Degassing of tankers in the EU

A study for LIFE4DEGAS project



CE Delft

Content

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More information about the study can be obtained from the project leader Diederik Jaspers (CE Delft)

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Summary

Introduction

Degassing of residual vapour substances to the atmosphere from inland and maritime shipping can cause environmental and health problems. For this reason, the Convention on the collection, deposit and reception of waste generated during navigation on the Rhine and other inland waterways (CDNI) treaty has recently introduced a ban on inland waterway transport (IWT) on the degassing of selected substances of concern in five EU Member States: Germany, Belgium, France, Luxembourg, the Netherlands, plus Switzerland.

Within the scope of the LIFE4DEGAS project CE Delft was requested to provide an overview of which substances are degassed, the quantities involved, and, where possible, the locations where degassing takes place within the EU. The overview covers both inland waterway vessels and maritime shipping within the EU's territorial waters.

Data availability and limitations

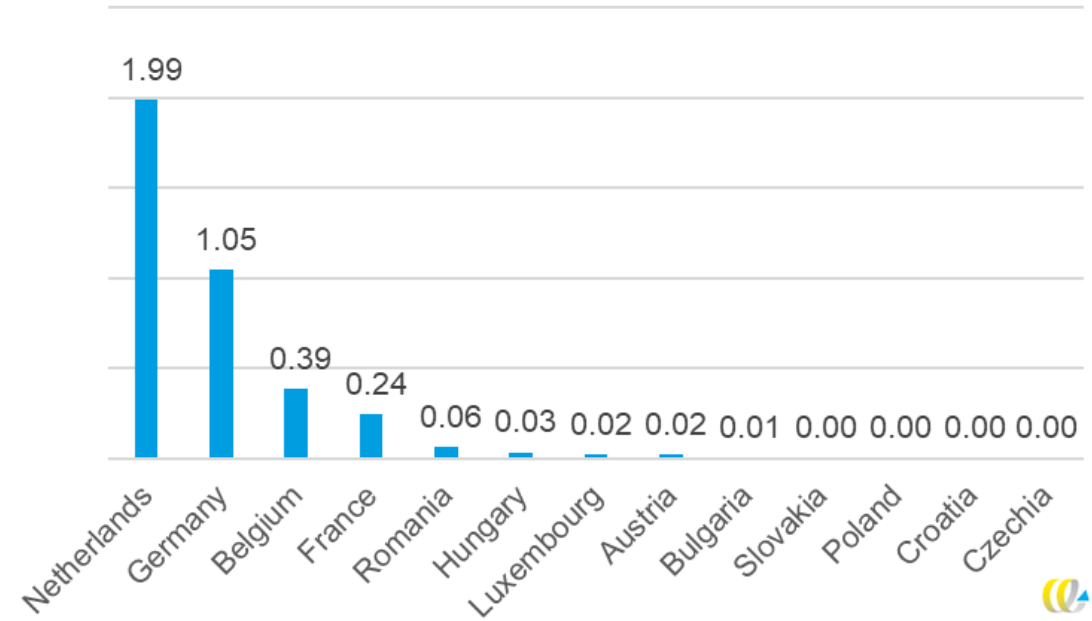
For inland shipping in the Netherlands, we were granted access to the non-public Information and Tracking System for Dutch Inland Shipping (IVS) database. This enabled us to estimate the locations and quantities of potential degassing of specific substances in the Netherlands using CE Delft's methodology from earlier degassing studies. No access was obtained to comparable databases in other Member States. Therefore, the Dutch data were extrapolated to provide a rough first-order estimate for the EU. This estimate should be confirmed using data from other Member States.

For maritime shipping, access to the Dutch SafeSeaNet database could not be obtained either, access is restricted by law. Access is granted exclusively to governmental regulators or emergency services/crisis organisations. This legal barrier also blocked the Dutch government from requesting data from other Member States. Furthermore, international access is also limited to information on individual ships rather than database-level access.

Main results and conclusions

For IWT the following NMVOC degassing emission estimates could be derived from the Dutch IWT dataset provided:

Figure 1 – Estimated degassing emissions by Member State (in kt), 2025



The first four countries, the Netherlands, Germany, Belgium and France, are most significant, and Romania, Hungary and Austria are attributed to smaller values.

The current lack of data availability and database access prevents EU policymakers from gaining a clear overview of degassing activities. This prevents insight if the level of degassing is significantly high, such that the CDNI ban on inland degassing is to be expanded to the whole EU territory and where degassing concentrations are located. Similarly, the extent of degassing of maritime shipping in EU territorial waters remains unclear due to the lack of access to data at EU level.

Recommendations

We recommend adapting the current data access system to allow international access for EU authorities and/or EU Member State governmental bodies. This would provide the data needed to obtain a comprehensive overview of degassing activities and support the development of future policies, such as a possible ban on the degassing of substances of concern to the atmosphere.

List of abbreviations

Table 1 – List of abbreviations

Abbreviation	Description
ADN	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
BAL	Besluit Activiteiten Leefomgeving (Environmental Activities Decree)
BCH code	Code for the construction and equipment of ships carrying dangerous chemicals in bulk
BOEL	Binding Occupational Exposure Limits
CDI	Chemical Distribution Institute
CDNI	Convention on the collection, deposit and reception of waste generated during navigation on the Rhine and other inland waterways, signed by Germany, Belgium, France, Luxembourg, the Netherlands and Switzerland
DWT	Deadweight tonnage
EMSA	European Maritime Safety Agency
EU	European Union
IBC code	International Code for the construction and Equipment of Ships Carrying Dangerous chemicals in Bulk
IGC code	International Code for the construction and Equipment of Ships Carrying Liquefied Gases in Bulk
IMO	International Maritime Organization
IOEL	Indicative Occupational Exposure Limits
IVS	Informatie- en Volgsysteem voor de Scheepvaart (Information- and Tracking System for Dutch Inland Shipping)
IWT	Inland Waterway Transport
kt	Kiloton (1,000 tons)
LEL	Lower Explosion Limit
LIFE	L'Instrument Financier pour l'Environnement (European Climate, Infrastructure and Environment Projects)
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MARPOL	International Convention for the Prevention of Pollution from Ships
NECD	National Emission Ceilings Directive (NECD)
NMVOC	Non-Methane Volatile Organic Compounds

Abbreviation	Description
N.O.S.	Not Otherwise Specified (UN number classification)
OCIMF	Oil Companies International Marine Forum
$PM_{2.5}$	Particulate Matter that is 2.5 micrometres or smaller in diameter
SafeSeaNet	Vessel traffic monitoring system in EU waters (EMSA)
SOLAS	International Convention for Safety of Life at Sea
SIGTTO	The Society of International Gas Tanker and Terminal Operators
SIRE	OCIMF's Ship Inspection Report Programme
VECS	Vapour emission control systems
VOC	Volatile organic compounds

1 Introduction

1.1 Background

Vapour residues from tankers transporting non-methane volatile organic compounds (NMVOCs) are frequently released to the atmosphere when cargo tanks are vented prior to subsequent loading. These NMVOC emissions contribute to ozone formation and fine particulate matter ($PM_{2.5}$), with associated impacts on human health as well as on crops and forests. In inland navigation, controlled alternatives exist through degassing via shore-based reception facilities and vapour recovery. However, practices and legal requirements vary across the EU and are largely absent in maritime transport. This results in uneven protection for workers and nearby communities, regulatory inconsistencies between sea basins, and uncertainty for ship owners and ports. The issue is inherently cross-border and EU-wide.

In addition, data on the scale of NMVOC emissions from ships are limited, making it difficult to assess how significant the problem is and whether it should be addressed through global, European, and/or national regulation.

The European LIFE4DEGAS project therefore assesses the current status of NMVOC transport and degassing across inland waterways and maritime routes, identifies the needs, bottlenecks and options, and prepares harmonised pathways, including recommendations. This study is part of the European LIFE4DEGAS project.

1.2 Objective and scope

The objectives of this study are:

1. To identify priority EU areas of concern related to ship degassing, both controlled and uncontrolled, into ambient air, and to explore approaches for improved identification in the future; and
2. To estimate NMVOC emissions from waterborne transport for five, and preferably ten, selected NMVOCs in the identified EU areas and Member States, and to compare these estimates with NMVOC emissions from other sectors in the same areas or Member States as reported under the National Emission Ceilings Directive (NECD).

The scope of this study covers both maritime shipping and inland waterway vessels within the EU's territorial waters.

This study assesses where degassing takes place on EU waterways and provides a high-level indication of their intensity. Given constraints in data availability and the overall project scope, the analysis is not intended to be exhaustive. It offers an EU-wide overview at an aggregated level. The study focuses exclusively on emissions to air. Emissions to water via wash water are out of scope. The study also does not draw conclusions regarding potential health effects for people on land or for crew members.

1.3 Outline of the report

In Chapter 2, we first explain the degassing process of cargo tanks on maritime and inland waterway vessels. Chapter 3 analyses the NMVOC emissions of inland waterway vessels, whilst Chapter 4 of maritime vessels. We then address the major areas of concern in the EU regarding ship degassing in Chapter 5. Finally, Chapter 6 presents the conclusions and recommendations.

2 Degassing of cargo tanks on maritime and inland waterway vessels

2.1 General process

Degassing is the process of reducing or removing the liquid and gaseous remnants of a previous cargo from the tank atmosphere and pipelines, either by ventilation, purging, or transfer to a vapour recovery system. The main reasons for degassing are:

- preventing contamination of the next cargo, this is the main cause for degassing events;
- gas-freeing the tank to allow for inspection or maintenance.

Typical cargoes that may need to be degassed are: i) chemicals, ii) gases, and iii) petroleum products. Degassing typically takes place after unloading cargo, as the final step of the following process to clean the tank:

- After unloading, some of the cargo remains as vapour in the tank, and for liquid cargo, some of the fluid remains. The amount of degassing can be reduced by unloading the cargo as completely as possible. The amount of fluid left depends on the tank design (related to age), the number of tanks and the efforts taken to remove the last bit out of the tank, e.g. by level trim of the ship.
- Depending on the compound and the purpose, tanks may be washed before degassing. This is typically the case for toxic chemicals and less volatile oil products. Wash water of seagoing ships can be discharged at sea under specific conditions; for IWT tankers, this is not allowed, and wash water needs to be deposited at specific reception stations (CDNI_2019EN.pdf).
- The remaining compound (with or without the washing step) can be removed by degassing to air, if not prohibited, or by connecting to an onshore degassing installation. When ventilating to air, fans or blowers introduce air into the tank, and the displaced vapour-air mixture leaves through designated vent outlets.

More details about the degassing process of cargo tanks on board maritime vessels are provided in Appendix A.

2.2 Regulations preventing degassing to air

For both seagoing and inland waterway tankers, ventilation to air is often prohibited by local authorities (e.g. Port authorities) and by ADN (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways) (https://unece.org/-transport/dangerous-goods/adn-2023) in port areas, in locks, under bridges and in populated areas. It should be noted, however, that each port has its own regulations and requirements regarding degassing, and therefore the same rules do not apply across European ports.

For seagoing tank ships, there are no regulations preventing degassing at open sea. There are only procedures for degassing related to safety on board. An overview of relevant regulations, guidelines and best practices are summarised in Appendix A.1.1.

For inland waterway transport (IWT), since recently CDNI[1] started prohibiting degassing to air for an increasing number of compounds in the CDNI treaty countries (see Table 2). The first phase of the ban started in October 2024. The second phase, covering more substances, will start in October 2026.

Table 2 – Cargoes for which a prohibition of venting to air will apply according to CDNI resolution 2017-I-4

Phase and date of entry	UN number	Compound
Phase 1 October 1st, 2024 (NL: July 1st, 2024)	UN 1114	Benzene
	UN1203	Petrol or fuel for an automotive engine
	UN1268	Petroleum distillates, petroleum products, Not Otherwise Specified (N.O.S.)
	UN3475	Ethanol and petrol, blended, or ethanol and fuel for automotive engines, blended, containing more than 10% ethanol
Phase 2 October 1st, 2026 (NL: July 1st, 2024)	UN 1267	Crude oil (containing more than 10% benzene)
	UN 1993	Inflammable liquid, N.O.S. containing more than 10% benzene
	UN 3295	Liquid hydrocarbons, N.O.S. containing more than 10% benzene
Phase 3 October 1st, 2027 (subject to the CDNI interim evaluation)	UN1090	Acetone
	UN 1145	Cyclohexane
	UN 1170	Ethanol (ethyl alcohol) or ethanol in solution (ethyl alcohol in solution), aqueous solution containing more than 70% alcohol by volume
	UN 1179	Ether ethylene butyl

[1] Convention on the collection, deposit and reception of waste generated during navigation on the Rhine and other inland waterways, signed by Germany, Belgium, France, Luxembourg, the Netherlands and Switzerland.

Phase and date of entry	UN number	Compound
	UN 1216	Isooctanes
	UN 1267	Methanol
	UN 1993	Crude oil (containing less than 10% benzene)
	UN 2398	Inflammable liquid, N.O.S. containing less than 10% benzene
	UN 3257	Methyl tertiary butyl ether (MTBE)
	UN 3295	Liquid transported when hot, N.O.S. (including molten metal, molten salt, etc.) at a temperature equal to or greater than 100 °C and below its flashpoint
	UN 9001	Substances with a flashpoint above 60 °C handed over for transport or transported at a temperature within the range of 15 K below the flashpoint or substances the flashpoint of which >60 °C, heated to within less than 15 K of the flashpoint
	UN 9003	Substances with a flashpoint greater than 60 °C and less than or equal to 100 °C which cannot be assigned to any other class or heading within class 9

Before 2024, there were some national and local bans. Degassing of gasoline was prohibited in the Netherlands (Staten-Generaal, 2021), Flanders (Vlaanderen, 2026) and Germany (Bundesministerium der Justiz und für Verbraucherschutz, 1998). From 2015 onwards, several Dutch provinces introduced provincial degassing bans ahead of the expected national and international CDNI ban. In practice, however, these measures remained fragmented and difficult to enforce consistently, because degassing was still allowed elsewhere in the Netherlands while the national government continued to prioritise the CDNI route (CE Delft, 2016).

