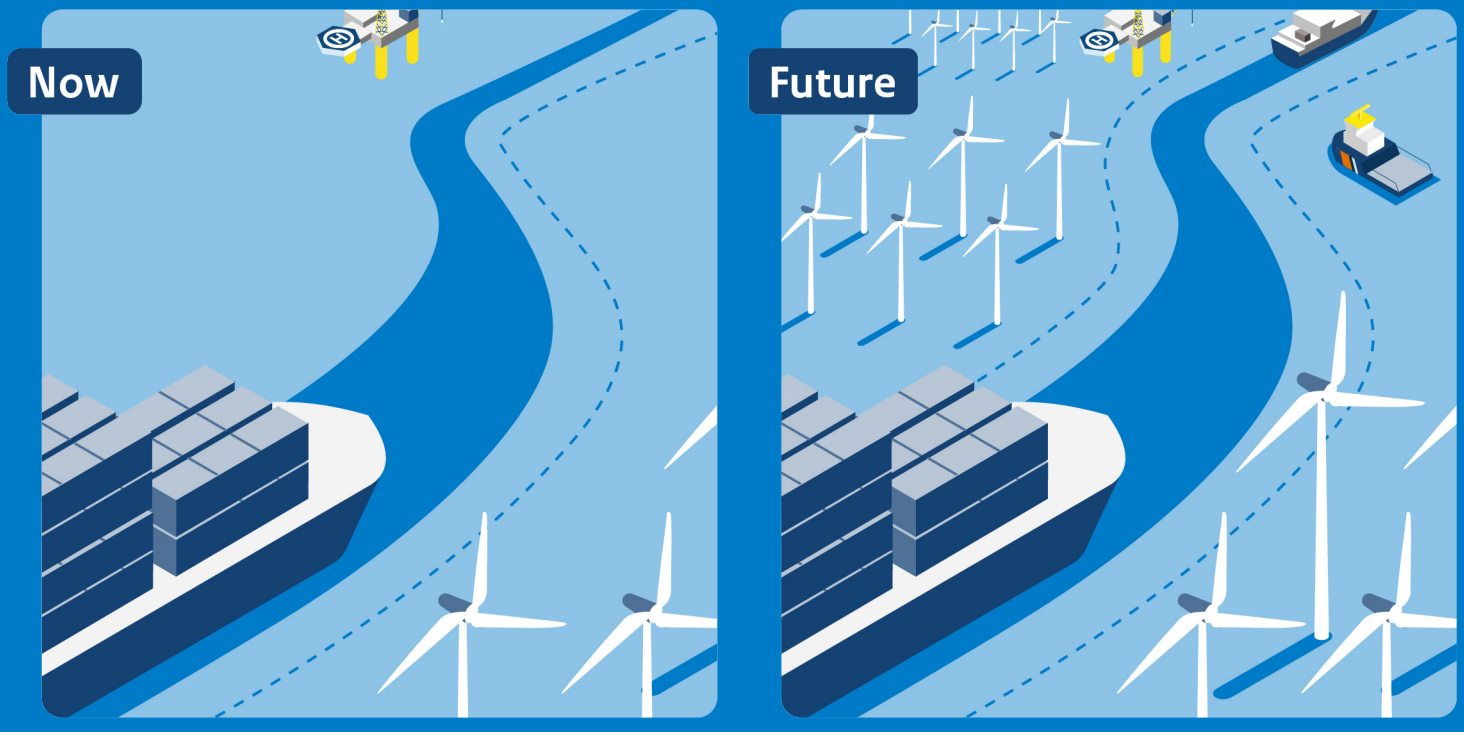
Ministerie van Infrastructuur
en Waterstaat

Juni 2025

Policy advice on Offshore Wind Energy Shipping Safety

Working together now towards a safe North Sea



Content

Foreword

The North Sea is changing rapidly. More and more wind farms are being built along busy shipping routes. This rapid growth of offshore wind energy offers opportunities for the energy transition, but it also poses risks for shipping. After all, ships need space to navigate safely.

The coming years will be crucial. With the site decisions for the Nederwiek and Doordewind wind farms and the update of the North Sea Programme, the spatial layout of a significant part of the North Sea has been established. It is therefore important that we now work together towards a safe North Sea; based on a comprehensive approach that factors in shipping more prominently.

This policy advice sets out both the framework and the substance for that approach. It contains the main conclusions and recommendations from five years of research within the MOSWOZ programme (Offshore Wind Energy Shipping Safety Monitoring and Research Programme).

We would like to thank all parties involved who contributed their knowledge and experience.

MOSWOZ programme team
Rijkswaterstaat

Summary

The number and size of wind farms in the North Sea are increasing. This has a negative impact on shipping safety. In the period 2020-2025, the Offshore Wind Energy Shipping Safety Monitoring and Research Programme (MOSWOZ) conducted research into the development of risks as a result of wind farms and into the effectiveness of safety measures. The programme focused on the policy objective of maintaining or improving the current level of risk for shipping on the North Sea. This policy advice describes the main conclusions and recommendations.

Conclusion: The current level of risk control is insufficient to keep shipping safe in the long term.

Five years of monitoring and research have provided a more detailed insight into the impact of wind farms on the safe navigation of ships. This shows that the risks continue to increase due to the growing number of offshore wind farms. A comprehensive package of safety measures has been implemented and investigated. These measures have proven to be largely effective and increase the level of safety. However, it does not seem to be sufficient to respond to the increasing risks and emerging risks resulting from the radical and rapid changes on the North Sea. This means that current risk control – and, in a broader sense, risk management – is still inadequately equipped to keep shipping safe in the long term

Advice: Make risk management more future-proof

The rapid expansion of wind energy introduces new safety challenges. To ensure an effective response, MOSWOZ recommends making risk management more future-proof, starting with enhancing our understanding of existing and emerging risks. This requires a verifiable safety objective to allow weighing up the risks. The risks can be controlled by making adjustments to the design of future wind farms, optimising existing measures and expanding measures. International cooperation can also be improved , including through the joint implementation of control measures. This creates a more systematic and comprehensive approach that contributes to a continuously up-to-date understanding of the risks regarding shipping safety and wind farms.

Reading guide

Chapter 1 contains an introduction that includes a description of the changing situation on the North Sea and the MOSWOZ programme. Subsequently, chapters 2 and 3 elaborate on the most important conclusions and recommendations. A complete overview can be found in the In-depth Policy Paper on the Offshore Wind Energy Shipping Safety Monitoring and Research Programme.

1. Introduction:

The North Sea is becoming increasingly busy

The situation in the North Sea is changing drastically. This introduction briefly explains the developments and what preceded this policy advice. The chapter concludes with a description of MOSWOZ, the objective, target group and scope of this policy advice, as well as a few key terms.

Developments

The Netherlands has great ambitions for offshore wind energy. The transition to renewable energy will make a significant contribution to achieving the climate targets[1]. Wind energy also offers economic and strategic advantages. It makes the Netherlands less dependent on oil and gas imports, while at the same time creating jobs and stimulating technological innovation.

