Baltic InteGrid

Integrated Baltic Offshore Wind Electricity Grid Development

Impact Mitigation Strategy of the Baltic Offshore Grid

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Interreg Baltic Sea Region

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Impact Mitigation Strategy of the Baltic Offshore Grid

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Abbreviations

BASREC	Baltic Sea Region Energy Cooperation
BCE	Boundary conditions envelope
BEMIP	Baltic Energy Market Interconnection Plan
Birds Directive	Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds
BOG	Baltic Offshore Grid
BSR	Baltic Sea Region
DG REGIO	Directorate-General for Regional and Urban Policy, European Commission
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIA Directive	Council Directive 2011/92/EU of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment
EIA Report	Report on the Environmental Impact Assessment
ENTSO-E	European Network of Transmission System Operators for Electricity
Espoo Convention	The Convention of the United Nations Economic Commission on environmental impact assessment in a transboundary context of 25 February 1991
European Commission	European Commission
EU	European Union
EUSBSR	European Union Strategy for the Baltic Sea Region
Habitats Directive	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
HELCOM MPAs	Marine Baltic Sea Protected Areas
IMO	International Maritime Organization
MS	Member State
NGO	Non-Governmental Organisation
OWE	Offshore wind energy
OWF	Offshore wind farm
PCI	Projects of Common Interest
PP	Project Partner
SEA Directive	Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the impact of certain plans and programmes on the environment
TSO	Transmission System Operator
TYNDP	Ten-Year Network Development Plan
UXO	Unexploded ordnance

1. Introduction

1.1 Impact Mitigation Strategy of the Baltic Offshore Grid

The Impact Mitigation Strategy of the Baltic Offshore Grid is being developed within the scope of the Baltic InteGrid "Integrated Baltic Offshore Wind Electricity Grid Development" project. The basic goal of the Baltic InteGrid is to prepare the concept of transmission infrastructure integrated with offshore wind farms, that is, the Baltic Offshore Grid (hereinafter: "BOG"), based on an in-depth analysis of spatial, market, policy and regulatory, as well as environmental, social and technological conditions.

The Impact Mitigation Strategy of the Baltic Offshore Grid offers suggestions for guidelines and objectives for environmental impact assessment in the scope of strategic assessment, indications of good practices for environmental procedures, and a dialogue with stakeholders for infrastructure investment projects within the BOG.

1.2 The Baltic InteGrid "Integrated Baltic Offshore Wind Electricity Grid Development" project

Baltic InteGrid "Integrated Baltic Offshore Wind Electricity Grid Development" is co-financed through the INTERREG Programme for the Baltic Sea Region in the financial perspective 2014-2020. The project's duration is fixed at 2016-2019.

The Baltic InteGrid project is exploring the potential of a meshed or integrated offshore grid for the Baltic Sea Region. It aims at contributing to sustainable electricity generation, the further integration of regional electricity markets and security of supply in the Baltic Sea Region by applying an integrated grid approach to optimize the potential and efficiency of offshore wind energy.

According to the recently launched WindEurope analysis on wind energy scenarios for 2030, the Baltic Sea, where 1.5 GW of offshore wind is grid-connected today, will represent the second largest basin for offshore wind, with potentially 9 GW installed by 2030 (according to WindEurope's central scenario)[1] Offshore wind energy (OWE) has an important role to play in the diversified, sustainable energy mix that the European Union (EU) is aiming for. The Baltic Sea Region (BSR) offers good conditions for offshore wind development: waters are relatively shallow, wave height is lower, tides are insignificant and the distances to the shore are shorter than in the North Sea, resulting in lower installation and grid infrastructure costs.

The offshore wind energy market in the Baltic Sea is at an early development stage, compared to the experience gained in the North Sea, where studies have shown that meshed, interconnected grids can bring about significant economic and environmental benefits. The European Commission's (EC) published "Study on the benefits of a meshed offshore grid in Northern Seas region" [2]concludes that a meshed grid entails higher initial costs than radial connections, however, these costs are outbalanced by annual savings - especially if the member states (MSs) also coordinate reserve capacities. The need for a better coordination of OWE and grid planning in the BSR is also supported by the Baltic Sea Region Energy Cooperation (BASREC)'s study "Electricity Grid Expansion in the Context of Renewables Integration in the BSR"[3], which foresees an increase in regional electricity exchange until 2030, outlining the need for more interconnectors.

The Baltic InteGrid project contributes to the EU Strategy of the Baltic Sea Region and fits into this strategy, as the development of a Baltic Offshore Grid concept is a step towards the creation of a fully interconnected and integrated regional energy market, the implementation of a Baltic Energy Market Interconnection Plan and the demonstration of coordinated OWF connection solutions.

The project pursues the objectives of:

- interconnection and integration of regional markets,
- development and integration of energy markets,
- improving the security of the electricity supply,
- fostering the diversification of energy sources and therefore helping to reduce the emission of greenhouse gases, and

[1] https://windeurope.org/newsroom/news/windeurope-urges-estonia-to-stimulate-regional-cooperation-on-offshore-wind-in-the-baltic/

[2] https://ec.europa.eu/energy/sites/ener/files/documents/2014_nsog_report.pdf

[3] http://basrec.net/wp-content/uploads/2015/01/BASREC%20Grid%20study%20-%20Final%20report%202014.pdf

- contributing to considerable economic growth due to new business activities in the renewable energy and grid sector.

The Baltic InteGrid project fosters the strategy for an Energy Union at themacro regional level and also contributes to the 10% electricity interconnection target - an increased goal of 15% by 2030 is currently being discussed at the EU level. The Baltic Offshore Grid concept also adds to the reformed BEMIP that aims to develop liberalised, transparent, competitive and fully functioning regional gas and electricity markets. The Baltic InteGrid fosters the integration of renewable energy in the electricity system. The Baltic Offshore Grid Forum established under Baltic InteGrid is an additional activity that enhances cross-border cooperation on renewable energy. The Baltic Offshore Grid Forum is a platform for knowledge exchange and discussion between industry experts which is implemented through a series of workshops, conferences, thematic working group meetings etc.

Therefore, the Baltic InteGrid project contributes to the objective of promoting the development of sustainable energy.

The Ministry of Economics of the Republic of Latvia, acting as the Policy Area Coordinator for the Policy Area Energy (PA Energy) of the EU Strategy for the Baltic Sea Region (EUSBSR) accepted the project Baltic InteGrid as a Flagship Project under the EUSBSR.

The Baltic InteGrid project is being implemented by a consortium of 14 project partners (PP) from 8 countries in the Baltic Sea Region:

PP 1 – Project Leader – Institute for Climate Protection, Energy and Mobility (Germany)
PP 2 – Foundation for Sustainable Energy (Poland)
PP 3 – Rostock Business and Technology Development (Germany)
PP 4 – Technical University of Denmark (Denmark)
PP 5 – Energy Agency for Southeast Sweden (Sweden)
PP 6 – German WindGuard GmbH (Germany)
PP 7 – Maritime Institute in Gdańsk (Poland)
PP 8 – German Offshore Wind Energy Foundation (Germany)
PP 9 – Latvian Association of Local and Regional Governments (Latvia)
PP 10 – Aalto University (Finland)
PP 11 – University of Tartu (Estonia)
PP 12 – Public Institution Coastal Research and Planning Institute (Lithuania)
PP 13 – Lund University (Sweden)
PP 14 – Aarhus University (Denmark)

In addition, the project consortium is supported by 35 Associated Organisations, which include, among others, Transmission System Operators from Poland, Lithuania, Germany, Denmark and Estonia, investors of the OWFs, enterprises, representatives of administrations from Germany, Lithuania and Latvia, as well as research and development agencies and institutions.

More information about the Baltic InteGrid project as well deliverables and information about events organized under the Baltic Offshore Grid Forum may be found under the link: www.baltic-integrid.eu.

2. Baltic Offshore Grid

2.1 Objective and scope of BOG

The Baltic Offshore Grid is a concept of offshore transmission infrastructure in the Baltic Sea. The aim of the transmission infrastructure is to link offshore wind farms (OWF) to the electro energetic network and to transmit energy onshore while making a cross-border exchange of electric energy possible among the countries of the Baltic Sea Region.

Goals (G) defined for the BOG:

G1 increasing the possibility to connect OWF in the Baltic Sea Region and the maximisation of advantages resulting from OWF development, increasing OWF energy supply stability through the possibility of transmitting the energy to where it is currently needed (not only in the country where they are installed),

G2 increasing the security of energy supply through additional possibilities of cross-border exchange,

G3 further integration and synchronisation of energy markets as a result of continuous efforts to unify the energy market in the Baltic Sea Region by establishing new cross-border connections and allowing for the exchange of energy, G4 OWF cost reduction through the application of a more coordinated attitude to OWF connection, while establishing cross-border energy exchange (each connection then has the function of transmitting the OWF energy and being a transmission factor at the same time).

Due to its complexity and its long-term perspective looking ahead to 2050, the BOG concept has a strategic/programme character and aims to indicate the future development direction for cross-border connections integrated with OWF, in such a way as to maximize the advantages resulting from connections which are densely interconnected. BOG should also ensure the execution of a thorough and long-term programme of offshore wind energy development for the countries in the Baltic Sea Region.

The expected results of the BOG execution should be:

- an increase in the renewable energy sources share in the energy mixes of the countries in the Baltic Sea Region,
- improvement of energy security,
- diversification of electricity supplies,
- reduction of energy prices in the region.

The final shape of BOG will depend on the results of the political, regulatory, spatial, market, technical and technological, as well as environmental and social analyses, while the latter are the subject of this document.

The spatial scope covers the Baltic Sea where the potential connections between Germany, Denmark, Sweden, Poland, Finland, Lithuania, Latvia and Estonia will be analysed.

From the technical perspective the BOG may consist of:

- offshore cables (HVAC, HVDC)
- offshore high voltage stations (OHVS)
- onshore transformer stations
- onshore cables.

BOG is a kind of a concept/vision of the Baltic grid consisting of individual cross-border connections integrated with OWF in the Baltic Sea, so it will be executed in an evolutionary way through a gradual extension of subsequent projects, that is, interconnectors and the development of new OWF.

Within the first spatial analyses the project consortium prepared an outline of the potential shape of BOG, as illustrated by the following map.

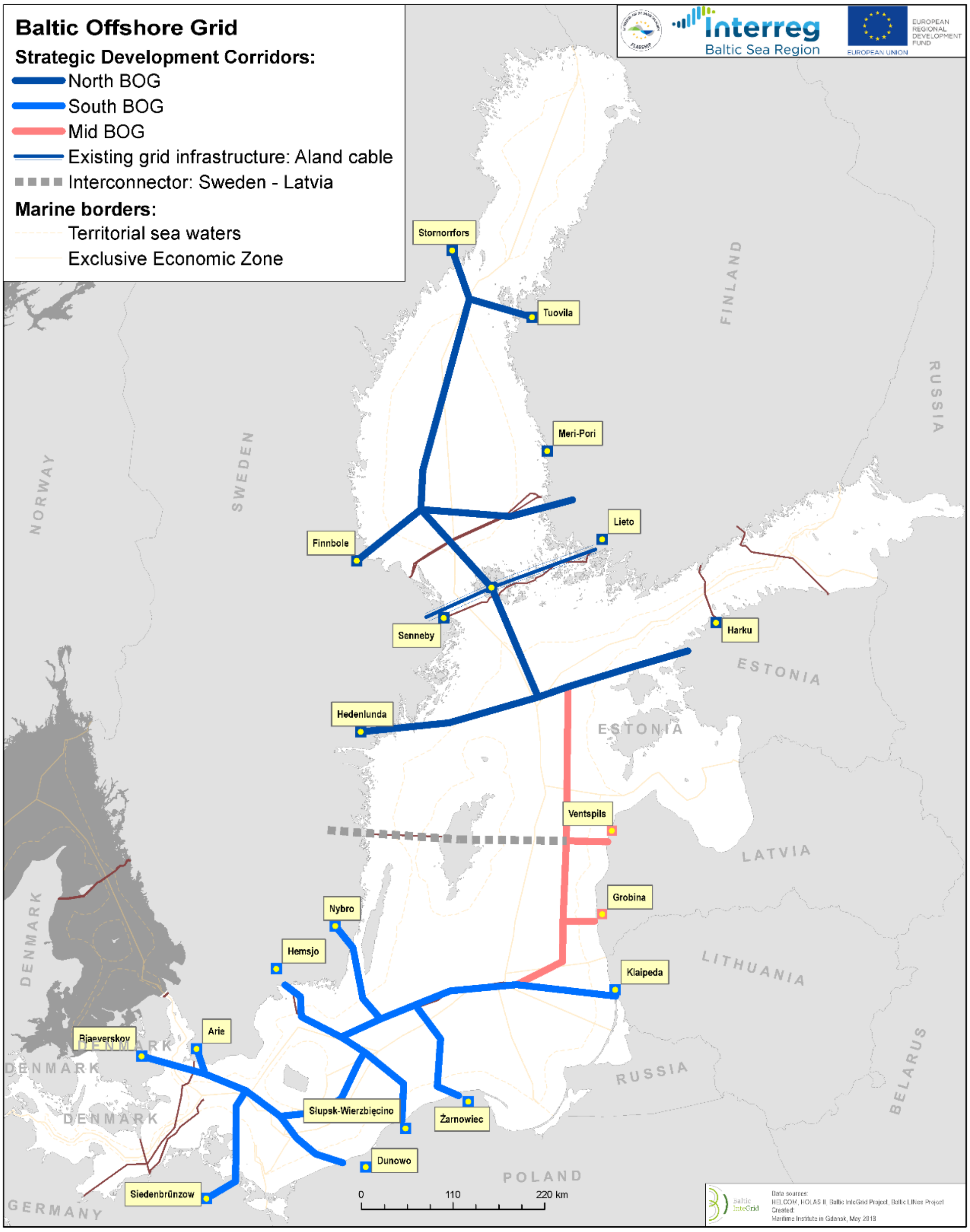

Figure 1 Baltic Offshore Grid concept[4]

In view of the currently considered projects of interconnectors and OWFs, the first stage of BOG development could be the connections between southern Baltic countries which are subject of two Prefeasibility studies (PFS) developed under the Baltic InteGrid project. The PFS investigate the integrated connections: among Germany and Sweden with the possibility to connect Denmark (Bornholm), and between Poland and Sweden, with the possibility to connect Lithuania.

[4] Baltic InteGrid (2018). Polish-Swedish-Lithuanian and German-Swedish-Danish interconnectors integrated with offshore wind farms – case studies.

2.1.1 Offshore wind energy industry development in the Baltic Sea

Offshore wind energy (OWE) is one of the most dynamically developing energy sectors in Europe. This has led to challenges with grid access for OWFs due to infrastructural limitations of the transmission systems, problems with balancing the fluctuating energy sources, high connection costs (long distances, lack of synergy between projects), long lead times on high voltage cables, legal constraints, ownership issues etc. Offshore wind energy is still less developed in the Baltic Sea than in the North Sea, although significant potential exists, and this may be an additional advantage of the Baltic Sea.

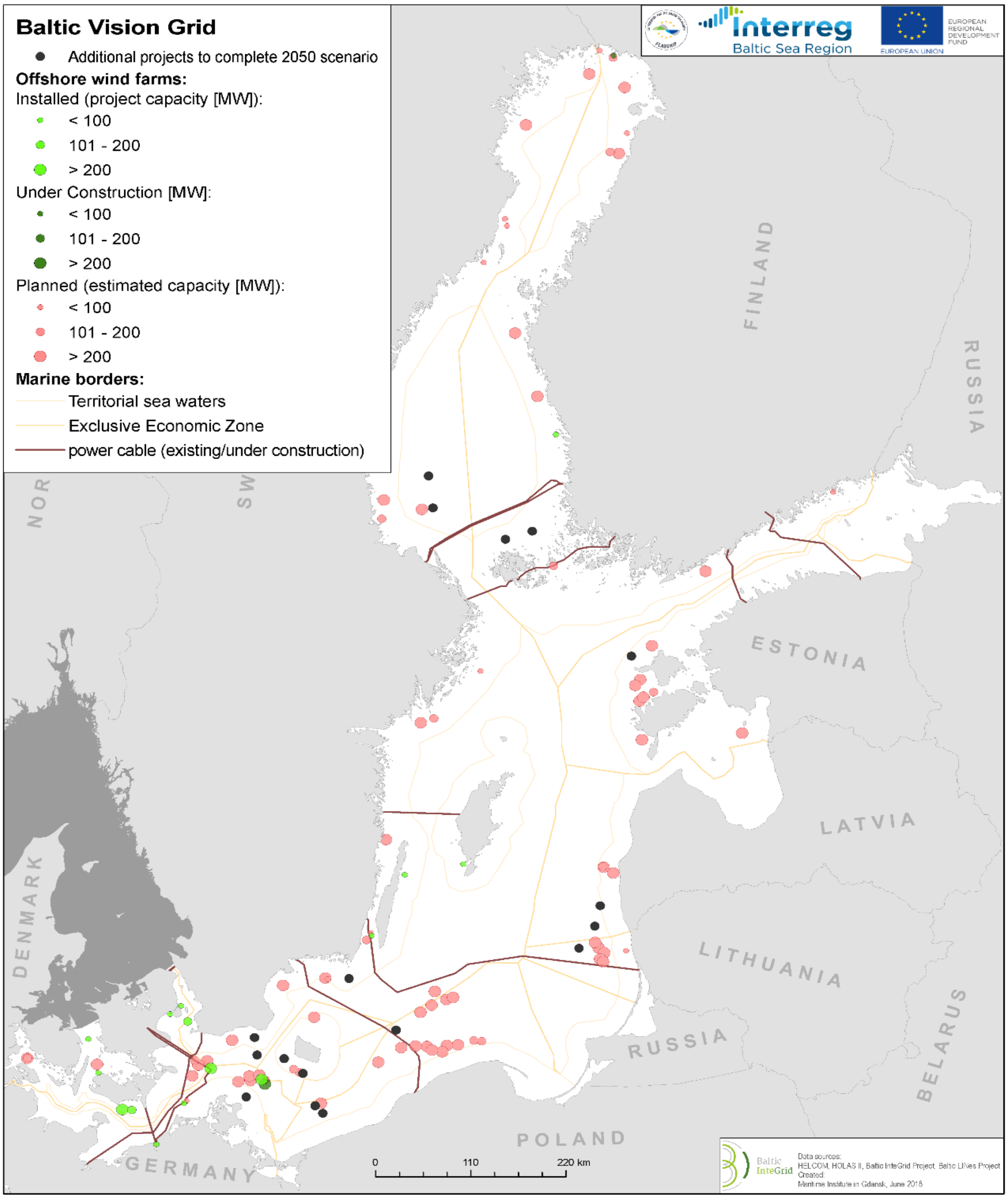

Figure 2 Map of existing and planned OWF and interconnection projects in the Baltic Sea[5]

[5] Baltic InteGrid (2018). Polish-Swedish-Lithuanian and German-Swedish-Danish interconnectors integrated with offshore wind farms – case studies.

At the end of 2017 the total capacity of OWF worldwide amounted to 18,814 MW. The share of OWF projects in the Baltic Sea in the European market is 12% (Appendix A).

There are 20 offshore wind farms currently operating in the Baltic Sea - 10 in Denmark, 3 in Finland, 3 in Germany and 4 in Sweden. The total capacity of the investment is 1,457 MW.

2 OWFs are being developed in Finland and Germany with a total capacity of 396.4 MW. a list of the projects which are planned for the Baltic Sea are presented in the Appendix B) while:

- projects (2 in Germany and 1 in Finland) are being prepared for construction (pre-construction stage),
- OWF projects (1 in Germany, 7 in Sweden) obtained the development permit from competent authorities (The permit for the wind farm has been approved by the responsible authority),
- 18 OWF projects (2 in Denmark, 1 in Finland, 7 in Germany, 4 in Lithuania, 2 in Poland and 2 in Sweden) are at the stage of obtaining permits from the authorities (The application for authorization has been submitted to the responsible authority).

The rest of the projects have obtained localization authorizations, early localization analyses or their execution has been suspended. Detailed information may be found in Appendix B.

2.2 BOG variants

BOG envisages the integration of the offshore transmission grid with OWFs, however different levels of this integration may be assumed, which should form the basis for variants preparation. In this document the BOG variants will be subject to analysis against the possibility of serious impacts on the natural environment and social environment (other sea users).

The following variants have been adopted:

- Variant “0” – no execution of BOG; assumes individual connection of all OWF radially or connecting project groups located in one area without integrating with the offshore cross-border connections. At the same time the execution of new underwater cross-border connections is scarce and executed by means of separate investments (instead, onshore connections are executed);
- Variant “1” – assumes the integration of all OWF projects with the offshore transmission grid; at the same time this is the furthest reaching scenario (so called “most far-reaching scenario”) in terms of the level of integration of OWF development with BOG; This variant includes the integration of the Southern Baltic grid with Northern Baltic via a connection near Baltic countries - Estonia, Latvia and Lithuania.

In practice not all OWF projects would be integrated. The distance involved should be one of the main criterium that decides the OWF connection costs and the choice of HVDC/HVAC transmission technology. Therefore, distance will probably be the main factor influencing which projects will be integrated with the offshore transmission grid. Thus, when individual parts of the BOG are developed, those projects for which the connection cost are the lowest and for which the advantages of integration with the transmission grid would be the highest will most likely be integrated.

Based on the spatial analysis performed for the project, a general proposition of cable corridors was presented. However, the corridors can only be treated as general because the planning of individual cross-border interconnections included in BOG is the responsibility of the transmission grid operators (the development of the network is coordinated within ENTSO-E through TYNDP).

3. Purpose of the Mitigation Strategy

Currently, the Baltic Offshore Grid is based on conceptual assumptions and does not set out a framework for the implementation of specific projects, but rather defines only general and theoretical directions of opportunities for the development of the cross-border Baltic transmission network, taking into account environmental, legal, social and economic factors. Therefore, the Impact Mitigation Strategy should be treated as a document of the nature and features of a strategy (or plan/programme) for the development of cross-border electricity grids.

The individual sections of the offshore cross-border transmission grids, integrated with the projects of the offshore wind farms in the Baltic Sea ("meshed grids"[6]), which will be implemented under BOG, will be investment projects carried out by or on behalf of the grid operators or operators of OWF. They may be awarded the status of projects of common interest (PCI) and investment support from EU funds, which may be reflected in the process of exploiting offshore energy investments and optimising the costs of energy connection and balancing by developing integrated grid connection systems.

The main objective of the Impact Mitigation Strategy of the Baltic Offshore Grid is to develop guidelines and assumptions for strategic environmental impact assessment and also to identify good practices for the environmental procedure for the infrastructure of offshore investments such as Baltic Offshore Grid, through:

- establishing standards of environmental and socio-economic impact analysis,
- analysis of offshore and onshore potential impacts of the BOG,
- creating an assumption of mitigation strategy for the BOG,
- providing assumptions for environmental surveys in the EIA process for the BOG (in advance).

In this document the outlined BOG objectives have undergone an assessment of the feasibility of their execution under the conditions of a potential energy union and energy market merging in the Baltic Sea basin, in accordance with the requirements and guidelines relating to the strategic environmental impact assessment contained in Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the impacts of certain plans and programmes on the environment (OJ L 197, 21.7.2001, p. 30–37; hereinafter also: the SEA Directive).

Impact Mitigation Strategy of the Baltic Offshore Grid contains a detailed description of:

- the Baltic InteGrid project,
- goals, character, scope and assumptions of the Mitigation Strategy for the Baltic Offshore Grid,
- the regulatory framework for the issues mentioned in this document,
- the goal and scope of the Baltic Offshore Grid,
- the assessment of the compatibility of the Baltic Offshore Grid objectives with the objectives of key strategic documents, policies and programmes of the European Union,
- methodological assumptions for carrying out assessments modelled on strategic environmental impact assessment,
- the state of the natural and social environment,
- the impact of the Baltic Offshore Grid implementation on the natural and social environment,
- potentially significant Baltic Offshore Grid impacts (taking into account potential transboundary impacts),
- proposals for steps to mitigate the potentially significant environmental impacts of Baltic Offshore Grid,
- recommendations in the scope of EIA for projects within the Baltic Offshore Grid.

3.1 Strategic character of the document

This Impact Mitigation Strategy identifies and investigates the environmental and societal impacts of a regional OWE grid and identifies the potential impact reduction and mitigation pathways. The document considers the potential impacts on the environment, protected areas and other sea users, suggesting mitigative solutions for all of them. A special focus on public acceptance with regard to renewable energy projects like offshore wind infrastructure will reflect the necessary societal considerations of an offshore wind grid. The use of the Impact Mitigation Strategy is to help a variety of stakeholders in the offshore grid planning process in the Baltic Sea Region. By summing up potential impacts and mitigative solutions, the document brings together previously scattered information and ties it together with new research to offer one easily accessible, comprehensive document, facilitating planning and decision making concerning the matter in the Baltic Sea region.

The Mitigation Strategy which takes into account the objectives of BOG (see 2.1) provides a basis for the environmental assessment in strategic terms of the BOG concept, by identifying and analysing the environmental, social and economic conditions for addressing in particular the following challenges:

- high and growing demand for electricity,

[6] International coordination and meshed grid supposed to connect power plants to interconnectors, thus giving sea cables the physical possibility to act either as interconnectors or as park-to-shore cables - or both simultaneously. In the international coordination constellation, an OWF has the physical possibility to send electricity to two different countries; in the meshed grid constellation, to three and more countries.

- an inadequate level of generation and transmission infrastructure, and
- climate protection and market integration commitments.

3.2 Linking the Baltic Offshore Grid to other strategic documents

For the purpose of the preparation of the Mitigation Strategy, the priorities of the energy sector and the methods for their implementation formulated in the strategic documents, policies and executive programmes of the European Union were analysed. The analysis was conducted in terms of the European and international development trends, social, economic and environmental policy objectives, while maintaining the principle of sustainable development in harmony with and with respect to the environmental protection requirements.

On the basis of the implemented BOG objectives conformity assessment with the objectives of the main strategic documents, policies and programmes of the European Union (Appendix C), for the purposes of this document, 4 leading EU energy policy priorities were identified and the degree of their fulfilment by the Baltic Offshore Grid was determined.

Priority 1: construction/expansion of the European energy infrastructure and cross-border interconnections,

Priority 2: ensuring the security of electricity supplies (security of production and transit), including the diversification of energy sources in response to the growing demand for energy,

Priority 3: slowing down adverse climate change by reducing greenhouse gas emissions,

Priority 4: the development of a research sector for innovative low-carbon technologies, by coordinating research and project financing with the private sector, as a part of supporting economic and political decision-making.

The Baltic Offshore Grid will contribute (directly or indirectly) to meeting the priorities of the EU energy policy through:

- the emergence of new cross-border interconnections enhancing competitiveness, stability and security of supplies within the internal energy market, in order to end the isolation of the Baltic States and support market integration in the region,
- integration of the grid with the offshore wind farms in the Baltic Sea, thereby optimising the costs of constructing the transmission infrastructure,
- increase the share of renewable energy sources in the energy mix of individual Baltic countries as an alternative to fossil fuels, and thus a reduction in greenhouse gas emissions,
- the diversification of energy supplies and reducing dependence on fossil fuel markets,
- enabling the development of innovative offshore technologies, where intensive R&D (research and development) is carried out in the scope of ever larger, more efficient and cheaper turbines, increased transmission voltage and the concept of the integration of transmission grids with OWF,
- obtaining additional funding from the EU budget for energy investments in line with the EU's energy objectives,
- developing cooperation between the transmission system operators of the Baltic States, and training multidisciplinary staff in the fields of engineering and planning, environment and research programmes, international law and national regulations as a target group supporting decision-making processes at the EU and national level.

4. Legal framework

In view of the assumption that the Baltic Offshore Grid is a concept for the construction of a cross-border grid in the Baltic Sea, which may in the future be partially implemented in national strategies, policies and plans for the development of electricity grids, and in view of the fact that the Mitigation Strategy itself is a strategic level document, this chapter presents the legal requirements of the European Union for a strategic environmental assessment[7].

The basic act on strategic environmental assessment is the SEA Directive which aims to ensure a high level of environmental protection for Member States and to contribute to the integration of environmental aspects into the preparation and adoption of plans and programmes to promote sustainable development.

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[7] In light of EU law projects planned under the BOG do not have to be the subject to an adequate assessment regarding their effects, before consent for their implementation is given.

The requirements included in the SEA Directive relate in particular to:

- agreeing on the level of detail of the information contained in the strategic environmental assessment,
- preparing a strategic environmental assessment,
- providing opportunities for public participation,
- cross-border proceedings where the implementation of the project or programme has the potential to have a significant impact on the environment of other EU Member States,

and have been partially taken into account in this document. This document will not be subject to statutory public consultation or cross-border proceedings, but will be consulted with representatives of interested countries during the Baltic InteGrid workshops.

The detailed scope of the impact assessment is set out in Article 5 and Annex 1 of the SEA Directive.

Other sources of EU law governing (directly or indirectly) the strategic environmental impact assessment procedure is listed in Appendix D.

The EU Member States are obliged to transpose and implement the provisions of Community law into their national legal systems, whereas international conventions are subject to ratification by individual states.

Because of the status and nature of the BOG some elements of the assumptions and scope of the strategic environmental assessment provided for in the SEA Directive have been adapted for the purpose of developing the Mitigation Strategy. Detailed methodological assumptions are described in the following Chapter: 5 *Methodological assumptions for the assessment based on the strategic assessment of the environmental impact of BOG*. It should be remembered that, assuming the future implementation of BOG (as a whole or in sections) a full assessment of the environmental impact will be required together with the procedure in a transboundary context, including a dedicated research campaign, analyses and modelling in accordance with the applicable national legislation.