A ban does not, however, mean that degassing is no longer allowed at all. Below 10% LEL[2], degassing/ventilation is still permitted under CDNI and Dutch province bans.

2.3 Preventing degassing to air

To fulfil the degassing ban or prevent degassing to air in general, there are several options:

1. Degassing at an installation (on land or mobile).
2. Using the tanks dedicated to one product.
3. Using the tanks for products which are compatible.

[2] 10% LEW refers to the Lower Explosive Limit, which is the minimum concentration of a flammable gas in air that can potentially ignite.

It is expected that degassing will, in practice, be prevented by Options 2 and 3 when possible, as degassing at an installation (Option 1) is a relatively expensive option, costing around € 1.25/m^3 of tank capacity and several thousand euros depending on the tanker size (EUR 2023). This excludes the time lost (and therefore the associated costs) for degassing via an installation, as well as any fuel that may be required to sail to the degassing installation.

2.4 Relevance of preventing degassing

Concerns about degassing emissions relate to serious health and safety issues. Because of this, *land-based* emissions are strictly regulated under the Industrial Emissions Directive (IED) and based on Best Available Technology (BAT)-BREF, but norms may differ per EU Member State and situation.

But for most *waterways,* these emissions are unregulated, and substances can be degassed freely in high concentrations to the air. Especially crew members and people working or living near the waterways run the risk of getting exposed to these high concentrations. Recently, several EU countries under the CDNI treaty started a phased ban on degassing to the air for *inland shipping*. The first list of banned substances includes benzene, as a substance of concern because of its known carcinogenicity.

To clarify the relevance of such a ban, see Table 3 with maximum allowed levels for substances currently under the CDNI degassing ban:

Table 3 – Comparison of much stricter land-based emission norms with those on waterways

UN number	Substance	Maximum land-based emission to the air for NL industry (BAL) (mg/Nm^3)/(ppm)	Land-based MAC, EU (BOEL/IOEL) values (8-hour TWA) for workers (mg/Nm^3)/(ppm)	Water ways non-CDNI ADN+2023 (50% LEL/theoretical maximum) (ppm)	Inland waterways under CDNI AVFL (10% LEL) (regulated) (ppm)
1114	Benzene	1-5/0.3-1.5	3.25/1	6,000/Up to 125,000	1,200
1203	Gasoline	50/14	192-221/50 as toluene/xylene	7,000/ Up to ≈ 600,000	1,400
1268	Petroleum distillates N.O.S.	50/12.5 1 (>10% benzene)	350/90 REL	5,500/Up to 100,000 – 400,000	1,100
3475	Gasoline >10% ethanol	50/20	1-10/0.3-0.5	9,500/Up to 10,000 – 1,000,000	1,900

Clearly, without regulation and a ban, emissions on waterways may dramatically exceed safe levels as specified for on-land operation (e.g. see Table 3 Dutch Environmental Activities Decree values (BAL) and occupational exposure limit values (BOEL/IOEL values). Even after a ban like the one in the CDNI is introduced, allowing degassing to air under 10% LEL, this is still the case.

Conclusion: Emission concentrations of degassing to air can reach extremely high values as compared to what is allowed for land-based installations. And also, as compared to occupational exposure limits. Under the CDNI ban, it is still allowed to degas to air below 10% lower explosion limit (LEL). Under the ban (when properly enforced), actual emission concentrations (and duration of degassing) are expected to decrease. But even then, degassing concentrations may still be much higher than allowed on land. The total volume of degassing will, of course, be much lower.

3 NMVOC emissions IWT

3.1 Introduction

Degassing events are not directly reported at the EU level and therefore need to be identified indirectly. In an earlier study, CE Delft has developed a bottom-up calculation method to estimate degassing emissions based on IWT activity data (CE Delft, 2013). This calculation method requires IWT voyage information **of individual ships**. For the present study, the Dutch government agency Rijkswaterstaat made such data available for the Netherlands for the year 2025. However, comparable data for all European countries could not be obtained within the scope of this study. Therefore, the results for the Netherlands were extrapolated to other countries using statistical data from Eurostat.

Section 3.2 describes the methodology applied. Section 3.2.1 focuses on the bottom-up approach based on the Dutch data, while Section 3.2.2 explains the extrapolation to the rest of Europe. Section 3.3 presents the results, and Section 3.4 provides recommendations for further work.

3.2 Methodology

3.2.1 Bottom-up calculation of degassing to air in the Netherlands

The methodology to estimate degassing from ship travel information is described in detail in CE Delft (2013). This section provides a summary of the elements most relevant for the present study. The approach consists of five consecutive steps:

Step 1: Collection of inland waterway transport data

IWT voyage data for tank vessels carrying UN substances for 2025 were obtained from Rijkswaterstaat (the Dutch Directorate-General for Public Works and Water Management). These data are collected within the framework of River Information Services (RIS)[3].

[3] Referred to as IVS data in the Netherlands.

The dataset covers voyages starting in, ending in, or passing through the Netherlands, and includes the following information:

- anonymised ship ID number;
- travel ID (with higher numbers indicating later voyages in time, to identify transport chains);
- loaded or empty status;
- origin and destination;
- type of cargo, expressed as a UN number;
- weight of this cargo.

Step 2: Identification of subsequent cargoes
For each loaded voyage, the subsequent loaded voyage was identified to determine the next cargo carried by the vessel. In many cases, one or more empty voyages occur between two loaded voyages, with the possible occurrence of degassing; these empty voyages were excluded from the matching process.

Step 3: Estimation of degassing occurrence
Based on the matrix presented in Table 4 (derived from (CE Delft, 2013)) each voyage was assigned an assumed probability of degassing to air **based on the combination of the cargo carried on the current voyage and the cargo carried on the next loaded voyage**. The percentages in Table 4 are conditional probabilities of degassing: they indicate the assumed percentage of cases in which degassing occurs within each type of cargo transition. They therefore do not represent the shares of identical, compatible and incompatible next loads and do not sum to 100% across a row.

Table 4 – Estimates of occurrence of degassing to air without the CDNI degas ban

UN number current cargo	Degassing probability identical next load	Degassing probability compatible next load	Degassing probability if next load is not compatible
UN 1203	0%	0% (UN 1202 or UN 1268)	100%
UN 1268 (distillates)	20%	20% (UN 1202, UN 1203)	100%
UN 1114 (benzene)	0%	N/A	100%
UN 1990, UN2398, UN 3295	80%	N/A.	100%
T products (AND): UN 1093, UN 1230, UN1662, UN 2312, UN 1547	0%	N/A	0%
Other	0%	N/A	100%

Source: (CE Delft, 2013).

Step 4: Application of product-specific emission factors
Product-specific emission factors, expressed in kg emission per tonne of cargo unloaded, were taken from CE Delft (2013). These emission factors are based on estimates of both residual vapour and residual liquid remaining after unloading. They were derived using substance-specific properties, such as saturated vapour pressure, and adjusted using correction factors for temperature, tank saturation, and the quantity of residual liquid left in the tank.

Step 5: Calculation of total emissions
These emission factors are then applied to the unloaded cargo. Total degassing emissions were then calculated for each product by multiplying the unloaded cargo quantity by the relevant emission factor and the assumed degassing frequency. Product-level emissions were subsequently aggregated to obtain total emissions per substance.

Emissions related to inspections at wharves were also added to the total emissions according to the methodology described in CE Delft (2013). In the Netherlands, inland vessels are required to undergo periodic inspections at a wharf or yard, and tanks must be fully degassed before such inspections, resulting in additional emissions.

The total emissions calculated do not yet take into account the CDNI degassing ban. However, the results in Section 3.3 will differentiate between:

- emissions to the air (not banned);
- emissions that need to be degassed by an installation.

3.2.2 Extrapolation of results for the Netherlands to other countries

For the Netherlands, this study could rely on a detailed database provided by Rijkswaterstaat to estimate the number of degassing emissions. No equivalent database was available for the other Member States. As a result, the number of degassing emissions outside the Netherlands was estimated by extrapolating from the Dutch results.

The extrapolation was based on Eurostat statistics for inland waterway tanker transport. The main dataset used for this purpose was *[iww_go_adago] Inland waterway transport of dangerous goods*. Within this dataset, the focus was placed on ADN category 3: *flammable liquids*, since this is the category in which virtually all degassing activity takes place.

Table 5 presents the volume of dangerous goods transported in ADN category 3 for the countries that report these data to Eurostat. The table includes the sum of imports, exports and national transport. It should therefore not be interpreted as a European total, since adding the country values would lead to double counting of international flows. Nevertheless, the table provides a useful indication of the geographical distribution of flammable liquid transport across the European inland waterway network.

Table 5 – Dangerous goods transport in ADN category 3 (flammable liquids), sum of import, export and national transport in **thousand tonnes**, for 2024 or the latest available year

Country	Flammable liquids (kton)
Czechia	-
Germany	32,259
Croatia	27[a]
Netherlands	61,166
Poland	48
Slovakia	57
Hungary	1,074
Romania	1,995
Bulgaria	178[b]
Luxembourg	116[c]

a = Data for 2023; b = Data for 2021; c = Data for 2022.

Note: Values represent the sum of import, export and national transport. They cannot be added to derive a European total, as this would result in double counting.

Source: Eurostat, iww_go_adago dataset

Not all relevant Member States were covered in the dangerous goods dataset. In particular, Belgium, France and Austria were missing. For these countries, degassing activity was estimated using a different Eurostat dataset: *iww_go_atygo*, which reports total inland waterway transport volumes by cargo type. For this study, the year 2024 was used, and attention was limited to the *NST2007 cargo groups* that are most likely to give rise to degassing, namely:

- coke and refined petroleum products;
- chemicals and chemical products.

These cargo groups were selected because they contain the substances most commonly associated with vapour emissions and degassing operations after unloading.

Table 6 – Inland waterway transport volumes (in **thousand tonnes**) for cargo groups most likely to require degassing, 2024

Member State	Coke and refined petroleum products (kton)	Chemicals, chemical products (kton)	Total (kton)
Belgium	6,665	8,151	14,816
France	4,189	2,759	6,948
Austria	375	35	410
Netherlands	34,335	29,279	63,614

The total degassing emissions for all Member States were determined on the basis of the Member States' transport volume relative to that of the Netherlands. Where available, the relative share was based on the volume of dangerous goods in ADN category 3 from dataset iww_go_adago (Table 5). For countries not covered by that dataset, the relative share was derived from the total transported volume of the two selected NST2007 cargo groups from iww_go_atygo (Table 6). In both cases, the Netherlands was used as the reference country.

The resulting country shares are shown in Table 7. These shares were then applied to the total degassing emissions estimated for the Netherlands in order to derive indicative total degassing emissions for each country.

Table 7 – Relative share compared with the Netherlands used for extrapolation of degassing emissions

Member State	Relative share compared to the Netherlands	Source for extrapolation
Netherlands	100%	
Germany	53%	iww_go_adago
Belgium	19%	iww_go_atygo
France	12%	iww_go_atygo
Romania	3%	iww_go_adago
Hungary	2%	iww_go_adago
Luxembourg	1%	iww_go_atygo
Austria	1%	iww_go_atygo
Bulgaria	0%	iww_go_adago
Slovakia	0%	iww_go_adago
Poland	0%	iww_go_adago
Croatia	0%	iww_go_adago
Czechia	0%	iww_go_adago

3.3 Results

This section presents the estimated emissions from degassing activities across Member States. The analysis is structured in two parts. First, emissions are quantified for the situation prior to the implementation of the CDNI ban, which has been introduced in phases since 2024. Second, the implications of a fully implemented ban are considered, under which degassing emissions are expected to be eliminated from inland waterways and instead managed at dedicated reception or treatment facilities.

3.3.1 Degassing emissions by Member State (Pre-CDNI Ban)

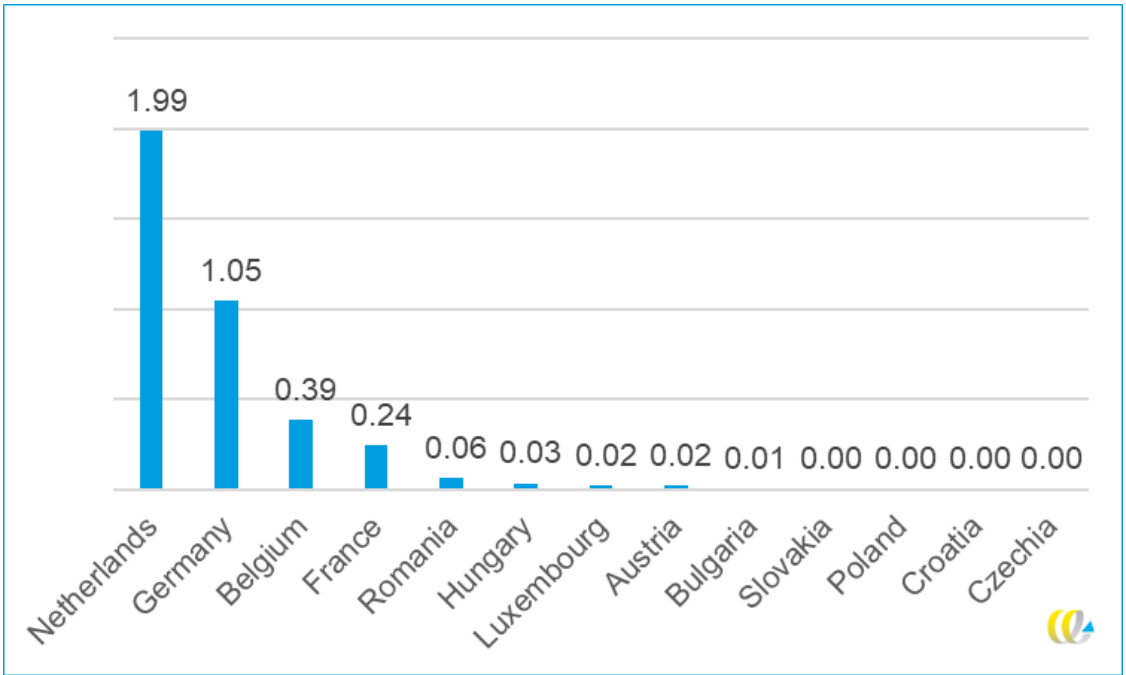
Figure 2 presents the estimated 2025 degassing emissions per Member State, expressed in kt (**thousand tonnes**).