As a result, more and more wind farms are being built along busy shipping routes. Currently (2025), there are around 700 wind turbines on the North Sea, a number that will grow to 1,700 by 2032 (see maps 1 and 2). The total area covered is approximately 3,800 km^2, or more than 6% of the surface area of the North Sea. And in the partial revision of the North Sea Programme, a doubling of the total power generated at sea is even anticipated by 2040. In other words, the North Sea is becoming increasingly busy, and not only due to the growth in wind turbines. It is expected that thousands of fixed objects will be added after 2032, with many different uses. For instance, there are also plans to convert wind energy into hydrogen or ammonia. This requires new platforms, which also take up space and introduce new risks. Other new objects include floating solar panels or installations for the production of shellfish or seaweed.

Changes in the scale of shipping also affect the available space. Although the number of ships on the Dutch North Sea remains stable, the average size of route-bound ships continues to increase[2].

All these significant developments affect shipping safety, because ships need space to navigate safely, especially as they become larger and heavier.

[1] The production of electricity using wind energy emits up to forty times less greenhouse gases than electricity generation using natural gas. Source: **https://www.rijksoverheid.nl/onderwerpen/duurzame-energie/duurzame-energie-infrastructuur.**
[2] Kauffman K, Hermans M, Nap A, de Jong T. (2024). North Sea Network Analysis 2023. MARIN.

Development of wind farms on the North Sea

Map 1: *The development of wind energy areas on the North Sea with operational wind farms in 2019 and planned wind farms in 2032.*

What preceded

The publication of this policy advice was preceded by various studies and decisions, the most important of which are listed below.

- **The report 'Offshore Wind 2030: consequences for shipping safety and possible mitigating measures' by MARIN** (Maritime Research Institute Netherlands) concluded in 2019 that risks to shipping are increasing due to wind at sea.
- The MARIN report resulted in a package of safety measures in 2019 (see Figure 1) and **the launch of the Offshore Wind Energy Shipping Safety Monitoring and Research Programme (MOSWOZ).** MOSWOZ aims to investigate and monitor risk development and the effectiveness of safety measures. The programme focused on the policy objective of maintaining or improving the current level of risk for shipping on the North Sea.
- In 2024, the Dutch Safety Board (OvV) published its **report 'Schipperen met ruimte'** (Compromise on room to manoeuvre) in response to the incident involving the Julietta D (also see the box 'Incidents'). The report concluded that risk control needs improvement and makes a number of recommendations to this effect.
- In response to this OvV report, a **Letter to Parliament**[3] was published in February 2025. In this letter, the Minister of Infrastructure and Water Management (IenW) describes the steps that have been and are being taken to ensure shipping safety on the North Sea now and in the future. An important step is *'the establishment of a periodic safety analysis, in which risks are identified using a variety of means and can be monitored based on a realistic safety objective yet to be established'*.

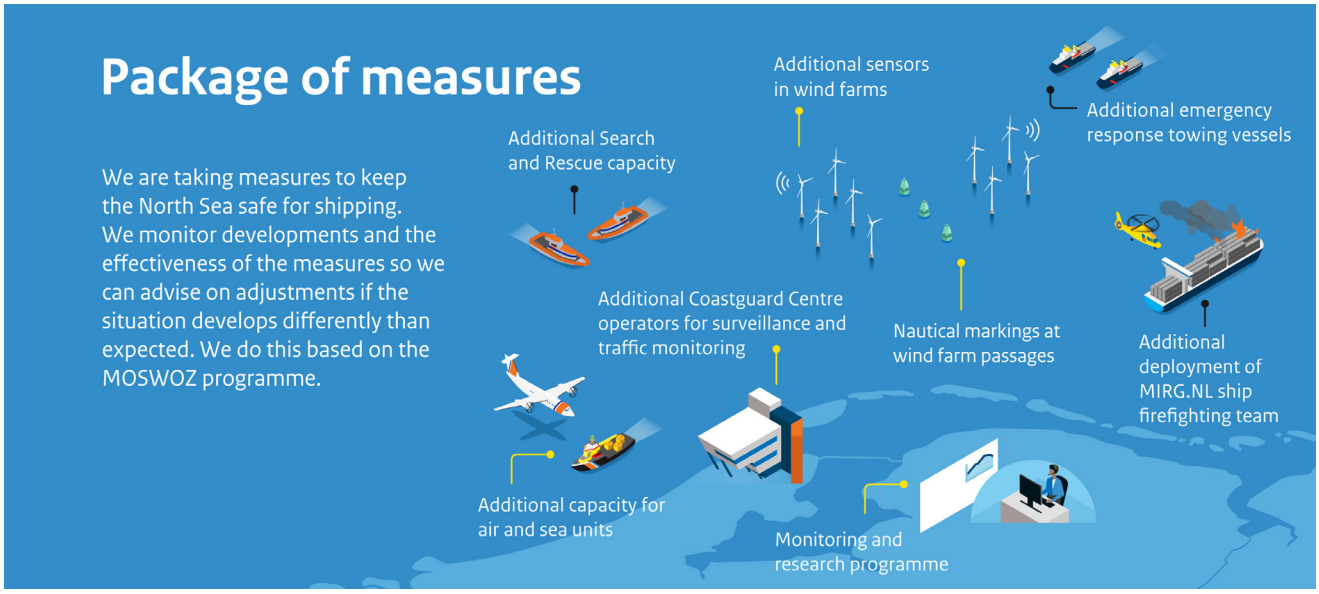


Figure 1: *Overview of a package of safety measures for a safe North Sea until 2031, as laid down in the MOSWOZ programme.*

[3] Follow-up response to OvV report 'schipperen met ruimte', IENW/BSK-2025/30453

Incidents

Although incidents are still relatively rare, there have already been several ship-wind turbine collisions and drift contacts. The following three incidents illustrate what the consequences are.

Julietta D

During storm Corrie, the Julietta D started drifting in the anchorage area near IJmuiden on 31 January 2022 and collided with the chemical tanker Pechora Star. After losing propulsion, the ship became unmanoeuvrable, drifted into the Hollandse Kust Zuid wind farm and collided with two foundations. The ship's crew and 109 people on a nearby platform had to be evacuated. A few hours later, a towing vessel managed to establish a tow connection and the Julietta D was towed to the port of Rotterdam. The incident caused considerable damage, demonstrating the significant risks associated with loss of control in busy sea areas with stationary objects.

Maersk Nimbus & Diamond Sky

During storm Eunice on 18 February 2022, two ships got into trouble on the North Sea, near Belgian wind farms. The Maersk Nimbus, a loaded tanker, drifted into a wind farm with a dragging anchor and nearly collided with a wind turbine. This vessel was towed to a safe location by a towing vessel. The unloaded Diamond Sky ran into trouble due to wind and waves over 5 metres high and was forced to sail straight through the Borssele wind farm. Although there was no damage, the incident underlines the vulnerability of anchorage areas in extreme weather conditions.