While recognising BOG as a plan/programme/strategy, provision should be made for a strategic impact assessment including cross-border proceedings and public participation. Since the Impact Mitigation Strategy of the Baltic Offshore Grid is an internal document within the BIG framework, it was decided to present in the study the legal requirements and assumptions for carrying out a cross-border assessment and public consultation as a recommendation for possible future actions.

The obligation to conduct environmental impact assessment procedures in a transboundary context results from:

- the Espoo Convention and the Protocol on Strategic Environmental Assessment (Kyiv Protocol),
- the EIA Directive (for concrete projects),
- the SEA Directive,
- international agreements (for non-EU countries or countries that have not ratified the conventions), international agreements.

Transboundary impact was defined in the Espoo Convention as "any impact, not exclusively of a global nature, in an area under the jurisdiction of a Party caused by a planned activity, the physical cause of which is wholly or partly located in another Party's jurisdiction".

In addition, the Espoo Convention also requires that all projects on their territory, which are likely to have significant adverse transboundary impacts on the environment, must be notified to and consulted with other Parties. The Convention defines the State in whose territory the planned activity will be carried out as the "Party of Origin" and the States affected by the project as the "Affected Parties".

Baltic Offshore Grid (treated as an electricity grid) is not an activity included in Annex I of the Espoo Convention, but Article 2 (5) of the Espoo Convention has been used for this study, in accordance with which: "Interested parties shall, at the initiative of either Party, discuss whether one or more planned activities not listed in Annex I are causing or are likely to cause significant adverse transboundary impacts and should therefore not be treated as if they were listed in the Annex".

Taking into consideration:

- the size of the planned linear infrastructure investment, which is a cross-border, multi-kilometre long power connection,

- preparation of variants, including the possibility of full or partial integration with the offshore wind farms in the Baltic Sea,
- the international nature of the investment within the Baltic Sea basin,
- location of the investment, understood as a transit through legally protected areas within the Baltic Sea (including Natura 2000 sites) and through places where the planned activity may have a significant impact on the population,
- exposure, understood as the potentially significant impact of the Investment on people or natural values,
- close proximity to international borders, on which the investment may have significant impacts (including locations distant from the investment location),

the need to carry out a cross-border environmental procedure for BOG should be considered in the future as good practise. For the case at hand, several Parties of Origin, Affected Parties and Parties (as defined in Article 1 of the Espoo Convention) will be identified. Countries of origin, when exposed to activities or events related to the Project that takes place in another country of origin may also be Affected Parties. The jurisdiction of each Party of Origin should ultimately coincide with the boundaries of that State's exclusive economic zone.

The documents drawn up under the cross-border procedure should include:

- a description of the undertaking and its purpose,
- a description of the variants considered (location or technology of the planned activity, including a no action option), with alternative variants being adequate to the level of detail in the document's provisions, including an analysis of the feasibility of achieving the strategic objectives, an analysis of the specific objectives,
- a description of the environment and a description of potential impacts of the undertaking and its variants on the environment,
- a description of measures to mitigate the impact on the environment,
- an indication of the forecasting methods and assumptions adopted, as well as the environmental data used,
- identification of knowledge gaps and uncertainties encountered in collecting the required information,
- a non-technical summary,
- an outline of the monitoring and management programme and post-execution analysis plans (optional if justified).

5. Methodological assumptions for the assessment based on the strategic assessment of the environmental impact of BOG

The Baltic Offshore Grid is being treated as a concept and does not determine and define the exact framework for the implementation of concrete undertakings/projects. It defines rather the direction of development (in the social, economic, legal and environmental areas).

Therefore, the analysis of the impact of BOG on the environment and society is comparative (compares the variants) and on a more general level, adjusted to the visionary level of the concept itself.

The following methodological assumptions have been adopted to carry out the assessment modelled on the Strategic Environmental Assessment:

- the objectives of the BOG → an element of the cross-border electricity grid (as a basic objective),
- the type of initiative → BOG was defined as a marine linear infrastructure,
- the variants assessed → under Variant “1” were identified – the BOG as the electricity grid with the maximum degree of integration with OWF in the Baltic Sea, Variant “0” – no execution of BOG; assumes the individual connection of all OWF radially or connecting project groups located in one area without integrating with the offshore cross-border connections,
- the area/coverage of the initiative → BOG as an offshore transmission infrastructure integrated with OWF in the Baltic Sea was identified,
- the environmental characteristic → main natural environmental components (biotic and abiotic) were identified and described as BOG surroundings,
- the list of potential impacts typical for a linear infrastructure initiative in the marine environment of the BOG was indicated as a potential cause of changes in the environment,

- the list of significant potential impacts with the definition of cumulative and transboundary impacts was indicated,
- proposals for solutions to mitigate → the solutions aiming to prevent, reduce or environmentally compensate for the negative impacts which may result from the BOG execution were indicated.

Potentially significant residual impacts were analysed after the application of measures minimizing individual negative impacts.

Significant impacts include those impacts of a large category that cause irreversible deterioration of the environment or its components thereby threatening its proper functioning as a result of the implementation of BOG, as a concept. As a part of the evaluation of the potential environmental assessment for receptors/objects assessed as significant, an analysis of cumulative impacts was also carried out taking into account existing and planned projects in the Baltic Sea area (offshore wind farms, power cables, gas pipelines mentioned in Appendix A, Appendix B).

For the spatial analyses the following assumptions were used: document Methodology and structure of Pre-Feasibility Studies. Polish-Swedish-Lithuanian and German-Swedish interconnectors integrated with offshore wind farms – case studies[8], Baltic InteGrid: 2050 offshore wind power vision for the Baltic Sea[9] and GIS software to perform quantitative analyses of selected phenomena with the indication of mutual correlations between environmental (e.g. distribution of nature protection forms, including Natura 2000 areas), social (e.g. shipping routes, military areas, fisheries) and energy aspects (e.g. power network corridors, OWF). Due to the sensitive nature of some "input" data, e.g. in relation to military areas, the methodology allows only for the possibility of the potential occurrence of spatial conflicts to be taken into consideration in the analysis.

6. Potential impacts of BOG, mitigation measures and recommendations for environmental impact assessment

6.1 Potential impact

For the purposes of this document initial identification and the general characterization of potential impacts of all technical elements included in the BOG has been completed in the form of matrices of interaction between emissions and impacts, both at sea (see: Table 1) and on land, including coastal areas (see: and Table 2). In the matrices information in the following categories has been given: type of emission/disturbance, source of emission/disturbance, type of impact, receptors/elements of the environment which may be affected directly and indirectly by the impact, environmental factors affecting the scale of impacts and the parameters of the investments affecting the scale of the impacts. These matrices have been developed to be used as a starting point for impact analysis. Nevertheless, the list of possible impacts and affected receptors shouldn't be treated as a final, enumerative catalogue and if required should be supplemented and/or adjusted.

Most of the identified environmental impacts are expected to be limited to the near proximity of the technical elements of BOG, with the exception of the impact of underwater noise emissions connected with the pilling of OHVS foundations which may be detectable even at a regional scale. Though the most detrimental effect on marine animals which may be caused by underwater noise like fatal injuries or a permanent change of the hearing threshold is expected to be spatially limited and occur at a relatively close distance to the source of noise. Most of the identified impacts, especially connected with the construction stage of individual projects, are expected to occur only temporarily (e.g. increase in water turbidity, disturbance of animals etc.), but BOG implementation can also lead to long-term effects like habitat loss or alteration (not only because of the physical transformation of the habitat but also due to the electromagnetic field and heat emission from cables).

In the context of estimating the overall importance of potential impacts of the BOG development it is important to note that none of its technical elements (defined in 2.1) are qualified according to the EIA Directive as a project which is likely to have significant effects on the environment. Therefore, projects planned under the BOG in the light of EU law are not required to be subject to an adequate assessment regarding their effects, before consent for their implementation is given.

However, it should be emphasized that the need for the assessment of potential impacts on the environment of specific types of projects (not mentioned in the EIA Directive) before issuing for them development consents may also arise according

[8] Baltic InteGrid (2018). Polish-Swedish-Lithuanian and German-Swedish-Danish interconnectors integrated with offshore wind farms – case studies.

[9] Baltic InteGrid (2018). Baltic InteGrid: 2050 offshore wind power vision for the Baltic Sea

to the national legal requirements in countries involved in the BOG implementation. For example, according to the Polish law, substations (including offshore high voltage stations and onshore transformer stations) are projects which are likely to have significant effects on the environment and therefore fall under the same requirements as projects listed in the EIA Directive.

In general, it is not expected that the development of the BOG could cause a significant effect on the environment, as long as all individual projects included in the BOG are planned and implemented taking into account existing environmental and social conditions, especially the presence of receptors particularly sensitive to their impact (e.g. presence of spawning grounds of rare and protected fish species in the area).

To ensure that environmental issues are properly considered during the planning stage of individual projects, the conduct of an environmental impact assessment should be included in their licensing procedures. This is especially important in terms of the possible impact of individual projects on Natura 2000 sites.

According to the current assumptions and concept of the BOG its technical elements will be placed in approximately 10 km wide corridors, which pass or may pass through 82 Natura 2000 sites. At this stage, a potentially significant impact on the Natura 2000 sites cannot be excluded. That is why the potential effects of the development of every technical element of the BOG should be analysed with reference to the Natura 2000 sites.

According to article 6 paragraph 3 of the Habitat Directive any plan or project not directly connected with or necessary for the management of the Natura 2000 sites but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to an appropriate assessment of its implications for the site in view of the site's conservation objectives. In line with this article the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.

Emission/ disturbances	Source	Type of impact	Direct impact on	Indirect impact on	Environmental factors affecting the scale of impact	Parameters of the investments affecting the scale of impacts
disturbance of the seabed sediments (other physical disturbance of the seabed)	• preparation of seabed for the installation of cables and OHVS foundations • cable laying • installation of OHVS foundations and protective layers against leaching • installation of cable protection components (e.g. concrete mattresses) • anchoring ships	• destruction and alteration of habitats • reduction of population • reduction of source of feeding • risk of damage to archaeologically valuable objects • leaching or burring raw materials	• sediments • benthos • fish • cultural heritage • extraction of raw materials	• sea birds • marine mammals	• type of seabed • size of sediments layer • presence of phytobenthic organisms on the seabed	• size and number of cables • method of cable laying • type and size of foundations • size of protective layers • size of cable protection components
release of contaminations, nutrients from the sediment into the water column	• preparation of seabed for installation of cables and OHVS foundations • cable laying • installation of OHVS foundations and protective layers against leaching • installation of cable protection components (e.g. concrete mattresses)	• increase in the amount of pollutants and nutrients in the water • plankton blooms • changes in living conditions • population decline • increase in pollutant concentrations in tissues of commercial fish species	• hydro-chemical conditions • plankton • benthos • fish • marine mammals	• sea birds • human health and wellness	• type of sediments • types and amounts of pollutants deposited in the sediments • weather conditions • speed and direction of currents	• size and number of cables • method of cable laying • width and depth of the cable corridor • type and size of foundations • cable technology

Emission/ disturbances	Source	Type of impact	Direct impact on	Indirect impact on	Environmental factors affecting the scale of impact	Parameters of the investments affecting the scale of impacts
	• heat emission from cables					
increase in the concentration of suspension in the water and deposition of a disturbed sediment	• preparation of seabed for installation of cables and OHVS foundations • cable laying • installation of OHVS foundations and protective layers against leaching • installation of cable protection components (e.g. concrete mattresses)	• changes in living conditions • increase in water turbidity	• plankton • benthos • fish • marine mammals • hydro-chemical conditions	• sea birds • human health and wellness	• type of sediments • weather conditions • speed and direction of currents • speed of sediment deposition	• size and number of cables • method of cable laying • width and depth of the cable corridor • type and size of foundations
emission of cable temperature	• cable exploitation - electric power transmission	• change of living conditions • changes in benthic organisms' population and species composition • emergence of alien species • increase in the amount of pollutants in water • change of the oxygenation conditions	• sediments • benthos • hydro-chemical conditions	• fish • sea birds	• type of sedimentary • deposits resistivity	• depth of cable burial • cable technology • number of cables • cable capacity

Emission/ disturbances	Source	Type of impact	Direct impact on	Indirect impact on	Environmental factors affecting the scale of impact	Parameters of the investments affecting the scale of impacts
emission of radiation and electromagnetic field	• OHVS • cable exploitation - electric power transmission	• disturbance of animal behaviour and migration (disorientation) • change of living conditions • interference with shipping and navigation • interference with radar systems	• fish • marine mammals • shipping and navigation • radar systems			• current • length of the cable • depth of cable burial • cable technology • number of OHVS • height of OHVS
generation of underwater noise and vibration	• seabed works • laying the cables • shipping • installation of OHVS foundations • decommissioning of infrastructure	• displacement of habitat • change of living conditions • injuries • risk of mortality • fishing reduction	• fish • marine mammals • sea birds	• sea birds • marine mammals • fishery	• depth • type of seabed • background noise level	• depth of cable burial • method of cable laying • number of constructing vessels • type and size of foundations • duration of installation of foundations • hydraulic hammer power

Emission/ disturbances	Source	Type of impact	Direct impact on	Indirect impact on	Environmental factors affecting the scale of impact	Parameters of the investments affecting the scale of impacts
new above-water structures	• OHVS	• increased interference risk • obstruction to migration • interference with shipping and navigation • seascape disturbance	• sea birds • migrating birds • bats • seascape • shipping and navigation • tourism • fishery			• distance from shore • number of OHVS
new underwater structures	• cable lines • cable protection components (e.g. concrete mattresses) • OHVS foundations and protective layers	• change in living conditions • interference with shipping and navigation • restrictions in sea use	• fish • shipping and navigation • fishery	• seabirds • marine mammals	• depth • type of seabed • type of sedimentary	• depth of cable burial • length of cable sections laid on the seabed (not buried) • width of safety zone • number of OHVS
new underwater structures - 'artificial reef' effect	• cable lines • cable protection components (e.g. concrete mattresses) • OHVS foundations and protective layers	• creation of new habitats • change in species composition • increase of food source • changes in living conditions	• benthos • fish	• sea birds • fish • sea mammals • tourism • fishery	• depth • physical-chemical parameters of water	• type and size of OHVS foundations • size of OHVS foundations protective layers

Emission/ disturbances	Source	Type of impact	Direct impact on	Indirect impact on	Environmental factors affecting the scale of impact	Parameters of the investments affecting the scale of impacts
		• increasing the quantity and quality of professional and tourist fishing • increasing incomes from the fisheries and tourism industry				• length of the cable sections laying on the seabed (not buried) • number and size of cable protection components (e.g. concrete mattresses)
increased ship traffic	• ships, boats	• barrier effect • risk of interference with animals • obstruction to migrations • disturbance of animals • seascape disruption • leakage of harmful substances • risk of vessel interference	• migrating and sea birds • bats • sea mammals • fish • benthos • seascape • water • sediments • shipping and navigation	• tourism		• number of vessels • type of vessels
emission of pollutants into the atmosphere	• ships, boats • helicopters	• deterioration of the air quality	• air quality • human health and wellness	• climate	• speed and direction of the wind	• number of vessels/ helicopters

Emission/ disturbances	Source	Type of impact	Direct impact on	Indirect impact on	Environmental factors affecting the scale of impact	Parameters of the investments affecting the scale of impacts
		• changes in living conditions	• birds • mammals			• intensity of vessels activity/ helicopters
emission of pollutants into the water	• ships used for cable laying • antifouling substances	• deterioration of the water quality • changes in living conditions	• hydro-chemical conditions • plankton • benthos • marine mammals • fish • sea birds		• weather conditions • speed and direction of currents	• type and quantity of substances used
waste and sewage production	• ships • construction activities • construction and services vessels • building service and maintenance	• water contamination • seabed contamination • change in living conditions	• benthos • sediments • marine mammals • fish • sea birds	• birds • human health and wellness		• duration of the construction • service frequency • number of ships

Table 1 Matrix of interaction between emissions and impacts at the sea

Emission/ disturbances	Source	Type of impact	Direct impact	Indirect impact	Environmental factors affecting the scale of impact	Parameters of the investments affecting the scale of impacts
destruction of the soil surface and intervention in the ground/ geological structures	• site preparation • excavation works, • construction works, • cable laying, • foundation of transformer station • activity of construction vessels • location of site facilities	• displacement and change of habitat • reduction of population • reduction of source of feeding • degradation of the subsurface layer of soil • mortality due to excavation traps • possibility of damage to the archaeologically valuable objects	• flora (habitat, species) • fauna (invertebrates, amphibians, reptiles, mammals, birds) • soil • cultural heritage	• fauna • landscape • economic land exploitation	• type of soil where works are conducted (e.g. forests, agricultural areas, wetlands) • conditions of work (seasonal) • high level of ground water	• number of cables • technology of construction works • cable technology
morphology changes to the coastal zone	• ground works • cable laying	• modification of existing morphology structures • disturbance of natural processes: hydro-, morpho-, lithodynamics • slight increase of a shoreline side • displacement and change of habitat	• morphological conditions of the coastal area • talitrus saltator	• flora, fauna, • human health and wellness • tourism	• morphological conditions of the coastal area • weather conditions during construction (storm)	• size and number of cables • width and depth of the cable corridor • duration of the construction • technology of construction • cable technology

Emission/ disturbances	Source	Type of impact	Direct impact	Indirect impact	Environmental factors affecting the scale of impact	Parameters of the investments affecting the scale of impacts
		• disrupting ecological corridors				
new structures	• cables • transformer stations	• mechanical barrier • risk of interference • mortality due to increased interference risk and excavation traps • change in living conditions • area occupancy • land acquisitions/use • restrictions on agriculture and forestry • habitat fragmentation/ migration corridors • change to landform or land cover	• flora • fauna • landscape • tourism • economic aspects of human activity	• land use • economic land exploitation	• type of soil where works are conducted • presence of migration corridors (ecological)	• parameters of transformer stations, • size of transformer station • width of technology line • technology of construction works
Increased vehicle traffic	• vehicles involved in the site preparation, construction and service works	• barrier effect • risk of interference with animals	• fauna	• human health and wellness		• technology of construction works • duration of works • service frequency

Emission/ disturbances	Source	Type of impact	Direct impact	Indirect impact	Environmental factors affecting the scale of impact	Parameters of the investments affecting the scale of impacts
		• mortality due to increased interference risk • obstruction to migrations • disturbance of animals • deterioration in living conditions				
noise emission	• site preparation • construction work • cable laying • foundation • exploitation - electric power transmission • machinery, construction and service equipment	• displacement of habitat • change in living conditions • deterioration of living conditions	• fauna • human health and wellness		• presence and quantity of fauna • usage of the land where the line is located • distance from acoustically protected areas and others (quality of touristic areas)	• technology of construction works • technical conditions of the machines • duration of works • service frequency
generation of electromagnetic fields	• exploitation - electric power transmission and transformer station	• displacement of habitat • change in migration behaviours • restrictions in land use	• fauna • human health and wellness		• usage of the land where the line is located • distance from the areas intended for human residence	• depth of cable burial • number of cables • type of transmission technology

Emission/ disturbances	Source	Type of impact	Direct impact	Indirect impact	Environmental factors affecting the scale of impact	Parameters of the investments affecting the scale of impacts
						• type and technical parameters of transformer station
change in ground temperature	• exploitation - electric power transmission	• change in soil temperature • change in living conditions	• soil conditions	• flora • fauna	• type of soil	• depth of cable burial • number of cables • type of transmission technology
waste and sewage production	• production of cables/components of transformer stations • construction process, • construction and service machinery • construction and maintenance service	• releases to land and water • impact on the physical and chemical properties of soil and water	• soil • water	• flora • fauna • human health and wellness	• type of soil • hydrological conditions in the area – surface water bodies and • groundwater level • sensitivity of aquifer	• duration of works • service frequency • time and place of waste storage • technology of construction works and technology of individual components
emission of pollutants into the atmosphere (gas and dust emission)	• site preparation • production of cables/components of transformer stations • transportation	• increased emission of pollutants, including greenhouse gases • dusting during movement of soil masses	• air quality	• climate • flora • fauna • human health and wellness	• weather conditions	• quantity, type and technical condition of used machinery and equipment • duration of works

Emission/ disturbances	Source	Type of impact	Direct impact	Indirect impact	Environmental factors affecting the scale of impact	Parameters of the investments affecting the scale of impacts
	• construction process • construction and service machines	• exceeding the maximum contaminant level				

Table 2 Matrix of interaction between emissions and impacts on land, including coastal area

For the purpose of this document a comparative analysis of Variant “1” (V”1”) and Variant “0” (V”0”) has been made. The main assumption for this analysis was to compare the scale of the potential effects of V “1” and V “0” implementation on the natural and social environment.

Since the impacts of the considered variants connected with the construction stage of the individual projects (technical elements) are expected to be limited in time and highly dependent on specific environmental conditions in the project’s impact zones, the analysis focused on potential differences in the overall environmental and social consequences of variants implementation as well as the level of risk connected to it.

Receptors/elements of the natural and social environment, which have been chosen for the purposes of this analysis as the most representative are the following:

- Natura 2000 sites,
- Benthic habitats and sea-floor integrity,
- Marine fauna – fish, marine mammals and seabirds,
- Coastal area and coastline integrity,
- Species habitats on land,
- Climate,
- Fisheries,
- Shipping and shipping lanes,
- Spatial planning,
- Minerals deposits,
- Cultural heritage,
- Visual landscape,
- Chemical munition and unexploded ordnance (UXO).

For the purposes of estimating the overall effect of variant implementation the following parameters have been taken into consideration:

- number of cable corridors,
- number of cable corridor landfalls,
- number of onshore transformer stations,
- size of onshore transformer stations and offshore high voltage stations (OHVS),
- width of cable corridors,
- occupied area,
- organization of the construction phase, operation and service processes in the context of scattering or centralization,
- restrictions and limitations in the use of land,
- sustainable development aspects in line with spatial planning.

For the requirements of comparative analysis, the following assumptions have been made:

- the number of cable corridors will be larger in V “0” and they will be more scattered in the Baltic Sea basin; in the Report from PreFeasibility Studies conducted within the Baltic InteGrid project, the integrated approach resulted in up to 6 times fewer cables than with zero integration,
- number of locations where the coastline is intersected by a cable corridor (cable corridor landfalls) will be larger in V “0”,
- number of onshore transformer stations will be larger in V “0”,
- both onshore transformer stations and offshore high voltage stations (OHVS) will be bigger in V “1”,
- cable corridors will be wider in V “1”,
- restrictions and limitations in the use of land will be larger in V “0”.

The output of this analysis is presented in Table 3.

No.	Receptor/element of the environment	Result of variants comparison	Justification
1.	Natura 2000 sites	N	Since Natura 2000 sites in the Baltic Sea area often cover shallow coastal waters as well as neighbouring coastal areas on land, it is expected that due to the larger number of cable corridors, cable corridor landfalls and transformer stations on land implementation of V "0" will affect Natura 2000 sites (species and natural habitats protected within Natura 2000 sites and sites integrity) to a greater extent than the implementation of V "1". As an example, Natura 2000 sites encompass coastal waters along almost the entire Polish coastline and cover a significant part of coastal areas on land, which leads to the situation when any additional cable corridor planned to be connected to the Polish power grid will almost certainly cross one of marine Natura 2000 sites and could possibly interfere with Natura 2000 sites on land. Most of the impacts of variants implementation on marine Natura 2000 sites relate to the construction stage of individual projects and will be limited in time (e.g. disturbance of animal species protected within the Natura 2000 site during construction works). Nevertheless, variants implementation could also cause permanent changes in Natura 2000 sites like alteration, loss or fragmentation of protected natural habitats, especially on land.
2.	Benthic habitats and sea-floor integrity	N	Since the introduction of artificial hard substrate on the seabed can lead to changes in benthic habitats and their fragmentation, it is expected that due to the larger number of cable corridors and their more scattered spatial distribution, the implementation of V "0" will affect benthic habitats and sea-floor integrity to a greater extent than the implementation of V "1".
3.	Marine fauna – fish, marine mammals and seabirds	N	Although the disturbance of marine animals living conditions on the construction stage of individual projects of V "0" will probably be greater, mainly due to a higher number of crossings of Natura 2000 sites designated for the protection of animal species (e.g. wintering seabirds), it is expected that the overall effect of V "0" and V "1" implementation on marine fauna will be comparable.
4.	Coastal area and coastline integrity	N	Construction and the physical existence of cable corridors could disturb the natural morpho-dynamic process and lead to changes in the morphology of the coastal zone in their landfall areas. Due to the larger number of cable corridor landfalls spread along the coast it is expected that the implementation of V "0" could affect the morphology and ecological values of the coastal areas as well as their flood protection function in more locations than the implementation of V "1" and therefore have a greater impact on coastline integrity.

5.	Species habitats on land	N	Construction and the physical existence of cable corridors and onshore transformer stations on land will result in changes to the existing environmental conditions in their area, including the possible alteration of, loss or fragmentation of species habitats. Since it is expected that the larger overall area on land will be transformed or occupied in V “0” (due to the larger number of cable corridors and onshore transformer stations), it may be assumed that V “0” implementation will have a greater impact on species habitats on land then V “1”.
6.	Climate	P	Since the aim of the V “0” and V “1” implementation is to link offshore wind farms to electro energetic networks and to transmit energy onshore, which should ultimately lead to a reduction of pollutant emissions from conventional generating units, both analysed variants should have a comparable positive impact in the context of climate protection. Concerning airborne emissions connected with variants implementation it has been estimated that in the Baltic Sea in 2015 total emissions from all vessels were 342 kt of NOx, 10 kt of SOx, 10 kt of PM, 23 kt of CO and 15.9 Mt of CO2, while the most significant contribution to emissions may be associated with RoPaX vessels, tankers, cargo ships and container ships. These emission estimates were based on over 1.65 billion AIS-messages sent by 21 616 different ships, of which 8 404 had an IMO registry number indicating commercial marine traffic. It should be emphasised that not all of vessels in the Baltic Sea are required to carry AIS onboard – according to a recent estimate, there are over 250 000 boats not equipped with AIS in more than 3 000 locations in the Baltic Sea area. Therefore, it is likely that the total number of AIS targets observed during the year 2015 represents less than 10% of the total waterborne vessels, but, since AIS is mandatory for large vessels, it describes the activity of commercial ship traffic very well[10]. Taking the above into consideration, it may be assumed that the amounts of emissions of substances into the atmosphere connected with variants implementation (regardless of the variant) added to the overall pool of emissions will be negligible.
7.	Fisheries	N	It is expected that due to the larger number of cable corridors and their more scattered spatial distribution the implementation of V “0” on the one hand could cause more difficulties/limitations for fisheries, both during the construction and operation stage (including service works), and on the other hand it is connected to a higher risk of cable line damage caused by fishing gears (larger number of spatial interferences of cable corridors with areas important for fishing).

[10] http://www.helcom.fi/baltic-sea-trends/environment-fact-sheets/

8.	Shipping and shipping lanes	N	It is expected that due to the larger number of cable corridors and their more scattered spatial distribution the implementation of V “0” on the one hand could cause more difficulties/limitations for shipping, both during the construction and operation stage (including service works), and on the other hand is connected with a higher risk of cable line damage caused by anchors (larger number of spatial interferences of cable corridors with shipping lanes).
9.	Spatial planning	N	It is expected that due to the larger number of cable corridors and their more scattered spatial distribution, as well as larger number of cable corridor landfalls and onshore transformer stations V “0” implementation will be less balanced in terms of the spatial planning and will lead to a bigger fragmentation of the area, so it may cause more obstacles to the location of future projects.
10.	Minerals deposits	N	Due to the larger number of cable corridors and their more scattered spatial distribution, as well as a larger number of onshore transformer stations V “0” implementation is connected with the higher risk of interference with prospective mineral deposits of economic value, hindering their extraction.
11.	Cultural heritage	N	Due to the larger number of cable corridors and their more scattered spatial distribution, as well as a larger number of cable corridor landfalls and onshore transformer stations V “0” implementation is connected with the higher risk of interference with objects of cultural value, especially archaeological sites.
12.	Visual landscape	N	V “1” implementation will result in the construction of smaller numbers of onshore transformer stations than V “0” implementation, but since they will be bigger, it is expected they will also be more visible. That is why V “1” implementation will have a greater impact on the visual landscape in particular locations, while V “0” implementation will have a slightly smaller impact on the visual landscape in particular locations but at the same time will affect more locations. Taking the above into consideration, it may be assumed that the overall effect of variants implementation on the visual landscape of the coastal area will be greater than in the case of V “0”.
13.	Chemical munition and UXO	N	Due to the larger number of cable corridors and their more scattered spatial distribution V “0” implementation is connected with the higher risk of interference with objects like chemical warfare and UXO.

Type of the overall effect of variants implementation: N – negative; P – positive.

