# Does vessel size matter?

## Policy instruments in maritime transport and their impact on the working and living conditions on board

ivl
Swedish Environmental Research Institute

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# Summary

This report examines the potential implications of size cut-offs in maritime regulation and legislation on seafarers' working and living conditions. The primary focus is on the newly introduced European Union (EU) environmental regulations. While the EU's new policies aim to cut greenhouse gas emissions and bring the sector into the climate action fold, there are potential unintended consequences to ship design and crew working conditions. Central to this debate is the 5 000 GT (Gross Tonnage) threshold, which dictates whether ships fall under these new rules. Smaller vessels, designed to dodge regulatory costs, could mean shrinking crew accommodations and cutting corners on working conditions.

The study explores two primary questions: (i) Do restrictions based on gross tonnage (GT) impact the working and onboard living conditions of seafarers? And (ii) Does the 5 000 GT threshold risk lowering the quality of seafarers' working and living conditions onboard? The report employs three primary methods to investigate this: a review of relevant regulations, semi-structured interviews with stakeholders, and an analysis of LinkedIn discussions on the topic. Additionally, a financial calculation illustrates the economic motivations driving compliance strategies.

The results suggest revisiting the threshold and introducing incentives, like reduced port fees, for ships prioritizing crew welfare. Eleven stakeholders were interviewed, including representatives from trade unions, shipping companies, and industry organizations. Respondents expressed concerns that the 5 000 GT threshold could unintentionally promote ship designs with substandard accommodations and working conditions. They emphasized the need for balance between environmental objectives and social sustainability to avoid exacerbating the already demanding conditions faced by seafarers. The report further identifies historical and current examples of when vessel size has been limited and adapted to meet size restrictions to avoid costs with negative effects for crew welfare.

The cost calculation example for general cargo vessels supports this further and highlights the financial incentives for designing ships below 5 000 GT. Avoiding the associated compliance costs will likely lead to large competitive advantages as stricter climate targets are introduced.

The report identifies a risk of carbon leakage, in part as smaller vessels are not included in the legislation and over time likely will become cost competitive and as smaller vessels are less energy-efficient and may undermine broader environmental

objectives. The emphasis on smaller vessels driven by the 5 000 GT threshold risks creating unintended negative consequences for seafarers. Policies such as port fee reductions or other economic incentives could encourage shipping companies to prioritize better onboard working conditions while meeting environmental goals.

The study concludes that revisiting the 5 000 GT threshold as well as other GT based cut-offs and aligning it with policies that promote both environmental and social sustainability is essential. Current regulatory frameworks inadequately address the intersection of environmental compliance and social sustainability. Balancing environmental and social sustainability isn't just a nice-to-have—it's a must. After all, what's a ship without its crew? Effective regulation must consider not only environmental impact but also the welfare of the workforce that sustains the industry. Future research should further explore the long-term implications of such thresholds and the potential for regulatory adjustments to mitigate adverse effects on seafarers.

# Sammanfattning

Denna rapport undersöker de potentiella konsekvenserna av storleksgränser i sjöfartsregler och lagstiftning för sjöfolks arbets- och levnadsvillkor. Huvudfokus ligger på de nyligen införda miljöbestämmelserna i Europeiska unionen (EU). Även om EU:s nya politik syftar till att minska utsläppen av växthusgaser och få med sektorn i klimatarbetet, finns det potentiella oavsiktliga konsekvenser för fartygens utformning och besättningens arbetsvillkor. I centrum för denna debatt står tröskeln på 5 000 GT (bruttodräktighet), som avgör om fartygen omfattas av de nya reglerna. Mindre fartyg, utformade för att minimera kostnader som kommer med att möta regleringarna, riskerar att begränsa besättningens utrymmen och försämra arbetsförhållandena.

Studien undersöker två primära frågor: (i) Påverkar restriktioner baserade på bruttodräktighet (GT) sjöfolks arbets- och levnadsvillkor ombord? (ii) Riskerar tröskelvärdet på 5 000 GT att sänka kvaliteten på sjöfolks arbets- och levnadsvillkor ombord? Rapporten använder tre metoder för att undersöka detta: en genomgång av relevanta regelverk, semistrukturerade intervjuer med intressenter och en analys av diskussioner på LinkedIn om ämnet. Dessutom illustrerar en finansiell beräkning de ekonomiska motiv som driver efterlevnadsstrategierna.

Resultaten visar att det kan vara viktigt att ompröva hur och när GT-baserade regler används och att överväga incitament, som sänkta hamnavgifter, för fartyg som prioriterar besättningens välbefinnande. Elva intressenter intervjuades, inklusive representanter från fackföreningar, rederier och branschorganisationer. De uttryckte oro för att gränsen på 5 000 GT kan leda till fartygskonstruktioner som försämrar boende- och arbetsförhållanden. De framhöll behovet av att balansera miljömål med social hållbarhet för att undvika att förvärra de redan krävande villkoren för sjöfolk. Rapporten lyfter även historiska och nutida exempel där fartygsstorlek anpassats för att undvika kostnader kopplade till storleksbegränsningar, vilket har påverkat besättningens välbefinnande negativt. Exemplet med kostnadsberäkningar för styckegodsfartyg stärker denna analys och visar på de ekonomiska incitamenten att bygga fartyg under 5 000 GT, där undvikandet av efterlevnadskostnader sannolikt ger en konkurrensfördel när klimatmålen skärps.