The results indicate that emissions are concentrated in a limited number of Member States along the West-Europe/Rhine corridor. The Netherlands accounts for the largest share, with approximately 1.99 kt of emissions[4]. Germany follows with 1.05 kt, while Belgium (0.39 kt) and Luxembourg (0.34 kt) also contribute notable shares.

Other countries show significantly lower emission levels. France accounts for 0.24 kt, while Romania (0.06 kt), Hungary (0.03 kt), Austria (0.02 kt), and Bulgaria (0.01 kt) contribute marginal amounts. Emissions in Slovakia, Poland, Croatia, and Czechia are negligible in this dataset.

In total, estimated degassing emissions in the EU amount to 3.81 **thousand tonnes**.

Figure 2 – Estimated degassing emissions by Member State (in kt), 2025



[4] This estimate for the Netherlands differs slightly from the degassing emissions reported by the Dutch Pollutant Release and Transfer Register (PRTR), where the reported value for the Netherlands is lower. Although the same methodology has been applied in this study, the exact implementation by the PTRT, including underlying assumptions and input data, is not fully transparent. Consultation with the party responsible for the calculations did not identify a direct explanation for the difference; this report therefore uses the estimate calculated for this study.

3.3.2 Degassing emissions by cargo type (Netherlands)

To better understand the drivers of degassing emissions, Table 8 provides a breakdown by UN cargo type for operations associated with unloading in the Netherlands. The table includes the share of voyages involving degassing, total unloaded volume, and the resulting emissions.

The table shows that degassing emissions are highly concentrated in a limited number of cargo types. Out of the 43 analysed UN numbers, 5 are responsible for more than 90% of the degassing.

Among these substances, hydrocarbons (UN 3295) are the largest contributor, accounting for approximately 0.5 kt of degassing emissions in the Netherlands. This is mainly explained by the very high share of voyages involving degassing (90%), combined with a substantial unloaded volume of 1.5 million tonnes. Petrol or gasoline (UN 1203) and petroleum products n.o.s. (naphtha, UN 1268) each account for around 0.4 kt. For petrol, emissions are driven primarily by the relatively large unloaded volume of 4.2 million tonnes, despite a lower degassing share of 13%. Many tankers transporting this cargo are dedicated. In contrast, naphtha combines both a high unloaded volume of 9.6 million tonnes and a higher degassing share of 30%, resulting in similarly high emissions.

Table 8 – Main cargo types contributing to degassing emissions pre CDNI ban in the Netherlands, 2025

UN number	Cargo name	Share of voyages with degassing	Unloaded volume in the Netherlands (million tonnes)	Degassing emissions pre CDNI ban (kton)
1203	Petrol or gasoline	13%	4.2	0.4
1268	Petroleum products n.o.s. (Naphtha)	30%	9.6	0.4
2398	Methyl tert-butyl ether	94%	0.6	0.3
3295	Hydrocarbons	90%	1.5	0.5
3475	Ethanol and gasoline mixture	47%	0.4	0.1
All other cargo groups[5]		N/A	6.11	0.1
Total (excluding emissions at wharf)		**N/A**	**22.43**	**1.82**

Methyl tert-butyl ether (MTBE, UN 2398) is also a major contributor, with estimated emissions of 0.3 thousand tonnes. Although the unloaded volume is relatively limited at 0.6 million tonnes, the exceptionally high degassing share of 94% makes this substance disproportionately important. Ethanol and gasoline mixtures (UN 3475) contribute a smaller but still relevant amount of approximately 0.1 thousand tonnes.

[5] Appendix C contains the full list of estimated degassing emissions for all cargo groups.

All remaining 43 cargo groups together account for only around 0.1 thousand tonnes of emissions. This shows that degassing emissions in the Netherlands are dominated by a very limited set of substances.

The cargo groups identified in the Dutch data are likely to provide a reasonable proxy for the main sources of degassing emissions across the wider European inland waterway network. At the same time, cargo composition and transport patterns are likely to differ between Member States. The extrapolation therefore offers a useful indication of the substances that are expected to be most relevant at EU level, while recognising that the relative contribution of individual cargo groups may vary by country.

3.3.3 Degassing emissions post-CDNI ban

The CDNI introduces a prohibition on the degassing of the most harmful substances transported by inland waterway vessels. This prohibition entered into force in phases from 2024 onwards. Table 9 summarises the substances covered under each phase and the corresponding implementation timeline.

Table 9 – Substances covered by the CDNI degassing ban and implementation timeline (CDNI, n.d.)

Phase	Cargo (UN numbers)	Phase
1	1114, 1203, 1268, 3475	1st of October
2	1267, 1993, 3295	2 years after entry into force
3	1090, 1145, 1170, 1179, 1216, 1230, 1267, 1993, 2398, 3257, 3295, 9001, 9003	3 years after entry into force

Please refer to Table 2 for the full listing with substance names.

Once the ban is fully in effect and degassing of prohibited substances is no longer allowed to be carried out during navigation, emissions from vessel degassing are expected to decline substantially if it is fully obeyed. Under the full implementation scenario, these vapours would instead need to be handled at dedicated reception or treatment facilities.

Table 10 presents the main cargo types still contributing to estimated degassing emissions in the Netherlands after full implementation of the CDNI ban, based on 2025 data. Before the ban, total degassing emissions in the Netherlands amounted to approximately 1.82 kt, excluding emissions from inspections at the wharf and/or yard. After implementation and full obedience of the ban, this falls to 0.077 kt. This corresponds to an expected reduction of more than 95%.

Table 10 – Main cargo types contributing to estimated degassing emissions in the Netherlands after full implementation of the CDNI ban, based on 2025 data

UN number	Cargo name	Share of voyages with degassing	Unloaded volume in the Netherlands (mton)	Degassing emissions (kt)
1863	Jet fuel	21%	1.90	0.018
1307	Xylenes/ethylbenzene (10% or more) mixture	71%	0.41	0.014
1294	Toluene	67%	0.23	0.012
1175	Ethyl benzene	60%	0.26	0.007
2055	Styrene monomer	22%	0.51	0.004
1219	Isopropyl alcohol	87%	0.04	0.004
1208	Hexanes	75%	0.01	0.004
1223	Kerosene	81%	0.08	0.003
1184	Ethylene dichloride	24%	0.08	0.003
1193	Methyl ethyl ketone	95%	0.01	0.002
All other cargo groups where degassing occurs post CDNI ban[6]		N/A	0.12	0.006
Total (excluding emissions at wharf)		**N/A**	**3.68**	**0.077**

A consequence is that the remaining emissions are more dispersed across a wider range of substances. The largest remaining contributor is jet fuel (UN 1863), with estimated emissions of 0.018 kt, followed by xylenes/ethylbenzene mixture (UN 1307) at 0.014 kt and toluene (UN 1294) at 0.012 kt. Their individual contributions are much smaller than those of the main degassing substances in the pre-ban situation.

Table 11 and Figure 3 give an overview per country of volumes still allowed to be degassed to air after the CDNI ban and volumes that are not allowed to be degassed.

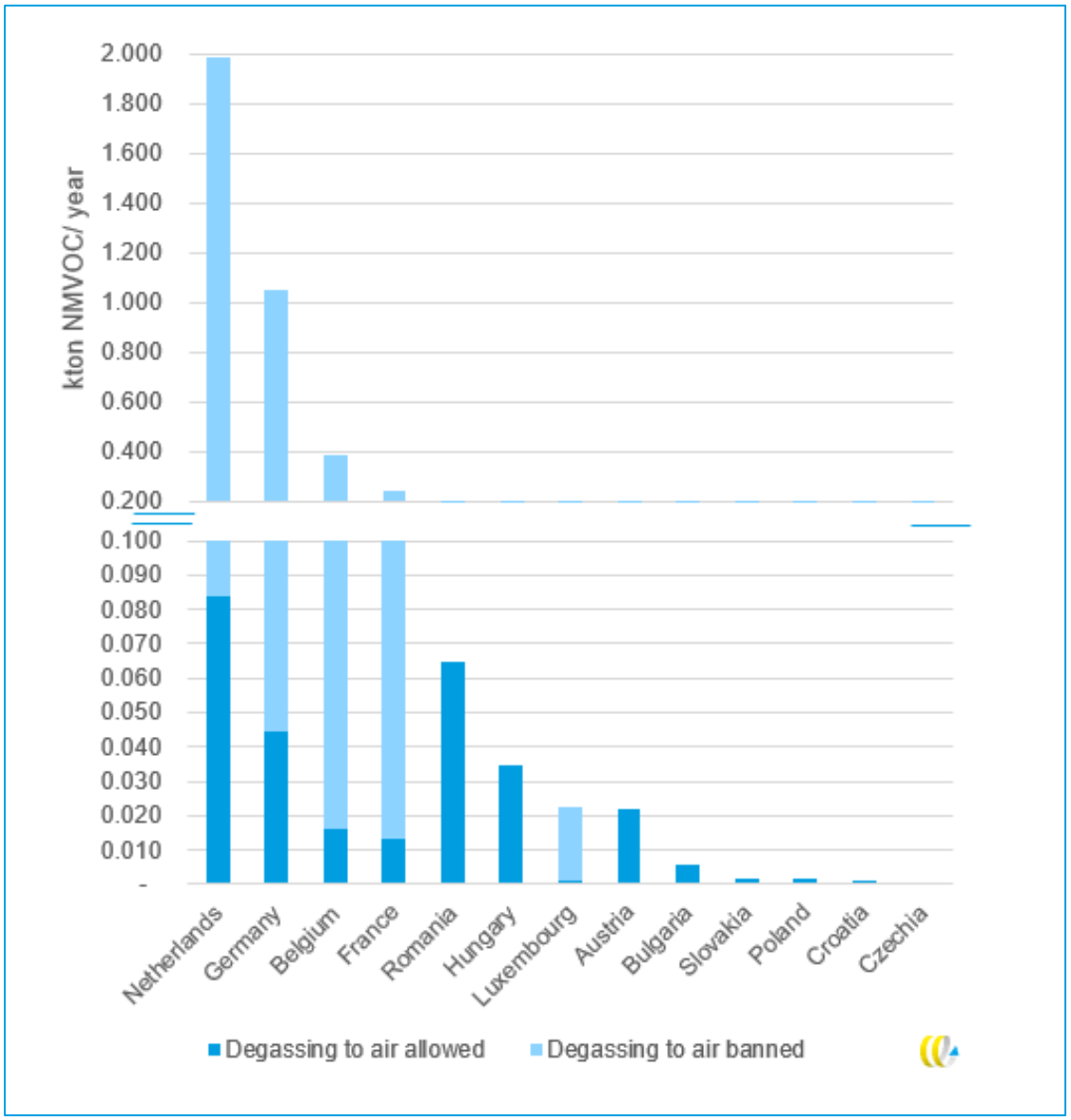
Of the 3,814 tons of degassing emissions recorded before the CDNI ban, 291 tons may still be degassed to air after the ban. When fully obeyed, the ban is therefore expected to prevent 3,523 tons of emissions from being released into the air.

[6] Appendix C contains the full list of estimated degassing emissions for all cargo groups.

Table 11 - Estimated degassing volumes post CDNI-ban (in ton)

Member State	Degassing allowed to air	Degassing not allowed to air (to be omitted or on installation) (ton)
Netherlands	84	1,901
Germany	44	1,003
Belgium	16	369
France	13	229
Romania	65	-
Hungary	35	-
Luxembourg	1	21
Austria	22	-
Bulgaria	6	-
Slovakia	2	-
Poland	2	-
Croatia	1	-
Czechia	0	-
Total	**291**	**3,523**

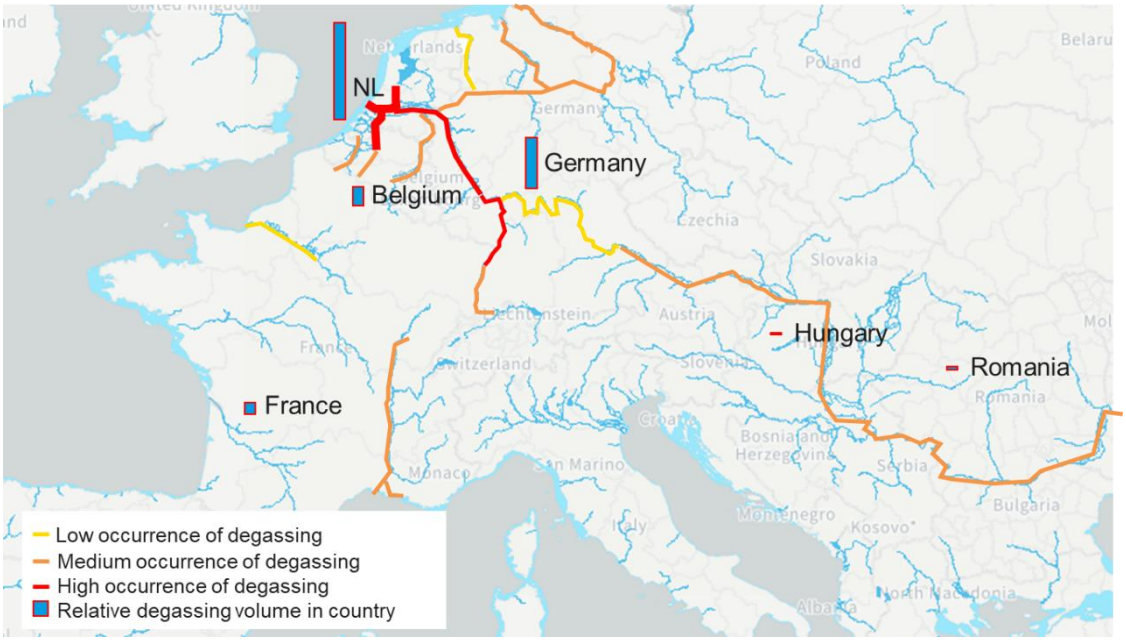
Figure 3 - Estimated degassing volumes per country, post CNDI ban



3.3.4 Localisation of degassing emissions

Figure 4 gives an overview of routes where degassing can be expected to occur (red, orange and yellow lines) and the relative volume of degassing (blue bars) of the most important countries where degassing occurs, either to air or to an installation. The routes give a global indication and do not include information on locations in areas where degassing to air is forbidden by ADN (because of dense population or locks, bridges).

