic chapter **Nature and environment**, Decision of the European Commission 2017/848/EU and actualisation of the initial assessment for the Belgian marine waters, Belgian State 2018).

In Flanders, the policy regarding the reception of waste from shipping in the ports is regulated by the Materials Decree of 23 December 2011 (Article 41) and VLAREMA (Article 5.2.10 Maritime waste and Article 5.2.11 Waste from inland navigation). The collected quantities of waste have a positive evolution (OVAM 2017) and can be consulted in the waste management plan for the port Bruges-Zeebrugge (2021-2022), the waste management plan for the Port of Antwerp (2021), the waste management plan for North Sea Port Flanders (2021) and the waste management plan for the Port of Oostende (2021).

In the past, waste streams specifically from fishing vessels were mapped by Maes and Douvere (2004) and Belpaeme (2006). Through the Fishing for Litter project, the waste caught by fishing vessels can be brought ashore and its composition evaluated (see also Devriese and Janssen 2021). In addition, there is a European cooperation with fishermen whereby the collected waste is evaluated and processed for upcycling (Waste Free Oceans).

2.5.5 Measures against air emissions from shipping

Air pollution from seagoing vessels is regulated by MARPOL Annex VI. The revision of the Annex in 2008 provides for stricter limits on the sulphur content of the fuel to 0.1% since 1 January 2015 in low emission zones (Sulphur Emission Control Areas, SECAs), such as the North Sea and Baltic Sea. In 2017, the latter areas were also designated as Low Emission Nitrogen Oxide Areas (NOx Emission Control Areas (NECAs) - entering into force on 1 January 2021), within which stricter limits on NOx emissions for diesel engines apply. Different emission standard levels are used based on the date of construction of the vessel (so-called Tier I, Tier II and Tier III standards), with a gradual, significant reduction of NOx emissions from vessels operating in NECAs between 2021 and 2040. The MARPOL Convention also bans emissions of ozone-depleting substances, including halons and CFCs.

In 2011, IMO adopted a package of technical measures on energy efficiency technology for new vessels (Energy Efficiency Design Index – EEDI) and operational greenhouse gas reduction measures in the form of a Ship Energy Efficiency Management Plan (SEEMP) for all vessels above 400 GT. In 2018, the 72th session of IMO's MEPC adopted a strategy with the goal of reducing total greenhouse gas emissions from international shipping by at least 50% by 2050 compared to 2008. In order to achieve this objective, the Intersessional Working Group on Reduction of GHG Emissions from Ships developed new draft amendments to MARPOL Annex VI in 2020 during MEPC 75, building on EEDI and SEEMP, with the aim of assessing and measuring the energy efficiency of all vessels and setting targets. To this end, both technical and operational requirements to reduce CO_2 emissions are elaborated, based on the new Energy Efficiency Existing Ship Index (EEXI) and the new operational Carbon Intensity Indicator

(CII), respectively. The measures were formally adopted during MEPC 76 (2021). The amendments to MARPOL Annex VI are expected to enter into force on 1 November 2022, with the requirements for EEXI and CII certification coming into effect from 1 January 2023.

The EU has also adopted a number of measures to combat air pollution from shipping by means of Directive (EU) 2016/802. As a result, the same conditions as those in MARPOL Annex VI apply within the EU. In addition, the directive also imposes the 0,10% fuel sulphur content standard on vessels in EU ports located outside of a SECA zone (Mediterranean, Atlantic, Black Sea). Implementing Decision (EU) 2015/253 provides for the adoption of rules on sampling and reporting of the sulphur content of marine fuels. In addition, in its strategy for sustainable and smart mobility (COM (2020) 789), the EU aims to become climate neutral by 2050, by reducing dependence on fossil fuels and developing a package of measures for the decarbonisation of maritime transport.