Table 3 Comparative analysis of the scale of potential impacts of V"1" and V "0" implementation

Comparison of the overall potential effect of variants implementation	Definition
V "1"<V"0"	V “1” will have a smaller overall effect on the receptor than V “0”
V "0"≈V"1"	V “1”and V “0” will have a comparable overall effect on the receptor

Table 4 Legend for comparative analysis

Conclusions

The comparative analysis shows that a highly integrated BOG – V “1” is more favourable from an environmental and social point of view than V “0” due to:

- more spatially limited intervention in the natural environment (smaller number of cable corridors, cable corridor landfalls and transformer stations on land), resulting in a lower level of interference with Natura 2000 sites, species habitats on land, as well as benthic habitats and sea-floor integrity,
- more spatially limited interference with the coastline (smaller number of cable corridor landfalls), resulting in a smaller number of locations where the morphology and ecological values of the coastal areas as well as their flood protection function may be affected and therefore result in a lower impact on coastline integrity,
- lower level of difficulties/limitations for fisheries and shipping, both during the construction and operation stage (including service works), arising from a lower number of possible special interferences of cable corridors with areas important for fishery and shipping lanes,
- the fact that it is better balanced in terms of spatial planning – will lead to a lesser fragmentation of the area and therefore fewer obstacles to the location of future projects,
- lower risk of interference with prospective mineral deposits of economic value, objects of cultural value, as well as objects like chemical warfare and UXO, connected to the lower number of cable corridors and their less scattered spatial distribution, and in the case of mineral deposits and cultural heritage also from a lower number of onshore transformer stations,
- the fact that it is visually affecting a lower number of locations on land.

Implementation of the V “1” is also expected to be more beneficial from a cable safety perspective because it is connected to a lower risk of cable line damage caused by fishing gears and anchors due to the lower number of special interferences of cable corridors with areas important for fishery and shipping lanes.

6.2 Mitigation measures

Taking into consideration the potential impacts of technical elements included in the BOG (see: Table 1 and Table 2) on the natural and social environment, a general catalogue of possible mitigation measures have been proposed for different stages of project development.

Nonetheless, it is highly recommended that all projects constituting BOG were covered by EIA, so the selection of the mitigation measures would be a result of the appropriate impact analysis and assessment. a systematic approach to EIA (methodology) has been proposed in chapter 6.3. All emissions/disturbances connected to BOG’s technical elements initially indicated in this document should be taken into consideration during individual EIA’s.

Routing of cable corridors and the location of substations

The proper selection of cable corridor routes and substations locations is highly important in terms of the minimisation of BOG’s possible effects. Proposed mitigation measures for this stage of project development have been listed below:

Identification and, if possible, avoidance of the most ecologically sensitive areas, with special regard to Natura 2000 sites (e.g. protected species habitats and natural habitats, areas of the seabed where macrophytes occur, fish spawning areas etc.). Due to the possible effects of underwater noise emission from pilling of OHVS foundations, it is not recommended to localize offshore substations which have foundations that require pilling in areas important for noise sensitive species (especially fish and marine mammals), and in their immediate vicinity;

- Identification and, if possible, avoidance of heavily contaminated seabed areas to prevent the release of substances potentially harmful to the marine organisms from sediments,
- Identification and, if possible, avoidance of areas of cultural heritage importance, including archaeological sites,
- Identification and, if possible, avoidance of areas where chemical munitions and unexploded ordnance (UXO) are deposited,
- Identification and, if possible, avoidance of areas of mineral deposits,
- Identification and, if possible, avoidance of the areas of special importance for fishery areas,
- Identification of shipping lanes and, if possible, minimising the spatial interferences with them, by:
  - avoidance of the location of substations on shipping lanes,
  - reduction of the number of cable corridor intersections with shipping lanes,
  - reduction of the length of sections where cable corridors intersect the shipping lanes by routing corridors perpendicular or close to perpendicular relative to the shipping lanes.

Identification of the areas mentioned above should be based both on desktop studies as well as on the results of dedicated site surveys.

Selection of technical solutions – design

The proper selection of technical solutions is very important in terms of BOG's possible effects minimisation. The proposed mitigation measures for this stage of the project's development have been listed below:

- Selection of the most appropriate technology/method of construction for the cable corridor coastline crossing in terms of existing environmental conditions in the landfall area, including morphology (e.g. cliffs) and morpho- and litho-dynamic processes in the area, as well as its ecological value and flood control function. In order to minimize the potential impact on the environment, technologies like horizontal drilling or direct pipe laying should be considered;
- The area of intervention, both on the seabed and on land, should be limited to the necessary minimum,
- The type of OHVS foundations and the technology of their installation, as well as cable laying technology should be selected taking into consideration the existing environmental conditions of the area, especially the presence of receptors sensitive to the specific impacts,
- The offshore cables, if possible, should be buried in the seabed to reduce exposure of sensitive marine species to electromagnetic fields especially fish and marine mammals,
- The depth of cable burial should be selected in order to minimise the impact of the surface sediments/soil temperature rise on the benthic communities/habitats and ecological processes,
- During the selection of technical solutions, the use of a means to reduce the emission of electromagnetic fields, such as the application of specific cable types or cable shielding, should be considered.

Construction – schedule

Proper construction scheduling could be very important in terms of the mitigation of project impact. The scheduling of construction activities should be made in a manner which avoids or minimises the disturbance of sensitive species identified in the area, by not performing or limiting construction activities in periods when they are most vulnerable to the impacts, e.g. wintering/nesting/spawning period. During the scheduling, both rare and protected species (especially those protected within Natura 2000 sites) as well as fish species of economic importance should be considered.

6.3 Recommendation for environmental impact assessment for BOG projects

This chapter is dedicated to recommendations for an environmental impact assessment and social dialogue for individual projects constituting BOG in case of a decision for implementation.

6.3.1 Recommendation for environmental impact assessment

Methodology

The general scheme of the methodology and of the environmental impact assessment dedicated to individual projects of the BOG is illustrated in the diagram below (Figure 3).

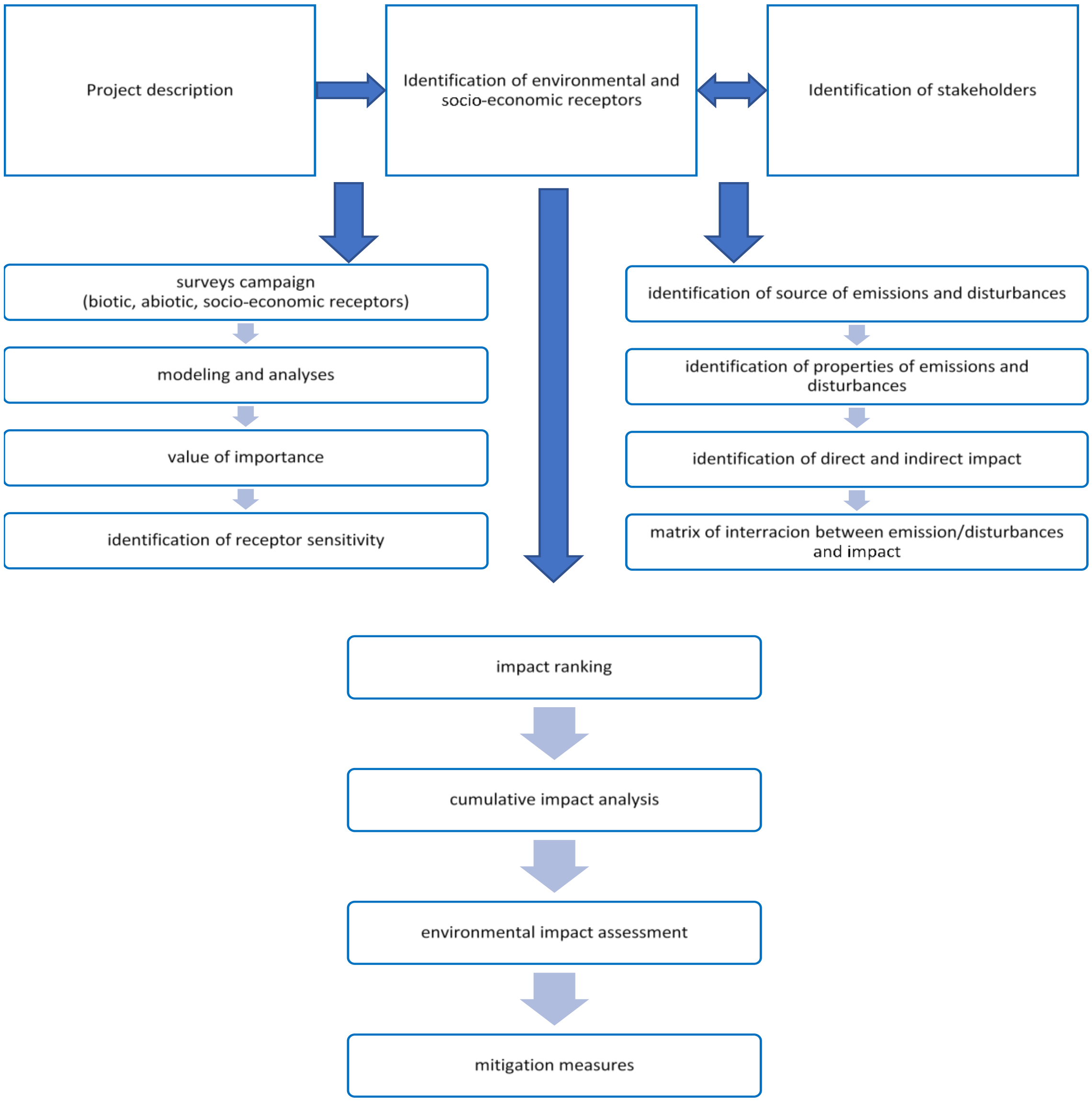

Figure 3 Scheme of EIA methodology

When the project is in the early stage and more than one technology is being considered, for the purpose of the EIA methodology it can be based on a bounding conditions envelope (BCE). BCE has been developed in order to identify the maximum design parameters and technical solutions without specifying a concrete technology and at the same time allow for performing an EIA. In this approach the project is outlined by the boundary conditions.

BCE method:

- takes into account that a project evolves over a number of years,
- forms a framework within which a project must be developed,
- allows for a flexible interpretation of the investor's intentions in the initial stages of the investment while at the same time binding the project development process to the results of the EIA,
- should be detailed enough to allow for an assessment of the likely environmental impact,
- should apply the "most far-reaching scenario".

The BCE is also considered to establish favourable conditions for effective public participation. It includes the possibility to adjust the project design at the initial stage of development. The boundary conditions envelope concept was used in the energy projects shown in the table below.

The idea behind using BCE can be narrowed down to the following points:

- identification of key impacts of the project on the environment,
- identification of project parameters affecting the scale of its impact (e.g. height, power output, noise emission etc.),
- establishing the BCE (maximum values of the parameters),
- performing an EIA for the “most far-reaching scenario” meaning maximum parameters of the BCE.

Scope of environmental surveys and modelling

In order to perform an environmental impact assessment for offshore energy projects it is obligatory to conduct an environmental survey campaign and also good practice. The campaign includes surveys and monitoring of environmental receptors. The results coming from the surveys should be modelled and analysed. Based on examples of energy projects in the Baltic Sea like offshore wind farms, cables and pipelines, the list of receptors as a scope of surveys and monitoring is presented below. The scope, detail and methodology depend on national conditions and accepted practices.

The recommendations for surveys and the monitoring of receptors in the offshore energy projects:

- Abiotic receptors:
  - hydrology and hydrography:
    - currents and waves
    - physicochemical properties
    - bathymetry
    - shoreline tachymetry
    - meteorology
  - geology of the seabed:
    - geophysical tests, magnetometer, shallow core, ROV (Remotely operated underwater vehicle which is tethered and operated by a crew aboard a vessel)
    - seabed deposits (physicochemical properties)
- Raw materials (based on literature analysis)
  - onshore abiotic receptors:
    - hydrology surveys (quantitative and qualitative)
    - hydrogeology surveys (quantitative and qualitative)
    - geomorphology surveys (quantitative and qualitative)
- Biotic receptors
  - benthos
  - fish
  - sea birds
  - migratory birds
  - sea mammals
  - bats
  - mushrooms
  - lichens
  - mosses and liverworts
  - plants and onshore habitats
  - invertebrates
  - ichthyofauna
  - land birds
  - mammals
- Other:
  - navigation (monitoring of shipping via AIS)
  - fishery (VMS system, surveys among fishermen, fishing reports etc.)
  - cultural heritage
  - chemical and conventional warfare
  - Nature 2000
  - management of mineral resources
- Emissions:
  - acoustic baseline

- electromagnetic field

The following receptors should be modelled and analysed in order to investigate the size and scale of impact:

- Abiotic receptors:
  - morphodynamics of shore modelling
  - morphodynamics of seabed modelling
  - hydrodynamic modelling
  - sediment spreading modelling
  - release and spread of pollutants from sediment modelling
  - groundwater level reduction analysis
- Biotic receptors:
  - habitat delimitation
- Other:
  - underwater noise modelling
  - surface noise modelling (if relevant)
  - analysis of impact on fisheries
  - analysis of impact on radar and radiolocation systems
  - analysis of the impact of external events.

Analysis methodology

The methodology described in this section is based on the methodology used for the purpose of the environmental impact assessments for investments in the energy sector and may be a foundation for the environmental and social-economic analysis for individual projects of BOG in the future.

The analytic cycle of the established analysis methods is presented in Figure 4, below.

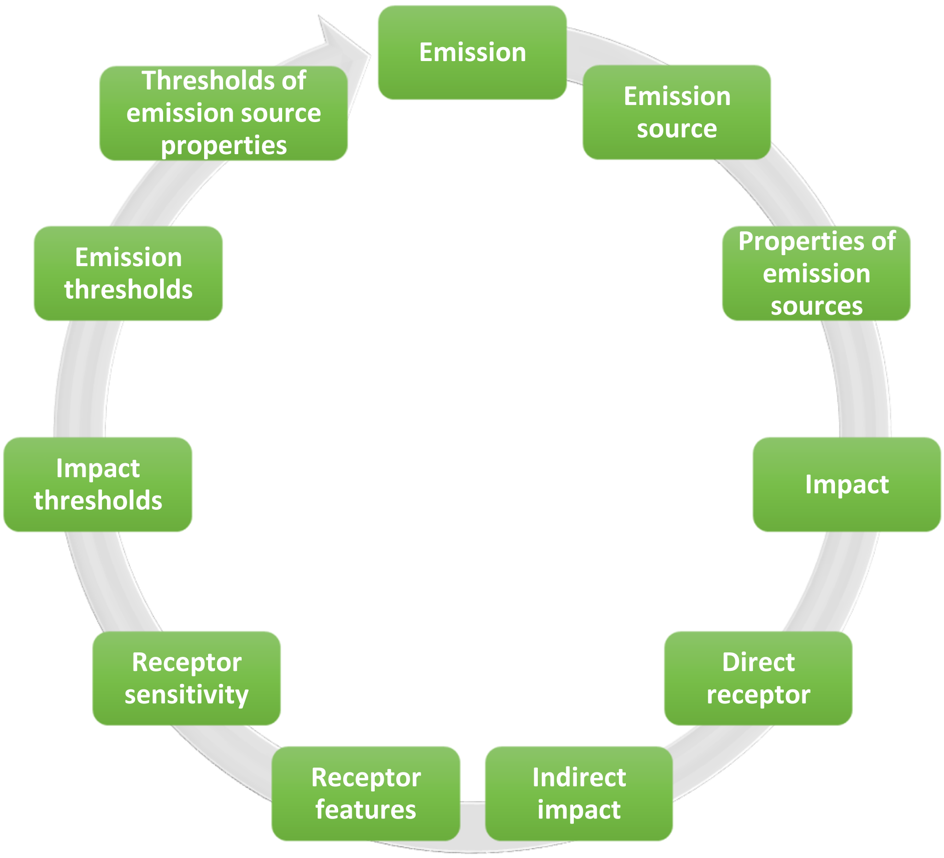

Figure 4 Recommendation for analysis methodology for EIA

This cycle includes a series of recommended solutions and analyses, their results and conclusions that should be implemented in order to prepare the EIA Report. Information about subsequent steps in the process of the assessment of impact on the environment is presented below.

Preparatory stage:

- determining the components of the project and technologies, equipment and processes that can be applied during construction, operation and decommissioning,
- determining, on the basis of the available literature, the possible impacts on various elements of the environment,
- specifying environmental components which are sensitive to various direct impacts,
- identifying the sources of emissions and environmental disturbances caused by the project,
- identifying factors that determine the occurrence and the scale of impacts:
  - on the project side,
  - on the environment side,
  - specifying relationships in land and marine ecosystems which may cause secondary effects,
  - planning an environmental research program aimed at providing information on resources and their condition, and sensitivity to impacts.

Assessment stage:

verifying the occurrence of environmental components sensitive to impact in the delimitated area, their sensitivity to impact and links between them,

- developing BCE (if applicable) – the technical concept containing a set of maximum and minimum parameters of various components of the project,
- identifying sources of emissions and disturbances that may be caused by the project, and verifying project parameters affecting the occurrence and scale (local, regional, national, international), frequency (single, repeatable), duration (temporary, short-term, medium-term, long-term), intensity (low, medium, high, very high), reversibility (reversible, irreversible), reversibility nature (positive, negative, no impact) and type (direct, indirect, secondary, cumulative) of impacts in identified environmental conditions,
- defining the time frame of the analysis will consist of identifying timeframes within which various impacts may occur, determined by the successive stages of the project:
  - planning,
  - construction,
  - exploitation/operation,
  - decommissioning,
- analysing the possible scale of impacts and verifying whether materiality thresholds can be exceeded by impacts on individual components of the environment based on various options being considered:
  - for the individual impact of various components of the project,
  - for cumulative impacts across the entire project,
  - for cumulative impacts with other plans or projects,
  - analysis of unplanned impacts,
  - analysis of transboundary impacts,
- analysis of available mitigating methods and their impact on reducing the scale of impacts,
- assessment of the impact on the integrity, coherence and object of protection of Natura 2000 sites:
  - research, initial assessment, screening – a process during which probable influences of the project on Natura 2000 sites are identified (alone or in combination with other projects or plans), and an analysis is implemented to determine whether the predicted impacts could have a significant influence on these areas,
  - proper assessment – assessment of the impact of the project on the integrity, coherence and object of protection of Natura 2000 sites (alone or in combination with other projects or plans) with respect to the structure of these areas, their function and conservation objectives; conducted only if the predicted impacts of the project may have a significant influence on Natura 2000 sites; if there are adverse impacts, potential mitigation measures are also assessed,

- assessment of alternative solutions – a process during which an analysis is made of alternative options for achieving the objectives of the project or plan, that allows for the avoidance of the adverse impact on the integrity, coherence and object of protection of Natura 2000 sites,
- assessment in cases where no alternative solutions exist and adverse impacts persist, assessment of compensatory measures – assessment of compensatory measures where, in the light of necessary public interest requirements, it is considered that the project or plan should be implemented.

Conclusions stage:

- identifying the bounding parameters of environmental sensitivity to the impact of individual components of the project, maintaining these ensures that the thresholds of significant impacts of the project on individual elements of the environment are not exceeded.

The matrix of interactions between emissions and impacts at sea/on land as a recommendation and an example to be used are included in Table 1 and Table 2. Matrices contain potential emissions and disturbances, direct and indirect impacts and the factors determining them, set against technology parameters. The most important element of the analysis of the impact on the environment should be a determination of the interrelations between the farthest-reaching technical parameters of all potential emission sources in the project options being considered and the possibility of impacts that may permanently, and irreversibly disturb environmental functioning.

6.3.2 Recommendation for social dialogue

Negligence in the engagement of social dialogue may lead to: delays, cost creep, loss of funding, permit refusal, loss of credibility for the investor and the project.

Therefore, it is necessary to apply a structured approach to the activities, thus minimizing the risk of potential protests. The steps proposed follow a proven methodology, applied to large, pioneering projects and at the same time they may be flexibly adapted to the project size, character, location and requirements. The following logic is applied:

- Learn about the environmental and social context,
- Define the types and areas of potential impact,
- Identify stakeholders,
- Inform broadly and transparently about the project,
- Listen and respond to feedback,
- Involve stakeholders,
- Prepare to defend the project.

Based on this approach the following steps and activities are proposed for the project:

Step 1. Preliminary analysis of local socio-economic conditions

- Appropriately collected data and assessment criteria adequate for a given project type allow for the identification of the most likely sources of potential conflict, including social groups or regions especially prone to conflicts as well as the most contentious issues that may lead to protests.
- Activities: analysis of socio-economic conditions and previous local conflicts against several dozen criteria, identification of potential focal points of conflicts.

Step 2. Identification of the stakeholder and the development of a Stakeholder Engagement Plan

- The adequate identification of stakeholders is a prerequisite to the development of a stakeholder management strategy, the aim of which is to increase the role and impact of positive stakeholders, while mitigating the impact of negative ones on the project.
- To make sure that the communication campaign is effective, each group of stakeholders has to be approached individually, taking into account its interests and the areas of impact that the project will generate for each particular group.

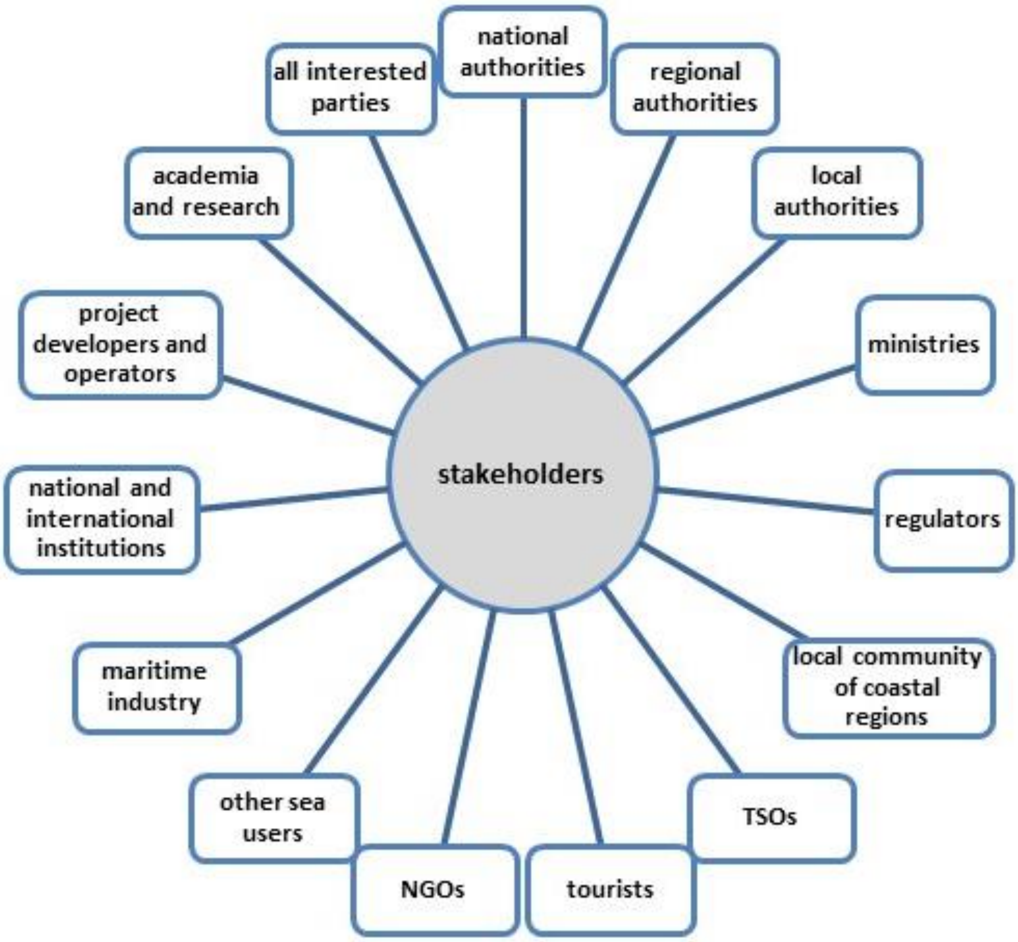

Figure 5 Potential group of stakeholders

- Activities: development of a Stakeholder Engagement Plan identifying and assessing all potential stakeholders (negative, positive, direct, indirect, internal, external), development of tailored-made communication strategies for each group.

Step 3. Development of a project website

- A dedicated website should be the basic source of information about the project. It allows the project managers to provide updates and present other topics in a flexible way. Through this website one can also perform consultation and provide feedback. It is a transparent resource that is easily available to the public.
- Activities: the development of a project-wide website in national languages, a dedicated website, the continuous update of the contents, presentation of substantive materials (project information sheet, EIA Report) as well as PR materials (news, press release, videos, infographics).

Step 4. Development of materials custom-made for stakeholders

- A dialogue with stakeholders should lead to the timely execution of the project in line with its business objectives. Therefore, this dialogue needs to be effective. To guarantee its effectiveness, the right content and materials needs to be developed in a proper form and scope e.g. information addressing the benefits for each group individually rather than for the general public.
- Activities: development of presentations for meetings custom-made for each stakeholder group, information brochures with infographics, promotional videos showing the need for the project and the amount of effort and involvement of world-class experts involved.

Step 5. Prepare stakeholders for dialogue (awareness raising)

- Given the ubiquitous Internet, everyone will try to “educate” themselves about the project. Therefore, it is better to enable access to credible and reliable sources of information.
- Activities: distribution of info-materials, media campaign (internet and traditional) – articles, press releases, promotion of project website as the primary and most updated source of information.

Step 6. Listen and respond to feedback (meetings with stakeholders)

- The most effective method for preventing acute conflict, which may result in a blocked project, is constant stakeholder dialogue. Explaining and diffusing doubts, presenting new facts and evidence to answer questions asked during consultations boosts the investor’s credibility and makes most stakeholders less active.
- Activities: a) early project information meetings with chosen stakeholder groups (e.g. fisheries organizations, tourist organizations, local authorities) to inform them about the project and investor’s intentions (participation of the investor’s representative is important), b) consultation meetings with relevant stakeholders after the execution of environmental surveys (based on real data), consultations with authorities responsible for transboundary procedures.

Step 7. Involve stakeholders

- Advocates of the project i.e. stakeholders who will benefit from it and who feel part of a common goal don’t stage protests!
- Activities: cooperation with local authorities and NGOs, use of local resources and workforce in the organization of local events, knowledge contests in local schools involving local opinion leaders and politicians.

Step 8. Prepare defence

- Not every awareness campaign will allow you to prevent attempts to challenge administrative decisions and permits. a basic line of defence lies in adequately drafted, complete, pertinent documentation. This step directly corresponds to the environmental documentation which is the basis for a potential defence in court.
- Activities: proper documentation of project activities, especially consultations (video footage from meetings), coordination of information from the permitting process.

Step 9. Horizontal – project-wide image campaign

- Social dialogue does not only focus on the local level but also includes broader aspects of the general nation-wide attitude towards the project which affects direct stakeholders.
- With a project of large magnitude and importance on a European scale the tasks performed should be correlated with efforts made by the investor at the European Union level.
- Activities: press articles in the nation-wide media, a continuous presence of the project in social media, proper administration of the project website.

7. Summary and conclusions

- The Baltic InteGrid project is exploring the potential of integrated offshore grids for the Baltic Sea region. It aims to contribute to sustainable electricity generation, the further integration of regional electricity markets and the security of supply in the Baltic Sea Region by applying an integrated approach to grid development to optimize the potential and efficiency of offshore wind energy.
- Baltic Offshore Grid is the concept of offshore transmission infrastructure in the Baltic Sea. The aim of the transmission infrastructure is to link offshore wind farms (OWF) to the electro-energetic network and to transmit electrical energy onshore while making a cross-border exchange of electrical energy possible between the countries of the Baltic Sea Region.
- Impact Mitigation Strategy of the Baltic Offshore Grid is a document containing a suggestion for guidelines and objectives for environmental impact assessment within the scope of strategic assessment and indication of good practice for environmental procedure and dialogue with stakeholders for infrastructure investment projects within BOG.
- Due to its complexity and a long-term perspective for 2050, the BOG concept may be treated as a strategic/programme character and aims to indicate the future development direction for cross-border connections integrated with OWF, in such a way as to maximize the advantages resulting from connections which are densely interconnected.

- The final shape of BOG will depend on the results of the political, regulatory, spatial, market, technical and technological, as well as environmental and social analyses.
- For the purposes of this document 2 variants have been adopted – Variant "0" – no execution of BOG and Variant "1" – assumes the integration of all OWF projects with the offshore transmission grid.
- BOG will contribute (directly or indirectly) to meeting the priorities of the EU energy policy.
- It is not expected that the development of the BOG could cause a significant effect on the environment and may improve the electro-energetic system in countries of the Baltic Sea region.
- A comparative analysis shows that a highly integrated BOG – V "1" is more beneficial for the environment than V "0" due to:
  - more spatially limited intervention in the natural environment (smaller number of cable corridors, cable corridor landfalls and transformer stations on land), resulting in a lower level of interference with Natura 2000 sites, species habitats on land, as well as benthic habitats and sea-floor integrity,
  - more spatially limited interference with the coastline (smaller number of cable corridor landfalls), resulting in a smaller number of locations where the morphology and ecological values of the coastal areas as well as their flood protection function can be affected and therefore a smaller impact on the coastline integrity,
  - lower level of difficulties/limitations for fishery and shipping, both during the construction and operation stage (including service works), arising from the lower number of possible special interferences of cable corridors with areas important for fishery and shipping lanes,
  - the fact that it is better balanced in the terms of spatial planning – will lead to a lower degree of fragmentation of the area and therefore fewer obstacles to the location of future projects,
  - lower risk of interference with prospective mineral deposits of economic value, objects of cultural value, as well as objects like chemical warfare and UXO, connected to the lower number of cable corridors and their less scattered spatial distribution, and in the case of mineral deposits and cultural heritage also from the lower number of onshore transformer stations,
  - the fact that it visually affects a lower number of locations on land.
- A catalogue of possible mitigation measures has been proposed for different stages of project development.
- For projects within BOG it is assumed that none of technical elements is qualified according to the EIA Directive as a project which is likely to have significant effects on the environment. Therefore, projects planned under the BOG in the light of EU law are not required to be the subject of an adequate assessment regarding their effects, before consent for their implementation is given.
- For implementation of the projects within BOG - as a good practice - should be carried out EIA process with individual program of surveys and monitoring and if relevant - transboundary impact assessment.
- For the project in the early stage and if more than one technology is considered for the purpose of the EIA methodology can be based on bounding conditions envelope (BCE). BCE has been developed in order to identify the maximum design parameters and technical solutions. In this approach the project is outlined by the boundary conditions.
- As a recommendation for effective EIA process for individual projects built BOG in case of decision of implementation is to procced social dialogue. Negligence in engagement in social dialogue can lead to: delays, cost creep, loss of funding, permit refusal, loss of credibility for the investor and the project. One of the most significant milestone should be identification of stakeholder and development of Stakeholder Engagement Plan.