Figure 4 - Degassing locations



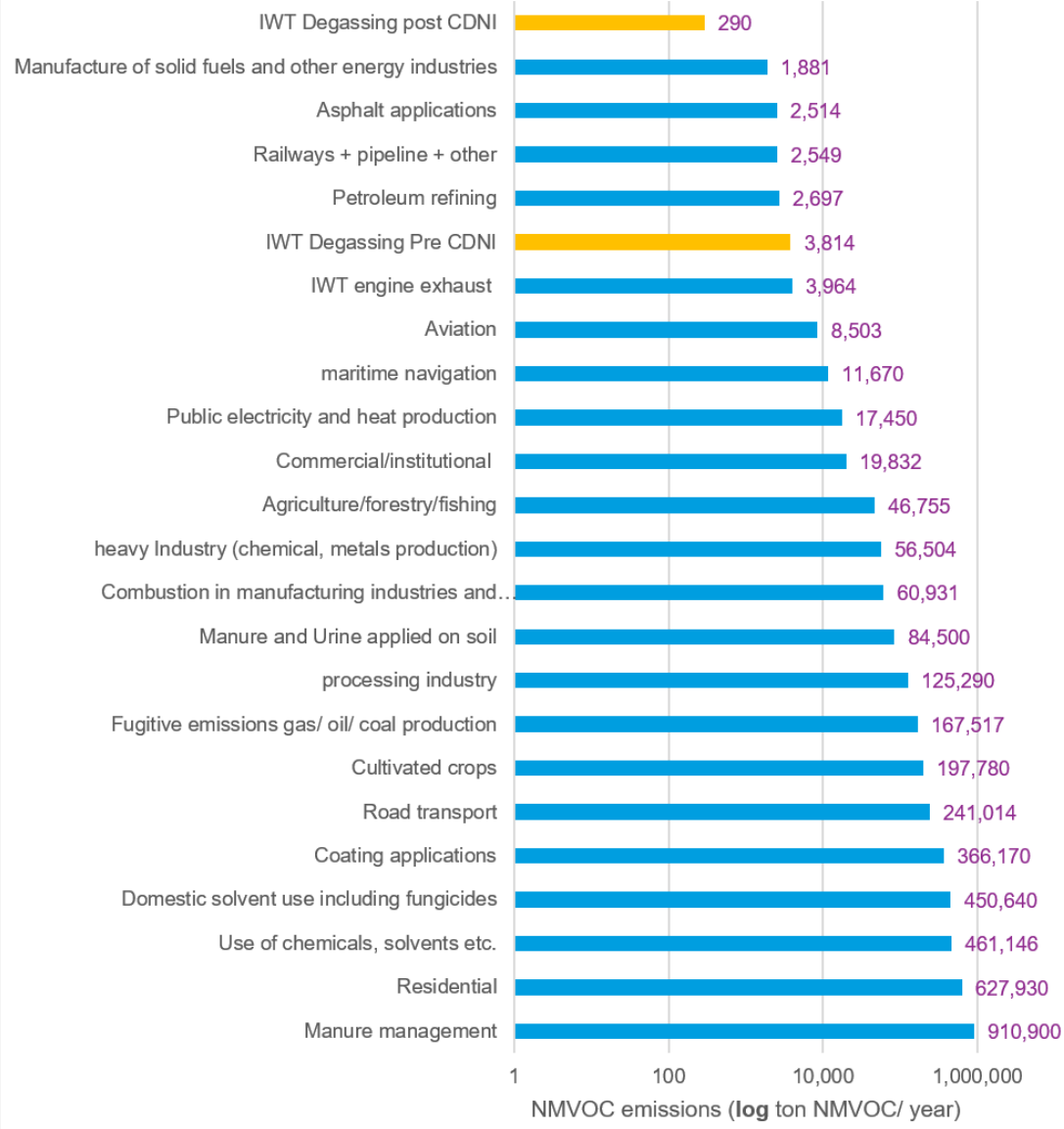
Note: Indicative volumes are either to air or at installations (under CDNI degassing ban). The lines give an indication of the routes where degassing occurs; however, along the route there are areas where degassing in general is forbidden by ADN (e.g. ADN-kaart varend ontgassen).

Source: ARCGIS, varend ontgassen.

3.3.5 Relative emissions

Figure 5 gives an overview of the total NMVOC emissions in the countries for which we calculated degassing emissions (Belgium, Bulgaria, Czechia, Germany, France, Croatia, Luxembourg, Hungary, Netherlands, Austria, Poland and Romania) relative to other emissions.

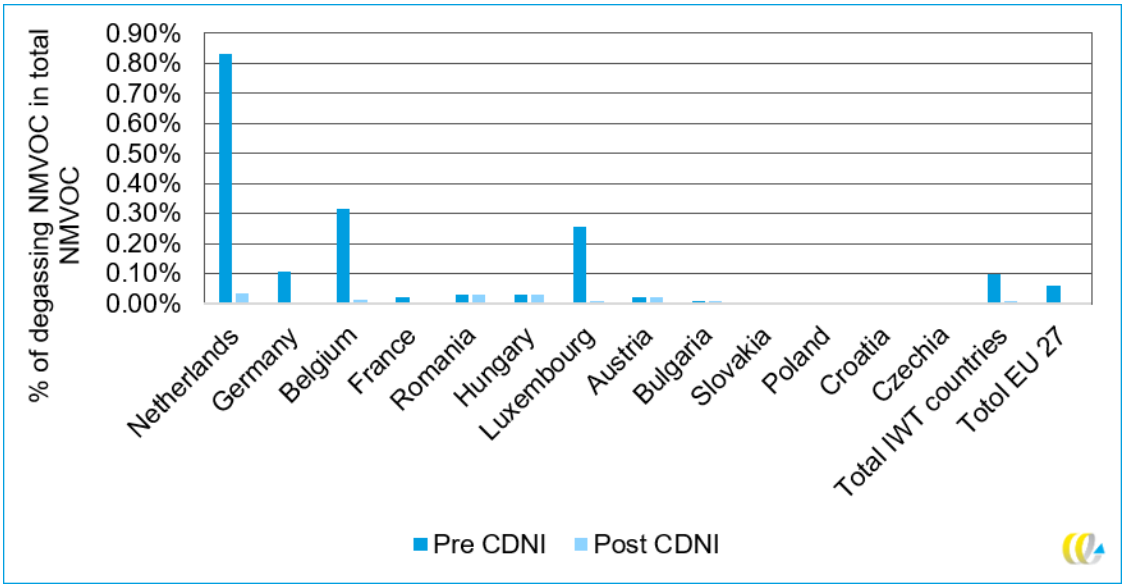
Figure 5 - IWT Degassing emissions to air relative to other sources (year 2023) for the total of countries with IWT degassing emissions (tonnes/year)



Source: Edited from Eurostat, Air pollutants by source sector [env_air_emis__custom_21257424].

In Figure 6, the share of the expected degassing emissions to air as a percentage of the total NMVOC emissions in the country is shown. For the post-CDNI phase, we have assumed that the ban is not violated.

Figure 6 - Share of degassing NMVOC to air in total NMVOC per country, pre-CDNI ban and post-CDNI ban, assuming no violations of the ban



3.4 Recommendations specifically to IWT

3.4.1 Illegal degassing

Although the CDNI establishes a phased prohibition on degassing for specified substances, the extent to which this results in full emission reduction depends on effective enforcement in practice. Dutch enforcement sources indicate that compliance monitoring remains challenging, notably because a nationwide monitoring system is not yet fully in place, while effective enforcement also depends on sufficient inspection capacity and the availability of reception facilities (Inspectie Leefomgeving en Transport, 2024). At CDNI level, the phased introduction of the ban itself reflects the need to develop the required infrastructure and logistics, suggesting that legal prohibition and practical enforceability do not necessarily progress at the same pace (Votob, 2024). Further research into illegal degassing practices is therefore recommended.

3.4.2 Local impacts and data availability

Although total degassing emissions may appear limited at the national level, they can be concentrated in specific locations and may therefore cause local nuisance and health concerns. It is therefore recommended to complement national emission estimates with a spatial monitoring approach, ideally using local sensor networks such as e-noses (electronic measuring stations, also referred to as ‘sniffer poles’) along waterways and near ports, so that local emission hotspots can be detected more effectively. This helps to better understand local nuisance and health concerns.

As a second-best option, degassing-related voyage data should be collected and stored in a harmonised format at EU level. The Netherlands has a relatively strong dataset that makes it possible to indirectly identify degassing behaviour, and in principle, similar information could also already be made available in many other countries through the exchange of data on dangerous goods transport. However, these data are not always stored in a structured way that allows transport chains to be reconstructed.
Since degassing can only be estimated when consecutive loaded voyages of the same vessel are known, maintaining such chain-level data is essential for improving future estimates of degassing emissions across Europe.

4 NMVOC emissions maritime vessels

4.1 Introduction

While Chapter 3 focuses on NMVOC emissions from inland waterway transport, this chapter specifically addresses NMVOC emissions from maritime vessels. Similar to IWT, the CE Delft algorithm requires data **at the individual vessel level** to assess the probability of degassing using the cargo type of both preceding as well as next trips and their location. In literature, regional degassing of substances in the Baltic region is reported by (Traficom, 2025), but this is not at the individual ship level, so unclear if preventable by next trips with the same or compatible substances.

Section 4.2 describes the routes we explored to obtain suitable databases for the analysis. Unfortunately, we were unable to obtain access to suitable databases, which means that we could not estimate NMVOC emissions from maritime vessels in Section 4.3. For that reason, Section 4.4 provides recommendations for creating suitable datasets in the future that would allow NMVOC emissions from maritime vessels to be determined.

4.2 Data collection and methodology

As with IWT, degassing events are not directly reported by ships and therefore need to be estimated indirectly with maritime vessel activity data, containing information on subsequent trips and cargo. SafeSeaNet seemed like a suitable source to us. SafeSeaNet is the European vessel traffic monitoring and maritime information exchange system operated by EMSA (European Maritime Safety Agency). It links maritime authorities across Europe and enables EU Member States, Norway and Iceland to share information on ships, ship movements and hazardous cargoes. The system supports maritime safety, port and maritime security, marine environmental protection, and the efficiency of maritime traffic and transport. SafeSeaNet includes, among other things, near-real-time AIS-based vessel positions, historical ship positions, ship identification and voyage information, estimated and actual arrival/departure times, hazardous-goods information, safety and pollution incidents, waste information and ship-security information.

We explored several routes to obtain access to (anonymised) data from SafeSeaNet:

- we contacted EMSA directly to obtain access;
- we contacted the European Commission to obtain access to the (anonymised) data in SafeSeaNet through them;
- we contacted Rijkswaterstaat (the Dutch Directorate-General for Public Works and Water Management), for both the entire European dataset and also especially for the Dutch national dataset in case the entire European dataset is not within our reach.

Unfortunately, we were unable to obtain data on maritime vessels through any of these three organisations. Some more details are given below.

4.2.1 Call with EMSA

We had an extensive call with EMSA, including a demonstration of the practical use of SafeSeaNet. This call made clear that there is no single database from which complete datasets from all Member States can be extracted. Each Member State stores the data for five years in its own local systems. Only upon specific request, for example in the event of an incident, can information be requested at single ship level from the relevant Member State. These data are not publicly accessible and are exchanged at the individual ship level only, not via exchange of a database. For our research purposes, EMSA data could not be provided to us in relation to the data we were looking for.

4.2.2 Call with European Commission

The European Commission itself does not have access to ship travel data but helped us to reach out to EMSA (see result above) and earlier provided us with a Letter of Recommendation (see Appendix B).

4.2.3 Rijkswaterstaat

We have contacted Rijkswaterstaat for both the entire European dataset and also especially for the Dutch national dataset. With regard to requesting the data at EU level, Rijkswaterstaat expects that this is challenging, as each Member State would need to invest time and resources in retrieving the data from local systems, irrespective of whether a legal basis exists for this release in other Member States.

Nevertheless, the Rijkswaterstaat route to obtain data has not yet been fully exhausted. Rijkswaterstaat is still discussing this issue with its legal advisers and has submitted the data request to the competent Dutch port authorities. At the time of writing this report, we had not yet received a final outcome on this matter and therefore do not know whether or where this process will lead.

4.2.4 Relevant differences between SafeSeaNet and EURIS for data analyses

Unlike EURIS for inland waterway transport, the SafeSeaNet system works with substance names (i.e. CAS); the UN number field is not populated for bulk transport. This is a problem for UN classes of (hydrocarbon/fuel) mixtures. Packaged cargo does work with UN numbers.

4.3 Results

Due to the lack of a suitable dataset, we were unable to estimate NMVOC emissions from maritime vessels, unlike for inland waterway transport. Eurostat dataset named 'mar_sg_am_ewx' states for maritime transport a total of 640,421 kt for liquid bulk in 2024, indicating about six times larger amount than the total flammable liquids amount shipped in 2024 in IWT. This indicates that NMVOC emissions might be substantial; however, this scaling factor cannot be used for extrapolation of emissions, as the substances carried by sea and IWT vessels are incomparable.

4.4 Recommendations to estimate the degassing by maritime vessels

The SafeSeaNet system, as currently configured, does not allow it to be used as a database at European level. This limits the options to estimate degassing volumes of maritime vessels based on vessel trip information. In addition, public access at the national level to vessel trip information is also restricted for study and research purposes. These restrictions are related to privacy considerations.

The current situation means that EU governmental bodies do not have access to robust data for both general purposes as well as needed to estimate the amount of degassing. Such data are needed to improve understanding of degassing by maritime vessels and to potentially develop policies aimed at limiting ship degassing.