Glomar Venture

On 20 April 2025, the Glomar Venture, a 45.70-metre-long Safety Standby Vessel (SSV), sailed head-on into a wind turbine at the Hollandse Kust Zuid wind farm in good weather conditions. The KNRM (Royal Dutch Rescue Association) arrived quickly on the scene and treated the three injured people, transporting them urgently to the mainland. The bow of the ship was badly damaged, but the ship was able to sail to the harbour under its own power. At the time of writing this policy advice, no information was available regarding damage to the wind turbine. The police are investigating the cause of the collision.

In-depth policy paper and policy advice

MOSWOZ is now concluding the 2020-2025 programme period with an interim evaluation, consisting of an in-depth policy paper and policy advice. The 'In-depth Policy Paper on the Offshore Wind Energy Shipping Safety Monitoring and Research Programme' compiles the results of five years of research, risk analyses and policy measures. This policy advice document, entitled 'Offshore Wind Energy Shipping Safety', contains the main conclusions from this in-depth policy paper and provides recommendations.

Target group, objective and scope of the policy advice

The policy advice is primarily intended for political leaders and policy officials of the Directorate-General for Aviation and Maritime Affairs (DGLM) of the Ministry of Infrastructure and Water Management (responsible for shipping safety) and the Ministry of Climate and Green Growth (KGG) (responsible for offshore wind farms). The users of the North Sea, other stakeholders and interested citizens are also part of the target group. The primary aim of this policy advice is to advise policymakers on the steps necessary to ensure shipping safety, both now and in the future.

The scope of these recommendations focuses on managing the shipping safety risks arising from the construction of wind farms on the North Sea. These risks cannot be addressed without including the broader shipping safety risks on the North Sea and the developments referred to above. To ensure sound policy choices, it is essential to take all these risks into account in the broader assessment of other North Sea interests, ecology, fisheries, defence and other sectors. MOSWOZ provides the knowledge and insights needed to properly consider shipping safety in and around wind farms in that comprehensive assessment.

Definitions

The following definitions are used in this policy advice.

- **Risk.** The probability of an incident multiplied by the consequences (probability x consequence).
- **Risk management.** The coherent process of identifying, analysing, evaluating and controlling risks in order to minimise negative consequences and make the most of opportunities (e.g. with ISO 31000). The in-depth policy paper contains a theoretical introduction to risk management.

MOSWOZ in facts and figures

- Since May 2021, **dozens of studies**[4] have been conducted, based on 7 research themes and more than 30 research questions. The results have been shared through more than 30 reports, 7 newsletters and 2 symposiums.
- The core team has invested around **6,000 man-hours** and **€3.5 million** has been outsourced to research agencies.
- MOSWOZ has **collaborated with knowledge institutions** such as MARIN, Deltares, TNO and Delft University of Technology and coordinated with the following **fellow ministries or agencies:** Coastguard, Hydrographic Service, TenneT, KNMI, Human Environment and Transport Inspectorate (ILT) and State Supervision of Mines (SodM).
- **Dozens of experts and stakeholders** are actively involved through expert sessions, working groups and advisory forums, including the North Sea Shipping Advisory Group (SAN). Stakeholders include port authorities, the Dutch Shipowners' Association (KVNR), the Royal Dutch Shipowners' Association (NVKK), representatives of the fishing industry, the National Nautical Traffic Service Training Centre (NNVO), Deep Sea Pilots, VTS operators, the Dutch Wind Energy Association (NWEA), wind farm operators, KNRM, the Watersport Association, Touring Sailors and Sea Sailors.
- **International cooperation** took shape through digital and a few physical consultations with representatives of our neighbouring countries in the North Sea Shipping Group, in addition to participation in formal international forums such as the International Maritime Organisation (IMO), International Organisation of Marine Aids to Navigation (IALA) and European Maritime Safety Agency (EMSA).

[4] See https://www.noordzeeloket.nl/publicaties/ voor een overzicht van de onderzoeken en rapportages.

2. Conclusion:

The current level of risk control is insufficient to keep shipping safe in the long term.

Five years of monitoring and research have provided a more detailed insight into shipping safety and the impact of wind farms. This shows that the risks continue to increase due to the growing number of offshore wind farms. A comprehensive package of safety measures has been implemented and investigated. These measures have proven to be largely effective and increase the level of safety. However, this is not sufficient to respond to the increasing risks and emerging risks resulting from the radical changes on the North Sea. This means that current risk control – and, in a broader sense, risk management – is still inadequately equipped to keep shipping safe in the long term. These conclusions are explained below.

2.1 The risks continue to increase due to the construction of new wind farms.

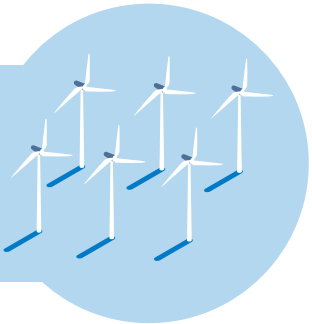
The rapid growth in the number of wind turbines is increasing the risks, mainly because it reduces the manoeuvring space for ships.

The main risk-increasing situations that can lead to a collision with a wind turbine are shown (see also Figure 2):

- **Lack of space at sea due to wind farms.** Wind farms along busy shipping routes restrict the manoeuvring space of ships, thereby increasing the risk of collisions, especially in the event of technical failure or bad weather. A ship may drift uncontrolled towards a wind farm. The increase in the size and gross tonnage of ships also increases the risk of collisions between ships and with wind turbines.
- **Higher risks near anchorage areas.** In anchorage areas located upwind of a wind farm, ships experiencing dragging anchors or anchor loss can drift into and collide with wind turbines within a relatively short period of time.
- **Increase in work traffic at wind farms.** The construction and maintenance of wind farms generate additional shipping movements within, and to and from, the wind farm, increasing the risk of collisions.

"Everything is being built up with wind farms, leaving insufficient space to tack safely in adverse weather conditions."