References

Baltic InteGrid (2018): *Baltic InteGrid: 2050 offshore wind power vision for the Baltic Sea*

Baltic InteGrid (2018): *Polish-Swedish-Lithuanian and German-Swedish-Danish interconnectors integrated with offshore wind farms – case studies.*

Beckholmen, Monica, Tirén, Sven a (2009): *The geological history of the Baltic Sea a review of the literature and investigation tools*, *Report number: 2009:17*, Swedish Radiation Safety Authority, Uppsala.

HELCOM (2010): Ecosystem Health of the Baltic Sea 2003–2007: HELCOM Initial Holistic Assessment.rrow/baltic-energy-market-interconnection-plan-gas.

HELCOM (2013): *Climate change in the Baltic Sea Area: HELCOM thematic assessment in 2013. Baltic Sea Environment Proceedings No. 137.*

HELCOM (2013): *HELCOM Chemical Munitions Dumped in the Baltic Sea. Report of the ad hoc Expert Group to Update and Review the Existing Information on Dumped Chemical Munitions in the Baltic Sea. Baltic Sea Environment Proceeding No. 142.*

HELCOM (2017): *First version of the 'State of the Baltic Sea' report – June 2017.*

HELCOM (2018): *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

HELCOM (2018): State of the Baltic Sea – Second HELCOM holistic assessment 2011-2016. Baltic Sea Environment Proceedings No. 155.

http://balticconnector.fi/en/

http://basrec.net/wp-content/uploads/2015/01/BASREC%20Grid%20study%20-%20Final%20report%202014.pdf

https://ec.europa.eu/energy/sites/ener/files/documents/2014_nsog_report.pdf

http://ec.europa.eu/environment/nature/natura2000/data/index_en.htm

https://elering.ee/en/balticconnector#redirected

https://en.wikipedia.org/wiki/Submarine_power_cable

http://estlink2.elering.ee/estlink-1-vs-estlink-2/

https://hub.globalccsinstitute.com/publications/connecting-europe-energy-infrastructure-tomorrow/baltic-energy-market-interconnection-plan-electricity

https://hub.globalccsinstitute.com/publications/connecting-europe-energy-infrastructure-tomorrow/baltic-energy-market-interconnection-plan-gas

http://natura2000.gdos.gov.pl/

http://new.abb.com/systems/hvdc/references/baltic-cable

http://new.abb.com/systems/hvdc/references/fenno-skan

http://new.abb.com/systems/hvdc/references/kontek http://new.abb.com/systems/hvdc/references/konti-skan

http://new.abb.com/systems/hvdc/references/nordbalt

http://new.abb.com/systems/hvdc/references/swepol-link

http://new.abb.com/systems/hvdc/references/the-gotland-hvdc-link

http://sambah.org/SAMBAH-Final-Report-FINAL-for-website-April-2017.pdf

http://stateofthebalticsea.helcom.fi/biodiversity-and-its-status/benthic-habitats/

http://stateofthebalticsea.helcom.fi/pressures-and-their-status/underwater-sound/)

https://windeurope.org/newsroom/news/windeurope-urges-estonia-to-stimulate-regional-cooperation-on-offshore-wind-in-the-baltic/

http://www.helcom.fi/action-areas/marine-protected-areas/HELCOM-MPAs-and-Natura-2000-areas

http://www.helcom.fi/baltic-sea-trends/environment-fact-sheets/

http://www.helcom.fi/Lists/Publications/Monitoring%20and%20assessment%20strategy.pdf

http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/Baltic_Sea_Ecoregion_Fisheries_Overview.pdf

https://www.nord-stream.com/the-project/pipeline/

https://www.nord-stream2.com/media/documents/pdf/en/2017/04/nsp2-espoo-report-eng.pdf

http://www.satbaltyk.pl/en/

https://www.submarinecablemap.com/#/submarine-cable/c-lion1

http://www.4coffshore.com/offshorewind/index.html?lat=54.041&lon=6.994&wfid=DE13

Leth, Jørgen O. et al. (2008): Baltic Sea marine landscapes and habitats: Mapping and modelling. BALANCE Technical Summary Report, part 2/4, Geological Survey Of Denmark and Greenland, Copenhagen

Uścinowicz, Szymon et al. (2011): Geochemia osadów powierzchniowych Morza Bałtyckiego, Polish Geological Institute - National Research Institute, Warsaw.

Appendix A Offshore wind farms and linear infrastructure under operation in the Baltic Sea

A.1. Offshore wind farms under operation in the Baltic Sea

Name of the wind farm	Country	Project capacity (MW)	Developer	Average distance to shore (km)	Project area (km^2)	Number of turbines	Hub height (m)	Rotor diameter (m)	Foundation
Avedøre Holme	Denmark	10,8	DONG Energy AS	0,4	<1	3	93,0	120,0	Grounded: Gravity-Base
Anholt	Denmark	400,0	DONG Energy - Anholt Offshore A/S (DONG Energy AS)	15,0	116,0	111	81,6	120,0	Grounded: Monopile
Frederikshavn	Denmark	7,6	DONG Energy AS	3,2	<1	1/2/1	80,0	90,0/90,0/82,4	Grounded: Monopile, Bucket
Middelgrunden	Denmark	40,0	DONG Energy AS	4,0	<1	20	64,0	76,0	Grounded: Gravity-Base
Nysted	Denmark	165,6	Energi E2	11,0	26,0	72	69,0	82,4	Grounded: Gravity-Base
Rødsand 2	Denmark	207,0	E.ON Vind Sverige AB (E.ON. Climate & Renewables GmbH)	4,0	34,0	90	68,5	93,0	Grounded: Gravity-Base
Samsø	Denmark	23,0	Samsoe Havvind	4,0	<1	10	70,0	82,4	Grounded: Monopile
Sprogø	Denmark	21,0	Sund & Baelt Holding A/S	10,6	<1	7	70,0	90,0	Grounded: Gravity-Base
Tunø Knob	Denmark	5,0	DONG Energy AS	6,0	<1	10	45,0	39,0	Grounded: Gravity-Base
Vindeby	Denmark	5,0	SEAS-NVE Energy Group	1,8	<1	11	35,0	35,0	Grounded: Gravity-Base

Name of the wind farm	Country	Project capacity (MW)	Developer	Average distance to shore (km)	Project area (km²)	Number of turbines	Hub height (m)	Rotor diameter (m)	Foundation
Kemi Ajos 1 (partly onshore)	Finland	15,0	Innopower Oy	3 (partly onshore)	2,0	5	88,0	100,0	Grounded: Artificial Island/ onshore
Kemi Ajos 2	Finland	15,0	Innopower Oy	> 3	1,0	5	88,0	100,0	Grounded: Artificial Island
Pori Offshore 1	Finland	2,3	Suomen Hyötytuuli Oy	1,2	<1	1	80,0	101,0	Grounded: Gravity-Base (Steel Shell Gravity)
Breitling/Rostock	Germany	2,5	WIND-projekt GmbH, Nordex Energy AG	0,5	<1	1	80,0	90,0	Grounded: Gravity-Base
EnBW Baltic 1	Germany	48,3	EnBW Baltic 1 GmbH	16,0	7,0	21	67,0	93,0	Grounded: Monopile
EnBW Baltic 2	Germany	288,0	EnBW Baltic 2 GmbH (EnWB Erneuerbare Energien GmbH)	57-65	30,0	80	78,3	120,0	Grounded: Monopile, Jacket
Bockstigen	Sweden	2,8	OM O2(formerly O2 Vindkompaniet)	5,7	<1	5	41,5	37,0	Grounded: Monopile
Kårehamn	Sweden	48,0	E.ON Vind Sverige AB (E.ON Climate & Renewables GmbH)	4,0	2,0	16	80,0	112,0	Grounded: Gravity-Base
Lillgrund	Sweden	110,4	Vattenfall Europe Windkraft GmbH (Vattenfall AB)	7,0	6,0	48	68,0	93,0	Grounded: Gravity-Base
Utgrunden I	Sweden	10,5	Energi E2 (DONG Energy AS)	7,0	<1	7	65,0	70,0	Grounded: Monopile

Source: data obtained from BIG Partners

A.2. Offshore linear infrastructure under operation in the Baltic Sea

Name of infrastructure	Type of investment	Countries connected	Capacity	Submarine length [km]
Nord Balt	submarine cable HVDC	Lithuania – Sweden	700 MW (voltage 300 kV)	400
SwePol Link	submarine cable HVDC	Poland – Sweden	600 MW (voltage 450 kV)	239
Konti-Skan 1	submarine cable HVDC	Sweden - Denmark	250 MW (voltage 250 kV)	88
Konti-Skan 2	submarine cable HVDC	Sweden - Denmark	300 MW (voltage 300 kV)	87
Kontek	submarine cable HVDC	Germany - Denmark	600 MW (voltage 400 kV)	52
HVDC Gotland 2,3	submarine cable HVDC	Swedish mainland – Swedish Island of Gotland	260 MW (voltage 150 kV)	2x96
Fenno-Skan 1	submarine cable HVDC	Sweden - Finland	550 MW (voltage 400 kV)	200
Fenno-Skan 2	submarine cable HVDC	Sweden - Finland	800 MW (voltage 500 kV)	200
Estlink 1	submarine cable HVDC	Estonia - Finland	350 MW (voltage 150 kV)	74
Estlink 2	submarine cable HVDC	Estonia - Finland	650 MW (voltage 450 kV)	74
Baltic Cable	submarine cable HVDC	Germany - Sweden	600 MW (voltage 450 kV)	250
Finlandskabeln	submarine cable HVDC	Finland	100 MW (voltage 80 kV)	158
Nord Stream	gas pipe	Russia - Germany	55 billion cubic metres a year	1224
Baltic connector	gas pipe	Finland - Estonia	2 billion cubic metres per annum	77

Source:

http://balticconnector.fi/en/
https://www.nord-stream.com/the-project/pipeline/
http://new.abb.com/systems/hvdc/references/fenno-skan
http://estlink2.elering.ee/estlink-1-vs-estlink-2/
https://en.wikipedia.org/wiki/Submarine_power_cable
https://elering.ee/en/balticconnector#redirected
http://www.4coffshore.com/offshorewind/index.html?lat=54.041&lon=6.994&wfid=DE13

https://www.submarinecablemap.com/#/submarine-cable/c-lion1
http://new.abb.com/systems/hvdc/references/nordbalt
http://new.abb.com/systems/hvdc/references/swepol-link
http://new.abb.com/systems/hvdc/references/konti-skan
http://new.abb.com/systems/hvdc/references/kontek
http://new.abb.com/systems/hvdc/references/the-gotland-hvdc-link
http://new.abb.com/systems/hvdc/references/baltic-cable

Appendix B Planned offshore wind farms and linear infrastructure in the Baltic Sea – different stages

B.1. Planned offshore wind farms in the Baltic Sea

Name of the wind farm	Country	Project capacity (MW)	Developer	Average distance to shore (km)	Project area (km2)	Number of turbines	Hub height (m)	Rotor diameter (m)	Foundation
Offshore wind farms under construction									
Ajos (Kemi Ajos 1 and 2)	Finland	42,4	OX2	> 3	3,0	13	92,5	130, 113	Groundet: Artificial Island
Wikinger	Germany	354,0	Iberdrola Renovables Deutchland GmbH, Deutsche Bank AG	77,6	34,0	70	97,5	135	Grounded: Jacket (Piled)
Offshore wind farms under pre-construction stage									
Tahkoluoto Offshore Wind Power Project (Pori Tahkoluoto)	Finland	40	Suomen Hyötytuuli Oy	0,5	6	10	90	130	Grounded: Gravity-Base (Steel Shell Gravity)
GICON Schwimmendes Offshore Fundament (SOF) Pilot	Germany	2,3	Grossmann Ingenieur Consult (GICON) GmbH	3,2	0	1		93	Floating: Tension Leg Platform
Arkona Becken Südost	Germany	185	E.ON AG	35	39	60		154	Grounded: Monopile
Offshore wind farms with consent authorised									
Arcadis Ost 1	Germany	348	KNK Wind GmbH (WV Energie AG)	17	29	58	100	150	Grounded: Jacket (Piled)
Kattegat Offshore	Sweden	282	Favonius AB (Agrivind AB)	8-13	22	28-47			Grounded: Monopolie or Jacket

Kriegers Flak II	Sweden	640	Sweden Offshore Wind AB (Vattenfall AB)	30	63	128			Grounded
Stora Middelgrunden	Sweden	648-864	Universal Wind AB	25	65	108			Grounded: Monopile (Grounded-Monopile or Grounded-Tripod)
Storgrundet	Sweden	420	Storgrundet Offshore AB (WPD offshore Gmbh)	11	67	70		150	Grounded: Gravity-Base
Taggen Vindpark	Sweden	300	Taggen Vindpark Elnät AB, Taggen Vindpark AB	19	50	60-83	100		Grounded
Trolleboda	Sweden	150	Vattenfall Europe Windkraft GmbH (Vattenfall AB)	6	22	30			Grounded
Utgrunden II	Sweden	86	E.ON Vind Sverige AB (E.ON Climate & Renewables GmbH)	8	10	24	150	120	Grounded
Offshore wind farm with submitted consent application									
Kriegers Flak	Denmark	600	Danish Energy Agency	15	183	60-200	125	190	Grounded: Monopiles suspected but Gravity-based or Jacket foundations are also options
Omo Syd	Denmark	260	Omo South Nearshore A/S	11,3	32	15-80	118	164	Grounded: Monopile estimated
Suurhiekka, Ii	Finland	400	Suurhiekka Offshore Oy (WPD Finnland Oy)	25	58	80	100	120	Grounded (caisson)
Adlergrund 500	Germany	72	Adlergrund 500 GmbH	40	4	20			Grounded
Adlergrund GAP	Germany	155	BEC Energie Consult GmbH	36	5	31			Grounded
Baltic Eagle	Germany	500	Sea Wind Management GmbH (Sea Wind Holding AG)	28	49	83			Grounded

Ostseeschatz	Germany	252	Financial Insurance GmbH (Windreich)	30	23	42			Grounded
Wikinger Nord	Germany	40	Iberdrola Renovables Deutschland GmbH	40	3	8			Grounded
Wikinger Süd	Germany	85	Iberdrola Renovables Deutschland GmbH	40,9	6	18			Grounded
Windanker	Germany	252	Iberdrola Renovables Deutschland GmbH	42	18	42	110	180	Grounded: Monopile
AVEC-1	Lithuania	81	UAB AVEC	8	16	27	80	90	Grounded
AVEC-2	Lithuania	198-266	UAB AVEC	37,6	38	38-66	80-98	90-154	Grounded
R1	Lithuania	300	UAB Renerga	32	26	38	98	164	Grounded
R2	Lithuania	300	UAB Renerga	38,7	27	37	98	164	Grounded
Polenergia Bałtyk II (previous Baltyk Srodkowy II)	Poland	600	Polenergia Bałtyk II Sp. z o.o. (Polenergia SA)	37	122	60	175	200	Grounded
Polenergia Bałtyk III (previous Baltyk Srodkowy III)	Poland	600	Polenergia Bałtyk III Sp. z o.o. (Polenergia SA)	22	117	75	175	200	Grounded
Södra Midsjöbanken	Sweden	2100	E.ON Nordic AB (E.ON Climate & Renewables GmbH)	70	337	300			Grounded
Svenska Björn Offshore	Sweden	-	Solid Vind AB	64	63	66			Grounded

B.2. Planned offshore linear infrastructure in the Baltic Sea

Name of infrastructure	Type of investment	Countries connected
Offshore cable	submarine cable	Denmark - Germany
Nord Stream 2	gas pipe	Russia - Germany
Baltic Pipe	gas pipe	Denmark - Poland
Gas pipe	gas pipe	Finland - Estonia
Gas pipe	gas pipe	Denmark - Germany

Source:

https://hub.globalccsinstitute.com/publications/connecting-europe-energy-infrastructure-tomorrow/baltic-energy-market-interconnection-plan-electricity

https://hub.globalccsinstitute.com/publications/connecting-europe-energy-infrastructure-tomorrow/baltic-energy-market-interconnection-plan-gas

Appendix C Assessment of compliance of the Baltic Offshore Grid objectives

Name of the document	Objectives and priorities set out in the document (selected for the paper purposes)	Assessment of the compatibility of the Baltic Offshore Grid objectives with the EU energy policy priorities resulting from strategic documents			
		C1	C2	C3	C4
The Europe 2020 Strategy - A strategy for intelligent and sustainable growth fostering social inclusion - a growth plan for the European Union's economy, follows on from the Lisbon Strategy of 2000-2010 and aims at smart, sustainable, inclusive and more coordinated action at the EU and member state levels. The priority objectives of the Strategy include achieving the "20/20/20" targets (reduction of greenhouse gas emissions by 20%, and if the conditions allow by 30%, achieving a 20% share of renewable energy sources, achieving 20% energy savings by 2020 compared to 1990).	3 interrelated priorities: • smart growth: development of economy based on know-how and innovation, • sustained growth: supporting the economy more efficiently using resources, more environment-friendly and more competitive, • inclusive growth: promoting a high-employment economy delivering social and territorial cohesion. Objectives: • 3% of the Union's GDP should be allocated to R&D investment, • achieve the "20/20/20" climate and energy targets (including reducing carbon dioxide emissions by up to 30% if conditions permit), flagship projects that will enable progress to be made under each thematic priority, including: • "Innovation Union" - a project to improve framework conditions and access to research and innovation funding so that innovative ideas can be turned into new products and services, which in turn will contribute to growth and jobs, • "Resource efficient Europe" - a project to make economic growth independent from resource use, shift to a low-carbon economy, increase the use of renewable energy sources, modernise transport and promote energy efficiency, • "Industrial policy for the globalisation era" - a project to improve the business environment, especially for SMEs, and to support the development of a strong and sustainable industrial base, prepared to compete in global markets.	X	X	X	X
A growth package for integrated European infrastructures in Baltic	The objectives and priorities for the Union's energy policy:	X	X	X	X

<table>
<tr><th rowspan="2">Name of the document</th><th rowspan="2">Objectives and priorities set out in the document (selected for the paper purposes)</th><th colspan="4">Assessment of the compatibility of the Baltic Offshore Grid objectives with the EU energy policy priorities resulting from strategic documents</th></tr>
<tr><th>C1</th><th>C2</th><th>C3</th><th>C4</th></tr>
<tr><td>Energy Market Interconnection Plan in Electricity (BEMIP Electricity Action Plan) sets out common challenges and guidelines for sectoral policies: (transport, energy and digital)</td><td>• competitiveness, sustainability and security of supply through the modernisation and expansion of the European energy infrastructure and cross-border network interconnections,
• develop a new EU energy infrastructure strategy to coordinate and optimise network development,
• the need to review the existing policy on trans-European energy networks (TEN-E) and the funding framework,
• implementation of the internal energy market and interconnecting isolated regions with the European network, development of alternative supply or transmission routes and sources of energy and development of renewable energy sources and their competitiveness with traditional sources.
The following corridors have been adopted for electricity:
• The Baltic Energy Market Interconnection Plan for Electricity (BEMIP electricity) - interconnection between the Baltic States and reinforcement of the internal network infrastructure, respectively, in order to finish the isolation of the Baltic States and promote market integration in the region.
• The following corridors have been adopted for gas:
• North-South gas interconnections in Central Eastern and South Eastern Europe - regional gas interconnections between the Baltic Sea, the Adriatic, the Aegean and the Black Sea, in particular with a view to enhancing diversification and security of gas supply.
• The Baltic Energy Market Interconnection Plan for Gas (BEMIP gas) - infrastructure to end the isolation of the three Baltic States and Finland and their dependence on a single supplier and increase diversification of supply in the Baltic Sea region.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Green paper A European Strategy for Sustainable, Competitive and Secure Energy - The Energy Security Plan, which has</td><td>6 priority areas:
• Energy for growth and jobs in Europe: completing the construction of Europe's internal electricity and gas markets,</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
</table>

Name of the document	Objectives and priorities set out in the document (selected for the paper purposes)	Assessment of the compatibility of the Baltic Offshore Grid objectives with the EU energy policy priorities resulting from strategic documents			
		C1	C2	C3	C4
been identified as a key element of the EU's political and economic independence in improving the European energy market.	• Internal energy market for supply security; Member states solidarity, • Security and competitiveness of energy supply: towards more sustainable, efficient and diversified energy, • Integrated approach to tackling climate change; • Encouraging innovation: a strategic European energy technology plan; and • Coherent energy policy.				

A framework strategy for a stable energy union based on a forward-looking climate policy - a plan focusing on climate change, ensuring energy security; it identifies the global challenges which the EU's energy system faces, requiring the EU countries to show solidarity and work together to ensure secure, affordable and sustainable energy for consumers.	Objectives and priorities:
	• ensuring security of electricity supplies through:
	  ◦ diversification of energy sources, including the use of indigenous sources in a more efficient way,
	  ◦ close cooperation between neighbouring countries (including eight non-EU countries, members of the Energy Community) in case of energy shortages or energy crises,
	  ◦ establish a body responsible for joint purchasing of gas in crisis situations.
	• reduction of emissions through:
	  ◦ reviewing the EU Emissions Trading Scheme and promoting investment in new technologies and new infrastructure,
	  ◦ achieving world leadership in the field of renewable energy, e.g. solar energy and wind energy,
	• achieving an integrated internal energy market through:
	  ◦ creating more interconnections between the EU countries to facilitate the rapid and free movement of energy,
	  ◦ stepping up the construction and maintenance of essential infrastructure elements,
	  ◦ increasing competition between suppliers, which should reduce prices,
		X	X	X	X

Name of the document	Objectives and priorities set out in the document (selected for the paper purposes)	Assessment of the compatibility of the Baltic Offshore Grid objectives with the EU energy policy priorities resulting from strategic documents			
		C1	C2	C3	C4
	• increasing energy efficiency by reducing energy consumption, which will reduce the need for energy imports, reduce pollution and help preserve internal energy sources, • research and innovation in low-carbon technologies through coordination of research and project funding in cooperation with the private sector.				
Energy Roadmap 2050 - the plan sets out clear energy efficiency standards to be met by the EU Member States by 2050.	Objective: • decarbonisation of the energy market, resulting in an 80-95% reduction in greenhouse gas emissions by 2050.	X	X		
The EU Strategy for Climate Change Adaptation - outlines the actions to improve Europe's resilience to climate change by enhancing the readiness and response capacity to climate change impacts at local, regional, national and EU levels, developing a coherent approach and improving the coordination of actions.	Priority objectives and directions: • the obligation for Member States to develop national adaptation strategies, • finance projects related to adaptation from the LIFE programme and the Structural Funds, • take adaptation into account in urban development planning, • continue scientific research to facilitate rational economic and political decision-making, • development of the Climate-ADAPT platform as a point of exchange of information on adaptation to climate change in Europe, • including the adaptation in the EU policies and legislation, with the Common Agricultural Policy, the Common Fisheries Policy, regional development and other policies, • providing resilient infrastructure, • promoting insurance and other financial products that will reduce the exposure of investments and trade decisions to the adverse effects of climate change.			X	
VII General EU Environment Action Programme 2020 Good quality of life, taking	Objectives: • protection, conservation and improvement of the Union's natural capital,	X	X	X	X

Name of the document	Objectives and priorities set out in the document (selected for the paper purposes)	Assessment of the compatibility of the Baltic Offshore Grid objectives with the EU energy policy priorities resulting from strategic documents			
		C1	C2	C3	C4
into account the limitations of our planet - sets the course for protecting natural capital, health and social well-being and stimulating growth and innovation based on a resource-efficient, low-carbon economy, taking into account natural constraints.	• making the Union a resource-efficient, green and competitive low-carbon economy, • protecting the Union citizens from environmental pressures and threats to health and well-being, • maximising the benefits of the Union environmental legislation by better implementing it, • improving the knowledge and evidence base of the EU environmental policy, • securing investments in environmental and climate policy and addressing environmental externalities, • better environmental mainstreaming and greater policy coherence, • promoting the sustainability of the cities of the Union. • making the Union more effective in addressing international environmental and climate challenges.				
Our life insurance, our natural capital: an EU biodiversity strategy to 2020 - provides a framework for the EU's actions over the next decade to achieve the 2020 biodiversity headline target.	Objective: • stop the loss of biodiversity and the degradation of ecosystem functions in the EU by 2020 and restore them as far as possible taking into account climate change, and strengthen the EU's contribution to preventing global biodiversity poverty.		X		
European Commission Clean Air Package - the strategy sets out support measures to enhance capacity and cooperation at all political levels, with a focus on areas such as urban air pollution, research and innovation, and the international dimension of air quality policy.	Objectives: • reducing the long-term impact of air pollution, • developing Community mechanisms for mitigating the effects of atmospheric warming and climate change.		X	X	

Name of the document	Objectives and priorities set out in the document (selected for the paper purposes)	Assessment of the compatibility of the Baltic Offshore Grid objectives with the EU energy policy priorities resulting from strategic documents			
		C1	C2	C3	C4
The 2020-2030 policy framework on climate and energy - promotes and sets the framework for a low-carbon economy and a competitive and secure energy system.	Objectives: • reduction of at least 40% in greenhouse gas emissions (compared to 1990 levels), • ensuring at least a 27% share of energy from renewable sources in total energy consumption, • increasing energy efficiency by 27%.	X	X	X	X
The Baltic Sea Action Plan HELCOM, the world's first action programme for marine protection, aims to improve the environment of the Baltic Sea.	Objectives: • preventing eutrophication, i.e. excessive growth of nutrients, leading to unnatural algae bloom and thus to the formation of anaerobic zones, • counteracting discharges of dangerous substances, including carcinogenic and toxic dioxins (including nitrogen, mercury and phosphorus), • ensure environmentally friendly maritime transport, • protection of biodiversity (security of evolution and sustainability of life support systems in the biosphere).			X	
Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning	Objectives: • promoting sustainable growth in the maritime economy, • promoting the sustainable development of marine areas with regard to the energy sector at sea, maritime transport, fisheries, aquaculture, conservation, protection and improvement of the environment, including climate resilience, • promoting the sustainable use of marine resources taking into account the specificities of marine regions and existing and future activities and uses of these areas, their impact on the environment and natural resources, as well as the interaction between land and sea.	X	X	X	X
Regulation of the European Parliament and of the Council 347/2013 of 17/04/2013 on guidelines for trans-European energy	Objective: • provide favourable conditions for the modernisation and expansion of European energy infrastructure and cross-border interconnections in order to contribute to	X	X	X	X

Name of the document	Objectives and priorities set out in the document (selected for the paper purposes)	Assessment of the compatibility of the Baltic Offshore Grid objectives with the EU energy policy priorities resulting from strategic documents			
		C1	C2	C3	C4
infrastructure, repealing Decision 1364/2006/EC and amending Regulations (EC) 713/2009, (EC) 714/2009 and (EC) 715/2009	the creation of a European energy market and increase security of supply.				
Regulation of the European Parliament and of the Council (EU) of 30 November 2011 establishing the Programme to support the further development of an Integrated Maritime Policy	Objective: • support the development and implementation of integrated maritime and coastal governance.	X	X	X	X
Directive 2009/28/EC of the European Parliament and of the Council of 23/04/2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC	Objectives: • establish common principles for the use of renewable energy in the EU as well as reducing greenhouse gas emissions and promoting cleaner transport, • binding national targets to achieve by 2020 the overall share of renewable energy sources at 20% of the EU's total energy consumption and at 10% of energy consumed in the transport sector (participation in both categories is measured taking into account gross total energy consumption, i.e. the share of renewable energy sources in total consumption of energy from all sources, including renewables).		X	X	X
Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common principles for the internal market in electricity and repealing Directive 2003/54/EC	Objectives: • introduction of common rules for the generation, transmission, distribution and supply of electricity, • establishing universal service obligations and consumer rights.	X	X	X	X
Directive 2008/56/EC of the European Parliament and of the	Objectives:			X	

Name of the document	Objectives and priorities set out in the document (selected for the paper purposes)	Assessment of the compatibility of the Baltic Offshore Grid objectives with the EU energy policy priorities resulting from strategic documents			
		C1	C2	C3	C4
Council of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive - establish a framework within which Member States shall take the necessary measures to achieve or maintain good environmental status in the marine environment by 2020 at the latest.	• protection, preservation, prevention of degradation or, where feasible, restoration of marine ecosystems in areas where they have been adversely affected, • prevent and progressively eliminate pollution of the marine environment to exclude significant impacts on marine biodiversity, marine ecosystems, human health or significant risks to human health or legitimate uses of the sea.				
Other					
Resolution of the European Parliament of 15 December 2015 on moving towards a European Energy Union - calls for the strategies implemented under these five pillars of the Energy Union to contribute to security of energy supply, decarbonisation, long-term sustainability of the economy and ensuring affordable and competitive energy prices.					
Resolution of the European Parliament of 5 February 2014 on a policy framework for climate and energy by 2030 - calls for the establishment of national targets to reduce greenhouse gas emissions by at least 40%, in relation to the 1990 level, to achieve 40% energy efficiency, in line with research on its potential and the commitment to achieve 30% of energy from renewable sources.					
Resolution of the European Parliament of 10 September 2013 on the establishment of the internal energy market - calls for better coordination of energy policy and cooperation between Member States, in a spirit of solidarity, as well as the creation of efficient and secure cross-border energy systems, thereby creating synergy through improved demand and supply management facilitated by intelligent technologies at distribution system level.					
Resolution of the European Parliament of 21 May 2013 on the current challenges and opportunities for energy from renewable sources in the European energy market - calls for the creation of an internal gas and electricity market by 2014, given the crucial importance of integrating renewable energy so it is a cost-effective way of balancing diversified electricity production.					
Resolution of the European Parliament of 12 June 2012 on establishing cooperation on energy policy with partners from outside the EU: a strategic approach to secure, sustainable and competitive energy supplies - calls for greater synergy between the EU's trade and energy policies, in line with the strategy papers on cooperation on energy policy with partners from outside the EU, including the Energy 2020 Strategy and the Commission communication on security of energy supply and international cooperation.					