We discussed this situation with Rijkswaterstaat and arrived at the following recommendations specifically for data on maritime vessels:

1. Have a European or Member State governmental body collect the national datasets for 2025 for the single use of this study on the basis of public interest. Although not a structural solution, if this would be allowed for the particular purpose of this study, it could be used to complement this study in a next concluding phase and provide better insight into maritime degassing.
2. Enable regular access to national SafeSeaNet databases within Member States for national governmental bodies responsible for maritime shipping. This should be done at individual ship level, potentially anonymised, and should include

substance data, so that the databases can be used for general statistical and data analysis purposes. Possibly this could be done under the current framework when there is a public interest.

3. Ideal solution would be to merge the national SafeSeaNet databases into one single EU database, with access restricted exclusively to EU authorities. This should be done at individual ship level, potentially anonymised, and should include substance data, so that the database can be used for statistical and data analysis purposes in general. This requires a system change, while currently, the databases are kept at the national Member State level.

To estimate the degassing of maritime shipping, currently no direct datasets are available on degassing events. As with IWT, degassing could be estimated based on trip information, including origin and destination, type of cargo and the order of trips. These data are not available now, as they are limited by law. For a future analysis, the data can possibly be made available on request of the European Commission to SafeSeaNet members. We think that if the Commission makes a clear argument that the data is needed for a public goal (investigation of options to improve air quality), requires pseudonymised ship information and is used solely to generate anonymous results, Regulation (EU) 2019/1239 and Directive 2002/59/EC could allow for the use of the data. Although CE Delft could provide an EC Letter of Support, access was rejected for now.

5 EU areas of major concern

5.1 Introduction

This chapter addresses the EU areas of major concern. To obtain a first general overview of where major tanker activity takes place, public AIS data in the EU were consulted. This enables focusing on areas of major concern and eliminating areas which do not have any tanker activity at all.

5.2 Methodology

The areas of main concern are derived from areas with a concentration of tanker activity. These are first located using public AIS data for a first-order determination. This does **not** include information on the type of substances (UN-, EHS- or CAS-numbers).

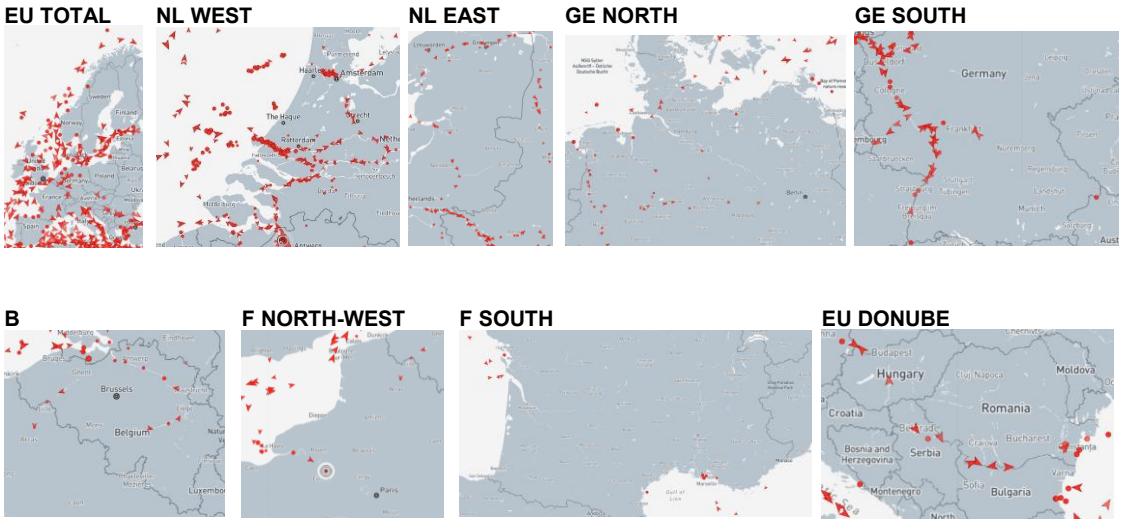
5.3 EU areas of major concern for ship degassing

Sample AIS data were obtained via Marinetraffic-Kpler website. It provides a real-time overview of ship activity at a certain moment and the possibility to select individual ships for data on draught and history tracking. After selecting tankers, in general, it shows concentrations with clustering of tanker activity in separate sectors in the EU. A limitation is that it only provides a view at a particular moment and does not contain information on loaded substances.

For inland shipping, these clusters with tanker concentration comprise:

- Netherlands (west);
- Netherlands (east);
- Germany (north);
- Germany (south);
- Belgium;
- France (north-west);
- France (south);
- EU Danube – Austria-Hungary-Romania.

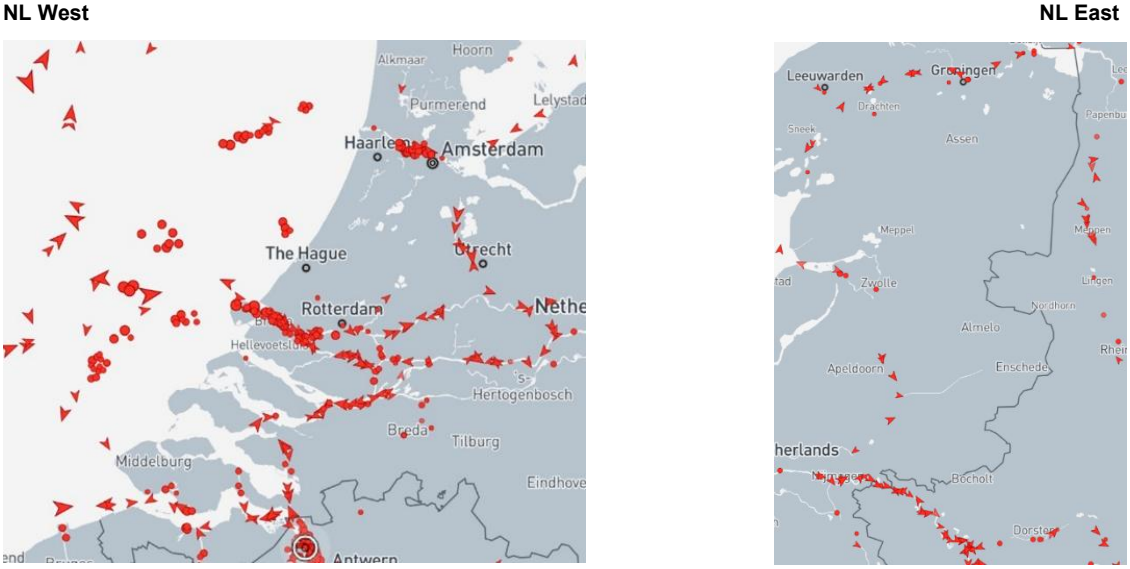
Figure 7 – Sectoral plot of inland tanker activity compared to total EU tankers



Source: AIS, Marinetraffic.com, date 15-1-2026.

While a complete dataset was exclusively obtained for inland shipping in the Netherlands, the data analysis was executed on these Dutch data. It is confirmed that this area has significant tanker activity, see Figure 8.

Figure 8 – Sectoral plot of inland tanker activity in the Netherlands



Source: AIS, Marinetraffic.com, date 15-1-2026.

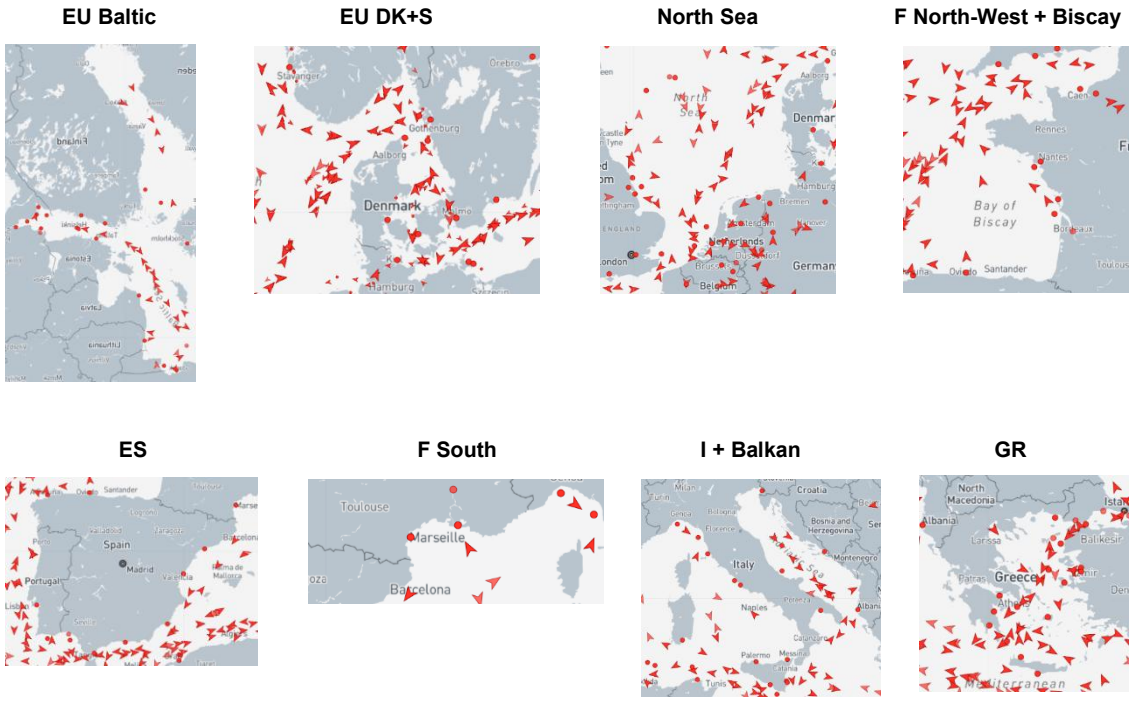
Of CDNI countries, inland shipping major concentrations are shown in two countries: The Netherlands and Germany, which is in line with the data. Second, the Danube has activity, which is also in line with expectations.

Preliminary examinations of the locations of departure and arrival of individual ships reveal that in the Netherlands and Germany there is significant traffic to and from refineries, while other locations, like Danube transport of hydrocarbons between storage tanks i.e. Hungary, seem significant.

For maritime shipping, these clusters comprise:

- EU Baltic – Finland, Sweden, Poland;
- EU Scandinavia (south) – Denmark, Norway, Sweden, Lithuania, Latvia, Estonia;
- North Sea – Netherlands, Belgium, Germany;
- France Atlantic (north-west) and Bay of Biscay;
- Spain;
- Italy, Slovenia and Croatia;
- Greece.

Figure 9 – Sectoral plot of maritime tanker activity



Source: AIS, Marinetraffic.com, date 15-1-2026.

6 Conclusions and Recommendations

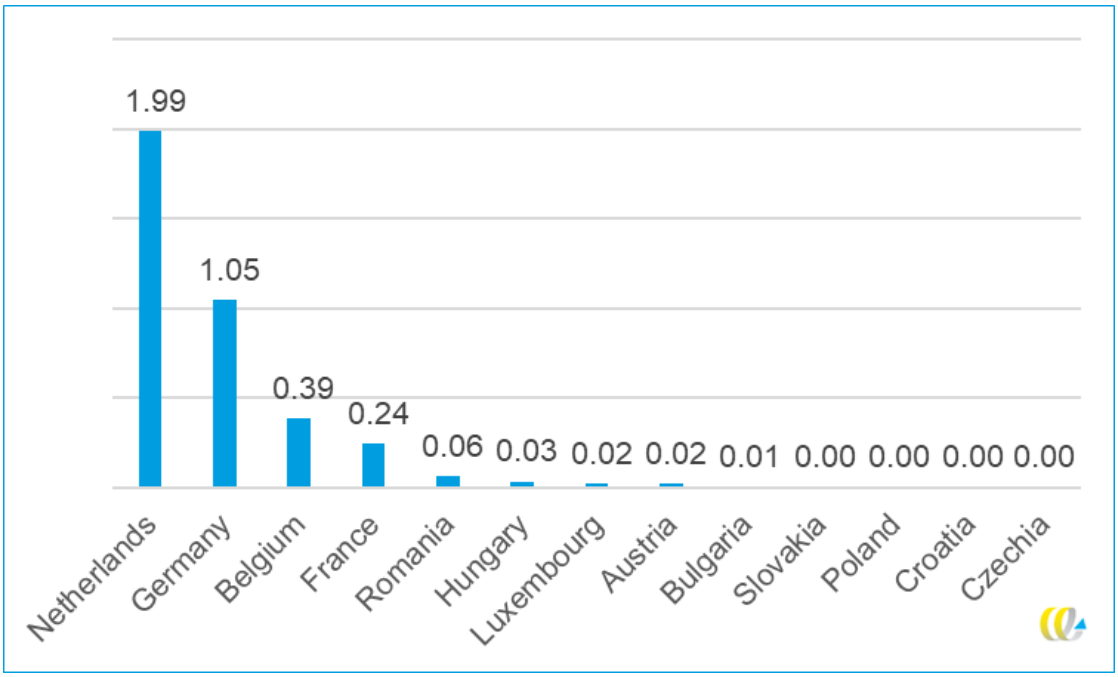
6.1 Conclusions

Degassing emissions to air from inland waterway and maritime vessels can reach high concentrations, which are far above levels typically permitted for land-based installations and may also exceed occupational exposure limits.

6.1.1 Inland waterway transport

The CDNI degassing ban reduces the emission concentrations of degassing of inland waterway transport in Belgium, Germany, France, Luxembourg, the Netherlands and Switzerland, provided that it is properly enforced. The total degassed volume to air under the ban is thereby also reduced. However, even under the ban, vessels may still degas at concentrations which can remain substantially higher than emission levels allowed for comparable land-based activities, as degassing below 10% of the lower explosion limit (LEL) is still allowed.

Figure 10 – Estimated degassing emissions by Member State (in kt), 2025



For inland shipping, the main tanker concentration areas can be grouped into the following clusters: the Netherlands (both eastern and western), Germany (both northern and southern), Belgium, France (both north-western and southern), and the EU Danube region covering Austria, Hungary and Romania. These clusters are particularly relevant for prioritising enforcement, monitoring and infrastructure measures to reduce degassing emissions.

The main cargo types contributing to degassing emissions after the CDNI ban in the Netherlands are, from high to low: Xylenes/ethylbenzene (10% or more) mixture, Toluene, Ethylbenzene, Styrene monomer, Isopropyl alcohol, Hexanes, Kerosene, Ethylene dichloride and Methyl ethyl ketone.