At national level, the measures against air pollution from vessels are addressed in the RD of 15 July 2020 on environmentally friendly shipping (transposition of the MARPOL Convention and the European measures at Belgian level). Specially trained inspectors from DG Shipping regularly carry out MARPOL Annex VI controls on board vessels in ports (including fuel sampling and analysis). Since September 2015, MUMM has been measuring sulphur emissions from vessels during offshore monitoring flights using a sniffer sensor. These results are systematically communicated to the inspectors of DG Shipping so that targeted controls can be carried out within the framework of port inspections (CompMon project, Schallier et al. 2018). Since 1 January 2021 (entry into force of North Sea NECA), after a test period in 2020, MUMM has also been carrying out offshore NOx emissions monitoring with a NOx sniffer sensor. This pioneering work contributes to the international approach to air pollution from shipping within the framework of the Bonn Agreement (Bonn Agreement Strategic Action Plan 2019-2025). The North Sea Policy Statement 2020 (Van Quickenborne 2020) states that Belgium wants to continue its pioneering role by also starting controls on soot (black carbon) emissions in 2021. The results of the tests carried out by Belgium will be used to develop new regulations at the international level.

At the Flemish level, the Government of Flanders decided on 23 April 2014 to set up a Programmatic Approach to Nitrogen Deposits (PAS). The PAS is a program that aims to tackle the problem of deposition of nitrogen in special protection areas under the European Habitats Directive (Directive 92/43/EEC) by means of source-oriented (on the emission side) and effect-oriented measures. However, on 25 February 2021, the Council for Permit Disputes stated that the assessment of a possible significant deterioration of nitrogen deposition on nitrogen-sensitive nature cannot be based exclusively on the assessment framework ('significance framework') as included in the roadmaps '*Eutrofiëring via de lucht*' (Eutrophication through air) and '*Verzuring via de lucht*' (Acidification through Air) (RvVb-A-2021-0697). The Council for Permit Disputes states that a case-by-case assessment is required, in which, based on the specific characteristics and effects of the project and the environmental characteristics and conditions of the Special Protection Area (SPA) in question, it is investigated whether a significant deterioration of the natural characteristics of this SPA can be excluded. This appropriate assessment must also take into account the conservation objectives of the SPA and any cumulative effects. As a result of this judgement, the significance framework of the aforementioned practical roadmaps can no longer be used with legal certainty for the granting of permits. A new assessment framework will be laid down in the PAS. In anticipation thereof, a Ministrial Instruction and accompanying guidelines with a temporary character apply (see also Natura2000.Vlaanderen).

In addition, the provision of shore power facilities (cold ironing) (e.g. Margarino 2014) and the transition to alternative fuels cf. Directive 2014/94/EU (LNG, electricity, biodiesel, methanol, LPG, ethanol, biogas, hydrogen, etc.) are important measures against air emissions from shipping (see also EMSA website). These fuels are virtually sulphur-free and can be used to comply with the sulphur content requirements (Directive (EU) 2016/802). They can be used in combination with conventional oil-based ship fuels, meeting only part of a ship's energy needs, or as a complete replacement for conventional fuels. The type of alternative fuel chosen and the proportion of conventional fuel that is replaced have a direct effect on the ship's greenhouse gas, NOx and SOx emissions. Preparations are being made in all Flemish seaports to make LNG supply possible (see also thematic chapter **Energy (including cables and pipes)**).

The shore-based power facilities in turn ensure that vessels can switch off their engines or generators while moored. In several Flemish ports and at quays on the inland waterways network, shore-based power facilities are provided for pleasure craft, inland navigation and sea-going vessels, supported by projects such as Shore Power in Flanders (TEN-T), Zero Emission Ports North Sea (ZEM Ports NS) and Innovation-driven Collaborative European Inland Waterways Transport Network (IW-NET). Furthermore, within the framework of European Directive (EU) 2019/883, a dossier can be submitted to the Public Waste Agency of Flanders (OVAM) for a reduced contribution for vessels that run on environmentally friendly fuel.

Furthermore, Port Oostende is involved in the ISHY project in which, with a view to the decarbonisation of the shipping industry, the effectiveness of low-carbon propulsion technologies and the feasibility of H2 bunkering facilities in ports will, among other things, be investigated.