Name of the document	Objectives and priorities set out in the document (selected for the paper purposes)	Assessment of the compatibility of the Baltic Offshore Grid objectives with the EU energy policy priorities resulting from strategic documents			
		C1	C2	C3	C4
Resolution of the European Parliament of 24 May 2012 on a resource-efficient Europe, together with the Roadmap to a Resource Efficient Europe - calls for the implementation of Europe's resource efficiency actions, as set out in the Europe 2020 Strategy and flagship initiative, as well as the Roadmap to a Resource Efficient Europe of the Commission's Communication.					
Resolution of the European Parliament of 15 March 2012 on a action plan for moving to a competitive low-carbon economy by 2050, together with the Roadmap for a low-carbon economy by 2050 - calls for the implementation of the measures to reduce greenhouse gas emissions as set out in the Europe 2020 Strategy and the Roadmap for a low-carbon economy by 2050 as set out in the European Commission's Communication, in line with the European Council's targets to reduce greenhouse gas emissions by 80 to 95% in relation to the 1990 level.					

Appendix D Community law governing the environmental impact assessment procedure

1.	**Council Directive 2011/92/EU of 13 December 2011** ***on the assessment of the effects of certain public and private projects on the environment*** - sets out the principles of environmental impact assessment of the projects.
2.	**Council Directive 92/43/EEC of 21 May 1992** ***on the conservation of natural habitats and of wild fauna and flora*** - sets the framework for ensuring biodiversity in the European territory of Member States by conserving natural habitats and species of wild flora and fauna in a conservation-friendly state, the main instrument for habitat protection is to establish a network of Natura 2000 protected areas.
3.	**Council Directive 2009/147/EC of 30 November 2009** ***on the conservation of wild birds*** - sets a minimum standard for the protection of birds in the areas belonging to the countries of the EU and provides a framework for maintaining (or adapting) the population of bird species at a level corresponding to ecological, scientific and cultural requirements.
4.	**Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014** ***establishing a framework for maritime spatial planning*** - sets out a framework for maritime spatial planning to promote sustainable growth in the maritime economy, sustainable development of maritime areas and sustainable use of marine resources.
5.	***Convention on Biological Diversity*** **of 5 June 1992**, Rio de Janeiro, Brazil - lays down rules on the conservation, reproduction and use of biodiversity resources.
6.	***United Nations Economic Commission for Europe (UN/ECE) Convention on Environmental Impact Assessment in a Transboundary Context*** **of 25 February 1991**, Espoo, Finland - defines a procedural and legal framework for carrying out environmental impact assessments in cases where the project carried out in one country (the Party of Origin) covers the territory of another country (the Affected Party) and is likely to have significant negative effects on the environment.
7.	**Council Decision 2005/370/EC of 17 February 2005 on the conclusion on behalf of the European Community** ***Convention on access to information, public participation in decision-making and access to justice in environmental matters*** - defines the framework and principles for public participation in decision-making and the conditions for access to environmental information.
8.	***Convention for the Protection of the Marine Environment of the Baltic Sea Area*** **of 9 April 1992,** Helsinki, Finland - sets out rules for monitoring and protecting the environment of the Baltic Sea.
9.	***The International Convention for the Safety of Life at Sea*** **of 1 November 1974, as amended**, London, Great Britain - sets out the principles for improving the safety of life at sea by laying down uniform rules and regulations for the construction of ships, as well as specimen documents to be issued.
10.	***The United Nations Convention on the Law of the Sea of 10 December 1982,*** *Montego Bay, Jamaica - regulates matters relating to the Law of the Sea, including the classification of maritime areas, designating their extent and defining such concepts as the law of navigation, chase, inspection and revision, piracy (excluding military activities at sea).*

Appendix E Characteristic of the Baltic Sea

This chapter includes only relevant components of marine environment which may have potential impact and which are considered in chapter 6 Potential impacts of BOG, mitigation measures and recommendations for environmental impact assessment. Because of the specificity of this document and its general character information on the state of environment were based mainly on HELCOM publications (as an extract) - as the most reliable source of information and publicly available materials describing the natural environment of the Baltic Sea, as well as the results of projects conducted by governmental environmental agencies, research institutes and projects such as Satellite Environment Control of Baltic Sea[11] and other publications related to the relevant issues.

Because of the multiple economic functions of the Baltic Sea, each new investment located in the marine areas may have an impact on social groups using the potential of the sea for their own purposes. In the case of installation of the linear infrastructure it is necessary to define the status of the environment, identify possible conflicts and manage the investment process in a way that enables to eliminate them. Most conflicts can be avoided or minimized at the stage of selecting the proper location and mitigation measures. Dedicated survey programme should be established in case of development particular projects of BOG and the results of the surveys should be base for environmental impact assessment for the projects.

The Baltic Sea is a relatively small sea with a surface area of 420 000 km2 and one of the largest semi-enclosed brackish water bodies in the world. It is located between 53° to 66° northern latitude and 10° to 26° eastern longitude and is bordered by the Scandinavian Peninsula, the mainland of northern Europe, Eastern Europe and central Europe, and the Danish islands. The Baltic Sea bordered with countries: Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia, Sweden and countries that are in the catchment area not bordered on the sea: Belarus, Czech Republic, Norway, Slovakia, Ukraine. The drainage area of the Baltic Sea is about four times larger than its surface area and is inhabited by around 85 million people. More than one third of the Baltic Sea is shallower than 30 meters, giving it a small total water volume in comparison to its surface area[12].

The Baltic Sea coastline is about 8 100 km2 long. It is well developed and very varied. It consists of a large number of bays, lagoons, peninsulas, as well as islands and islets, which are particularly numerous on the north and west coasts[13]. The population density varies from less than 1 person/km2 in the northern and north-eastern parts of the catchment to more than 100 persons/km2 in the southern and western parts. In the Baltic Sea region, there are 11 cities with more than 500 000 citizens in the catchment areas. About 15 million people live within 10 km of the coastline[14].

The Baltic Sea is a source of naturally occurring mineral deposits (e.g. oil, natural gas, amber and gravels) and a prospective area for energy investments (offshore wind farms (Appendix A), nationally and internationally electricity grids and gas networks (Appendix B).

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[11] http://www.satbaltyk.pl/en/

[12] HELCOM (2017). *First version of the 'State of the Baltic Sea' report – June 2017.*

[13] HELCOM (2010). *Ecosystem Health of the Baltic Sea 2003–2007: HELCOM Initial Holistic Assessment.*

[14] HELCOM (2010). Ecosystem Health of the Baltic Sea 2003–2007: HELCOM Initial Holistic Assessment.

Figure E-1 Area of the Baltic Sea[15]

[15] HELCOM (2017). *First version of the 'State of the Baltic Sea' report – June 2017.*

E.1. Bathymetry and hydrography

The average depth of the Baltic Sea reaches 52,3 m and maximum depth reaches 459 m. From north to south and east to west, the Baltic Sea has different basins or sub-areas Strong gradient in salinity and hence in biological features, the Baltic Sea is sub-divided into 17 sub-basins (Kattegat, Great Belt, The Sound, Kiel Bay, Bay of Mecklenburg, Arkona Basin, Bornholm Basin, Gdansk Basin, Eastern Gotland Basin, Western Gotland Basin, Gulf of Riga, Northern Baltic Proper, Gulf of Finland, Åland Sea, Bothnian Sea, The Quark, Bothnian Bay) based on topography and hydrology[16].

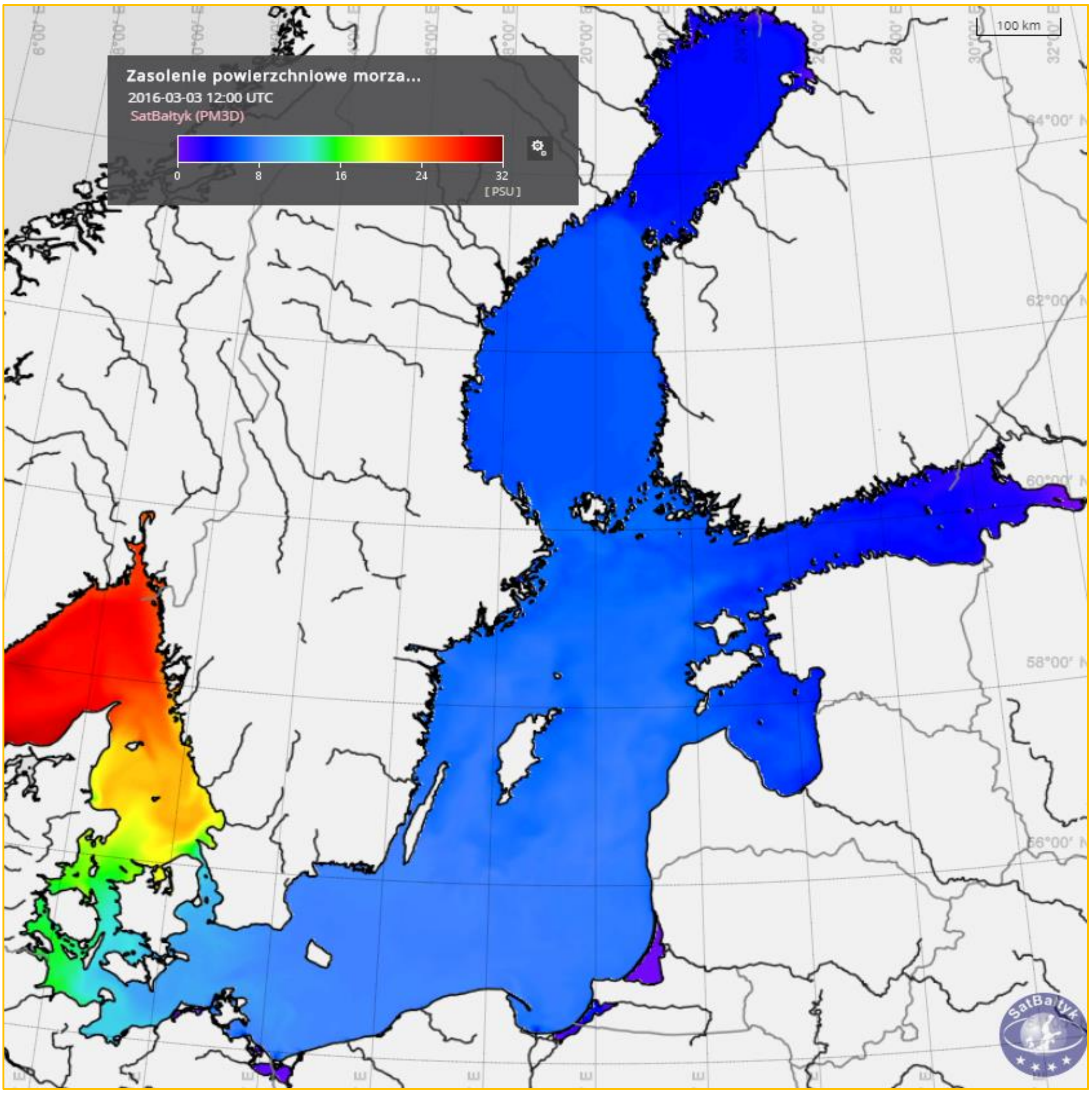

Figure E-2 Salinity of the Baltic Sea[17]

Freshwater reaches the Baltic Sea from numerous rivers, corresponding to about one fortieth of the total water volume per year[18]. About 250 rivers flow to the Baltic Sea, the largest are: Wisła, Newa, Odra, Niemen, Lule, Gota, Kemi, Ångerman i Dźwina.

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[16] http://www.helcom.fi/Lists/Publications/Monitoring%20and%20assessment%20strategy.pdf

[17] http://www.satbaltyk.pl/en/

[18] HELCOM (2017). First version of the ‘State of the Baltic Sea’ report – June 2017.

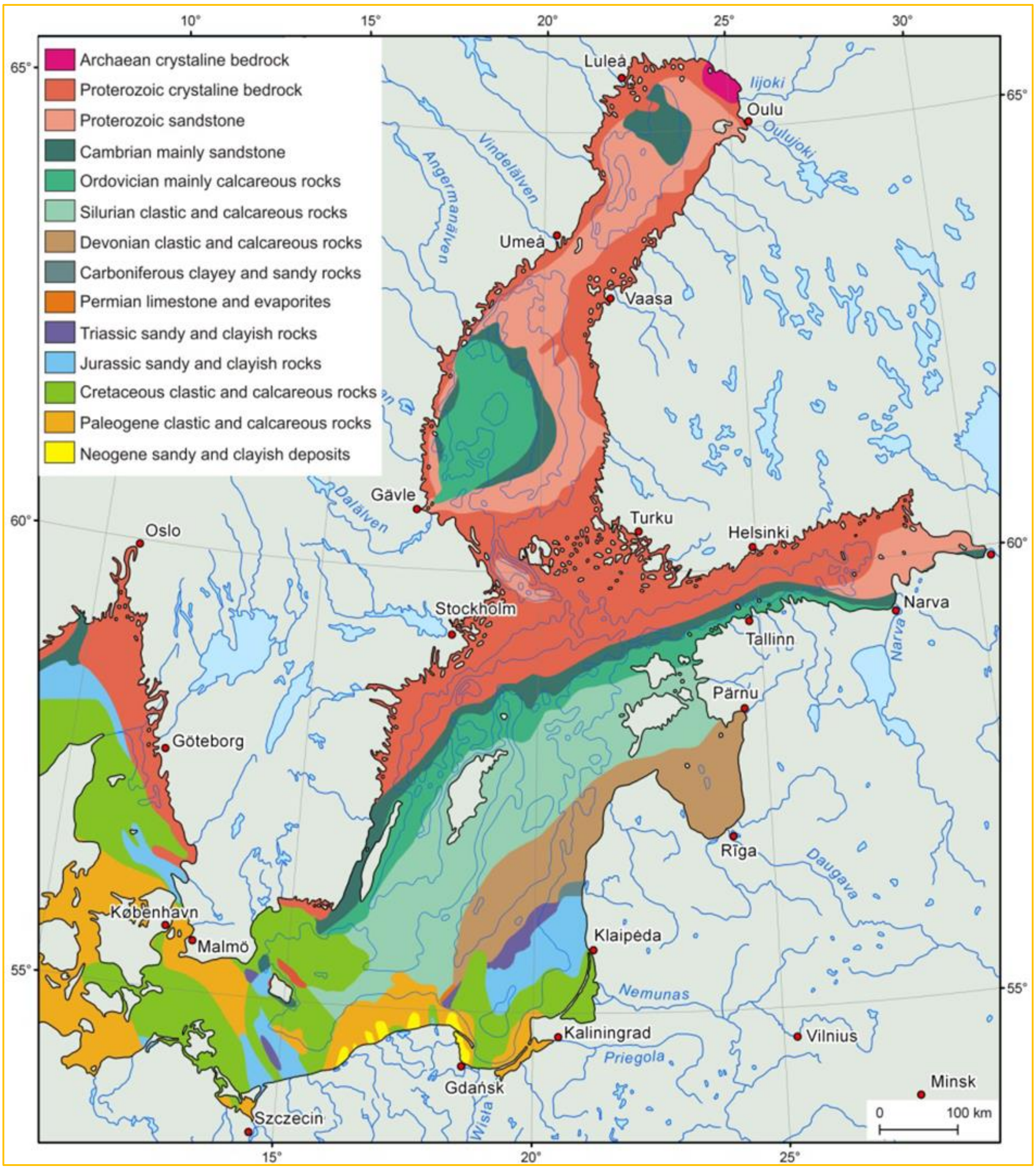

Figure E-3 Geological map of the Baltic Sea (without Q)[19]

Hydrological conditions give rise to the characteristic brackish water gradient of the Baltic Sea, where there is gradual change from a surface water salinity of 15–18 [psu] in the entrance at the Sound, 7–8 in the Baltic Proper and 0–2 in the north-eastern parts. These inflows elevate salinity in the region, and also improve oxygen conditions in the deep waters [20,21].

[19] Szymon Uścinowicz et al. *Geochemia osadów powierzchniowych Morza Bałtyckiego,* Warsaw, 20111, Polish Geological Institute - National Research Institute.

[20] http://www.satbaltyk.pl/en/

[21] HELCOM (2017). First version of the 'State of the Baltic Sea' report – June 2017.

The majority of the Gulf of Finland is usually covered by ice from January to March when the water temperature in the eastern part of the gulf is close to 0°C. During summer and spring season water temperature are 16-18°C. Higher temperatures around 18-22°C in July and September occur in surface water in the semi-enclosed and shallow parts like bay of Greifswalder Bodden. The bottom water is on average 4-8°C in summer and remains relatively constant throughout the year [22].

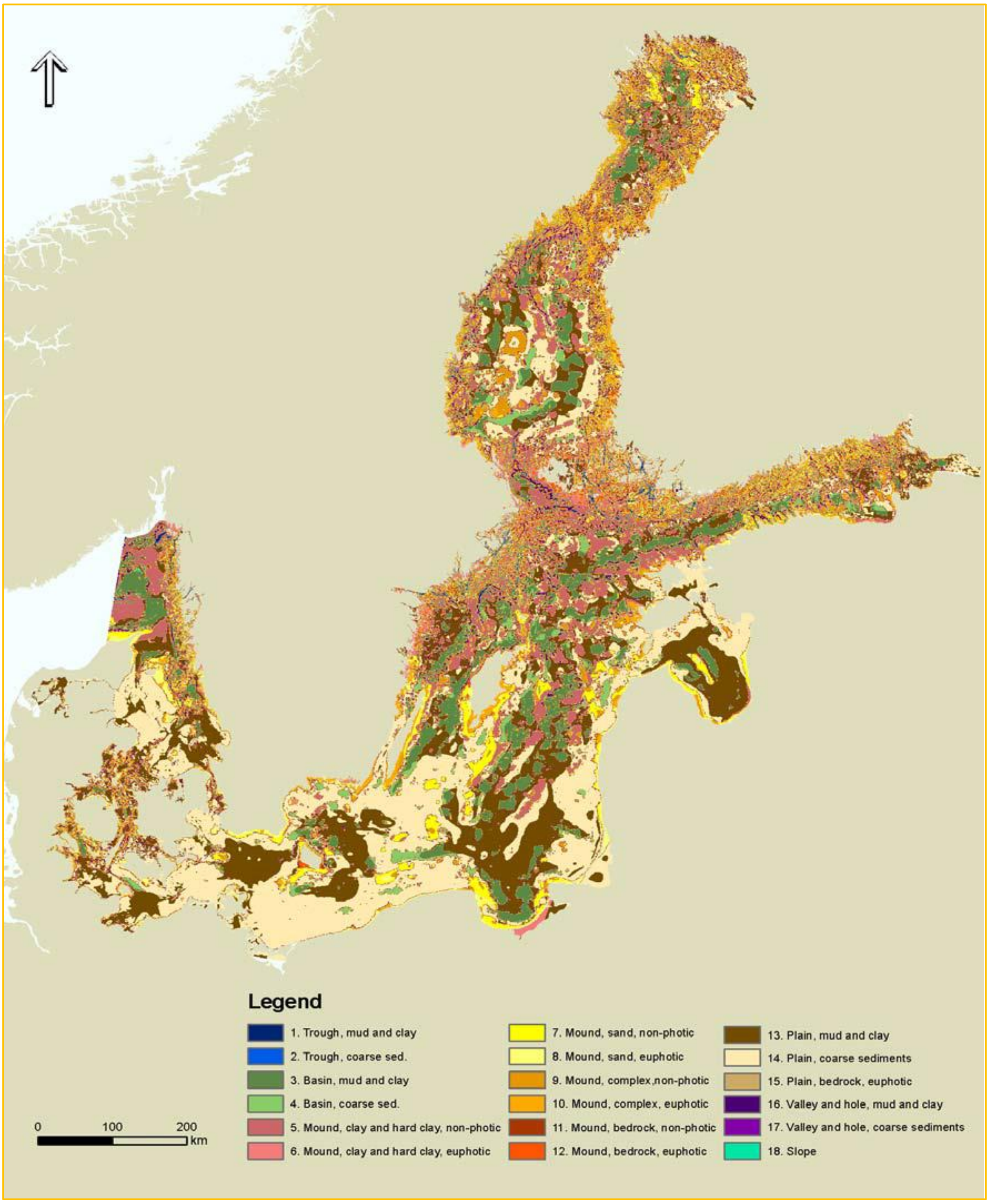

Figure E-4 Topographic and bed-form features identified in the Baltic Sea[23]

22 HELCOM (2017). First version of the 'State of the Baltic Sea' report – June 2017.

[23] Jørgen O. Leth et al. *Baltic Sea marine landscapes and habitats: Mapping and modelling. BALANCE Technical Summary Report, part 2/4*, Copenhagen*,* 2008, Geological Survey Of Denmark and Greenland.

E.2. Geological structure, surface sediments and contaminants

The Baltic Sea is situated on the Eurasian continental plate, providing relatively stable geological conditions with nearly devoid of earthquake activity in global terms. The geology of the Baltic Sea comprises bedrock covered by sediments. The bedrock's morphology is a result of fluvial and glacial erosion, with troughs and valleys created by erosion of less resistant bedrock layers forming pronounced seabed features seabed features. In the Baltic Sea, it can be indicated two general zones: sedimentation and erosion/non-deposition. Sedimentation areas are Gulf of Finland and the Northern Baltic Proper where basins are deep or covers sheltered areas. Erosion areas are part of south and south-west of Gotland with shallow waters and areas to wave- or current-induced water motion[24].

The northern part of the sea is located on the Precambrian Baltic plate, the south-eastern part on the Eastern European platform. The small area of the south-western part of the Baltic Sea belongs to the Paleozoic West European platform, separated from the East European platform by a fragment of the Trans-continental Teisserye-Tornquist fault zone[25].

The crystalline Precambrian foundation exposed on the Baltic plate decreases towards to the south and south-east and submerges under the sedimentary cover of the East European platform. With the lowering of the foundation ceiling, the thickness of the platform sludge cover increases. At the bottom of the Quaternary, increasingly younger sedimentary rocks fall from the Quaternary, from the Cambrian to the north (on the Narva-Oland line) to the Neogene an the Polish coast. The Paleozoic and Mesozoic rock complexes of the Eastern European platform are included in the system of tectonic blocks limited by faults most of which are rooted in the crystal Precambrian foundation.

The area belonging to the Western European Platform of the Paleozoic shows a greater degree of tectonic deformation. The ceiling of the Precambrian rocks occurs here at a depth of about 10-15 km. Higher are the undulating sediments of the Lower Palaeozoic (Cambrian, Ordovician and Silurian), which are covered by Permian and Mesozoic sediments, and locally also by the Paleogene. Quaternary substrate is made up of Eocene-Miocene sediments represented by mud-sandy, clay, quartz-glauconite formations with numerous pyritic clusters, sometimes with fine phosphorites of Eocene and sands or sandy muds with brown burnt muds[26].

Historical and present pollution of the Baltic Sea with contaminants has led to some contamination of the seabed sediments, whereas eutrophication from nutrients has increased the deposition of particulate organic matter to the seabed. Contaminants enter the Baltic Sea via atmospheric deposition, fluvial input, input from the surrounding sea and from point sources. Both heavy metals and organic contaminants have a tendency to adsorb to fine-grained sediments and particulate organic matter. Therefore, the highest concentrations of contaminants can be expected to occur in the seabed sediments in the deepest areas of the route, i.e. in the Arkona Basin. Due to the fact that the input of contaminants to the Baltic Sea is lower now than e.g. 50 years ago, the highest concentrations can be expected to be found buried some centimetres below the seabed surface[27.]

E.3. Climate and air quality

Great seasonal temperature contrast characterises the Baltic Sea. Temperature and Baltic Sea's climate are influence by air pressure system mainly from the North Atlantic Oscillation during winter. It effects on the atmospheric circulation and precipitation in the Baltic Sea basin. Simulations of future climate shows that temperature in the Baltic Sea will increase over time and an increase will be larger than corresponding increase in global term. Surface waters in the Baltic Sea have warmed

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[24] Monica Beckholmen, Sven A Tirén. *The geological history of the Baltic Sea a review of the literature and investigation tools*, Uppsala, 2009, Report number: 2009:17, Swedish Radiation Safety Authority.

[25] Szymon Uścinowicz et al. *Geochemia osadów powierzchniowych Morza Bałtyckiego,* Warsaw, 2011, Polish Geological Institute - National Research Institute.

[26] Monica Beckholmen, Sven A Tirén. *The geological history of the Baltic Sea a review of the literature and investigation tools*, Uppsala, 2009, Report number: 2009:17, Swedish Radiation Safety Authority.

[27] Szymon Uścinowicz et al. *Geochemia osadów powierzchniowych Morza Bałtyckiego,* Warsaw, 2011, Polish Geological Institute - National Research Institute.

[27] Monica Beckholmen, Sven A Tirén. *The geological history of the Baltic Sea a review of the literature and investigation tools*, Uppsala, 2009, Report number: 2009:17, Swedish Radiation Safety Authority.

since 1985, where the annual mean sea-surface temperature has increased by up to 1°C per decade from 1990 to 2008. At the same time, the annual maximum ice extent of the Baltic Sea has decreased about 20% over the past 100 years[28].

The whole Baltic Sea region is situated in a temperate (average) climate zone. The middle and northern areas have longer winters with stronger frosts, whilst the southwestern and southern areas have relatively moist and mild winters. Global climate change is also seen in the Baltic Sea region - the maximum extent of ice cover is lower today than the historical average, with a decline in recent years as well as decrease in the mean number of ice days[29].

In the Baltic Sea over the past 140 years' surface air temperature have increased. Since 1871, the annual mean temperature trends show an increase of 0.11°C per decade north of 60°N and 0.08°C south of 60°N, while the trend of the global mean temperature was about 0.05°C per decade for the period 1861-2000. The daily temperature cycle changes and increase in temperature extremes that result in seasonal changes like increase of the length of the growing season and decrease of length of cold season. Temperature of surface water of the Baltic Sea increase by up to 1°C from 1990 to 2008. The greatest increase take place in the northern Bothnian Bay - Gulf of Finland, Gulf of Riga and the northern Baltic Proper. The annual maximum ice extent has a decrease trend that reach 20% over 100 past years. Also, a length of ice season decrease. For example, in the Bothnian Bay decrease reached by about 18 days/century. The forecast of future climate assumes the largest changes of the sea surface temperature in the Bothnian Bay in the summer season and in the spring season in the Gulf of Finland. About to 2oC in the southern part and to 4oC in the northern part of the Baltic Sea may increase sea surface temperature in the summer season near the end of this century. Climate change scenarios for the Baltic Sea assume that surface water layers temperature will decrease more than deep water layer and drastic decrease of ice cover[30].

Forecasts indicate increase of runoff in the winter seasons and increase in precipitation in the summer are projected in the northern part of the Baltic Sea. Extreme weather conditions are the results of higher temperatures and greater precipitations. The changing is also seen to affect the long term trend in water temperature and salinity due to increased input of freshwater to the sea, although the large scale variability over time in temperature and salinity is also influenced by hydrodynamic factors. The increase in carbon dioxide is also expected to cause acidification, with a decreasing pH in the long term. There are uncertainty and differences in projections of sea level changes, but all models indicate a rise over the 21st century. HELCOM models assume middle and high scenario respectively 0,6 and 1,1 m sea level rise for the Baltic Sea.

Regarding changes in the sea surface salinity: large changes are projected especially in the Belt Sea of the Baltic Sea and smaller in the northern and eastern part. The salinity changes in Bothnian Bay may be the smallest. Additionally, increasing CO_2 concentration in the atmosphere effect on dissolution of CO_2 and decrease the pH in seawater.

The air quality near the coasts is impacted by emissions from land-based activities. Also, the Baltic Sea is one of the world's most densely used sea routes, associated combustion of fuel oil causes emissions to the air, the most significant of which are greenhouse gasses (GHGs), mainly carbon dioxide, and air pollutants such as nitrogen and sulphur oxides and particulate matter[31].