Quote from a seafarer from the 2024 Maritime Experience Survey



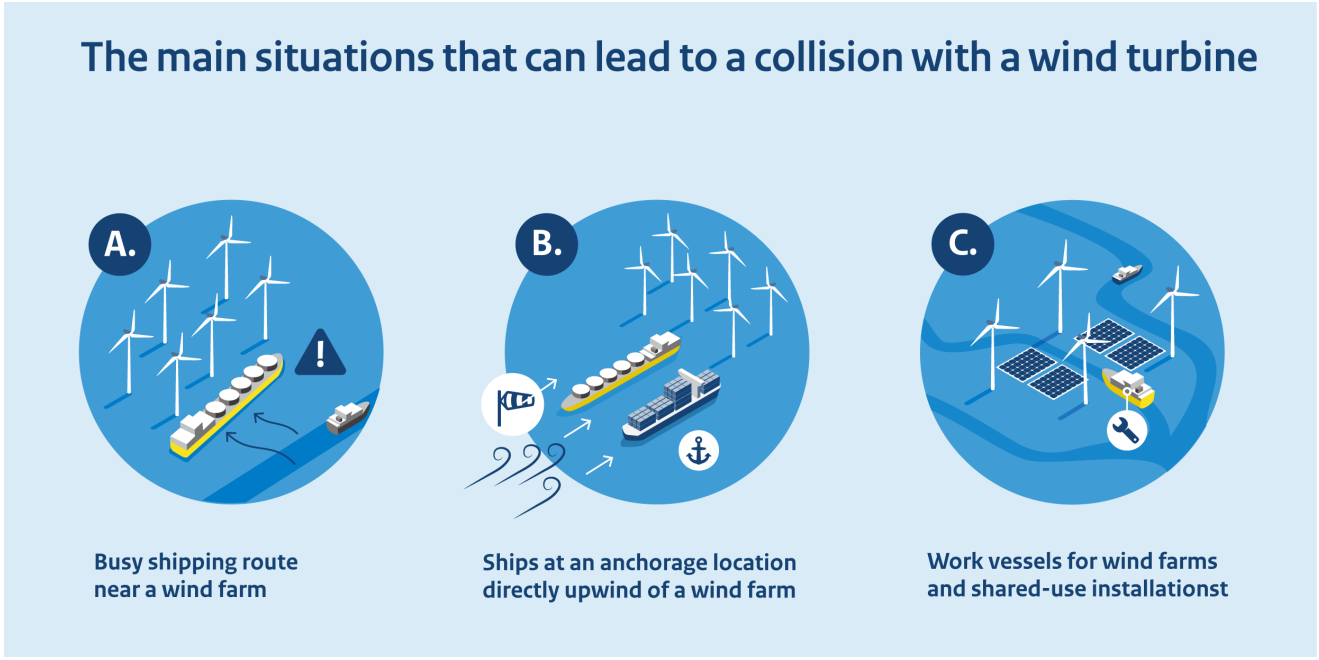


Figure 2: *Overview of the three risk-increasing situations affecting shipping safety resulting from the construction of offshore wind farms.*

The level of risk on the North Sea is increasing, particularly from ship-turbine collisions, according to risk analyses[5]. In 2019, the risk of ship-turbine collisions was still negligible, as there were hardly any wind turbines near busy shipping routes. This risk will increase to one to two collisions per year by 2032. Due to the increased risk of ship-turbine collisions and their consequences, these incidents are placed in a higher risk category in the risk matrix[6]. This means that additional safety measures are required.

The consequences of a collision between a ship and a wind turbine have also been investigated using 2D and 3D simulations (see box). These indicate that a large proportion of ship-turbine collisions will result in limited damage. However, if a large ship encounters difficulties and ends up in a wind farm, the consequences can be significant, with considerable damage to both the ship and the wind turbine or wind turbines. These consequences could include casualties or people in distress and environmental damage caused by loss of cargo or fuel.

In specific scenarios, such as when turbine components (nacelle) fall onto a ship, the consequences can be extremely serious. These are referred to as High Impact Low Probability (HILP) risks. The scope of these HILP risks is not entirely clear because the current risk models do not show them as results. This may lead to critical risks being underestimated.

[5] Source: In-depth Policy Paper on the Offshore Wind Energy Shipping Safety Monitoring and Research Programme, Chapter 4 and section 8.2.
[6] A risk matrix is a tool for assessing safety risks based on probability and impact (consequences). The risk matrix is used in the North Sea risk analysis, among other things.

With the exception of HILP risks, the existing risks are therefore identified. This applies to a lesser extent to new risks arising from the radical changes on the North Sea. For instance, risks resulting from shared use, such as for seaweed farms or floating solar panels. Or risks associated with the use of hydrogen or autonomous sailing. These new risks are difficult to predict. This calls for new risk assessment methodologies, such as scenario thinking, whose use is still limited.

Consequential damage visualised by 2D and 3D simulations

Previous risk analyses focused on preventing collisions or limiting their consequences. Based on 2D and 3D simulations, MOSWOZ has now also identified the damage patterns caused by ship-turbine collisions. In this process, 2D simulations provide a general picture of forces and deformation in a single plane, whereas 3D simulations can simulate spatial damage and structural failure in detail. These insights help to take more targeted measures and better tailor policy to the expected consequences of a collision.

Three different ship types were analysed in the simulations, in both sailing and drifting scenarios. The analyses demonstrate that collisions between ships and wind turbines can cause significant damage. Ships sustain damage to their bows or hulls, but usually remain intact, meaning without losing cargo. The main risks lie with the wind turbines, which often collapse completely. An additional simulation showed that a falling nacelle (upper part of the wind turbine) can cause serious damage, such as damaging multiple ship decks. This HILP scenario is rare, but it can result in many casualties or significant environmental damage.

2.2 The current measures are effective, but do not completely eliminate the increase in risks

From 2020 onwards, a comprehensive package of safety measures has been implemented and investigated.
These measures have proven largely effective and contribute to an increased level of safety by preventing incidents or mitigating their consequences.

However, it seems unlikely that the measures will be able to completely eliminate the increase in risks; they do not provide a foolproof guarantee against collisions. Furthermore, the measures are not yet tailored to an uncertain future with new risks.

This conclusion is based on various qualitative analyses, such as simulations, expert sessions and BowTie analyses[7]. Quantitative data is currently still limited, and some measures are still implemented to an insufficient extent. Monitoring and research should continue in the coming years in order to gain the necessary insights.

The safety measures are explained in more detail below.

Risk management for wind farms on the North Sea comprises three types of measures:

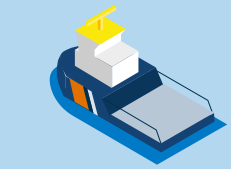
- **Generic safety measures**, such as international regulations and training requirements for crews. These form a generally accepted foundation for shipping safety.
- **Measures for the spatial layout of wind farms**, such as permit requirements, safe distances between wind farms and shipping routes or fairways.

[7] A BowTie analysis is a visual and systematic method for identifying and controlling risks.

- **Additional measures**, which have been implemented from 2020 onwards to achieve further risk reduction, such as sensors, increased surveillance and enforcement, and additional Emergency Response Towing Vessels (ERTVs). This '2020 package of measures' delivers safety gains. The effectiveness of these measures does, however, remain dependent on further optimisations and adequate monitoring. Table 1 provides a comprehensive overview of the 2020 package of measures, their effectiveness and points for attention. Section 3.3 contains the recommendations regarding the measures.

"The wind farms are relatively close to shipping lanes. In the event of a breakdown, you can quickly drift into the wind farms due to wind and current. The situation has improved due to the addition of ERTVs, but these are not always available either, and it can easily take a couple of hours before they are in position."