2.5.6 Measures against the introduction of alien species

To combat the spread and introduction of alien species through ships' ballast tanks, the Ballast Water Convention (2004) requires vessels to produce a ballast water and sediment management plan and to carry a ballast water record book in which all ballast operations are recorded. In addition, ballast water management shall be performed according to standard procedures (website IMO) and ballast water treatment shall be performed by IMO recognised systems. The convention entered into force on 8 September 2017 and was implemented into Belgian law by the RD of 11 August 2017. More information about the convention can be found in Verleye et al. (2018). Exceptions to the application of this convention may be granted under certain circumstances. Prior to the entry into force, a harmonised procedure was developed by HELCOM/OSPAR so that exemptions can be granted in an unambiguous manner without harming the environment, human health, property or resources. A first risk analysis for Belgium was elaborated in accordance with the HELCOM/OSPAR procedure by Saelens and Verleye (2015).

In addition to transport via ballast water, biofouling (adhesion on the hull) also plays a role in the spread and introduction of alien species. In contrast to ballast water transport, no binding regulations have yet been developed on this matter. However, at MEPC 62 in 2011, the Biofouling Guidelines (Resolution MEPC.207(62)) were adopted. These were expanded in 2012 at MEPC 64 with guidelines (MEPC.1/Circ.792) aimed at recreational navigation. In addition, the International Convention on the control of harmful anti-fouling systems on ships (AFS) was adopted in 2001. However, the focus of this convention is the prevention of harmful effects resulting from the use of anti-fouling systems and the biocides they may contain, rather than on preventing the transfer of invasive aquatic species through hull fouling.

The International Council for the Exploration of the Sea (ICES) established two working groups to study biological invasions and alien species: The ICES/IOC/IMO Working Group on Ballast and Other Ship Vectors (WGBOSV) and the Working Group on Introduction and Transfers of Marine Organisms (WGITMO). In 2005, ICES published a new version of the 1995 Code of Practice on the Introduction and Transfer of Marine Organisms.

At European level, Regulation (EC) 1143/2014 regulates the prevention and control of the (intentional and unintentional) introduction and spread of invasive alien species. This is based on a hierarchical approach at three levels: (1) prevention; (2) early detection and rapid eradication and (3) management of widespread invasive species. Under this regulation, which applies to terrestrial, freshwater and marine species, a Union list of priority species is established and frequently updated. Furthermore, the introduction of alien species is labelled as a biological disturbance in the MSFD and is also included as a descriptor for the definition of good environmental status. The criteria and methodological standards for determining good environmental status with regard to alien species were established in Olenin et al. (2010).

In Belgium, both the intentional and unintentional introduction (through ballast water) of marine alien species are prohibited by the Law of 20 January 1999 and the RD of 21 December 2001 on the protection of species. Invasive species are also included as one of the ten processes with the largest negative impact on ecosystem components in the Ecosystem Vision for the Flemish Coast (2017) (Van der Biest et al. 2017b). The coordinated implementation of Regulation (EC) 1143/2014 by the federal State, the Communities and the Regions, as well as the necessary exchange of information between the parties concerned, is regulated through the IAS Cooperation Agreement of 30 January 2019 which entered into force on 16 July 2020. For this purpose, a National Committee, a National Scientific Council and a National Secretariat for Invasive Alien Species were established. Protocols have been developed within the framework of the Belgian forum on invasive species (invasive species environmental impact assessment (ISEIA - Branquart 2009) and the 'Harmonia+'-protocol – D'hondt et al. 2015) to assess the impact of species on the environment and their dispersal and colonisation. The alien species in the BNS are reported by ILVO and MUMM to the Marine Environment division (FPS Public Health, Food Chain Safety and Environment) within the framework of the monitoring programme for Belgian marine waters (Belgian State 2014, MSFD) and the ICES working group WGITMO. An overview of the established alien species in the BNS and Scheldt estuary is given in Verleye et al. (2020) (see also website Alien species).

Projects such as RINSE, MEMO, SEFINS and TrIAS focus, among others, on the problem of invasive alien species in the Southern Bight of the North Sea and adjacent estuaries through research, development of tools, exchange of good practice examples, etc.