E.4. Eutrophication

The Baltic Sea still suffers from eutrophication. Excessive input of nutrients to the marine environment enhances the growth of phytoplankton, leading to reduced light conditions in the water, oxygen depletion at the sea floor (as excessive primary producers are degraded), and a cascade of other ecosystem changes. 97 % of the sea was assessed as eutrophied in 2011–2015 according to the integrated status assessment. Nutrient inputs from land have decreased as a result of regionally reduced nutrient loading, but the effect of these measures are not yet detected by the integrated status assessment. Although signs of improvement are seen in some areas, effects of past and current nutrient inputs still predominate the overall status. The goal of the Baltic Sea Action Plan is to a reach a Baltic Sea unaffected by eutrophication. Concentrations of the main triggers of eutrophication (nitrogen and phosphorus) increased in many areas of the Baltic Sea up until the late 1980s, attributed to increased nutrient loading from land since the 1950s onwards. As a result of locally improved waste water treatment, decreases in nutrient loading occurred in some local areas during the 1980s and 1990s, and in the 1990s the first effects of

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[28] HELCOM (2013). *Climate change in the Baltic Sea Area: HELCOM thematic assessment in 2013. Balt. Sea Environ. Proc. No. 137.*

[29] HELCOM (2017). First version of the 'State of the Baltic Sea' report – June 2017.

[30] HELCOM (2013). *Climate change in the Baltic Sea Area: HELCOM thematic assessment in 2013. Balt. Sea Environ. Proc. No. 137.*

[31] HELCOM (2017). First version of the 'State of the Baltic Sea' report – June 2017.

reducing loss of nutrients from agriculture were also seen. Since the late 1990s, the role of nutrient runoff from cultivated land has been recognised as a highly significant nutrient source in the Baltic Sea[32].

E.5. Underwater noise

The underwater noise environment comprises ambient noise (i.e. sound from rain falling on the surface, waves, marine animals, etc.) and noise from distinct and identifiable anthropogenic sources (i.e. sound from shipping, mechanical installations, construction activities, etc.)[33].

Sound waves propagate over long ranges in water and their impact may occur far from the sources, across national boundaries. Two categories of sound are identified: continuous and impulsive. Continuous sound from a source can be constant, fluctuating, or slowly varying over a long time interval. Various human activities may generate continuous sound. Examples of such activities are among others bridges, offshore wind turbines, shipping and boating which also influence on the local sound environment. Human activity can generate continuous sound which may mask animals' communication and signals used for orientation. Impulsive sound is characterised by short duration and a fast pulse rise time. The sound associated with piling, underwater explosions or airgun signals used in seismic surveying are examples of impulsive sound. This type of sound can displace animals, as they are scared away from the area, and can also cause temporary or permanent hearing loss if no mitigation measures are applied[34].

Based on results of the HELCOM noise monitoring and modelling areas with high sound level overlap clearly with the location of major shipping routes. The sound produced from shipping is within a frequency interval that overlaps with the hearing range of several species. Harbour porpoise and seals are species that are likely to be especially affected by human generated sound. They have very good underwater hearing abilities and rely on sound for their orientation, communication and foraging. Harbour porpoise also uses echolocation to find prey. Many Baltic fish species hear and produce sound at low frequencies.

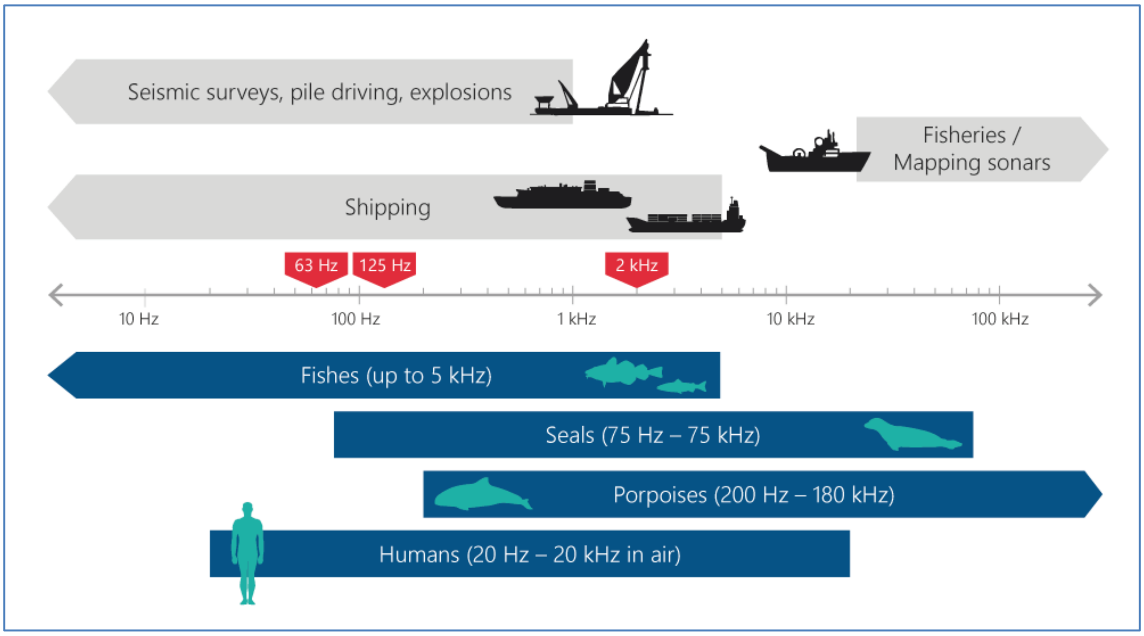

Figure E-5 Auditory range of some marine species present in the Baltic Sea and sound frequencies generated by human activities[35]

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[32]HELCOM (2017). First version of the 'State of the Baltic Sea' report – June 2017.

[33] Ursula Verfuß et al. *BIAS Standards for noise measurements. Background information, Guidelines and Quality Assurance. Amended version 2015.*

[34] HELCOM (2017). First version of the 'State of the Baltic Sea' report – June 2017.

[35] http://stateofthebalticsea.helcom.fi/pressures-and-their-status/underwater-sound/)

Some of the human activities which may generate underwater sound, such as offshore construction work, energy installations and shipping, as well as dredging and leisure boating are likely to increase. Depending on these developments as well as technical improvements, it is likely that both the level of sound and its character will change over time. Mitigation measures and the implementation of sound reduction solutions are foreseen to play an important role in counteracting and reducing the impact of sound in areas where elevated sound levels are found to impose a risk to sound-sensitive species[36].

E.6. Benthic and pelagic habitats

The seabed encompasses several types of habitat, from species-rich seagrass meadows and macroalgae in shallow areas, to soft bottom fauna which can also thrive deeper down. Due to the lack of tides, all species live continuously submerged. Habitat loss and disturbance affect benthic habitats and, many benthic communities are also negatively affected by eutrophication. A special concern is the large area with low oxygen or no oxygen at all in the deep basins of the central Baltic Sea, which limits the distribution of benthic fauna with implications for overall food web productivity. The conspicuous salinity gradient is reflected in the composition of benthic communities, and species diversity decreases with decreasing salinity towards the inner areas. The southern Baltic Sea areas are dominated by marine species, such as polychaete worms and molluscs, including the bivalves Arctica islandica and Astarte borealis. The benthic vegetation on hard substrates is dominated by brown and red seaweeds, and eelgrass (Zostera marina) is an important species on shallow sandy bottoms. Typical species further in, along the salinity gradient, include amphipods (mainly Monoporeia affinis), the isopod Saduria entomon, and the Baltic clam (Limecola balthica). Among the benthic vegetation, the importance of marine macroalgae decreases with decreasing salinity. Many freshwater plants and animals also thrive in this brackish water. In all areas, crustaceans, worms, snails and mussels are an important food sources for water birds and many fish species[37,38].

Microscopic primary producers support the growth of zooplankton, which all fish species depend upon during at least some part of their life. The status of pelagic habitats is affected by human induced pressures such as eutrophication and hazardous substances, as well as by natural and human-induced changes in climate. Primary producers generally show not good status in the Baltic Sea region, except in the Kattegat. Zooplankton were only assessed north of the Gotland Basin, indicating good status in the Gulf of Bothnia but not in the other assessed areas. Phytoplankton form the base of the pelagic food web and support the growth of zooplankton, either directly as food, or by a more complex route including the microbial loop. Phytoplankton blooms are a natural phenomenon in the Baltic Sea ecosystem, with blooms in late summer dominated by nitrogen-fixing cyanobacteria. Due to eutrophication, however, the phytoplankton blooms have become more frequent and extensive. Zooplankton consist of small crustaceans and several other animal groups. Cladocerans and copepods are the dominating groups of crustaceans, and a key food base for pelagic fish. Since larger zooplankton are often more nutritious, and a strong production of zooplankton is important for the productivity of higher trophic levels, the biomass and size distribution of the zooplankton community is a useful measure of the status of the pelagic food web[39].

E.7. Fish

Fish have an important role in the Baltic Sea food web. They are predators on e.g. benthic fauna, plankton (e.g. zooplankton, eggs, fish fry) and a food source for higher trophic levels - birds and marine mammals. Fishes are also a basic source to commercial fisheries.

About 230 fish species are recorded in the Baltic Sea. Coastal and open sea areas are characterised by different species groups, and there are also clear differences in species composition among sub-basins due to the gradient in salinity. Marine species are the most common in the southwest and in open sea areas. Coastal areas are key habitats for freshwater species, such as perch and cyprinids, as well as providing spawning and feeding areas for many marine species, such as cod, flounder, and herring. Most of the migrating species, including salmon, sea trout, sea lamprey and some populations of whitefish, are born and spawn in rivers but spend most of their growth phase in the Baltic Sea. The eel of the Baltic Sea is a highly migrant species and belongs to the same population as all other European eels[40]. Fish communities in the Baltic Sea are divided into groups of origin:

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[36] HELCOM (2017). First version of the 'State of the Baltic Sea' report – June 2017.

[37] http://stateofthebalticsea.helcom.fi/biodiversity-and-its-status/benthic-habitats/

[38] HELCOM (2017). First version of the 'State of the Baltic Sea' report – June 2017.

[39] HELCOM (2017). First version of the 'State of the Baltic Sea' report – June 2017.

[40] HELCOM (2017). First version of the 'State of the Baltic Sea' report – June 2017.

- *marine species dominated the Baltic Proper (>75%): cod (Gadus morhua), herring (Clupea harengus) and sprat (Sprattus sprattus) are in majority in terms of biomass and number, other species: flounder (Platichthys flesus), plaice (Pleuronectes platessa), dab (Limanda limanda), turbot (Psetta maxima) and brill (Scophthalmus rhombus) prefere more saline area of central or south-western parts of the Baltic Sea,*
- *freshwater fish that come from lakes and rivers: perch (Perca fluviatilis), pike (Esox lucius), pikeperch (Sander lucioperca), bream (Abramis brama), roach (Rutilus rutilus), burbot (Lota lota), vendace (Coregonus albula),*
- glacial relicts as remnants of the last glacial period: eelpout (Zoarces viviparus), lumpfish (*Cyclopterus lumpus*) and fourhorned sculpin (*Myoxocephalus quadricornis*),
- *alien species introduced to the sea beyond their natural range: beluga sturgeon (Huso huso), sterlet (Acipenser ruthenus), the Siberian sturgeon (Acipenser baeri), the Russian sturgeon (Acipenser gueldenstaedtii), chum salmon (Oncorhynchus keta), pink salmon (Oncorhynchus gorbusha), longnose sucker (Catostomus catostomus), Chinese sleeper (Perccottus glenii), silver carp (Hypophthalmichthys molitrix), spotted silver carp (Aristichthys nobilis), Rainbow trout (Oncorhynchus mykiss) and a few whitefish forms (Coregonus spp.), The Prussian carp (Carassius gibelio), the round goby (Neogobius melanostomus) and visits species: whiting (Merlangus merlangus), European anchovy (Engraulis encrasicolus), mackerel (Scomber scombrus) and grey mullets (e.g. Liza ramada),*
- *species migrate – anadromous migrate between from sea to fresh water to breed: Atlantic salmon (Salmo salar), sea trout (Salmo trutta), whitefish or powan (Coregonus species), vimba bream (Vimba vimba), river lamprey (Lampetra fluviatilis), grayling (Thymallus thymallus) and smelt (Osmerus eperlanus) and catadromous species migrate from lakes or rivers to sea: the catadromous European eel (Anguilla anguilla).*

The most important commercially exploited species in the Baltic Sea that took 90% of the commercial catches are cod, sprat, herring and flounder. Other commercially exploited species are plaice, turbot and salmon. Spawning areas of cod, herring and sprat are illustrated below (Figure E-6). There are two population eastern and western Baltic cod of which eastern population is the largest and has about 90% of all Baltic Sea population. Cods overlap mainly in the Arkona Basin and east of Borholm Island. Sprat distribution cover whole Baltic Sea despite the Bothnian Bay, where the salinity is too low. They are rarely found near the coast due to preferences of open sea. Herrings migrate seasonally between coastal archipelagos and open sea. During spring and autumn, they stay close to the coast and summer spend in open sea. Coastal areas with depth 3-15 m along the Baltic Sea are sprawning areas. Depends on herring population sprawning periods for spring are: between May and June - Gulf of Finland, including Narva Bay and islands in the eastern Gulf of Finland, April-May, March-May and April-June – central Baltic and March-May – western part of the Baltic Sea[41,42].

[41] https://www.nord-stream2.com/media/documents/pdf/en/2017/04/nsp2-espoo-report-eng.pdf

[42] HELCOM (2017). First version of the ‘State of the Baltic Sea’ report – June 2017.

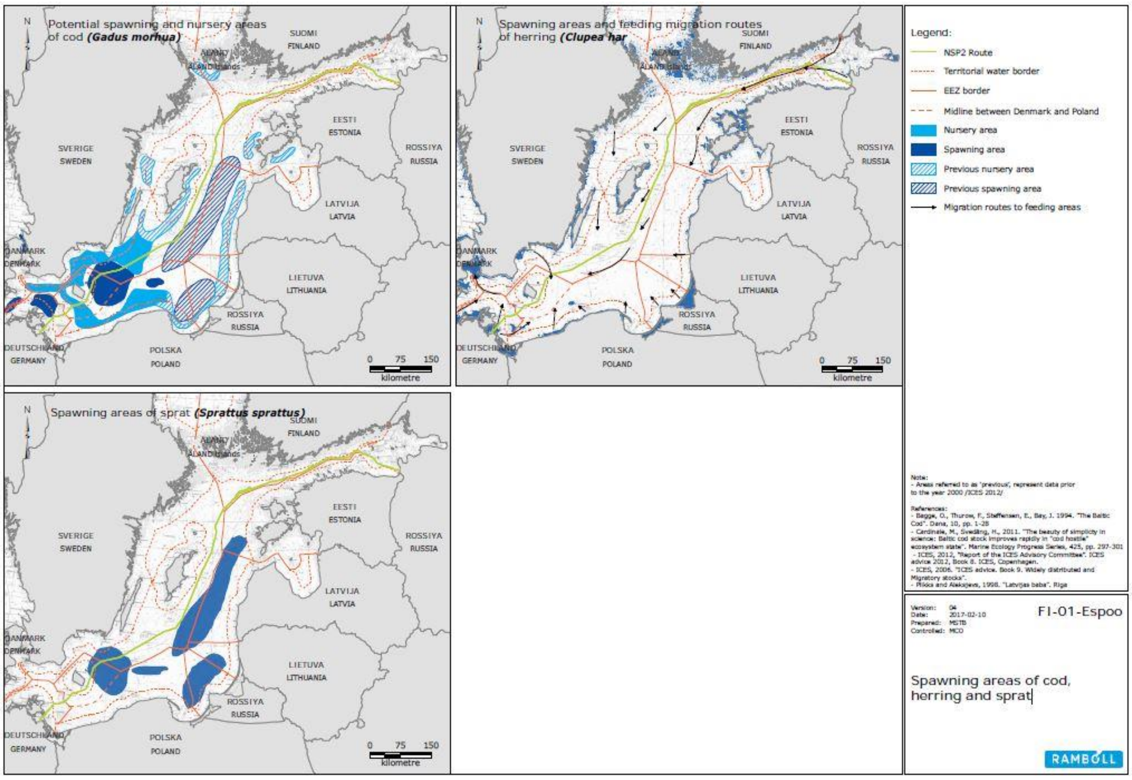

Figure E-6 Spawning areas of cod, herring and sprat in the Baltic Sea[43]

E.8. Marine mammals

Four marine mammal species are resident in the Baltic Sea: a harbour porpoise (Phocoena phocoena), a grey seal (Halichoerus grypus), a harbour seal (Phoca vitulina) and a ringed seal (Pusa hispida). They have significant role in regulating the food web and they are also sensitive to pressures in all their area of distribution, as well as to changes in the food web. Their exposure to accumulated pressures make marine mammals important indicators of the health of the ecosystem. The status of marine mammal species is assessed as unfavourable. At species level, grey seals and harbour seals show increasing population sizes[44]:

- the grey seal - the number of grey seals counted in the whole Baltic Sea region in 2015 was 30000 individuals, which is above the limit reference level of 10 000 individuals, the population trend is assessed as being in good status,
- the harbour seal – only in one - Kattegat unit of three management units of harbour seals in HELCOM area, the population trend is assessed as being in good status, the harbour seals in the southwestern Baltic and the Kattegat are connected and were assessed as one so called metapopulation with respect to abundance, they have been assessed as separate sub-populations in terms of growth rate, the metapopulation was about 16 000 animals in 2015 and achieves the threshold value for abundance, but the sub-population in the southwestern Baltic has not achieve threshold value for growth rate,
- the ringed seal - the status is not good, in areas where ringed seals occur, namely the Gulf of Bothnia, as well as the management units consisting of the Archipelago Sea, Gulf of Finland, Gulf of Riga and Estonian coastal waters, the distribution is restricted compared to pristine conditions, the size of the population is above the limit reference level of 10 000 seals in the Gulf of Bothnia (where around 20 000 ringed seals reside), but the growth rate is below threshold values in both managements units, the status of the ringed seal population in the southern management unit is critical, the population is decreasing, and the eastern part of the Gulf of Finland has only around 100 animals,

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[43] https://www.nord-stream2.com/media/documents/pdf/en/2017/04/nsp2-espoo-report-eng.pdf

[44] HELCOM (2017). *First version of the 'State of the Baltic Sea' report – June 2017.*

- the harbour porpoise – a particular concern is the local population of harbour porpoise in the Baltic Proper (mainly occurring east of Bornholm) and the other one occurring in southern Kattegat, the Belt Sea, and the southwestern parts of the Baltic Sea, with a population size recently estimated at around 500 animals, according to results of SAMBAH - Figure E-7 shows predicted density of porpoises[45].

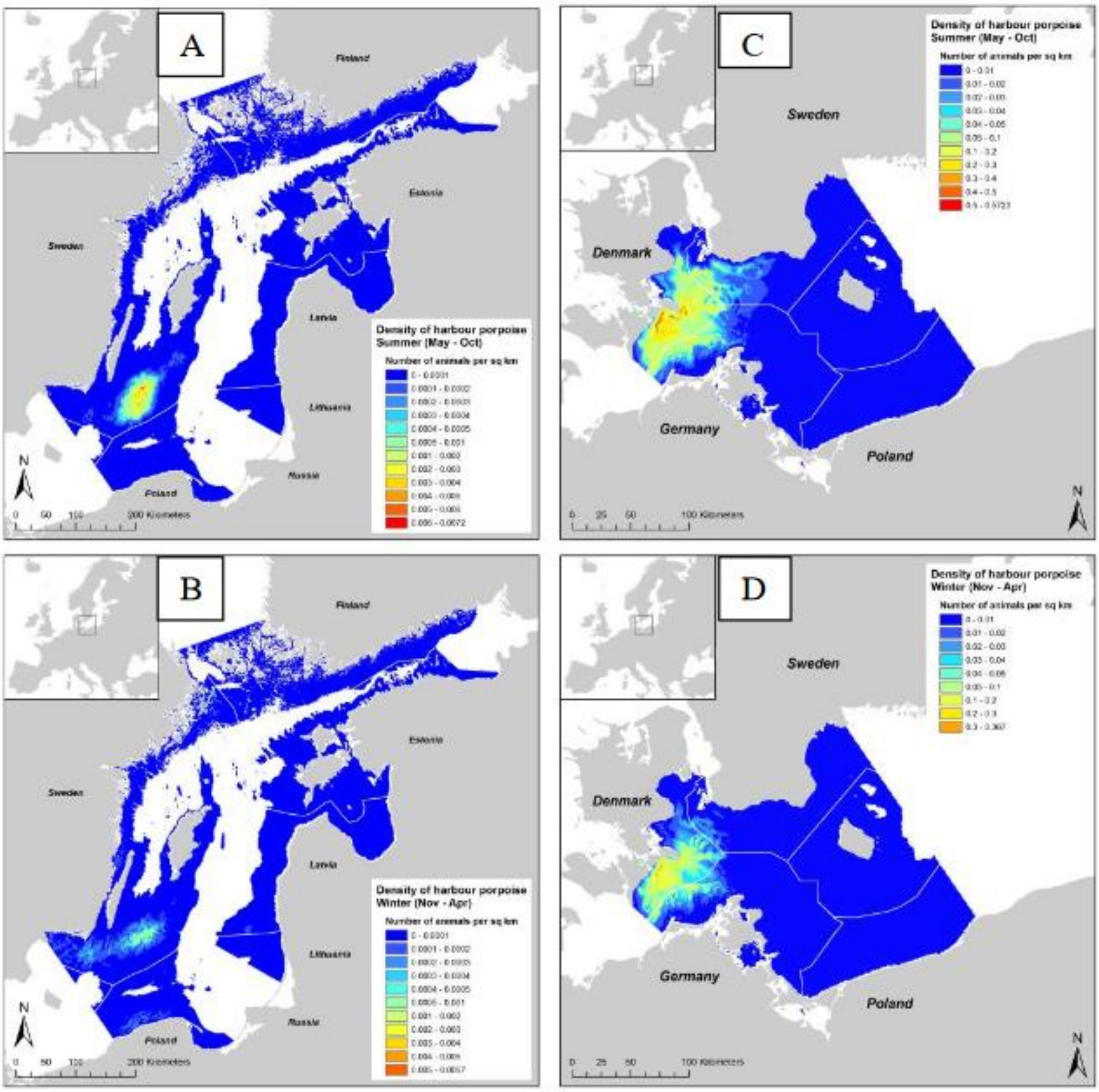

Figure E-7 Predicted density of porpoises[46]

E.9. Birds

The Baltic Sea is an important resting, feeding, breeding and wintering area for around 80 bird species. The water birds connect food webs in water with those on land, and by migration they also link the Baltic Sea with other marine regions. Population of many bird species have decreased over the last few decades - like common eider, which feeds on blue mussels at the seafloor, and the common gull, which scouts the sea surface for fish. A decline is also seen in long-tailed duck, whereas other species have increased, great cormorants and barnacle goose, for example. The changes are seen both during the wintering and the breeding season. Changes can be attributed to factors such as disruptions of food web structure, climate

[45] http://sambah.org/SAMBAH-Final-Report-FINAL-for-website-April-2017.pdf

[46] http://sambah.org/SAMBAH-Final-Report-FINAL-for-website-April-2017.pdf

change and habitat alteration. The Bird community is highly variable with seasons. Many species, such as the long-tailed duck, use the area as wintering ground, whereas others, such as the Arctic tern, migrate to the area for breeding. Others, such as the herring gull, occur in the Baltic Sea both during the wintering and the breeding period. The Baltic bird species also encompass many different feeding types. Birds are predators of fish, mussels and shellfish, but the Baltic Sea waterbirds also include scavengers and grazers feeding on coastal vegetation. Some species are occurring all over the Baltic Sea basin, such as breeding common terns and wintering long-tailed ducks, others are restricted to smaller parts of the Baltic or only selected sites, for example breeding pied avocets and wintering Steller's eiders[47].

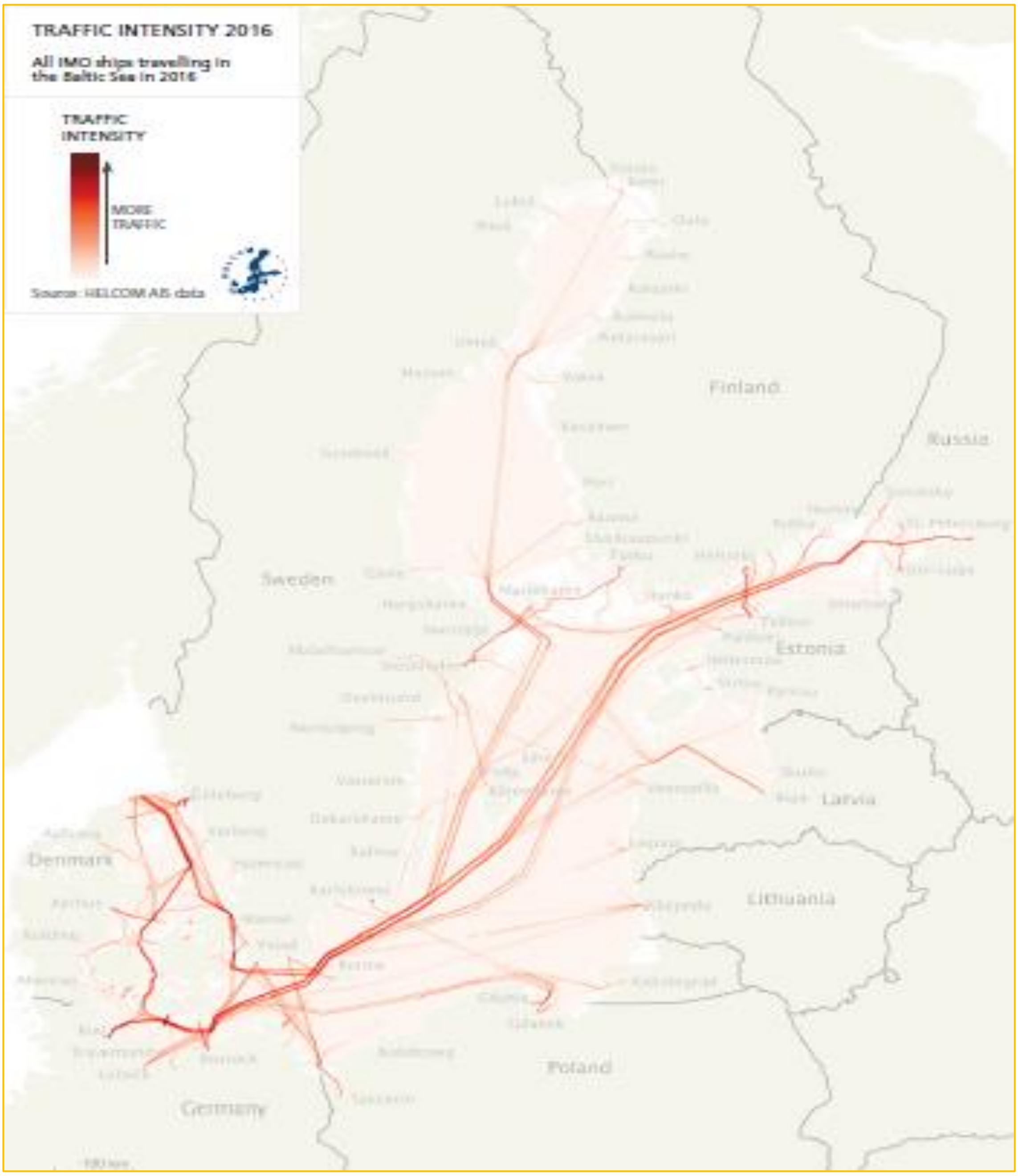

Figure E-8 Traffic intensity in 2016[48]

[47] HELCOM (2017). *First version of the 'State of the Baltic Sea' report – June 2017.*

[48] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

E.10. Shipping and shipping lanes

The Baltic Sea is a sea of very intensive navigation. On the basis of the HELCOM AIS data[49] it turns out that freighters, tankers and passenger ferries dominate in the shipping traffic on the Baltic Sea. Differences in intensity of commercial vessel traffic within a year are small, but passenger ferries run more frequently during the summer months, from the end of May to September. Currently there are several main shipping lanes in the Baltic Sea. Passenger traffic is predominantly associated with the ports in the western part of the Baltic Sea. The main routes of ferries in this area lead to: Denmark (Copenhagen, Koege and Roenne), Sweden (Ystad and Trelleborg), Germany (Rostock and Sassnitz) and Poland (Świnoujście). Fishing vessels, on the contrary, seem to increase their activity during winter. From approximately January to March the sea freezes in some parts of the Baltic Sea, which presents challenges to marine traffic. In some cases, ships have to deviate routes as there can be solid ice that cannot be broken by icebreakers.

Vessel gross ship type AIS	Vessel detail ship type AIS	IMO ships operating in the Baltic sea in 2015 by type	
		%	**number of vessels**
Cargo ship	General cargo, bulk cargo or other cargo ship	48,0	3778
Tanker ship	Chemical tanker, crude oil tanker, gas tanker, oil product tanker or other tanker	22,0	1734
Passenger ship	Cruise ship, ferry, ro-ro passenger ship or other passenger ship	5,4	425
Fishing vessel	Fishing vessel	5,2	412
Service ship	Service ship	4,3	341
Container ship	Container ship	4,1	329
Ro-ro cargo ship	Vehicle carrier or ro-ro cargo ship	3,1	242
Other ship	Tug, dredger or other ship	7,4	586
Unknown		0,5	42
Total		**100**	**7889**
Limitations: IMO ships, including tanker ships over 150 gross tonnage, passenger ships certified for more than 12 passengers, other ships over 400 gross tonnage, as well as fishing vessels			

Table E-1 Ship types AIS device[50]

68% of the International Maritime Organization (IMO) -registered ships travelling the Baltic Sea are in the category "cargo"- general cargo ships. The number of ships in the AIS dataset seem to be increasing in all ship types from 2006 but for some ship types this can be due to the fact that more ships carry AIS transmitters. The technology has become more affordable and due to its usefulness in collision avoidance it is also attractive for those ships that are not formally obliged by IMO to carry an AIS device. The numbers of tugs and other smaller vessels not required to carry AIS, included in the category "Other", have

[49] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

[50] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

particularly increased in recent years. Most of the cargo ships enter through Skagen and go to the main hubs of general cargo traffic (Klaipeda, Riga but also ports such as Szczecin, Rostock and Gdansk). Many cargo ships enter also through Kiel Canal. If all traffic is considered (also smaller general cargo ports), 72% of general cargo ship trips are inside the Baltic Sea and 28% are to or from outside the Baltic. Tanker ships transport liquid or gas in bulk and are relatively common, as every fifth IMO ship in the Baltic Sea is a tanker. Traffic of tanker ships between the 50 biggest ports in terms of tanker traffic, with more than 100 tanker visits in the Baltic. Tanker traffic between the larger ports in the Baltic Sea are to or from a port outside the region, between Skagen and Gothenburg, Ust-Luga, Primorsk, Kilpilahti and other main tanker ports. If all traffic is considered, 77% of tanker vessel trips are within the Baltic Sea and 23% are to or from outside the Baltic[51].