Quote from a seafarer from the 2024 Maritime Experience Survey



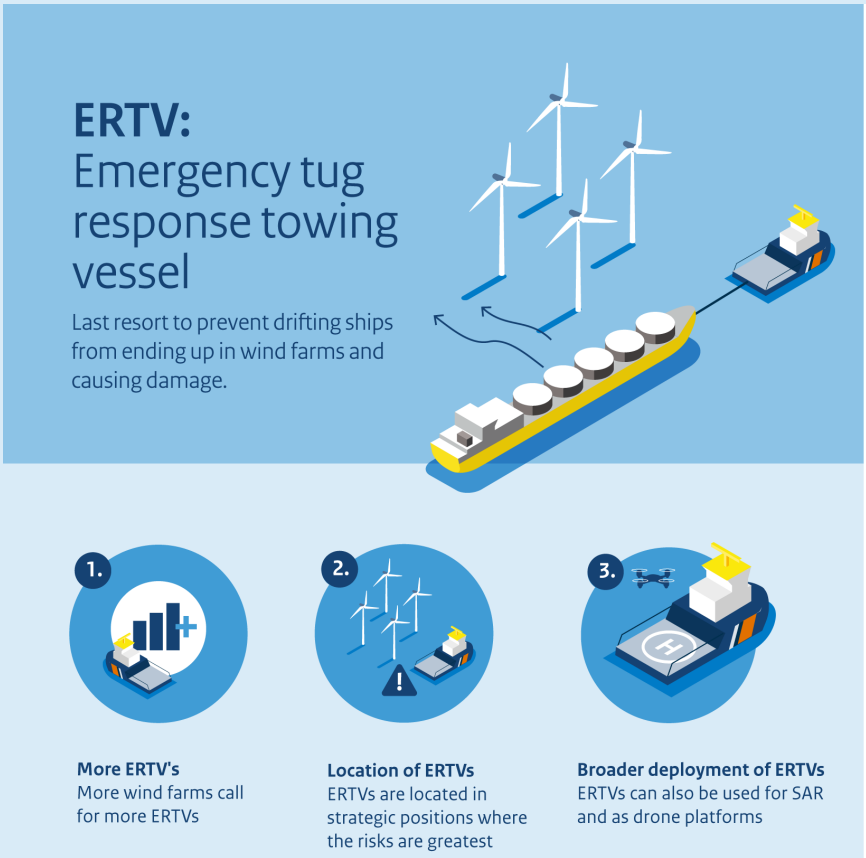


Figure 3: *Overview of the relevant elements and opportunities to optimise the deployment of ERTVs*

Table 1: Measures and effectiveness of the 2020 package of measures

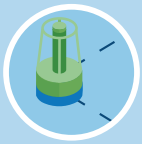
 **Additional sensors in and around wind farms**	Additional nautical sensors are being installed in the wind farms, such as Automatic Identification System (AIS), radar and marine radio (VHF). With each new wind farm, the coverage area of the sensors is further expanded. The sensors have proven to be effective as a supplement to the Coastguard's image building in Search and Rescue (SAR) operations and for surveillance and enforcement. They thus increase shipping safety. The use of Radio Direction Finders (RDF) and smart cameras is currently being investigated. Tests for image reconstruction using sailing and flying drones on the North Sea are also being conducted.
 **Additional monitoring and enforcement**	In the period 2020-2025, the Coastguard has expanded its monitoring and enforcement of compliance with safety zones and the use of wind farms with an Offshore Wind (WOZ) desk at the Coastguard Centre and additional monitoring from the air and from the water. The added value of the monitoring by the WOZ desk has so far proved to be limited. Little happened in and around the wind farms, and the Coastguard operators did not find the work challenging. Partly due to a lack of capacity, the Coastguard has been performing this task less intensively in recent years. No conclusion can yet be drawn with regard to the additional enforcement from the water, as the additional vessel required for this purpose will not be in service until 2026. From that moment on, there will be extra surveillance at sea. The Coastguard aircraft is an effective means of aerial surveillance at wind farms. For the wind farms further out at sea, the aircraft can quickly provide an overview of the situation in case of incidents.
 **Vessel Traffic Monitoring VTMon**	Vessel Traffic Monitoring (VTMon, see also Figure 4) is conducted by a desk at the Coastguard Centre that can warn ships in a timely manner in case of a risk of collisions around wind farms. This new task for the Coastguard is currently being implemented and will commence on 1 October 2025. The Human Factors study (see box on page 16) already shows that VTMon, supported by good sensory and analytical tools, is an important preventive measure. Expert sessions with seafarers also confirm this expectation. It is important that a method for measuring the effectiveness of VTMon is developed in collaboration with the Coastguard. The analysis capabilities can also be greatly improved.
 **Additional emergency response towing vessels**	Emergency Response Towing Vessels (ERTVs) are large emergency tugboats that can be deployed as a last resort to prevent or reduce the impact of a drifting contact by an unmanoeuvrable vessel (see Figure 3). Two additional ERTVs have been deployed at the wind farms, which since 2021 have rescued a ship in distress on seven occasions and prevented damage to vital infrastructure. The vessels appear to be effective, but key concerns are their response times and the timely establishment of a tow connection. With the construction of the Nederwiek and Doordewind wind farms further offshore, one or two additional ERTVs will be required, taking into account acceptable response times. The effectiveness of ERTVs can be further enhanced by means of a Towing Assistance Team (TAT) that helps to establish a tow connection (see section 3.3). The ERTVs are also used by the Coastguard for other tasks, such as enforcement and monitoring though drone inspections. The ERTV will therefore always remain immediately available for its primary task of providing emergency towing assistance

SAR and firefighting in the North Sea

To support SAR operations, fast rescue boats have been installed on the ERTVs. Resources have also been made available for the expansion of the Rotterdam-Rijnmond Safety Region's North Sea firefighting team (MIRG.NL). Since 2020, there has been a ship fire every year, where the MIRG team has been deployed or has provided advice. With the advent of wind farms further out at sea, the task of providing remote advice is becoming increasingly important. The safety region has a great deal of expertise in this area. The safety region is also developing an information system to continuously adjust the risk assessment during an incident based on data and information. For wind farms further out at sea, it will take longer for emergency assistance to arrive. This requires shipping crews and maintenance crews to be more self-reliant.

Use of anchorages

In the approach areas to the ports of Rotterdam and IJmuiden, the authorities have been working with the Coastguard since 2023 to inform anchored ships in adverse weather conditions so that they can weigh anchor in a timely manner if the master deems this necessary. In some cases, it is evident that ships do indeed weigh anchor before or during a storm in order to sail a safe course.



Marking of wind farms

Lighting makes the wind turbines more visible to ships, which reduces the risk of a ship colliding with a turbine. Contour lighting was already mandatory and installed in wind farms in 2020. Wind farms are marked in accordance with international IALA guidelines. Additional lighting requirements have been introduced to make night-time passage through wind farms safer, including indirect lighting of signs displaying the unique code of a wind turbine (ID signs). This is included as a requirement in the site decisions for the new wind farms[8]. A point of concern with regard to the marking is the enormous number of flashing lights, especially for the aeronautical lighting. Seafarers indicate that crucial navigation lights can sometimes be overlooked as a result

Deep Sea Pilot

The Deep Sea Pilot advises masters of seagoing vessels on safe routes and navigation, particularly in complex or busy areas. This assistance contributes to safe navigation past wind farms. This also became evident from the Human Factors study. In addition to knowledge of the area, communication skills had a significant positive influence on rapid intervention in dangerous situations. The use of the Deep Sea pilot is currently still limited, mainly because there is no obligation and the costs play a role.