2.5.7 Measures against harmful anti-fouling substances

On 5 October 2001, the International convention on the control of harmful anti-fouling systems on ships (AFS) was adopted in the IMO and entered into force on 17 September 2008. This convention prohibits the use of harmful substances, including organotin compounds, in antifouling paints used on ships. Organotin compounds have also been included by OSPAR in the list of chemicals requiring priority action (OSPAR List of Chemicals for Priority Action 2013, more information: the Background document on organotin compounds 2011).

At the European level, the use of organtin compounds in antifouling agents on ships as active biocides is prohibited by Regulation (EC) 782/2003 and Regulation (EC) 1907/2006 (REACH). In the Water Framework Directive (WFD, Directive 2000/60/EC) organtin compounds are included in the indicative list of main pollutants.

In Belgium, the transposition of the AFS Convention is ensured by the Law of 16 February 2009 and the Decree of 9 May 2008.

2.5.8 Measures against underwater noise from ships

At international level, the IMO's MEPC has formulated recommendations for reducing underwater noise effects on cetaceans (Guidelines MEPC 2014). In addition, measures against the impact of the underwater noise of ships on small cetaceans are also adopted in the framework of ASCOBANS (Resolution ASCOBANS 2003, Resolution ASCOBANS 2006, CMS Family Guidelines - Prideaux 2016).

At European level, the problem of underwater noise is included in the MSFD which identifies the supply of energy, including underwater noise, as one of the descriptors for good environmental status (Tasker et al. 2010) (see also thematic chapter **Energy (including cables and pipes)**). The RD of 23 June 2010 provides for the transposition of the MSFD measures into national legislation. Furthermore, within the framework of the Interreg project JOMOPANS, a network for the monitoring of (anthropogenic) underwater noise in the North Sea is being set up.

Legislation reference list

Overview of the relevant legislation on international ('Year A': adoption; 'Year EIF': entry into force), European, federal and Flemish level. For the consolidated European policy context see Eurlex. The national legislation can be consulted on the Belgian official journal and the Justel-database, the Flemish legislation is available on the Flemish Codex.

International conventions and agreements			
Acronyms	**Title**	**Year A**	**Year EIF**
FAL	Convention on facilitation of international maritime traffic	1965	1967
LL	International Convention on load lines	1966	1968
TONNAGE	International Convention on tonnage measurement of ships	1969	1982
Bonn Akkoord	Agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances	(1969) - 1983	1989
CLC	International Convention on civil liability for oil pollution damage	(1969) - 1992	(1975) - 1996
FUND	International Convention on the establishment of an international fund for compensation for oil pollution damage	(1971) - 1992	(1978) - 1996
COLREG	Convention on the international regulations for preventing collisions at sea	1972	1977
MARPOL	International Convention for the prevention of pollution from ships, as modified by the Protocol of 1978	1973	1978
SOLAS	International Convention for the safety of life at sea	1974	1980
LLMC	Convention on limitation of liability for maritime claims	1976	1986
STCW	International Convention on standards of training, certification and watchkeeping for seafarers	1978	1984
SAR	International Convention on maritime search and rescue	1979	1985
UNCLOS	United Nations Convention on the law of the sea	1982	1994
MoU Parijs	Paris Memorandum of Understanding on port state control	1982	1982
OPRC	International Convention on oil pollution preparedness, response and co-operation	1990	1995
ASCOBANS	Agreement on the conservation of small cetaceans of the Baltic, North East Atlantic, Irish and North Seas	1991	1994
OSPAR	Convention for the protection of the marine environment of the North-East Atlantic	1992	1998
OPRC-HNS protocol	Protocol on preparedness, response and co-operation to pollution incidents by hazardous and noxious substances	2000	2007
AFS	International Convention on the control of harmful anti-fouling systems on ships	2001	2008
BUNKER	International Convention on civil liability for bunker oil pollution damage	2001	2008
BWM	International Convention for the control and management of ships' ballast water and sediments	2004	2017
MLC	Maritime labour Convention	2006	2013
WRC	Nairobi international Convention on the removal of wrecks	2007	2015
HNS	International Convention on liability and compensation for damage in connection with the carriage of hazardous and noxious substances by sea	2010	-