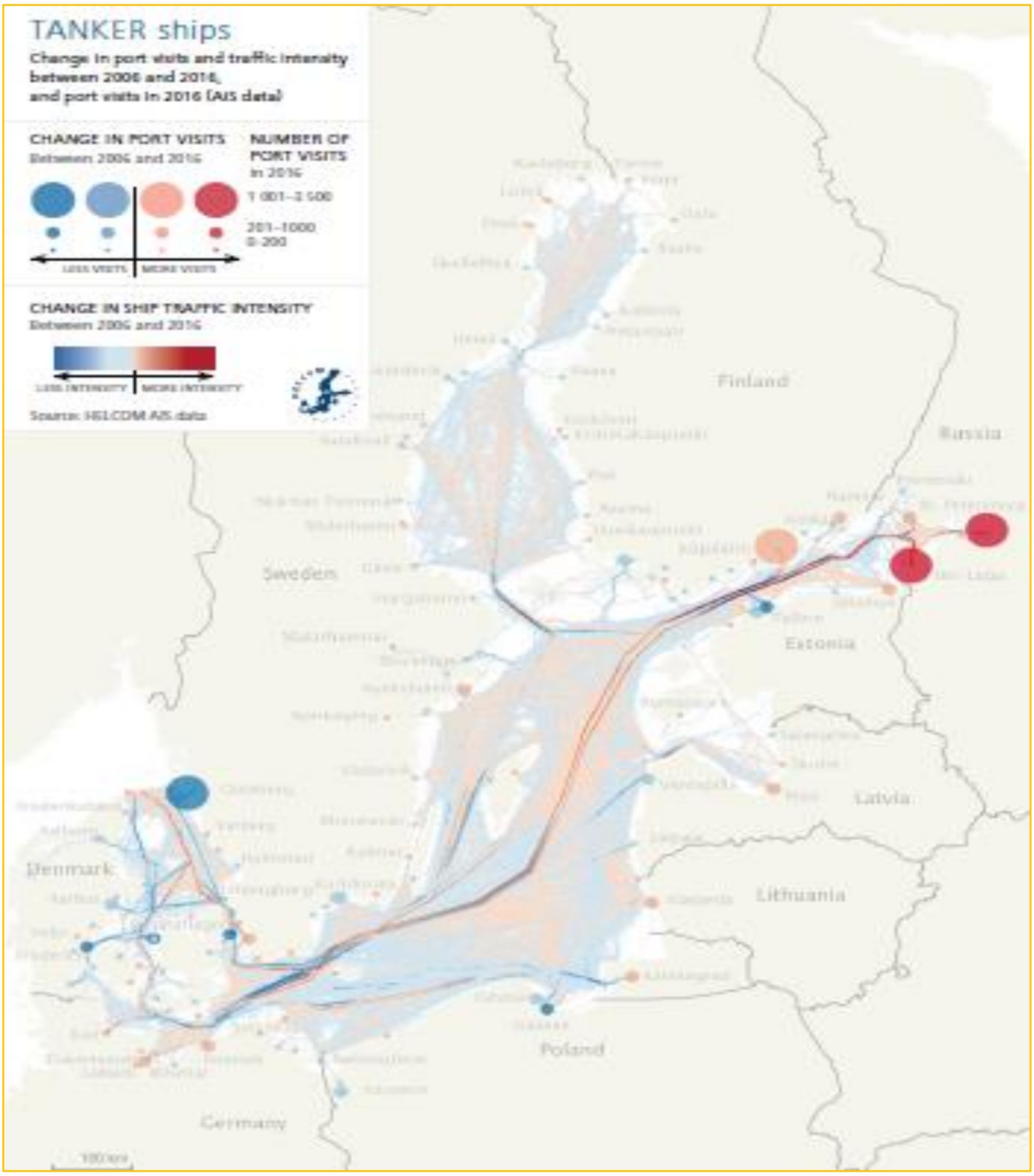

Figure E-9 Tanker ships - change in port visits and traffic intensity between 2006 and 2016, and port visits in 2016[52]

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[51] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

[52] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

Only 6% of the IMO ships in the Baltic Sea are passenger ships. Ferries make many trips, sometimes several per day, they spend almost 1,4 million hours and sail nearly 10 million nautical miles in the Baltic Sea every year. That is nearly one fifth of the time and distance IMO ships sail in total. The busiest passenger ports in the region include ferry ports such as Helsinki and Tallinn. Most of the passenger traffic is the result of ferries and therefore inside the Baltic Sea. During summer time, cruise ships (passenger ships without fixed routes) increase overall passenger traffic[53].

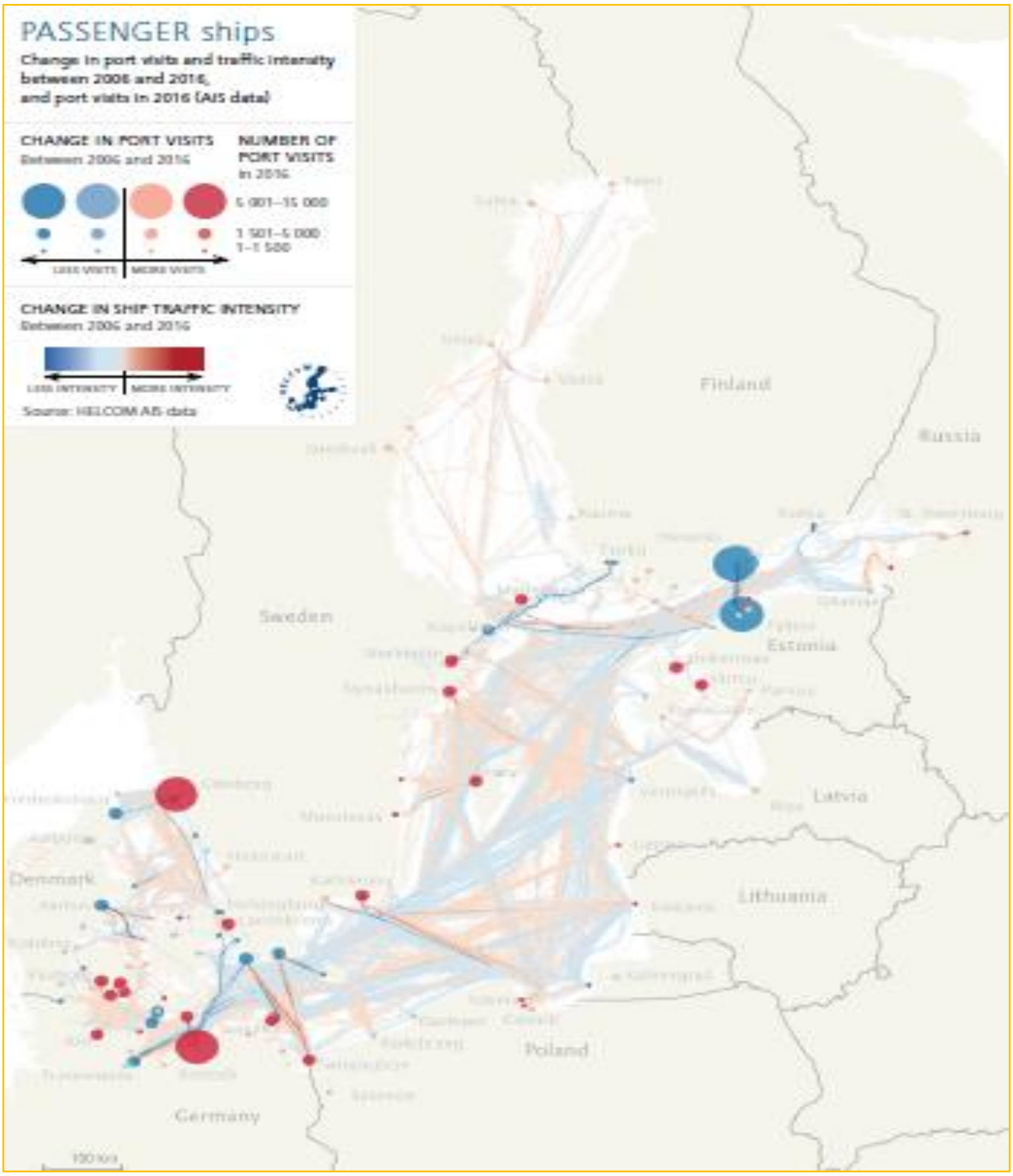


Figure E-10 Passenger ships - change in port visits and traffic intensity between 2006 and 2016, and port visits in 2016[54]

[53] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

[54] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

Many of the biggest ships operating in the Baltic Sea region are container vessels which carry various containerized goods, often over great distances. Partly due to their size these are relatively few in number and do fewer visits than many other vessel types. The largest container ports in 2015, that have over 300 container vessel visits are St. Petersburg, Gothenburg, Vuosaari, Gdynia, Aarhus, Kotka, Klaipeda, Helsingborg, Riga, Gdansk, Copenhagen, Tallinn and Muuga. Many Baltic Sea ports have seen a rapid growth in container traffic over the last decade[55].

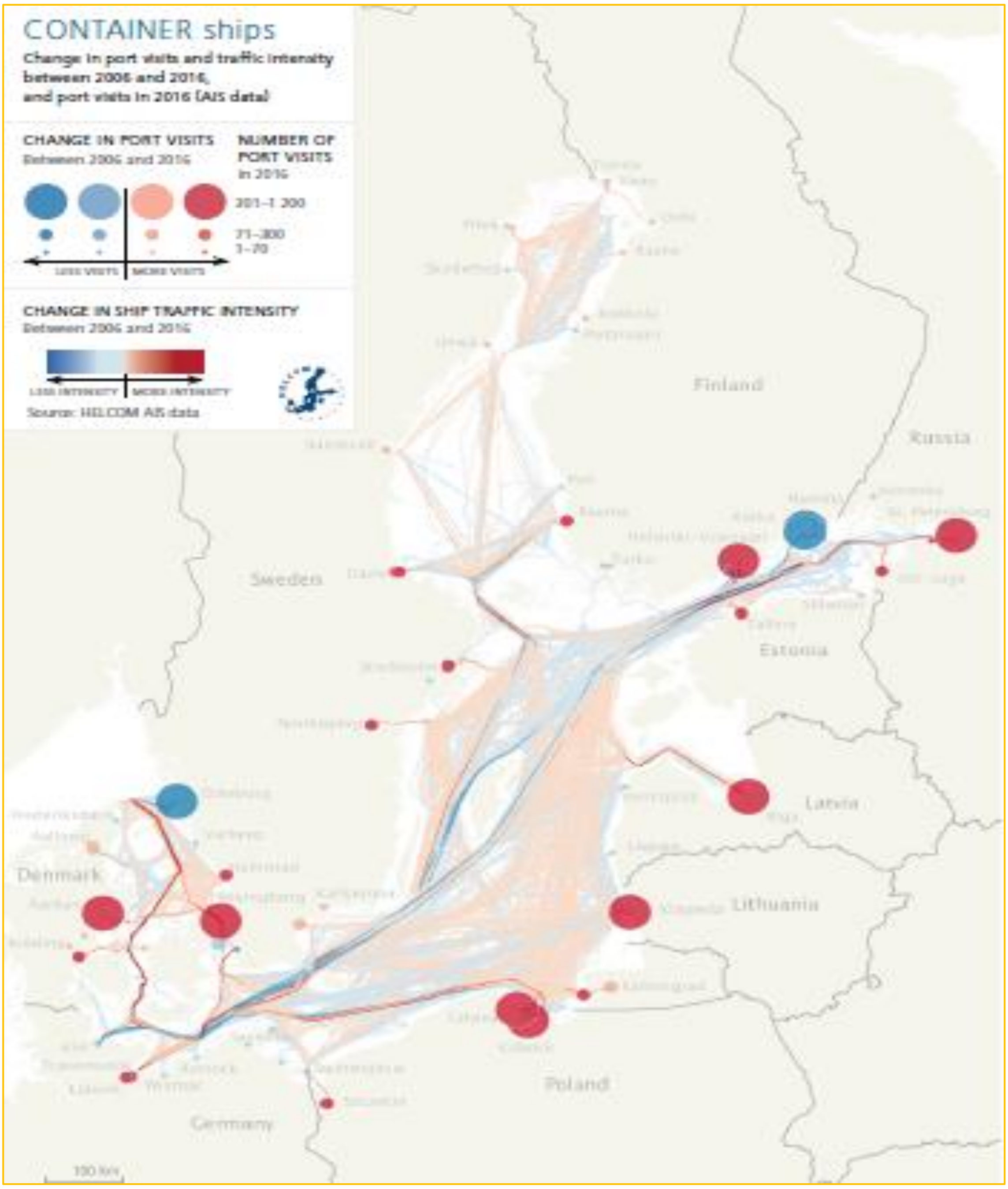


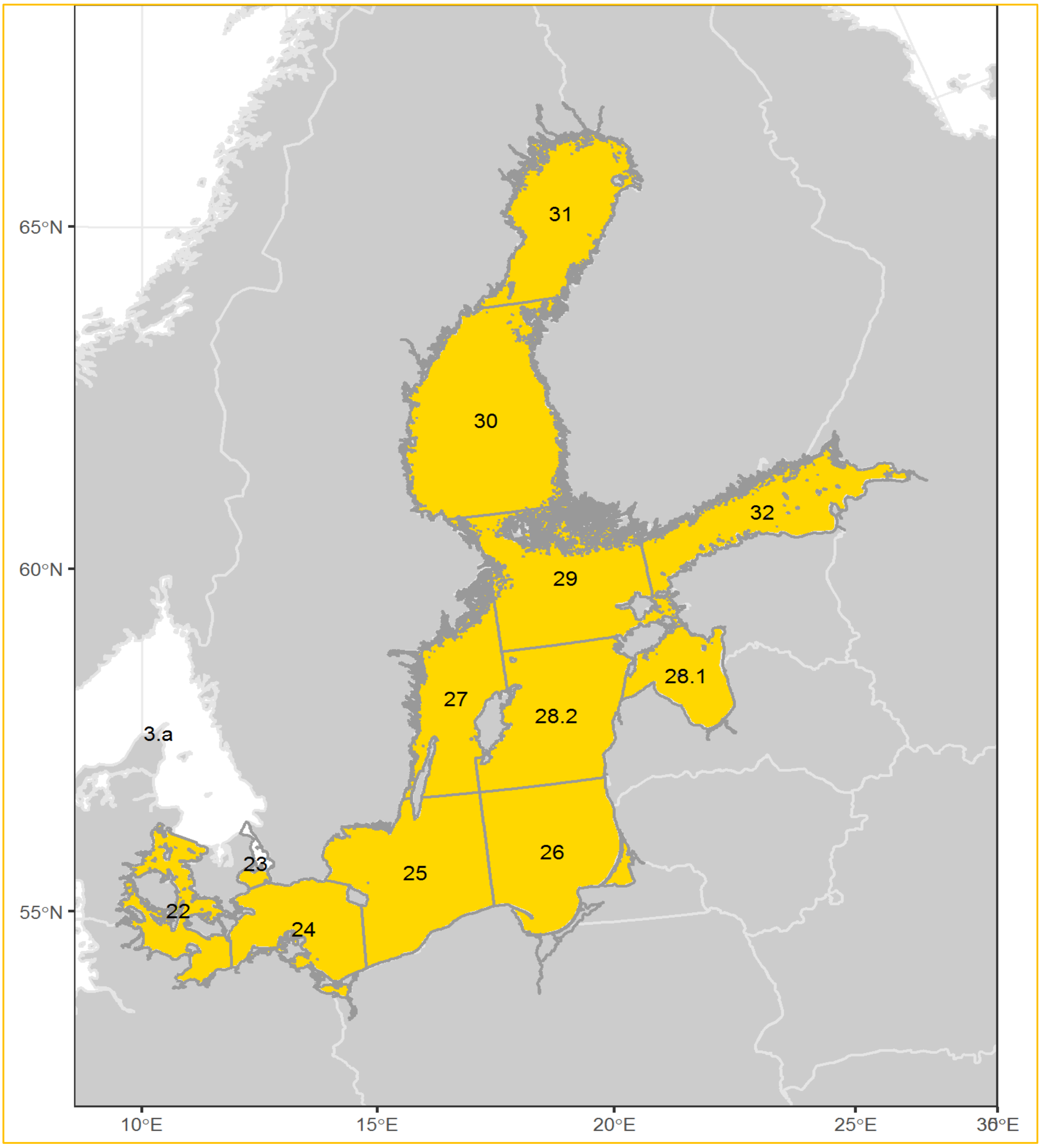
Figure E-11 Container ships - change in port visits and traffic intensity between 2006 and 2016, and port visits in 2016[56]

[55] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

[56] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

E.11. Marine fishery

Commercial fishing includes mainly activities of vessels registered in national fishery vessel registers. Fisheries in the Baltic Sea land annually in the order of 7–800 000 tonnes of fish. The target species include herring (Clupea harengus), sprat (Sprattus sprattus), cod (Gadus morhua), European floun¬der (Platichthys flesus), salmon (Salmo salar) and sea trout (Salmo trutta) and a number of coastal species, e.g. vendace (Coregonus albula), pike (Esox lucius), perch (Perca fluviatilis), pike perch (Sander lucioperca) and garfish (Belone belone) (in the southern Baltic only). In the western parts of the Baltic Sea and Kattegat there are fisheries targeting other flatfishes, as well as Norwegian lobster and prawn. Eel (Anguilla anguilla) fishery has diminished during the last 30 years. In terms of volume the main species targeted by commercial fishing in the Baltic Sea include, in decreasing importance, Atlantic herring and sprat (midwater trawls) as well as cod (demersal trawls). These three species constitute together about 95% and that of herring and sprat alone nearly 90% of the commercial catch in terms of volume[57].



[57] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

Figure E-12 The Baltic Sea ecoregion ICES[58]

The pelagic fisheries, which account for the largest catches (by weight) in the region are the mid-water trawl fisheries for sprat and for herring. The most important demersal fisheries are the bottom-trawl fisheries for cod and flatfish. The demersal fisheries are concentrated in the south and west of the Baltic Sea, while the pelagic fisheries are more widespread. Basin-wide, commercial fishing effort has declined in recent years[59]. Due to hydrological characteristics of the Baltic Sa, the basin has a limited diversity of fish species, dominated by marine species in the southwestern areas and a combination of marine and freshwater species in the north-eastern areas[60].

Fishing vessels operate in the Baltic Sea, with the highest number of large vessels (>12 m) are from Sweden, Denmark and Poland.

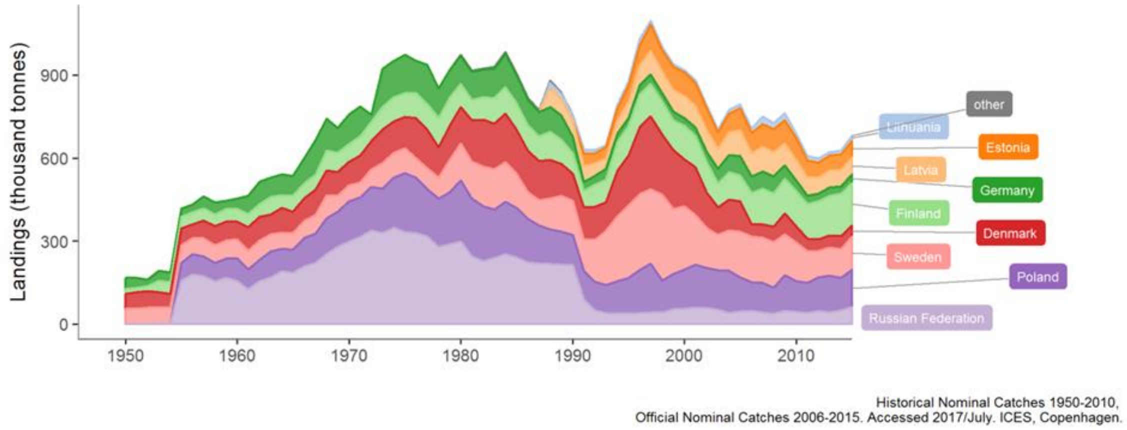


Figure E-13 Landings (thousand tonnes) from the Baltic Sea in 1950–2015, by country[61]

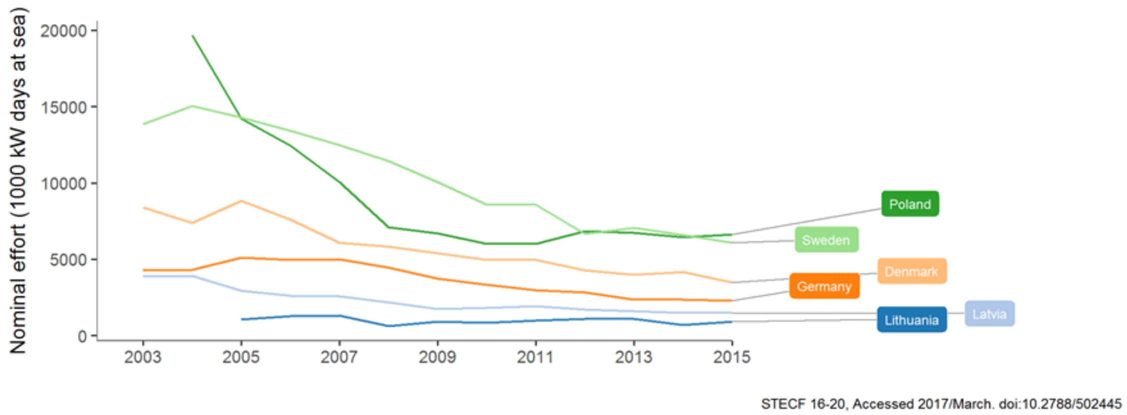


Figure E-14 Baltic Sea fishing effort (thousand kW days at sea) in 2003–2015, by EU nation[62]

The principal species targeted in the commercial fisheries are cod, herring, and sprat, which together constitute about 95% of the total catch. The fisheries for cod in the Baltic use mainly demersal trawls and gillnets, while herring and sprat are mainly caught by pelagic trawls. Other target fish species having local economic importance are salmon, plaice, flounder, dab, brill,

[58] http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/Baltic_Sea_Ecoregion_Fisheries_Overview.pdf
[59] http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/Baltic_Sea_Ecoregion_Fisheries_Overview.pdf
[60] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*
[61] http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/Baltic_Sea_Ecoregion_Fisheries_Overview.pdf
[62] http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/Baltic_Sea_Ecoregion_Fisheries_Overview.pdf

turbot, pikeperch, pike, perch, vendace, whitefish, turbot, eel and sea trout. The herring, sprat, cod and sprat are having the highest landings.

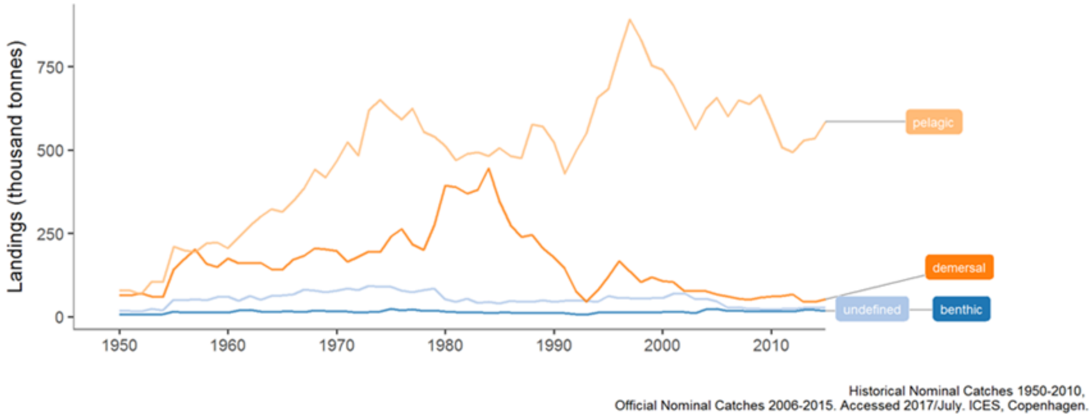


Figure E-15 Landings (thousand tonnes) from the Baltic Sea in 1950—2015, by fish category[63]

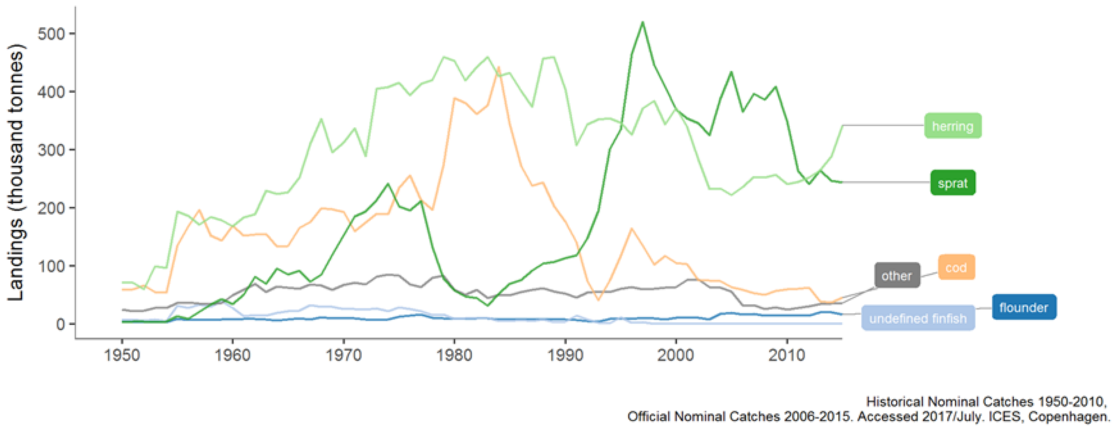


Figure E-16 Landings (thousand tonnes) from the Baltic Sea in 1950-2015, by species[64]

[63] http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/Baltic_Sea_Ecoregion_Fisheries_Overview.pdf

[64] http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/Baltic_Sea_Ecoregion_Fisheries_Overview.pdf

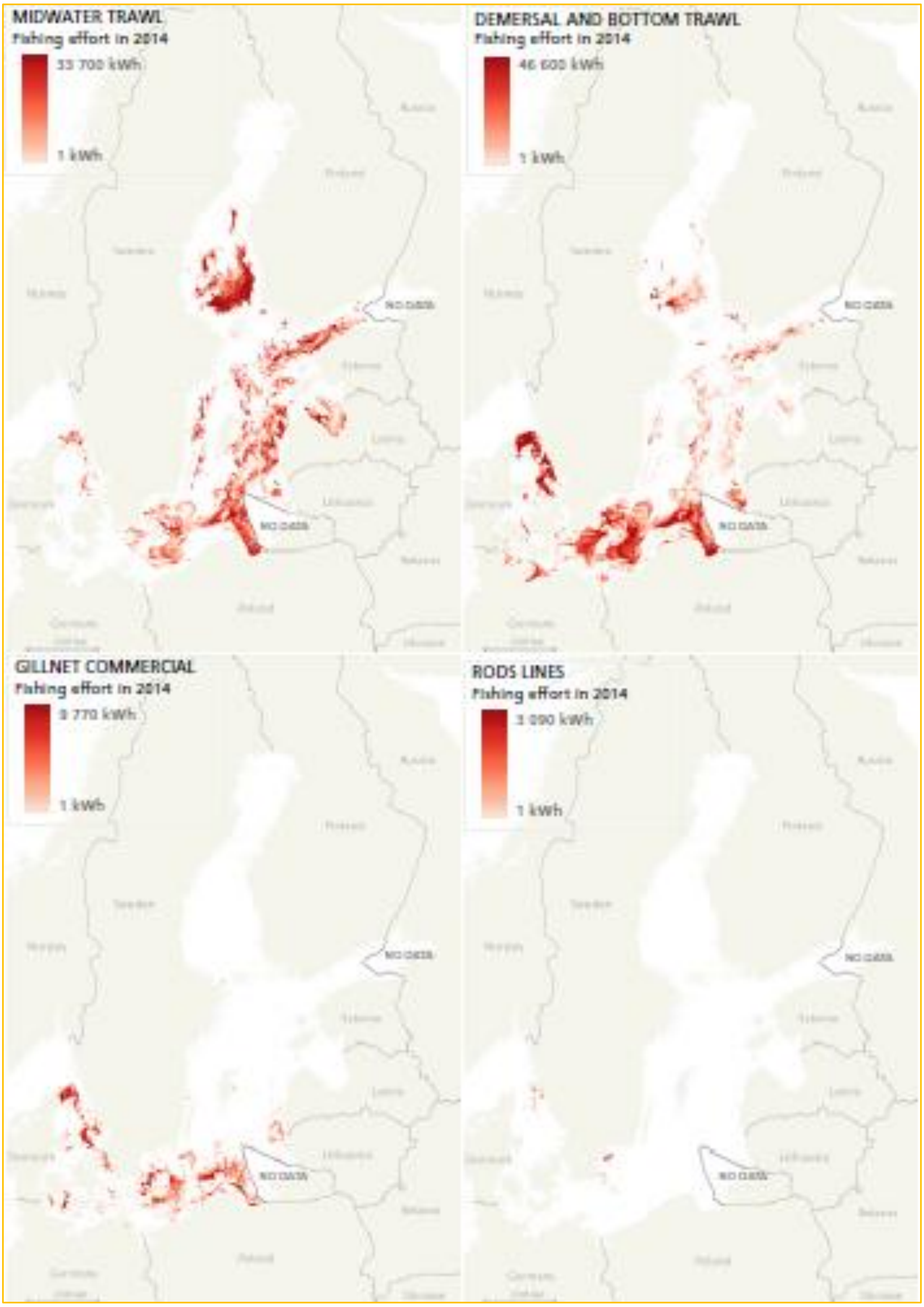


Figure E-17 Commercial fishing effort with different gears in the Baltic Sea[65]

[65] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

E.12. Conventional weapons and chemical warfare

Because of the military actions during the Second World War in the Baltic Sea there are remains of conventional munitions and chemical warfare. About 40,000 tonnes of chemical munitions were dumped into the Baltic Sea after the Second World War of which about 15 000 tonnes of chemical warfare agents[66,67]. Area designated for conventional weapons and chemical warfare is presented on Figure E-18 with the risk assessment of occurrence mines and chemical warfare in the Baltic Sea. During transport to the dumping areas east of Bornholm and south-east of Gotland munitions have been thrown overboard while ships were en-route. As some munitions were dumped in wooden cases some have drifted outside the area where they were dumped. All kinds of munitions may also occur outside the designated dumping areas, as munitions are known to have been thrown overboard while ships were on their way in order to save time.