MOSWOZ

The Offshore Wind Energy Shipping Safety Monitoring and Research Programme (MOSWOZ) itself is also a measure from the '2020 package of measures'. The programme increases insight into shipping safety risks and the effectiveness of measures taken. With the construction of wind farms further out at sea, this will remain vital in the coming years. MOSWOZ has been instructed by DGLM to continue the programme until 2029.

[8] Dutch Law Database. Site decision for the site Alpha wind energy area IJmuiden Ver. Consulted on https://wetten.overheid.nl/BWBR0049193/2024-02-01.

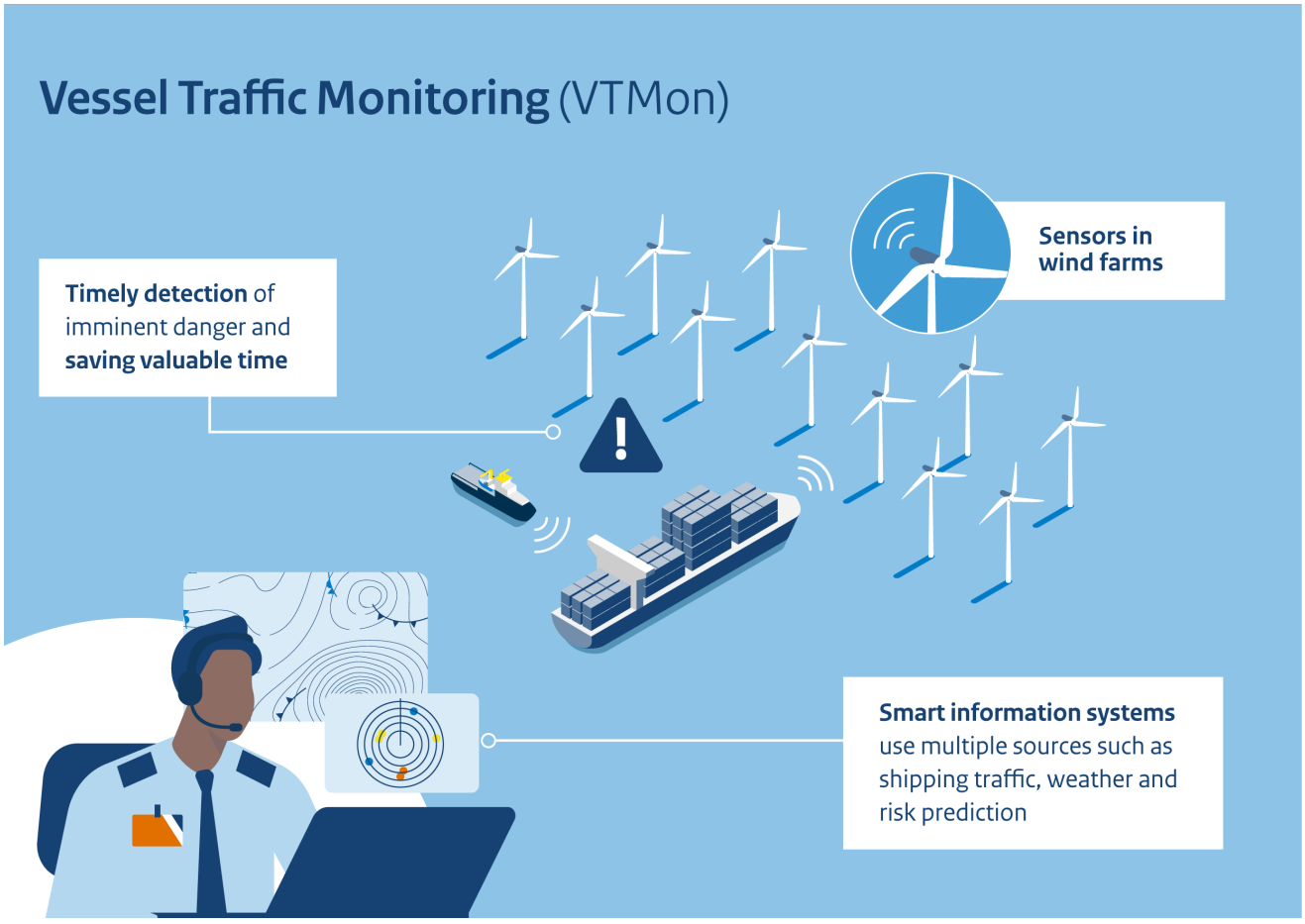


Figure 4: *Monitoring and control of shipping via VTMon.*

Human Factors study: learning from exceptional scenarios

In October 2024, an exploratory simulation study was conducted into the effect of wind farms on the sailing behaviour of ship crews. This is relevant since human error plays a role in 75% of incidents[9]. The Human Factors study provides a valuable contribution to shipping safety because it allows studying scenarios that rarely occur or do not yet exist in a safe environment. This enables the early detection of risks and helps to better prepare policy and operations for the changing North Sea. The study comprised seafarers going through various scenarios in shipping simulators, such as a ship with a dragging anchor drifting towards a wind farm, a ship becoming unmanoeuvrable, or a collision between two ships close to a wind farm. In general, crews were alert to their surroundings, but small objects, such as sailing yachts without AIS, were regularly overlooked in situations with poor visibility. The study also examined risk mitigation measures, such as VTMon, ERTVs and the deployment of a Deep Sea Pilot. The conclusion of the study was that these measures are effective and offer added value.

[9] Source: https://www.researchgate.net/publication/334780381_The_human_factor_and_maritime_safety.

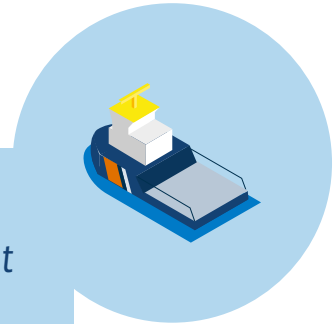
2.3 The current safety objective does not appear to be achievable

The current safety objective for offshore wind energy stipulates that shipping safety on the North Sea should be maintained or improved. This does not seem feasible, on the one hand because it is unrealistic, and on the other because the safety objective cannot be verified.

Section 2.2 already explained that although the '2020 package of measures' contributes to an increased level of safety, it seems unlikely that it will be able to completely offset the expected increase in risks associated with the wind farms. This makes achieving the safety objective unrealistic.

It is also difficult to assess the exact extent to which the measures contribute, partly because objective criteria for the desired level of shipping safety are still lacking. The rapidly changing situation on the North Sea makes it difficult to accurately express the level of safety. As a result, the acceptable level of risk has yet to be defined in sufficient detail. This impedes effective decision-making and makes accountability more difficult.