European legislation and policy context			
Document number	**Title**	**Year**	**Number**
Decisions			
Implementing Decision (EU) 2015/253	Implementing Decision laying down the sampling and reporting requirements under Council Directive 1999/32/EC as regards the sulphur content of marine fuels	2015	253
Communications			
COM (2000) 142	Commission communication on the safety of the seaborne oil trade (Erika I)	2000	142
COM (2000) 802	Commission Communication on a second set of Community measures on maritime safety following the sinking of the oil tanker Erika (Erika II)	2000	802
COM (2004) 453	Commission communication on short sea shipping	2004	453
COM (2005) 585	Communication from the Commission - third Maritime Safety Package (Erika III)	2005	585
COM (2009) 8	Communication from the Commission - Strategic goals and recommendation for the EU's maritime transport policy until 2018	2009	8
COM (2011) 144	WHITE PAPER Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system	2011	144
Directives			
Directive 92/43/EEC	Directive on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)	1992	43
Directive 2000/60/EC	Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)	2000	60
Directive 2002/59/EC	Directive establishing a Community vessel traffic monitoring and information system and repealing Council Directive 93/75/EEC (Monitoring Directive)	2002	59
Directive 2005/35/EC	Directive on ship-source pollution and on the introduction of penalties for infringements	2005	35
Directive 2005/65/EC	Directive on enhancing port security	2005	65
Directive 2008/56/EC	Directive establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56
Directive 2008/106/EC	Directive on the minimum level of training of seafarers (recast)	2008	106
Directive 2009/15/EC	Directive on common rules and standards for ship inspection and survey organisations and for the relevant activities of maritime administrations	2009	15
Directive 2009/16/EC	Directive on Port State Control (Port State Control Directive)	2009	16
Directive 2009/18/EC	Directive establishing the fundamental principles governing the investigation of accidents in the maritime transport sector and amending Council Directive 1999/35/EC and Directive 2002/59/EC of the European Parliament and of the Council	2009	18
Directive 2009/20/EC	Directive on the insurance of shipowners for maritime claims	2009	20
Directive 2009/21/EC	Directive on compliance with flag State requirements	2009	21
Directive 2010/65/EU	Directive on reporting formalities for ships arriving in and/or departing from ports of the Member States and repealing Directive 2002/6/EC (Reporting Directive)	2010	65
Directive 2014/90/EU	Directive on marine equipment and repealing Council Directive 96/98/EC	2014	90
Directive 2014/94/EU	Directive on the roll-out of alternative fuels infrastructure	2014	94
Directive (EU) 2016/802	Directive on a reduction of the sulphur content of certain liquid fuels	2016	802
Directive (EU) 2019/883	Directive on port reception facilities for ship-generated waste and cargo residues	2019	883

European legislation and policy context (continuation)			
Document number	**Title**	**Year**	**Number**
Regulations			
Regulation (EC) 1406/2002	Regulation establishing a European Maritime Safety Agency	2002	1406
Regulation (EC) 782/2003	Regulation on the prohibition of organotin compounds on ships	2003	782
Regulation (EC) 725/2004	Regulation on enhancing ship and port facility security	2004	725
Regulation (EC) 1907/2006	Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency	2006	1907
Regulation (EC) 391/2009	Regulation on common rules and standards for ship inspection and survey organisations	2009	391
Regulation (EC) 392/2009	Regulation on the liability of carriers of passengers by sea in the event of accidents	2009	392
Regulation (EU) 530/2012	Regulation on the accelerated phasing-in of double hull or equivalent design requirements for single hull oil tankers	2012	530
Regulation (EU) 1315/2013	Regulation on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU	2013	1315
Regulation (EU) 1143/2014	Regulation on the prevention and control of the introduction and spread of invasive alien species	2014	1143
Implementing Regulation (EU) 2021/1158	Implementing decision laying down the sampling and reporting requirements under Council Directive 1999/32/EC as regards the sulphur content of marine fuels	2021	1158