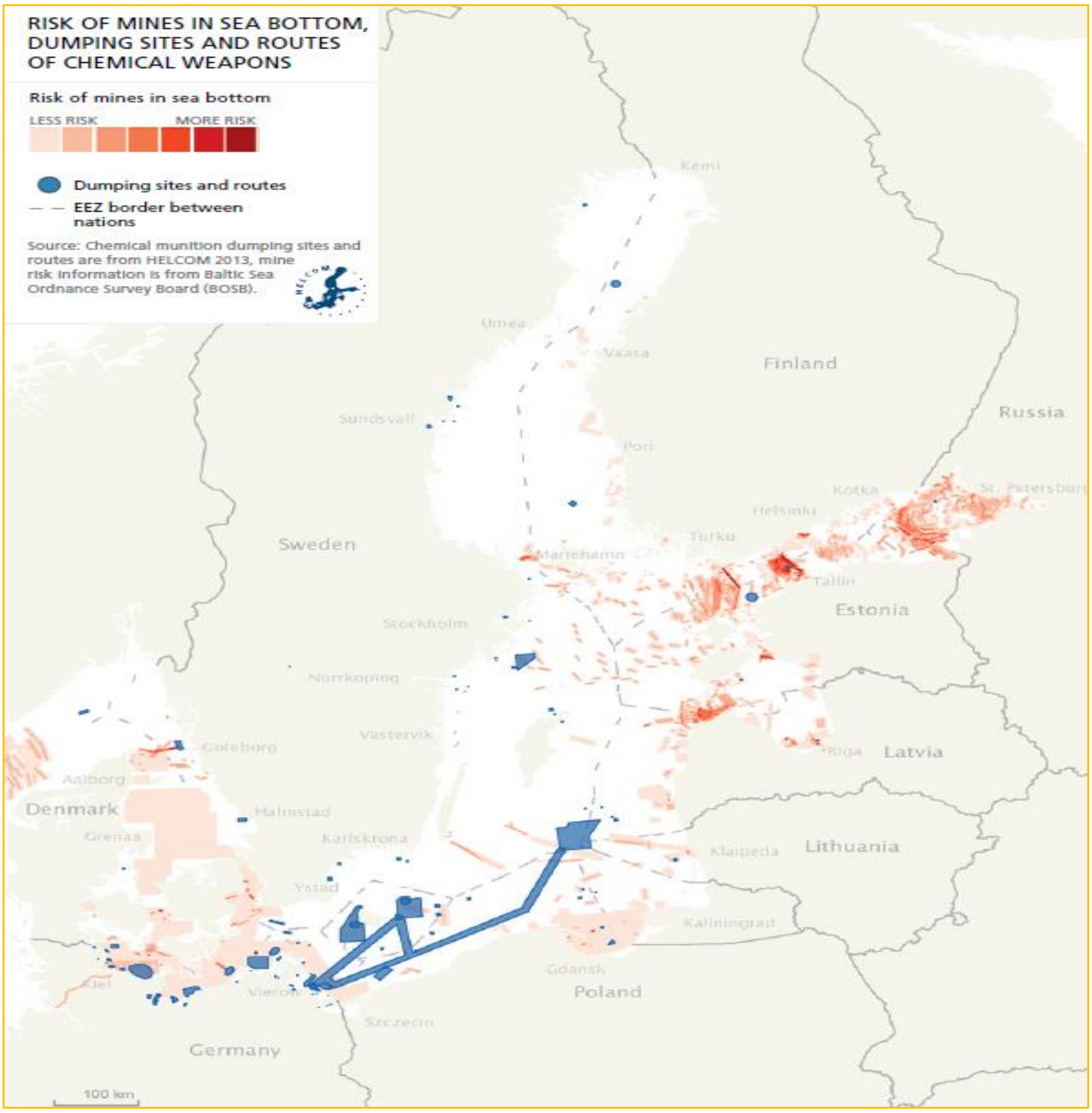


Figure E-18 Risk assessment of occurrence mines and chemical warfare in the Baltic Sea[68]

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[66] HELCOM (2013). *HELCOM Chemical Munitions Dumped in the Baltic Sea. Report of the ad hoc Expert Group to Update and Review the Existing Information on Dumped Chemical Munitions in the Baltic Sea. Baltic Sea Environment Proceeding No. 142.*

[67] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

[68] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152.*

Chemicals from chemical warfare can spread from the disposal sites of the containers due to natural and anthropogenic processes. Sediment testing of the dumping areas are in various stages of contamination with chemicals presumably originating from chemical warfare materials. Arsenic-containing warfare agents have been shown to contaminate areas of the sea bottom and to spread both within and outside the dumpsites. In all cases investigated so far, however, no chemical warfare agent parent compounds or degradation products were detected in the water column in measurable quantities[69]. There is a high risk of exposing people to chemical munitions and more extensive contamination of the marine environment in case of containers with chemical substances being damaged. by anchors, ploughs or other equipment which come in contact with the seabed.

E.13. Mining area

Offshore mining sector – especially oil and gas exploration is one of marine activity becoming relevant in the Baltic Sea.

Currently there are three exploited oil and gas fields[70]:

- two in the Polish Exclusive Economic Zone (EEZ):
  - B-3 field – situated about 80 km north of Rozewie, in the vicinity of the Hel Peninsula, the field hosts the "Baltic Beta" platform which is a production facility for both oil, shipped via a tanker to the refinery in Gdansk, as well as gas, which is transported by a pipeline to the heat and power plant of Władysławowo on the Polish coast, the operations commenced in 1992 and the extraction licence is valid until 2026,
  - B-8 field– is a newly developed oil field which is estimated to contain 3.5 million tonnes of recoverable crude oil, operations on the "Petrobaltic" rig on B-8 commenced in 2015 with a licence valid until 2031 and produce 250 000 tonnes annually, the field is situated 35 km from B-3 and the two are connected with an underwater pipeline which carries crude oil from the operations in B-8 to the production platform on B-3.
- one in Russian waters west from Kaliningrad – Kravtsovskoye (D-6) is situated 22,5 km west from the coast of Kaliningrad region and is estimated to contain 9,1 million tonnes of recoverable crude oil. Extraction began in 2004 and today two rigs are in place on the D-6 field, both operated by Lukoil. The field produces in the order of 600 000 tonnes of crude oil annually. Produced oil and associated gas is transported by a 47-kilometre underwater pipeline to the Romanovo oil-gathering unit on the shore. Produced crude oil is exported through the Izhevsky oil terminal.
- There are also two unexploited gas deposits, B-4 and B-6, in the Polish EEZ for which the company Lotos holds licenses (valid until 2032).

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[69] HELCOM (2013). *HELCOM Chemical Munitions Dumped in the Baltic Sea. Report of the ad hoc Expert Group to Update and Review the Existing Information on Dumped Chemical Munitions in the Baltic Sea.Baltic Sea Environment Proceeding No. 142.*
[70] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152*

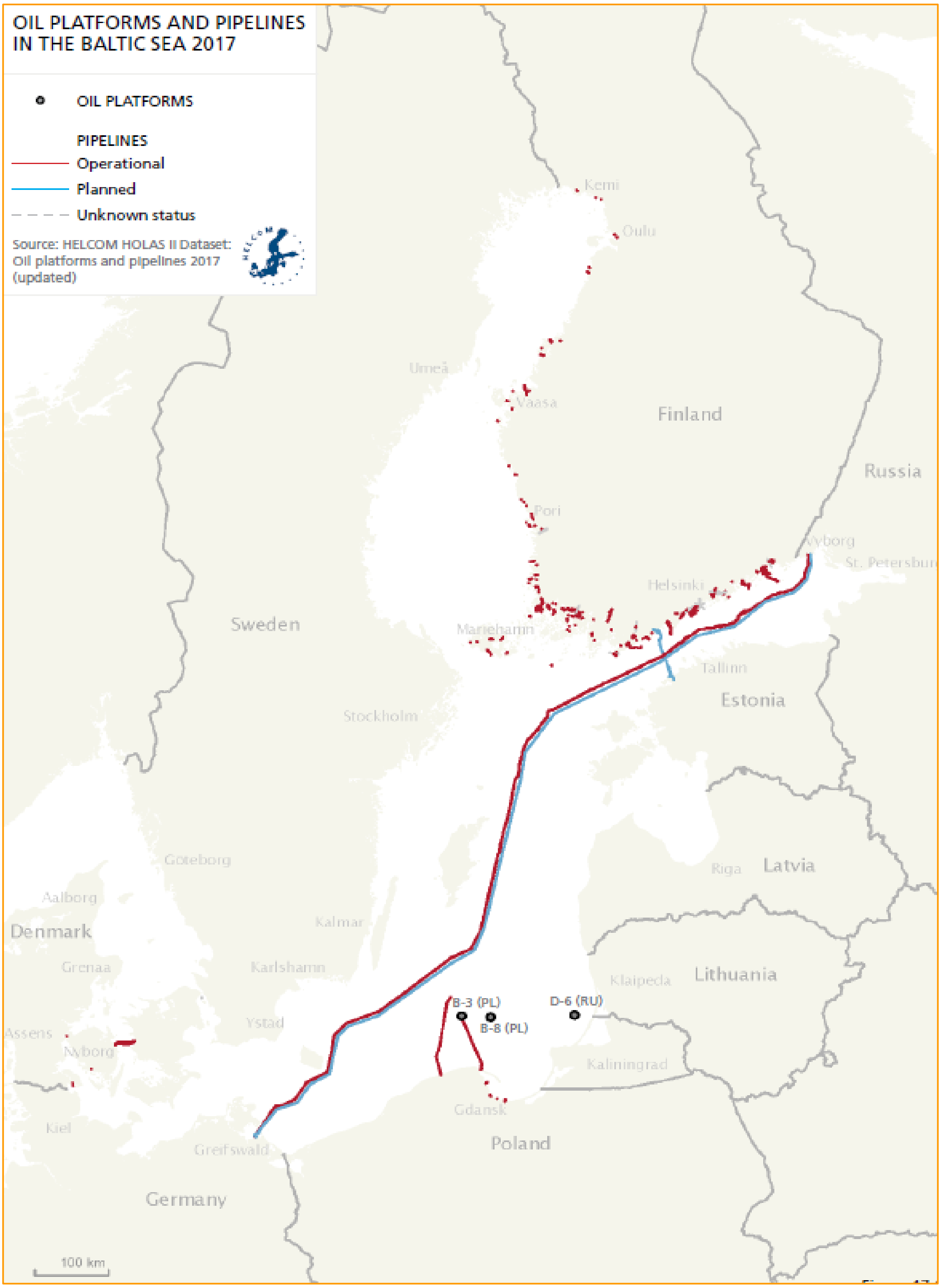

Figure E-19 Oil platforms and pipelines in the Baltic Sea in 2017[71]

The Baltic Sea is also source other minerals like sand and amber as an economic value.

[71] HELCOM (2018). *HELCOM Assessment on maritime activities in the Baltic Sea 2018. Baltic Sea Environment Proceedings No.152*

E.14. HELCOM Marine Protected areas and Natura 2000 sites

The coastal and marine Baltic Sea Protected Areas (HELCOM MPAs) – included Natura 2000 sites have been established to protect valuable marine and coastal habitats in the Baltic Sea. This is done by designating areas with particular nature values as protected areas, and by managing human activities within those areas[72]. The aim of the Natura 2000 network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats. The Natura 2000 network is based on two directives: Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds ("Birds Directive") and Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora ("Habitats Directive"). Member States must ensure that the sites are managed in a sustainable manner, both ecologically and economically[73,74]. There are approx. 2000 species and 230 habitat types for which core sites need to be designated as Natura 2000 sites. Nature reserves, national parks or other nationally or regionally protected sites are established exclusively under national law which can vary from country to country. Sites may be designated for a range of different purposes and may also concern species/habitats other than those targeted by the Natura 2000 network.

[72] http://www.helcom.fi/action-areas/marine-protected-areas/HELCOM-MPAs-and-Natura-2000-areas

[73] http://natura2000.gdos.gov.pl/

[74] http://ec.europa.eu/environment/nature/natura2000/data/index_en.htm

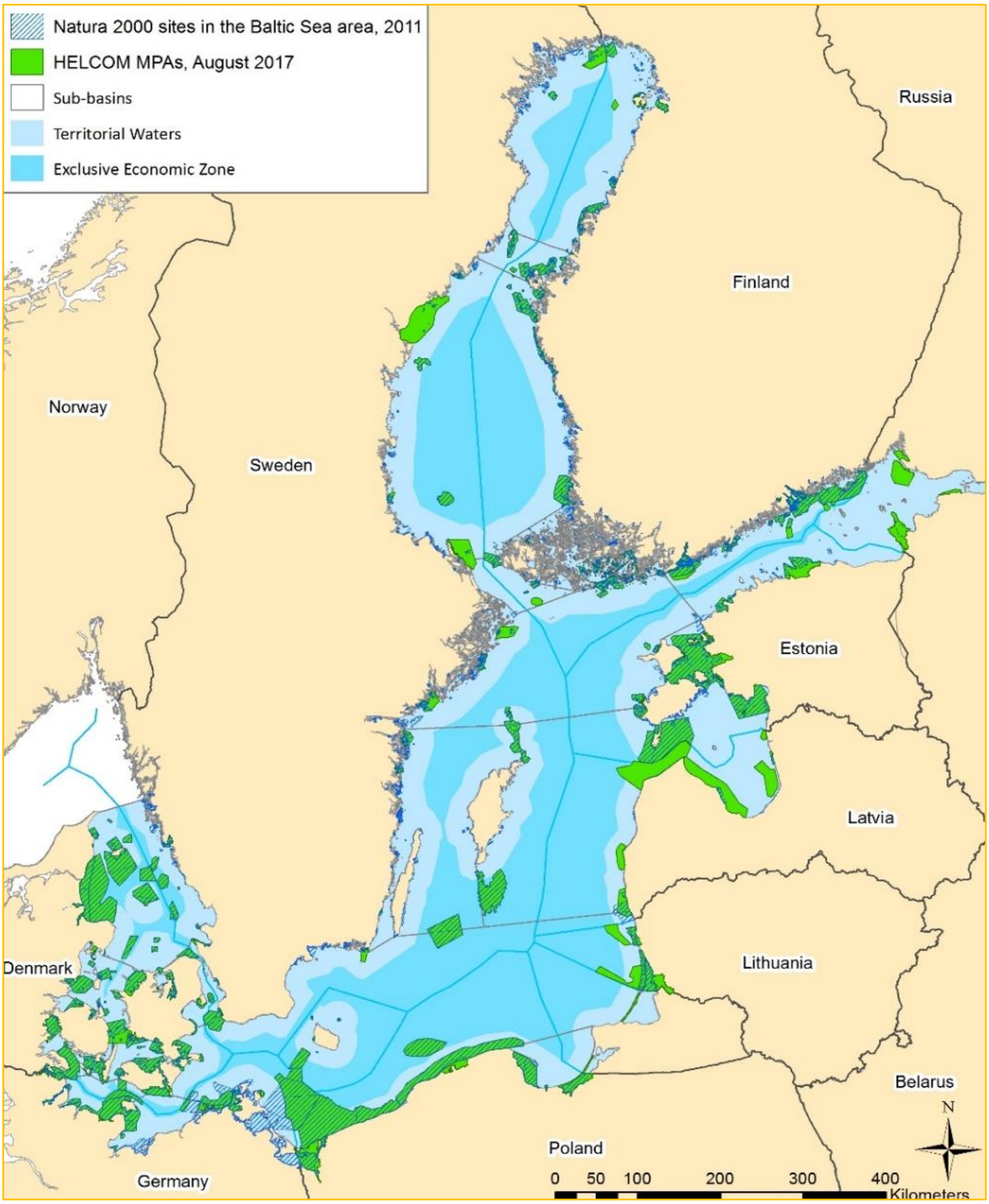

Figure E-20 HELCOM protected areas and Natura 2000 sites in the Baltic Sea[75]

Nowadays there are 176 HELCOM MPAs with total area of 54 266 km2, which includes both coastal and marine areas. The marine fraction of this area is about 90% (49 016 km2, excluding coast and islands). Most HELCOM MPAs are situated near the shores of the Baltic Sea, and only 8 679 km2 is situated in the open water (or the Exclusive Economic Zone). The marine area covered by HELCOM MPAs has risen from 3.9% in 2004 to 11.7% in 2013 and 11.8% in 2018[76].

[75] http://www.helcom.fi/action-areas/marine-protected-areas/HELCOM-MPAs-and-Natura-2000-areas

[76] http://www.helcom.fi/action-areas/marine-protected-areas/HELCOM-MPAs-and-Natura-2000-areas

For the purpose of this document and based concept of the BOG it is assumed that technical elements will be placed in approximately 10 km wide corridors, which pass through 82 Natura 2000 sites: Special Protection Areas (SPAs) designated under Birds Directive and Special Areas of Conservation (SACs), as well as proposed Sites of Community Importance (pSCIs) and Site of Community Importance (SCIs) established under Habitats Directive (see: Figure E-21, Appendix F, Appendix G). At this stage potential significant impact on the Natura 2000 sites cannot be excluded. That is why potential effect of development of every technical element of BOG should be analysed with reference to the Natura 2000 sites.

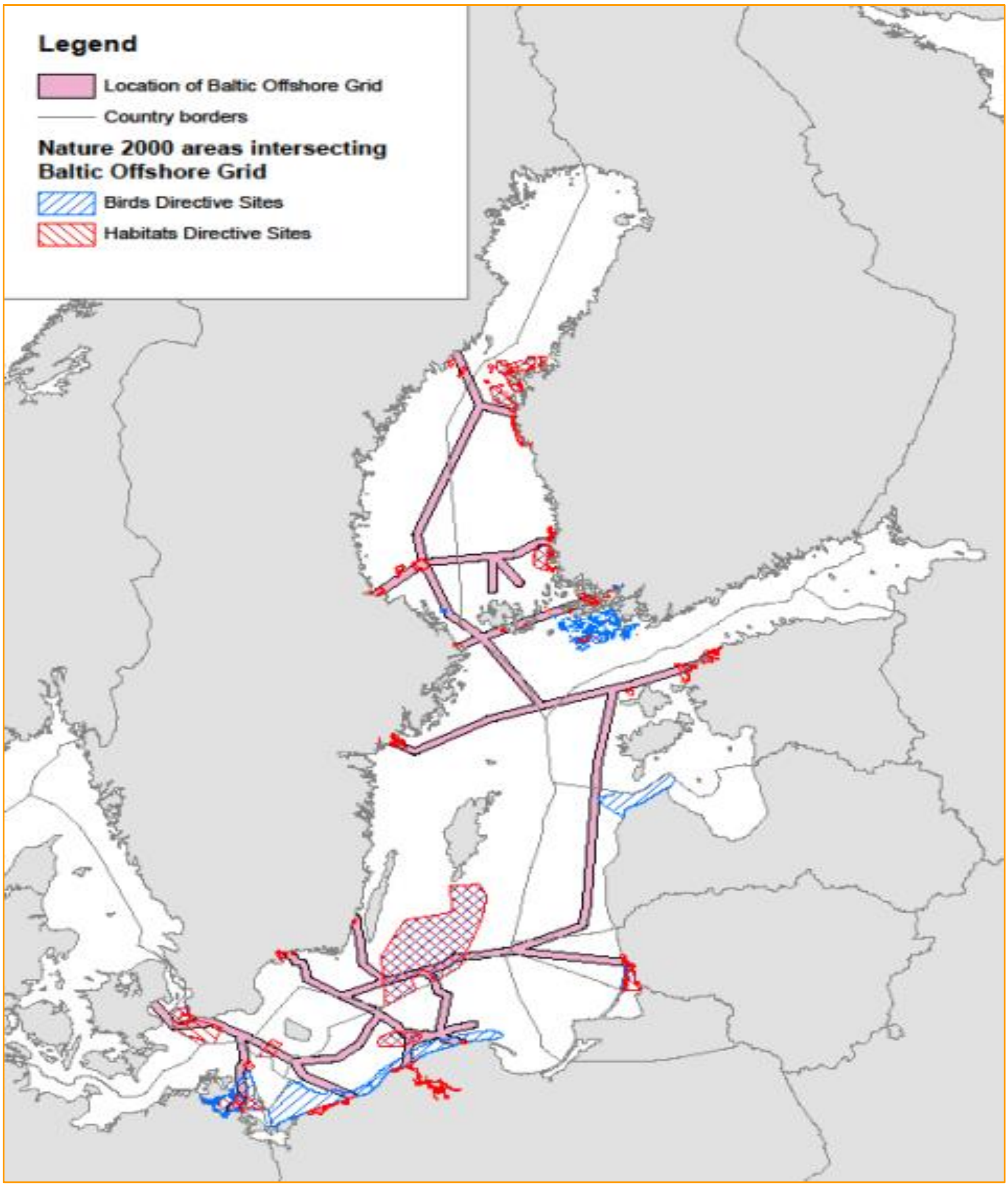

Figure E-21 Nature 2000 sites intersecting Baltic Offshore Grid

Appendix F List of Nature 2000 sites intersecting Baltic Offshore Grid

Fid	Site Code	Site Name	Release Date	Member State	Site Type
1	DE1249301	Westliche Rönnebank	27.09.2016	DE	B
2	DE1648302	Küstenlandschaft Südostrügen	27.09.2016	DE	B
3	DE1649401	Westliche Pommersche Bucht	15.11.2016	DE	A
4	DE1747301	Greifswalder Bodden, Teile des Strelasundes und Nordspitze Usedom	27.09.2016	DE	B
5	DE1747402	Greifswalder Bodden und südlicher Strelasund	15.11.2016	DE	A
6	DE1749302	Greifswalder Boddenrandschwelle und Teile der Pommerschen Bucht	27.09.2016	DE	B
7	DK00VA261	Adler Grund og Rønne Banke	27.01.2016	DK	B
8	EE0010129	Pakri	26.01.2016	EE	C
9	EE0010155	Vasalemma	26.01.2016	EE	B
10	EE0010184	Pedase	26.01.2016	EE	B
11	EE0040129	Hiiu madala	26.01.2016	EE	B
12	EE0040201	Nõva-Osmussaare	26.01.2016	EE	C
13	FI0200028	Kaarinan metsät	28.09.2012	FI	B
14	FI0200036	Paimionlahti	28.09.2012	FI	A
15	FI0200038	Aasla - Kramppi	28.09.2012	FI	B
16	FI0200058	Kuusistonlahti	28.09.2012	FI	A
17	FI0200064	Seilin saaristo	28.09.2012	FI	C
18	FI0200065	Pakinaisten saaristo	28.09.2012	FI	B
19	FI0200067	Lövskärsfjärdenin reunasaaret	28.09.2012	FI	B
20	FI0200072	Uudenkaupungin saaristo	28.09.2012	FI	C
21	FI0200073	Rauman saaristo	28.09.2012	FI	B
22	FI0200090	Saaristomeri	28.09.2012	FI	B
23	FI0200092	Pettebyviken	28.09.2012	FI	A
24	FI0200129	Paraisten orkidea-alue	28.09.2012	FI	B
25	FI0200134	Paraisten kalkkialueet	28.09.2012	FI	B
26	FI0200154	Harsholm	28.09.2012	FI	B
27	FI0200159	Kotkavuori	28.09.2012	FI	B
28	FI0200164	Saaristomeri	28.09.2012	FI	A
29	FI0200177	Lassasin metsä	28.09.2012	FI	B

Fid	Site Code	Site Name	Release Date	Member State	Site Type
30	FI0200186	Uutiskuuva	28.09.2012	FI	B
31	FI0800130	Merenkurkun saaristo	28.09.2012	FI	C
32	FI0800135	Närpiön saaristo	28.09.2012	FI	C
33	FI1400004	Espholm	28.09.2012	FI	B
34	FI1400005	Nåtö - Jungfruskär	28.09.2012	FI	B
35	FI1400012	Blåskären - Salungarna - Stora Bredgrundet	28.09.2012	FI	B
36	FI1400031	Ytterstberg	28.09.2012	FI	B
37	FI1400043	Sandön	28.09.2012	FI	B
38	FI1400059	Södra Järsö	28.09.2012	FI	B
39	FI1400061	Västra Espholm	28.09.2012	FI	B
40	LTKLA0005	Lužijos ir Tyrų pelkės	16.01.2017	LT	B
41	LTKLAB001	Kuršių nerijos nacionalinis parkas	16.01.2017	LT	A
42	LTKLAB010	Kuršių marios	16.01.2017	LT	A
43	LTNER0005	Kuršių nerija	16.01.2017	LT	B
44	LTSIU0012	Kuršių marios	16.01.2017	LT	B
45	LV0900300	Irbes saurums	30.09.2016	LV	A
46	PLB990002	Przybrzeżne wody Bałtyku	24.11.2015	PL	A
47	PLB990003	Zatoka Pomorska	24.11.2015	PL	A
48	PLC990001	Ławica Słupska	24.11.2015	PL	C
49	PLH220003	Białogóra	24.11.2015	PL	B
50	PLH220052	Dolina Słupi	24.11.2015	PL	B
51	PLH220100	Klify Poddębskie	24.11.2015	PL	B
52	PLH320017	Trzebiatowsko-Kołobrzeski Pas Nadmorski	24.11.2015	PL	B
53	PLH320068	Jezioro Wicko i Modelskie Wydmy	24.11.2015	PL	B
54	SE0110149	Hamnudden	17.01.2017	SE	B
55	SE0110211	Arsläjan	17.01.2017	SE	B
56	SE0110260	Samnäsfjärden	17.01.2017	SE	B
57	SE0110268	Rörvik	17.01.2017	SE	B
58	SE0210040	Västerbådan, Lågagrundet	17.01.2017	SE	A
59	SE0210212	Billudden	17.01.2017	SE	B
60	SE0210286	Långsandsörarna	17.01.2017	SE	B
61	SE0220124	Horsvik	17.01.2017	SE	B

Fid	Site Code	Site Name	Release Date	Member State	Site Type
62	SE0220126	Nynäs	17.01.2017	SE	B
63	SE0220129	Skärgårdsreservaten	17.01.2017	SE	C
64	SE0220218	Stendörren	17.01.2017	SE	C
65	SE0220231	Rågö	17.01.2017	SE	C
66	SE0220702	Svärtaån	17.01.2017	SE	B
67	SE0330123	Värnanäs skärgård	17.01.2017	SE	B
68	SE0330217	Värnanäs	17.01.2017	SE	B
69	SE0330308	Hoburgs bank och Midsjöbankarna	17.01.2017	SE	C
70	SE0410068	Pukaviksbukten	17.01.2017	SE	B
71	SE0410071	Stärnö	17.01.2017	SE	B
72	SE0410133	Tärnö-Yttre Ekö	17.01.2017	SE	B
73	SE0410163	Tärnö-Harö-Brorsö	17.01.2017	SE	B
74	SE0430002	Falsterbo-Foteviken	17.01.2017	SE	A
75	SE0430095	Falsterbohalvön	17.01.2017	SE	B
76	SE0430187	Sydvästskånes utsjövatten	17.01.2017	SE	B
77	SE0630026	Orarna	17.01.2017	SE	C
78	SE0630027	Eggegrund och Gråsjälsbådan	17.01.2017	SE	C
79	SE0630260	Finngrundet-Östra banken	17.01.2017	SE	B
80	SE0630262	Finngrundet-Västra banken	17.01.2017	SE	B
81	SE0810003	Snöanskärgården	17.01.2017	SE	B
82	SE0810519	Sydostbrotten	17.01.2017	SE	B

Appendix G Characteristic of Nature 2000 sites intersecting Baltic Offshore Grid – excel file