6.1.2 Maritime vessels

Due to the lack of a suitable dataset, we were unable to estimate NMVOC emissions from maritime vessels, unlike what we did for inland waterway transport. However, based on AIS data, degassing emissions from maritime vessels are expected to be concentrated in several key European coastal and sea regions. The main clusters identified are the EU Baltic region, comprising Finland, Sweden and Poland; southern Scandinavia, including Denmark, Norway, Sweden, Lithuania, Latvia and Estonia; the North Sea region, covering the Netherlands, Belgium and Germany; the north-western French Atlantic coast and the Bay of Biscay; Spain; the Adriatic and northern Mediterranean region, including Italy, Slovenia and Croatia; and Greece.

Based on the limited number of interviews conducted, we expect that degassing or venting from maritime vessels mainly takes place at sea. For safety reasons, vessels are likely to select quiet locations for venting, rather than busy anchorages or other areas with high vessel traffic. This spatial pattern makes venting less visible and more difficult to monitor, while also underlining the importance of coordinated enforcement and monitoring beyond port areas.

6.2 Recommendations

6.2.1 Policy recommendations:

We recommend adapting the current data access system to allow international access for EU authorities and/or EU Member State governmental bodies. This would provide the data needed to obtain a comprehensive overview of degassing activities and support the development of future policies, such as a possible ban on the degassing of substances of concern to the atmosphere.

6.2.2 Recommendations for a potential follow-up study

We propose the following recommendations for a possible follow-up study:

- Make available both IWT- and marine data on single ship level to enable obtaining a clear view of the intensity, substance and location of degassing to the atmosphere.
- A regulatory framework is already in place for degassing of inland tankers under the CDNI. For the present study, only a relatively concise literature review was carried out. For a future study, it may be useful to analyse this regulatory framework in greater depth in order to identify more precisely where the key gaps lie, particularly with regard to if bans are indeed obeyed and other aspects of degassing that are currently not covered by the existing regulations.
- It is recommended to avoid the use of LEL as an indicator for the health and environmental impact of degassing. Measurement of ppm concentrations of individual substances or substance classes is to be preferred, being more relevant.
- Conduct additional interviews with a broader range of stakeholders, including shipping companies, ports, degassing facilities, and public authorities, to develop a better understanding. Additional interviews will provide valuable insights and possibly suggestions for solutions.
- Enforcement of a degassing ban can be supported by monitoring with gas sensors on riverbanks. In the Netherlands, a network of e-Noses which detect general hydrocarbon emissions give a first indication in real-time that emissions are occurring. This can help to initiate targeted enforcement of a degassing ban in that area.
- Use of certificates for proof of degassing at an installation.
- Develop an enforcement system for degassing by sniffing. CE Delft has conducted a study on targeted benzene emission detection by degassing of IWT ships using drones for the Province of South-Holland and the enforcement authority DCMR.

6.2.3 Additional noteworthy recommendations

During this study, we identified several noteworthy findings that officially fall outside its scope but suggest that further investigation into the following areas may be valuable:

- This study focuses exclusively on emissions to air. However, some (maritime shipping) tankers wash their cargo tanks before, or instead of, degassing them. Tank washing generates significant emissions to the wash water. Where a prewash is required, the resulting prewash slops must be discharged to a port reception facility. Where a prewash is not required, residual volumes often end up in the sea. A subsequent study should examine the extent to which emissions to water influence emissions to air. Further research into the impact of emissions on water is also recommended.

- In addition, we recommend conducting further research into the most appropriate type of policy instrument. Besides a possible ban on degassing, this can also include, among others:
  - a ban on discharge of prewash slobs;
  - policies requiring terminals to receive residual vapours after cargo has been unloaded;
  - policies requiring prewash procedures for a wider range of products with mandatory discharge of the resulting prewash slobs to port reception facilities;
  - policies requiring ports to allow tank washing in their ports;
  - policies requiring ports to receive the prewash slobs.

Further information is provided in Appendix A.

A Details about degassing of cargo tanks on maritime and inland waterway vessels

A.1 Degassing of cargo tanks on maritime vessels

When referring to the degassing of cargo tanks on maritime vessels, this primarily concerns tanker vessels such as chemical tankers, gas tankers, oil tankers, and product tankers. Degassing of cargo tanks is required when the next cargo to be loaded into a tank is not compatible with the previous cargo.

Degassing of tankers may take place:

- on board during a sea voyage, outside coastal areas;
- at the quay of a terminal, under certain conditions (e.g. via shore-based reception facilities and vapour recovery).

A.1.1 Existing regulations, best practices and guidelines for maritime tanker vessels

- There are international as well as regional and national regulations, best practices and guidelines that maritime tankers have to comply with. Most relevant for this study is:
  - IMO MARPOL Annex VI, Regulation 15, guidance on VOC management plans and vapour emission control systems for tankers and terminals. MARPOL Annex VI, Regulation 15:
- Allows countries to designate ports/terminals where VOC emission from tankers are only allowed via a vapour emission control system (VECS).
- Requires that the vapour emission control systems (VECS) comply with MSC/Circ. 585 ‘Standards for vapour emission control systems’ (design/safety), but does not provide a global NMVOC limit value for ships.
- Requires all crude oil tankers to have an approved VOC management Plan, specifying how VOC emissions during loading, storage, transit and venting are controlled.

Other relevant regulations, best practices and guidelines are:

- SOLAS, the International Convention for Safety of Life at Sea, is a global convention designed to ensure the safety of merchant ships and their crews by setting minimum standards for ship construction, equipment, and operation.
- International Convention for the Prevention of Pollution from Ships (MARPOL), Annex II: Regulations for the control of Pollution by Noxious Liquid Substances in Bulk.
- IMO IBC code, International Code for the construction and Equipment of Ships Carrying Dangerous chemicals in Bulk.
- IMO IGC code, International Code for the construction and Equipment of Ships Carrying Liquefied Gases in Bulk.
- IMO MARPOL Annex VI, Regulation 15, guidance on VOC management plans and vapour emission control systems for tankers and terminals. MARPOL Annex VI, Regulation 15:
  - Allows countries to designate ports/terminals where VOC emission from tankers are only allowed via a vapour emission control system (VECS).
  - Requires that the vapour emission control systems (VECS) comply with MSC/Circ. 585 'Standards for vapour emission control systems' (design/ safety), but does not provide a global NMVOC limit value for ships.
  - Requires all crude oil tankers to have an approved VOC management Plan, specifying how VOC emissions during loading, storage, transit and venting are controlled.
- SIGTTO, Liquefied Gas Handling Principles on Ships and in Terminals.
- Information paper from Oil Companies International Marine Forum (OCIMF), for example, about VOC emissions from cargo systems on oil tankers.
- INTERTANKO, Cargo Tank Cleanliness Standards for Chemical Tankers.
- Rotterdam Port By-Laws 2020, including provisions regarding hazardous liquids and the basis for restrictions on degassing in the port area.
- OCIMF[7], CDI[8] and SIRE[9] vetting inspections.

However, none of these documents provides NMVOC emission limits for degassing cargo tanks of maritime vessels.

[7] Oil Companies International Marine Forum.
[8] Chemical Distribution Institute.
[9] OCIMF's Ship Inspection Report Programme.

A.1.2 Chemical tankers

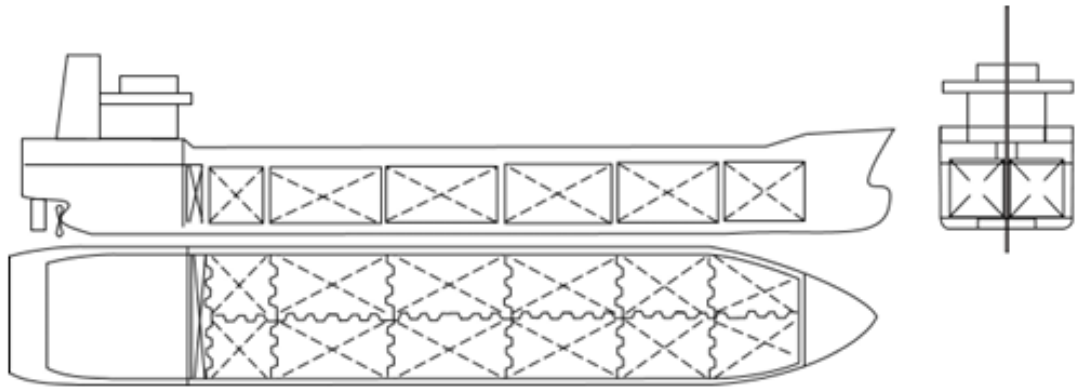
Design of chemical tankers

Liquid bulk carriers used for the transport of chemicals and similar products are typically in the range of 3,000 to 30,000 DWT, although the fleet also includes smaller vessels of around 1,000 DWT and larger vessels of up to 60,000 DWT. These vessels are generally equipped with 10 to 60 separate cargo tanks of varying sizes. On chemical tankers, each cargo tank must be fully segregated from the others, which means that the associated pipes, pumps, valves and manifolds are tank-specific and can be isolated from the rest of the cargo system.

This design reflects the operational requirements of carrying multiple liquid bulk cargoes on a single vessel. Because cargoes may be incompatible, segregation is necessary to prevent accidental mixing and associated health, safety and environmental risks. In addition, cargoes may require different transport conditions, such as heating or refrigeration. Although these vessels can carry a relatively high number of segregated cargoes, in practice, more than ten different product types are rarely transported simultaneously on a single vessel (Swedish Institute for the Marine Environment, 2022).

Figure 9 provides a schematic cross-section of a chemical tanker.

Figure 9 – Schematic cross-section of a 12,700 DWT chemical tanker with separate tanks capable of transporting various chemicals as liquid bulk



Source: (Swedish Institute for the Marine Environment, 2022).

Regulations for the transport of chemicals

The International Maritime Organization (IMO) regulates the transport of chemicals in bulk by vessels by SOLAS[10] chapter VII, Part B (Carriage of dangerous goods) and MARPOL[11] Annex II (Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk).

[10] International Convention for the Safety of Life at Sea.
[11] International Convention for the Prevention of Marine Pollution from Ships.

Both SOLAS and MARPOL Annex II require chemical tankers built after 1 July 1986 to comply with the IMO International Bulk Chemical (IBC) code, which establishes standards for ship design, construction and required equipment, and includes a list of chemicals with their hazards, required ship type and environmental hazard rating. Tankers built before that date should comply with the predecessor BCH code.

As part of degassing and tank preparation, chemical tankers may wash cargo tanks when changing cargo types or to enable maintenance activities. For most chemicals, regulations allow the discharge of cargo residues mixed with wash water while en route, provided that the discharge occurs at least 12 nautical miles from shore, through an outlet below the waterline, in water deeper than 25 metres, and at a vessel speed of at least 7 knots to support adequate mixing and dispersion.

Under MARPOL Annex II[12], liquid chemicals are classified according to their potential impacts on the marine environment and human health: Category X (major hazard), Category Y (hazard), Category Z (minor hazard), and Other Substances (OS, no identified harm in this context). Annex II specifies allowable residue ('stripping') volumes and discharge conditions, and sets tank-washing requirements for substances classified as Category X or Category Y.

- Category X: Vessels carrying Category X chemicals are required to wash the tanks in port and deliver ashore after unloading unless an exemption applies. Washing must be sufficient to ensure that the concentration of the chemicals in the strip after washing is at or less than 0.1%.
- Category Y: An onshore washing requirement applies only to Category Y chemicals that have a high viscosity, or are solidifying substances or persistent floaters. No specific post-wash concentration threshold is specified.
- Other Category Y substances, and Categories Z and OS: Tank washing is not required, and residues are allowed to be discharged to sea.

In some situations, tank washing is not required despite the hazardous properties of the substance. Exemptions may be granted, for example, for 'load-on-top' operations, where a tank is reloaded with the same or a compatible substance after unloading without intermediate washing, or where residues are removed through ventilation because of the substance's high vapour pressure. Where ventilation is used instead of washing, it must be conducted in accordance with Appendix 7 of MARPOL Annex II (ventilation procedures). This Appendix states, among others, that cargo residues of substances with a vapour pressure greater than 5 kPa at 20ºC may be removed from a cargo tank by ventilation. (Traficom, 2025) (IMO, 2026a) (MARPOL Training Institute, 2026)

[12] MARPOL Annex II regulates pollution from noxious liquid substances carried in bulk through a categorisation system.

MEPC.2/Circ.31 provides a comprehensive overview of products/chemicals, including the MARPOL Annex II category (X, Y, Z, OS) to which they belong.

MARPOL Annex II also tightens residue limits. It includes requirements aligned with modern stripping techniques. For ships built on or after 1 January 2007, the maximum allowable residue remaining in the tank and associated piping after discharge is 75 litres for substances in Categories X, Y, and Z. Ships built before 1 January 2007 have higher limits.

Table 12 provides an overview of the stripping and discharge requirements for noxious liquid substances carried in bulk according to MARPOL Annex II and IBC code.

Table 12 – Overview of stripping and discharging requirements for noxious liquid substances carried in bulk according to MARPOL Annex II and IBC code

Category	Ships constructed before 1 July 1986	Ships constructed on or after 1 July 1986, but before 1 January 2007	Ships constructed on or after 1 January 2007
X	Strip 300 l + 50 l tolerance Prewash required Max. 0.1% 12 mile 25 m depth 7 knots, en route	Strip 100 l + 50 l tolerance Prewash required Max. 0.1% 12 mile 25 m depth 7 knots, en route	Strip 75 litres Prewash required Max. 0.1% 12 mile 25 m depth 7 knots, en route
Y – high viscosity/ solidifying substances/ persistent floaters	Strip 300 l + 50 l tolerance Prewash required 12 mile 25 m depth 7 knots, en route	Strip 100 l + 50 l tolerance Prewash required 12 mile 25 m depth 7 knots, en route	Strip 75 l Prewash required 12 mile 25 m depth 7 knots, en route
Y	Strip 300 l + 50 l tolerance 12 mile 25 m depth 7 knots, en route	Strip 100 l + 50 l tolerance 12 mile 25 m depth 7 knots, en route	Strip 75 l 12 mile 25 m depth 7 knots, en route
Z	Strip 900 l + 50 l tolerance 12 mile 25 m depth 7 knots, en route	Strip 300 l + 50 l tolerance 12 mile 25 m depth 7 knots, en route	Strip 75 l 12 mile 25 m depth 7 knots, en route
OS (Other Substances)	No limitations	No limitations	No limitations

Source: (Honkanen et al, 2012).