Belgian and Flemish legislation		
Dates	**Title**	**File number**
Decisions of the Govt. of Flanders		
Decision of the Government of Flanders of 13 July 2001	Besluit van de Vlaamse Regering houdende de aanduiding van de voorlopige begrenzing van de havengebieden	2001-07-13/93
Decision of the Government of Flanders of 26 October 2007	Besluit van de Vlaamse Regering betreffende het Maritiem Reddings- en Coördinatiecentrum	2007-10-26/30
Decision of the Government of Flanders of 26 October 2007	Besluit van de Vlaamse Regering betreffende de begeleiding van de scheepvaart	2007-10-26/31
Decision of the Government of Flanders of 17 February 2012	Besluit van de Vlaamse Regering tot vaststelling van het Vlaams reglement betreffende het duurzaam beheer van materiaalkringlopen en afvalstoffen (VLAREMA)	2012-02-17/18
Decrees		
Decree of 2 March 1999	Decreet houdende het beleid en het beheer van de zeehavens (Havendecreet)	1999-03-02/37
Decree of 16 June 2006	Decreet betreffende de begeleiding van de scheepvaart op de maritieme toegangswegen en de organisatie van het Maritiem Reddings- en Coördinatiecentrum	2006-06-16/51
Decree of 9 May 2008	Decreet houdende instemming met het Internationaal Verdrag betreffende de controle van schadelijke aangroeiwerende systemen op schepen, opgemaakt in Londen op 5 oktober 2001	2008-05-09/53
Decree of 23 December 2011	Decreet betreffende het duurzaam beheer van materiaalkringlopen en afvalstoffen (Materialendecreet)	2011-12-23/33
Royal Decrees		
RD of 20 July 1973	Koninklijk besluit houdende zeevaartinspectiereglement	1973-07-20/30
RD of 2 February 1993	Koninklijk besluit tot vaststelling van de lijst van de havens en hun aanhorigheden overgedragen van de Staat aan het Vlaamse Gewest	1993-02-02/31

Belgian and Flemish legislation (continuation)		
Dates	**Title**	**File number**
RD of 21 December 2001	Koninklijk besluit betreffende de soortenbescherming in de zeegebieden onder de rechtsbevoegdheid van België	2001-12-21/72
RD of 6 February 2009	Koninklijk besluit tot oprichting en organisatie van het maritiem informatiekruispunt	2009-02-06/39
RD of 23 June 2010	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden	2010-06-23/05
RD of 20 March 2014	Koninklijk besluit tot vaststelling van het marien ruimtelijk plan	2014-03-20/03
RD of 11 August 2017	Koninklijk besluit ter uitvoering van het Internationaal Verdrag voor de controle en het beheer van ballastwater en sedimenten van schepen, gedaan te Londen op 13 februari 2004 en ter wijziging van het koninklijk besluit van 22 december 2010 betreffende havenstaatcontrole	2017-08-11/11
RD of 22 May 2019	Koninklijk besluit tot vaststelling van het marien ruimtelijk plan voor de periode van 2020 tot 2026 in de Belgische zeegebieden	2019-05-22/23
RD of 4 February 2020	Koninklijk besluit tot instelling van veiligheidszones in de zeegebieden onder Belgische rechtsbevoegdheid	2020-02-04/12
RD of 15 July 2020	Koninklijk besluit inzake milieuvriendelijke scheepvaart	2020-07-15/12
Cooperation agreements		
Cooperation agreement of 8 July 2005	Samenwerkingsakkoord tussen de Federale Staat en het Vlaamse Gewest betreffende de oprichting van en de samenwerking in een structuur Kustwacht	2005-07-08/62
Laws		
Special law of 8 augustus 1980	Bijzondere wet tot hervorming der instellingen	1980-08-08/02
Law of 20 January 1999	Wet ter bescherming van het mariene milieu in de zeegebieden onder de rechtsbevoegdheid van België	1999-01-20/33
Law of 16 February 2009	Wet houdende instemming met het Internationaal Verdrag van 2001 betreffende de controle op schadelijke aangroeiwerende systemen op schepen, en met de Bijlagen, gedaan te Londen op 5 oktober 2001	2009-02-16/51
Law of 25 December 2016	Wet tot instelling van administratieve geldboetes van toepassing in geval van inbreuken op de scheepvaartwetten	2016-12-25/38
Law of 8 May 2019	Wet tot invoering van het Belgisch Scheepvaartwetboek	2019-05-08/15