The Minister of Infrastructure and Water Management recognises this challenge and is working on a new, more realistic and verifiable safety objective, as explained in the Letter to Parliament dated February 2025[10]. The new safety framework will determine the future application of risk control on the North Sea.



"I find all those flashing lights and large spots on the radar unsafe. Of course you can sail around them. But you cannot always see or observe the ships properly."

Quote from a seafarer from the 2024 Maritime Experience Survey

[10] Follow-up response to OvV report 'Schipperen met ruimte', IENW/BSK-2025/30453.

3. Advice:

Make risk management more future-proof

The rapid expansion of wind energy introduces new safety challenges. To ensure an effective response, MOSWOZ recommends making risk management more future-proof, starting with enhancing our understanding of existing and emerging risks. A feasible and verifiable safety framework is required in order to weigh up these risks. The risks can be controlled by making adjustments to the design of future wind farms, optimising existing measures and expanding measures. National and international cooperation should also be improved, including through the joint implementation of control measures. This will create a more systematic and comprehensive risk management system that can respond to the changing situation on the North Sea. These steps are explained below, followed by information on who the advice is intended for.

3.1 Enhance understanding of the risks

DGLM and Rijkswaterstaat

The rapid growth in the number of wind turbines is increasing the risks, mainly because it reduces the manoeuvring space for ships. Having an up-to-date and complete overview of the risks at all times requires improving our understanding of the existing and emerging risks and translating this understanding into implementation. The following methods are available to achieve this:

a. Conduct comprehensive safety analyses on a regular basis.
b. Improve the monitoring of traffic incidents and near misses so that trends and new risks are identified at an early stage and addressed in the implementation.
c. Use additional analysis methods such as scenario studies to gain a better understanding of the risks and effectiveness of safety measures to mitigate risks.
d. Ensure continuous knowledge development and training so all parties involved in risk management work according to a common methodology and risk awareness is increased.
e. Encourage innovative technologies for data-driven risk management to identify and mitigate future risks more quickly.

3.2 Develop a verifiable safety objective

DGLM

In order to assess and evaluate the effectiveness of measures, it is necessary to develop a realistic and verifiable safety objective, as announced in the Letter to Parliament of February 2025[11]. The corresponding recommendations are:

a. Develop a verifiable safety objective and establish acceptable risk levels and measurable evaluation criteria.
b. Integrate long-term scenarios into policy-making.
c. Ensure a transparent and standardised assessment framework so risks are classified unambiguously and control measures are implemented based on uniform standards.
d. Implement a systematic evaluation of control measures. Periodically assess the effect of measures taken and make the corresponding adjustments.

3.3 Invest in expanding the measures

DGLM, KGG and Rijkswaterstaat

Increasing the level of safety requires investments in various measures. Possible adjustments to the spatial layout and use of wind farms offer significant opportunities, which could potentially reduce the number of measures required. The risks can be controlled by optimising existing measures and expanding measures. Furthermore, monitoring and data collection are required. The recommendations for the various measures are explained in more detail below.

Design and use of wind farms

DGLM and KGG

a. Evaluate and study the spatial planning and policy regarding wind farms. This can be done in the following ways::
    i. Study wider safety distances (safety zones).
    ii. Evaluate the passage and shared use policy and optimise it for shipping safety.
    iii. For wind farms located far out at sea, ensure that the turbines are aligned in at least one direction (SAR lanes) to enable search and rescue operations by SAR helicopters (see Table 2), in accordance with the recent IALA guideline[12].
b. Reduce the risk of collisions between work vessels and wind turbines and other ships in wind farms by regulating shipping routes and speeds.
c. Investigate the use of TenneT platforms far out at sea as a hub for mobile data traffic on the North Sea for a more efficient deployment of the Coastguard and emergency services. Set up several platforms to enable refuelling of the SAR helicopter for long-term or complex (search) operations. This is to compensate for the dismantling of oil and gas platforms in the coming decades, which will result in the disappearance of these functions.

[11] Follow-up response to OvV report 'Schipperen met ruimte', IENW/BSK-2025/30453.
[12] https://www.iala.int/product/g1185-enhancing-the-safety-and-efficiency-of-navigation-around-offshore-renewable-energy-installations/

Figure 5: *Safe design and use of wind farms.*

Expansion and optimisation of measures

DGLM and Rijkswaterstaat

d Increase the operational effectiveness of the measures, for instance, through smart analysis tools for the VTMon operator and a shorter response time for the deployment of an ERTV of SAR operation.

e. Consider deploying a Towing Assistance Team (TAT) to establish a tow connection with the ERTV more quickly, even in difficult conditions (see Table 2).

f. Improve SAR capacity and self-reliance, especially for wind farms located far out at sea. Intensify research and exercises with regard to SAR, oil spill response and firefighting at wind farms.

g. Encourage wider deployment, safeguarding and expansion of certified Deep Sea pilots, especially for crews with a limited knowledge of the local area.

Monitoring and data collection

DGLM and Rijkswaterstaat

h. Continue to monitor and evaluate on an ongoing basis in order to timely adapt the effectiveness of measures to changing circumstances, new insights and further expansion of wind farms.

i. Explore and evaluate the possibilities of smart cameras, in particular in combination with sailing and flying drones.

Table 2: Possible (new) measures, examined during the MOSWOZ programme period 2020 – 2025.

	**Design of No-Anchoring Areas**	Designating No Anchoring Areas helps to reduce the risk of drifting vessels. In these areas, ships can keep moving, outside the regular shipping lane, if the weather conditions are too severe for anchoring. From 1 July 2025, the first No Anchoring Area in the Dutch Exclusive Economic Zone (EEZ) will be a reality. It is located between the approach areas of both Rotterdam and IJmuiden. Research by MARIN has shown that many parts of the Dutch North Sea are already inaccessible to shipping, which means that hardly any additional No Anchoring Areas can be designated.
	**Design of SAR lanes**	A SAR lane is an obstacle-free, straight corridor with a width of at least 500 metres within a wind farm, intended for rescue helicopters. In addition, SAR lanes offer advantages for shipping safety, incident management (such as the deployment of ERTVs and oil spill response), shared use by fishing vessels as well as ecological benefits, for instance, for migratory birds. These corridors increase the safety and effectiveness of search and rescue operations (SAR operations) while also improving visibility for ships. Research shows that constructing SAR lanes by aligning wind turbines in 1 or 2 directions leads to a 1 to 2% reduction in energy yield respectively.
	**Towing Assistance Team (TAT)**	A Towing Assistance Team (TAT) is a specialised team that is flown in by helicopter to a ship in distress to assist with a towing connection to an Emergency Response Towing Vessel (ERTV). This saves valuable time and improves communication between the ship in distress, the towing vessel and other emergency services. France and Germany already have experience with a TAT team. Based on an impact analysis, it is recommended to include the deployment of a TAT team as an additional requirement in a subsequent tender for the ERTVs. To this end, it should be determined whether the SAR helicopter can be used to get the team on board.