Procedure for washing and ventilating cargo tanks on board chemical tankers

For chemical tankers, the degassing process depends on the product being transported, but usually proceeds as follows:

- Step 1: Stripping after unloading: After cargo discharge, the tank and associated piping are stripped to remove as much remaining cargo residue as possible. This operation aims to minimise the residual volume left in the system before tank

washing begins. A smaller residue volume reduces the concentration of cargo in subsequent wash water. Stripping performance is subject to regulatory standards, which are generally more stringent for newer vessels than for older ones (see Table 12 for maximum allowable stripping volumes).

- Step 2: Prewash, where required: A prewash is required for tanks that have carried MARPOL category X substances or category Y substances classified as high-viscosity or solidifying. This operation is to be carried out ashore, preferably immediately after unloading. After completion, the tank and associated pipelines are stripped, and the resulting prewash effluent is discharged to a port reception facility.
- Step 3: Main washing: After stripping or prewashing, the tank is washed with the appropriate medium: fresh water, seawater, hot or cold water, solvent, or water with detergent. The choice depends on cargo properties. Water-soluble cargoes are usually washed with water, while hydrophobic or water-reactive substances may require detergents or solvents. The resulting washings are collected in slop tanks.
- Step 4: Discharge of washings: Prewash effluent goes ashore, but the main washings may be discharged at sea if MARPOL conditions are met: at least 12 nautical miles from land, in water deeper than 25 m, at least 7 knots, and normally through an underwater outlet for rapid dispersion.
- Step 5 Gas freeing/ventilation: For highly volatile cargoes, residues can sometimes be removed by ventilation alone rather than washing. Tanks are ventilated until odour, toxic substances and explosive concentrations are within safe limits. Because vapours can be toxic and flammable, this is often not allowed in port and may be done at sea. (Honkanen et al, 2012)

Although this study focuses on emissions to air, it is also important to note that, on chemical tankers, tank washing generates significant emissions to wash water. Depending on the type of substance carried, a prewash may or may not be mandatory. Where a prewash is required, the resulting prewash slops must be discharged to a port reception facility.

A.1.3 Gas tankers

Design of gas tankers

A gas tanker is a ship designed for the transport of liquefied gases, such as LNG, LPG, ammonia, ethylene, or other petrochemical gases. This study focuses on NMVOCs, so LNG is excluded from the scope. For clarity, the differences with LNG are discussed.

The design of a gas tanker is largely determined by the physical properties of its cargo. Because these substances can only be transported in liquid form at low temperature, elevated pressure, or a combination of both, gas tankers are fitted with specialised cargo tanks and associated systems for temperature and pressure control. Depending on the

type of gas and the transport system used, these vessels may be fully refrigerated, pressurised, or semi-refrigerated.

Gas tankers are equipped with specialised cargo tanks for transporting liquefied gases under controlled pressure and/or temperature conditions. The international design and safety framework governing these ships is laid down in the IGC code. Within this framework, several tank types are distinguished, including independent Type A, B, and C tanks, as well as membrane tanks. Type A tanks are particularly suitable for fully refrigerated gas cargoes with relatively low vapour pressure. Type B tanks are mainly used on LNG carriers because of their advanced structural safety design. Type C tanks are pressure vessels most commonly found on smaller LPG carriers, ethylene carriers, and small-scale LNG vessels. Membrane tanks are non-self-supporting tanks and, due to their efficient use of volume, are primarily applied on large LNG carriers. The number of cargo tanks varies by ship type, but is generally much lower than on chemical tankers; Large LNG carriers typically have four to six tanks, while smaller LPG carriers often have two to three tanks. (IMO, 2026b)

Procedure for venting and purging cargo tanks on board gas tankers
In gas tanker operations, a distinction can be made between purging/gas freeing and venting:

- Purging is a tank preparation procedure carried out when a vessel needs to be made suitable for dry docking, shipyard entry, or the carriage of a subsequent cargo with different product specifications or cleanliness requirements.
- Venting refers to the release of vapours or residual gases into the atmosphere. Venting after cargo discharge may be necessary when a significant quantity of residual cargo vapour remains in the tank, the discharge terminal does not take back these vapours, and the next cargo receiver cannot accept them due to product quality or contamination concerns. This occurs particularly in the case of higher-pressure cargoes, for which relatively large vapour volumes may remain on board after unloading.

As this study focuses on the preparation of cargo tanks for the next cargo, the explanation below is limited to the venting procedure.

The venting process after cargo discharge generally proceeds as follows:

1. Cargo is discharged, but residual vapour remains in the tank. In the case of high-pressure cargoes, this may amount to as much as 30-50 tonnes of vapour in a 3,000-tonne tank. For low-pressure cargoes, the residual vapour quantity is generally much smaller.
2. From a technical perspective, these vapours could also be returned to the discharge terminal. In practice, however, this is often commercially unattractive,

as the terminal would need to cool and reliquefy the vapours, which requires additional time, energy, and berth occupancy.

3. If the terminal does not accept the vapours, the vessel may leave port with residual vapour still on board.
4. If the next loading terminal or cargo owner considers the residual vapour compatible with the next cargo, the vapour may remain in the tank. In that case, venting is not required.
5. If there is a risk of contamination of the next cargo, or if product quality requirements do not allow the vapour to remain, venting becomes necessary. In such cases, the vapour is released from the tank in a controlled manner through the ship's cargo tank venting system. In general, gas carriers are equipped with dedicated venting and pressure-relief arrangements to protect the cargo containment system against harmful overpressure or underpressure. Vapour from the tank is routed through the venting system and discharged via a vent outlet or vent mast, where it is directed upwards rather than along the deck. In mechanical terms, venting means that the remaining vapour phase is allowed to flow out of the cargo tank or vapour space and escape into the atmosphere until the remaining vapour inventory and tank pressure have been reduced to an acceptable level.

Venting generally takes place:

- at sea;
- often outside territorial waters, i.e. beyond the 12-nautical-mile zone;
- in a quiet location, for safety reasons, rather than at a busy anchorage; and
- usually not in port.

(Source: interview with an anonymous gas tanker shipping company.)

Venting constitutes a relevant emissions issue. Based on an interview with an anonymous gas tanker shipping company, this issue cannot be attributed exclusively to the vessel but should be understood as a chain-wide issue involving multiple actors in the logistics chain. In principle, venting could be avoided if discharge terminals were to accept residual vapours. However, doing so requires additional cooling and reliquefaction capacity, which entails extra time, energy consumption, and costs. Under current market conditions, discharge terminals do not always have sufficient incentives to receive these vapours, while cargo owners may be required to bear the additional costs associated with alternatives to venting to air.

A.1.4 Oil tankers

Unfortunately, we were not able to consult a shipping company operating oil tankers to better understand how degassing of cargo tanks on board such vessels is generally carried out. We were also unable to identify reliable literature on this subject. Gaining insight into the procedures for degassing cargo tanks on oil tankers could therefore be given additional attention in a follow-up study.

For example, it remains unclear whether these vessels typically operate on a dedicated basis, potentially reducing the need for degassing, or whether they transport different types of oil products during different voyages. It is also unclear to what extent methods, such as inerting the tanks, are required. In the case of heavy oil residues, it is also possible that tanks need to be physically cleaned by specialised cleaning companies. In other words, further research into these vessel types would therefore be of added value.

A.1.5 Location and frequency of degassing of tanks on maritime vessels

Based on the limited number of interviews conducted as part of this study, it is evident that European ports apply different rules regarding the degassing of maritime vessels. Some ports maintain very strict rules and do not allow the degassing of seagoing vessels at all. However, at least one port appears to apply the same approach to maritime vessels as to inland waterway vessels, extending the prohibitions under the CDNI convention to seagoing ships as well. It is not known to us whether there are also seaports in Europe that allow all forms of degassing of maritime vessels within the port area.

Degassing within territorial waters is possible. However, based on the limited number of interviews, we consider it more likely that this mainly takes place outside territorial waters.

It is very difficult to estimate how often maritime vessels within the EU degas. Anthony Veder, a specialised small-scale gas tanker operator, is one of the few shipping companies that provide transparency in their Sustainability Growth Report on the annual amount of cargo vapours vented, purged, or flared per cargo type relative to total transported cargo. Anthony Veder operates globally. As a result, these cargo vapour emissions are not necessarily vented, purged, or flared within the EU.

Figure 10 – Amount of cargo vapour emissions yearly vented/purged or flared by Anthony Veder

Cargo vapour emissions	Total vented/purged (mt)		Total flared (mt)		Scope 1 emissions: total vented/purged/flared (mt CO_2-eq.	
Year	2024	2023	2024	2023	2024	2023
LNG	0	64	0	0	0	1,792
CPG	45	98	20	9	151	224
PGP	234	65	4	0	482	130
RGP	51	0	9	0	129	0
Ethylene	86	13	90	0	606	52
Butadiene	42	14	10	0	201	56
Propane	32	20	0	10	0	327
LPG mix	0	0	0	0	0	0
Butane	0	74	0	10	0	327

Cargo vapour emissions	Total vented/purged (mt)		Total flared (mt)		Scope 1 emissions: total vented/purged/flared (mt CO_2-eq.	
Year	**2024**	**2023**	**2024**	**2023**	**2024**	**2023**
Butane - 1	**0**	30	**0**	3	**0**	129
Ammonia	**0**	5	**0**	0	**0**	0
CC4	**0**	3	**0**	0	**0**	12
Total	**490**	386	**134**	33	**1,665**	2,813
	Total Transported cargo (mt)		**Total vented/purged (mt CO_2-eq.**		**Ratio venting/purging on total transported cargo (kg CO_2-eq./mt cargo)**	
Year	**2024**	2023	**2024**	2023	**2024**	2023
Cargo transport	**3,190,000**	4,132,783	**1,269**	2,714	**0.40**	0.66

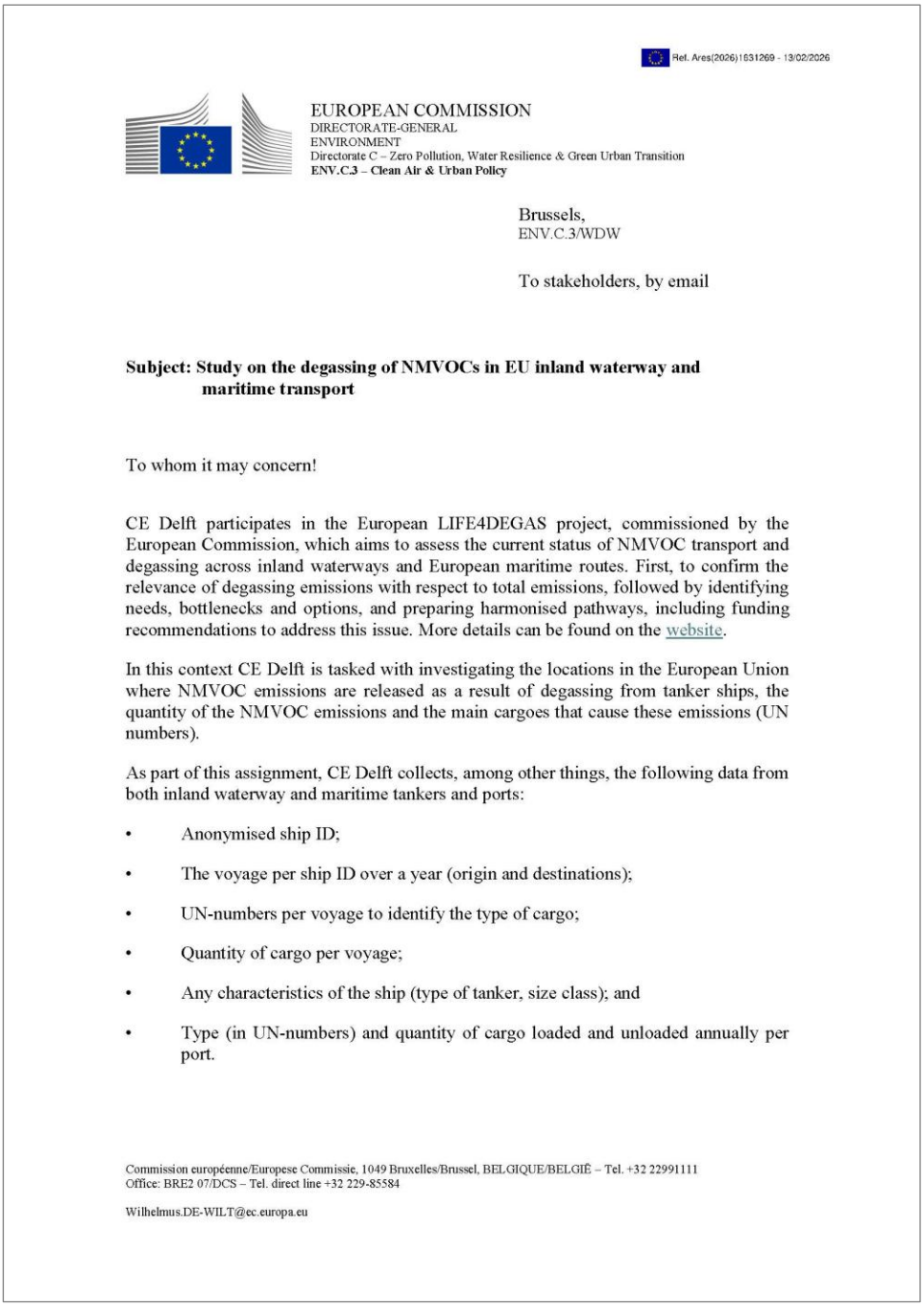
Source: (Anthony Veder, 2025).

It would be an oversimplification to extrapolate Anthony Veder's ratio of venting and purging relative to total transported cargo to all maritime tankers. Anthony Veder operates in the small-scale gas segment, and it is therefore possible that larger gas tankers operate more efficiently. At the same time, we do not have sufficient insight into the operational profiles of all individual vessels and shipping companies and therefore do not know how often degassing is actually necessary. Depending on the operational profile and the agreements with the terminals and cargo owners, the frequency may vary between vessels and operators.

It is also important to note that some types of vessels, such as chemical tankers, wash their cargo tanks prior to, or instead of, ventilation or degassing. As a result, emissions may end up in the wash water, and potentially in the sea, rather than in the air. The extent to which wash water is discharged into the sea, and the associated impacts, fall outside the scope of this study.

B Organisations contacted

To facilitate the data collection and obtaining of background information CE Delft was provided with the following Letter of Recommendation by Mr. Wilhelmus de Wilt of the EC:



Ref. Ares(2026)1631269 - 13/02/2026

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
ENVIRONMENT
Directorate C – Zero Pollution, Water Resilience & Green Urban Transition
ENV.C.3 – Clean Air & Urban Policy

Brussels,
ENV.C.3/WDW

To stakeholders, by email

Subject: Study on the degassing of NMVOCs in EU inland waterway and maritime transport

To whom it may concern!

CE Delft participates in the European LIFE4DEGAS project, commissioned by the European Commission, which aims to assess the current status of NMVOC transport and degassing across inland waterways and European maritime routes. First, to confirm the relevance of degassing emissions with respect to total emissions, followed by identifying needs, bottlenecks and options, and preparing harmonised pathways, including funding recommendations to address this issue. More details can be found on the website.

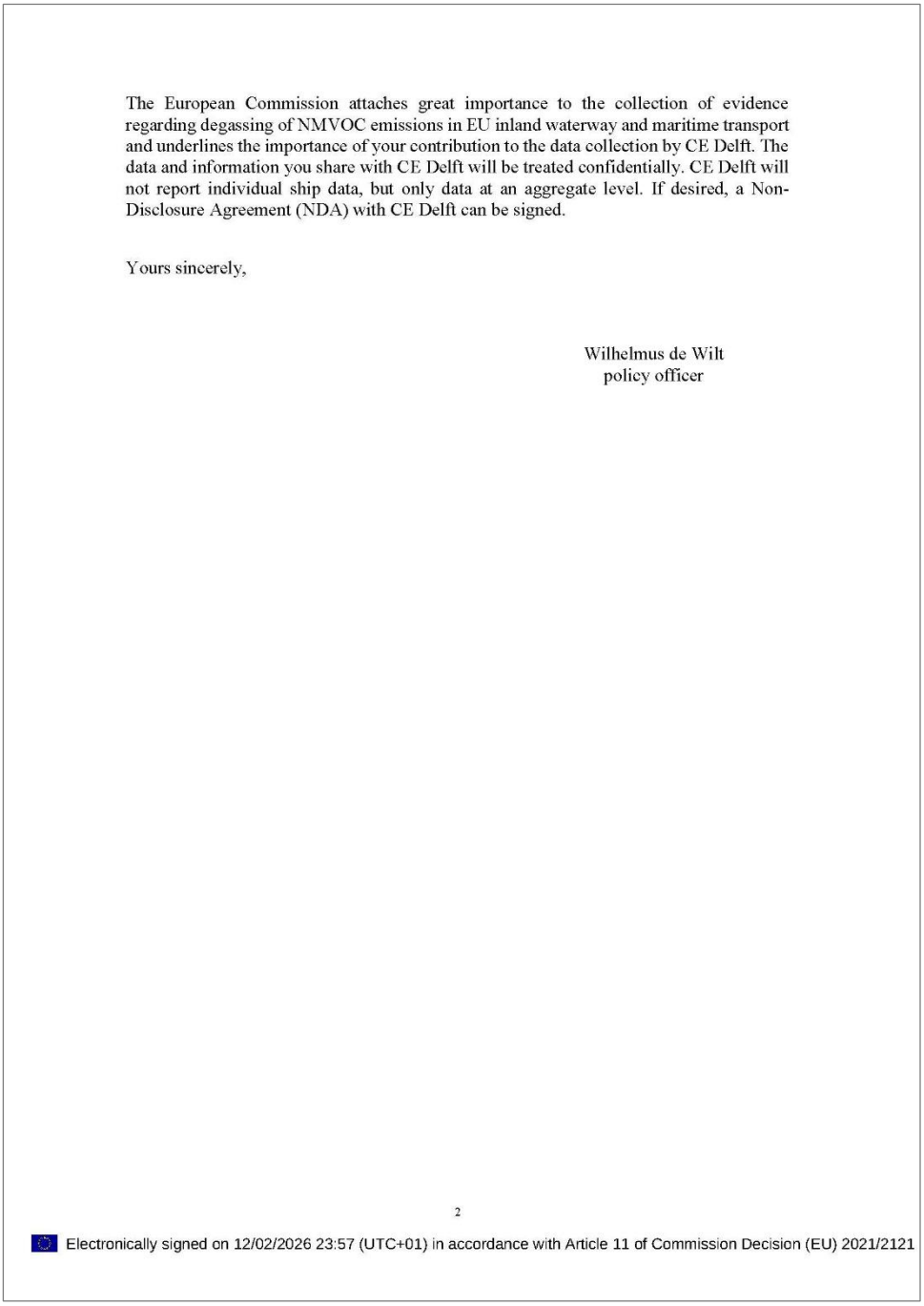
In this context CE Delft is tasked with investigating the locations in the European Union where NMVOC emissions are released as a result of degassing from tanker ships, the quantity of the NMVOC emissions and the main cargoes that cause these emissions (UN numbers).

As part of this assignment, CE Delft collects, among other things, the following data from both inland waterway and maritime tankers and ports:

- Anonymised ship ID;
- The voyage per ship ID over a year (origin and destinations);
- UN-numbers per voyage to identify the type of cargo;
- Quantity of cargo per voyage;
- Any characteristics of the ship (type of tanker, size class); and
- Type (in UN-numbers) and quantity of cargo loaded and unloaded annually per port.

Commission européenne/Europese Commissie, 1049 Bruxelles/Brussel, BELGIQUE/BELGIË – Tel. +32 22991111
Office: BRE2 07/DCS – Tel. direct line +32 229-85584

Wilhelmus.DE-WILT@ec.europa.eu



The European Commission attaches great importance to the collection of evidence regarding degassing of NMVOC emissions in EU inland waterway and maritime transport and underlines the importance of your contribution to the data collection by CE Delft. The data and information you share with CE Delft will be treated confidentially. CE Delft will not report individual ship data, but only data at an aggregate level. If desired, a Non-Disclosure Agreement (NDA) with CE Delft can be signed.

Yours sincerely,

Wilhelmus de Wilt
policy officer

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Electronically signed on 12/02/2026 23:57 (UTC+01) in accordance with Article 11 of Commission Decision (EU) 2021/2121

Organisations consulted and interviewed for this study which could provide us with information are listed in Table 13.

We also approached several additional organisations (such as chemical tanker shipping companies, oil tanker shipping companies and NMVOC suppliers). However, in these cases, no appropriate contact person was available to participate in an interview.

Table 13 – Consulted organisations who could provide information.

#	Organisation	Name
1	SuperFlox, developer of on-board catalytic oxidiser	Michiel Molenaar
2	An anonymous seaport in Europe	Anonymous
3	An anonymous gas tanker shipping company	Anonymous
4	An anonymous Dutch institute	Anonymous
5	Rijkswaterstaat - IWT (Directorate-General for Public Works and Water Management in the Netherlands)	Ernst Bolt
6	VEMOBIN (Association Energy for Mobility and on behalf of the Dutch refining sector)	Erwin Tijssen

Senior advisor Dr. Kåre Press-Kristensen from Green Global Future has, in regular meetings, provided input, suggestions, and comments to the work on this study.

C Emissions

Table 14 – Unloaded cargo volumes and estimated degassing emissions in the Netherlands before and after the CDNI Degassing Ban

UN number	Cargo name	Unloaded volume in the Netherlands (kton)	Share of voyages with degassing pre-CDNI ban	Degassing emissions pre-CDNI ban (ton)	Degassing emissions post-CDNI ban (ton)
1090	Acetone	66	50%	8.2	-
1093	Acrylonitrile	43	0%	-	-
1114	Benzene/pygas/reformate >10% benzene	376	13%	10.3	-
1120	Butanols	8	87%	0.4	0.4
1145	Cyclohexane	5	48%	0.7	-
1170	Ethyl Alcohol	1,103	51%	37.1	-
1173	Ethyl acetate	12	84%	1.9	1.9
1175	Ethyl benzene	262	60%	7.2	7.2
1179	Ethyl butyl ether	42	93%	7.1	-
1184	Ethylene dichloride	82	24%	3.1	3.1
1193	Methyl ethyl ketone	13	95%	2.5	2.5
1203	Petrol or gasoline	4,236	13%	361.0	-
1206	Heptanes	2	87%	0.3	0.3
1208	Hexanes	11	75%	3.6	3.6
1213	Isobutyl acetate	-	-	-	-
1216	Iso octenes	3	35%	0.5	-
1219	Isopropyl alcohol	44	87%	3.8	3.8
1220	Isopropyl acetate	-	-	-	-
1223	Kerosene	81	81%	3.2	3.2
1230	Methanol	207	0%	-	-
1265	Pentanes (all isomers)	-	-	-	-
1268	Petroleum products n.o.s. (Naphtha)	9,597	30%	380.8	-
1280	Propylene oxide	266	9%	-	-

UN number	Cargo name	Unloaded volume in the Netherlands (kton)	Share of voyages with degassing pre-CDNI ban	Degassing emissions pre-CDNI ban (ton)	Degassing emissions post-CDNI ban (ton)
1294	Toluene	234	67%	12.2	12.2
1300	Turpentine substitute	2	100%	0.1	0.1
1301	Vinyl acetate	2	78%	0.2	0.2
1307	Xylenes/ethylbenzene (10% or more) mixture	414	71%	13.7	13.7
1547	Aniline	72	0%	-	-
1662	Nitrobenzene	9	0%	-	-
1863	Jet fuel	1,903	21%	17.5	17.5
1918	Isopropylbenzene	31	82%	1.4	1.4
1993	Flammable liquid n.o.s.	138	28%	6.3	-
2048	Dicyclopentadiene	6	93%	0.1	0.1
2055	Styrene monomer	513	22%	3.9	3.9
2312	Phenol	108	0%	-	-
2398	Methyl-tert-butylether	598	94%	335.1	-
2491	Ethanolamine	-	-	-	-
2789	Acetic acid	42	79%	1.2	1.2
3092	1-Methoxy-2-propanol	8	80%	0.2	0.2
3272	Esters	8	100%	0.3	0.3
3295	Hydrocarbons	1,518	90%	471.5	-
3463	Propionic acid (>90% acid by mass)	1	95%	0.0	0.0
3475	Ethanol and gasoline mixture	364	47%	125.0	-
Total		**22,428**		**1,820.4**	**77**

Literature

Anthony Veder. (2025). *2024 Sustainable Growth Report*.

Bundesministerium der Justiz und für Verbraucherschutz. (1998). Zwanzigste Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Verordnung zur Begrenzung der Emissionen flüchtiger organischer Verbindungen beim Umfüllen oder Lagern von Ottokraftstoffen, Kraftstoffgemischen oder Rohbenzin) (20. BImSchV). In. Bundesministerium der Justiz und für Verbraucherschutz,. https://www.gesetze-im-internet.de/bimschv_20_1998/BJNR117400998.html?utm_source

CDNI. (n.d.). *Part B – Degassing/Venting*. CDNI. https://www.cdni-iwt.org/part-b-degassing/?lang=en#03

CE Delft. (2013). *Update estimate emissions degassing inland tank vessels*.

CE Delft. (2016). *Varend ontgassen in kaart*.

Honkanen et al. (2012). *Tank cleaning in the Baltic Sea - Assessment of the ecotoxicity of tand cleaning effluents*.

IMO. (2026a). *Carriage of chemicals by ship*. International Martitime Organization. https://www.imo.org/en/ourwork/environment/pages/chemicalpollution-default.aspx

IMO. (2026b). *IGC Code*. International Maritime Organization. https://www.imo.org/en/ourwork/safety/pages/igc-code.aspx

Inspectie Leefomgeving en Transport. (2024, 4-11-2024). *Binnenvaart lijkt nieuwe ontgassingsverboden na te leven*. Inspectie Leefomgeving en Transport. https://www.ilent.nl/actueel/nieuws/2024/11/04/binnenvaart-lijkt-nieuwe-ontgassingsverboden-na-te-leven

MARPOL Training Institute. (2026). *Annex II- Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk - Appendices to Annex II*. MARPOL Training Institute. https://www.marpoltraininginstitute.com/MMSKOREAN/MARPOL/Annex_II/app7.htm

Staten-Generaal, T.K.d. (2021). *Aanhangsel van de Handelingen; Vragen van het lid Bouchallikh (GroenLinks) aan de Minister en de Staatssecretaris van Infrastructuur en Waterstaat over varend ontgassen in Flevoland (ingezonden 27 oktober 2021).* Den Haag: Tweede Kamer der Staten-Generaal Retrieved from https://zoek.officielebekendmakingen.nl/ah-tk-20212022-866.html

Swedish Institute for the Marine Environment. (2022). *Tank cleaning and its impact on the marine environment*.

Traficom. (2025). *TRAFICOM report on HELCOM BSAP Action S16*.

Vlaanderen. (2026). *Veelgestelde vragen rond ontgassen/ventileren van tankschepen binnenvaart*. Vlaanderen. https://www.vlaanderen.be/mobiliteitsprofessionals/goederenvervoer/binnenvaart/binnenvaartservices/afvalinzameling-voor-binnenschepen/deel-b-afval-van-lading/veelgestelde-vragen-rond-ontgassen-ventileren-van-tankschepen-binnenvaart

Votob. (2024, 19-2-2024). *Approaching ban on barge degassing* https://votob.nl/wp-content/uploads/2024/02/Information-letter-degassing-ban-in-the-Netherland-version-19-2-2024.pdf