3.4 Strengthen national and international cooperation

To respond quickly and adequately to the changing and complex situation on the North Sea, it is necessary to further strengthen cooperation, both nationally and internationally. The corresponding recommendations are:

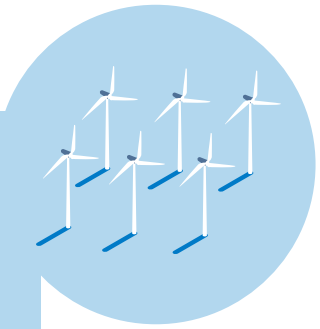
- Ensure more efficient knowledge exchange (both nationally and internationally) by sharing risk analyses in a transparent manner and using a standardised conceptual framework.
- Promote international cooperation within the International Maritime Organisation (IMO), International Organisation of Marine Aids to Navigation (IALA), North Sea Shipping Group (NSSG), European Maritime Safety Agency (EMSA) and neighbouring countries, in order to accelerate and coordinate decision-making on maritime safety and shipping routes.
- Work together with neighbouring countries to ensure the efficient cross-border deployment of resources and measures, for example for the deployment of ERTVs.

3.5 Ensure a comprehensive risk approach

DGLM

A comprehensive approach contributes to a continuously up-to-date understanding of the risks regarding shipping safety and wind farms, enabling policy to be better geared to the changing situation on the North Sea.

- Implement a risk management system in accordance with ISO 31000, the international standard for risk management. The cyclical approach, in which risks are continuously identified, analysed, evaluated and controlled, ensures assurance from policy to operation.
- Devote attention to governance and cooperation, as both are essential prerequisites for effective risk management.

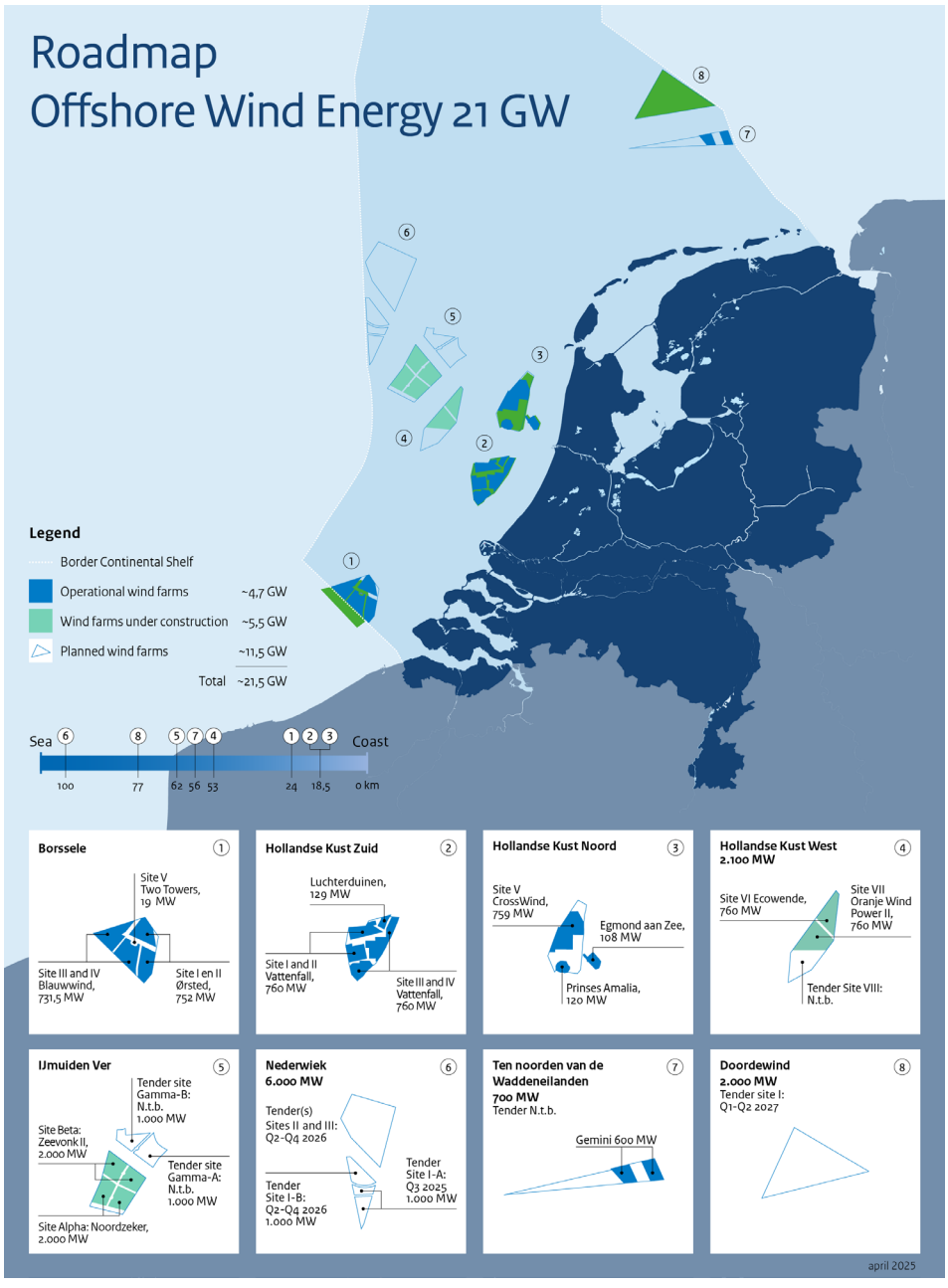


"The width of the TSS [traffic separation scheme, ed.] is adequate in itself. However, safety would benefit if recreational vessels could use the space within wind farms instead of having to tack in the margins of the TSS"

Quote from a seafarer from the 2024 Maritime Experience Survey

What next?

MOSWOZ has been instructed by DGLM to continue the programme for the period 2025-2029. Together with the clients – the Directorate-General for Aviation and Maritime Affairs of the Ministry of Infrastructure and Water Management and the Ministry of Climate and Green Growth – as well as with the Coastguard as an important implementing body, the course for the coming period is being set. Which research and advisory questions will be addressed? This also includes attention to issues that have not yet been given sufficient priority, such as the cost-effectiveness of the measures and an exploration of possible policy standards. The above recommendations serve as guiding principles in this regard. We are also looking at ways to strengthen cooperation with knowledge institutes to stimulate knowledge development. All this will be elaborated in an Action Plan for the next five years. MOSWOZ seeks to expressly involve stakeholders on the North Sea in this process, because a safe North Sea can only be achieved through joint efforts.



Map 2: *The Roadmap Offshore Wind Energy 21 GW provides an overview of existing and planned wind energy areas up to 2032.*

Imprint

Published by: Rijkswaterstaat, June 2025
Authors: MOSWOZ (Offshore Wind Energy Shipping Safety Monitoring and Research Programme)
Editor: Marieke Bos, Schrijft wat jij bedoelt
Design: Public Cinema