Rapporten identifierar en risk för att utsläpp flyttas från en reglerad sektor eller fartygstyp till en annan, mindre reglerad. Detta kan ske eftersom mindre fartyg inte omfattas av samma lagstiftning och sannolikt kommer att bli mer kostnadseffektiva över tid, trots att de ofta är mindre energieffektiva och kan motverka bredare miljömål. Tröskelvärdet på 5 000 GT riskerar också att driva fram en ökning av

mindre fartyg, vilket kan leda till negativa konsekvenser för sjöfolkens arbetsförhållanden. Politiska åtgärder, såsom sänkta hamnavgifter eller andra ekonomiska incitament, skulle kunna motivera rederier att prioritera bättre arbetsvillkor ombord samtidigt som de uppnår miljömålen.

Sammantaget är det nödvändigt att omvärdera tröskelvärdet på 5 000 GT och andra liknande GT-baserade regler för att utveckla en politik som stödjer både miljömässig och social hållbarhet, exempelvis genom att exkludera välfärdsfrämjande ytor. Det nuvarande regelverket hanterar inte tillräckligt kopplingen mellan miljöhänsyn och sjöfolkens välfärd. För att effektiv reglering ska fungera måste den balansera båda dessa aspekter. Framtida forskning bör undersöka de långsiktiga effekterna av sådana tröskelvärden och möjligheten att anpassa regler för att mildra negativa konsekvenser för arbetskraften inom sjöfartsbranschen.

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# 1 Introduction

In the maritime industry, good working environment and conditions onboard are significant, competitive advantages and are often highlighted both in recruitment and new builds (Rai, 2020). This includes not only their physical health and safety but also their mental health, job satisfaction, and the ability to maintain meaningful connections with family and friends (Lanner et al., 2020). The seafarers onboard are a key part of the business, and investments in seafarers' working and living conditions should be profitable for shipping companies which prioritize good working conditions on board. Historically, labor conditions in the sector have been inadequate, with issues such as long working hours, isolation, limited access to healthcare, and substandard living environments being frequently reported (Larsson et al., 2024). This underscores the importance of ensuring a fair, safe, and healthy working environment for all those working in the maritime industry and to promote the sustainable development of the sector in the long term (Zhou et al., 2023). However, as the industry moves towards greater environmental responsibility, there is concern whether new environmental regulations could negatively impact the seafarers' working conditions.

To reduce greenhouse gas emissions from shipping, various policy instruments are introduced and proposed, such as the European Unions (EU) Fit for 55 (European Commission, 2023a). The EU Fit for 55 initiative introduces policies to bring the shipping sector in line with European climate goals. Since 2024, shipping activities are included in the European Emissions Trading System (EU ETS), creating a financial incentive to reduce emissions. Additionally, the FuelEU Maritime directive mandates a gradual reduction in the greenhouse gas (GHG) intensity of shipping fuels (European Commission, 2023b), and the Alternative Fuels Infrastructure Regulation (AFIR) requires that certain ports offer shore-to-ship electricity, reducing in-port emissions from vessel power generation.

The FuelEU Maritime and EU ETS regulations are designed to complement one another. FuelEU Maritime directly targets the carbon intensity of the fuels used by shipping, encouraging a shift to energy sources with lower environmental emissions. Meanwhile, the EU ETS imposes a direct economic cost on GHG emissions, motivating companies to reduce fuel consumption and emissions overall. Together, these policies aim to establish a new standard for sustainable maritime operations, driving the sector toward a lower-carbon future.

The Fit for 55 regulations only apply to ships over 5 000 GT. Vessels exceeding this tonnage are subject to the EU ETS and FuelEU maritime, while those below it are not. This cut-off

has raised concerns within the industry that it may inadvertently incentivize the use of smaller vessels or altered ship designs to avoid regulatory costs. GT is a volumetric measurement based on the total internal enclosed space of the ship, calculated from the molded volume of all spaces available for cargo, passengers, crew, stores, and shelters. As a result, GT reflects the overall size of a ship in terms of its internal capacity, rather than its actual weight or cargo carrying capacity. There are no legislative precedents of a 5 000 GT threshold at the IMO or in the EU before of the introduction of the Monitoring, Reporting, and Verification (MRV) regulation. IMO climate policies pre 2018 all targeted vessels exceeding 400 GT (Transport & Environment, 2022) and EU legislation has drawn various lines.

Within the industry, there is growing concern that an increasing number of new builds will aim to register below the 5 000 GT threshold, potentially creating competitive advantages in certain segments. Such adjustments could prioritize cargo space over crew accommodations, raising concerns about the impact on onboard working conditions and seafarer welfare. Another worry is that new builds might prioritize cargo space even further at the expense of crew accommodations, undermining what is generally referred to as the conditions for a sustainable working life. All these aspects could affect working conditions on board, making it essential to identify the industry's perspective on this and the impacts of new policy instruments. The risks associated with such policy measures must be highlighted and the policies must never conflict with a sustainable working life.

To some extent, working and living conditions on board are regulated through international labor and safety standards, including those set by the International Labor Organization (ILO), the Maritime Labor Convention (MLC), and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) as well as national regulations. All of these must be complied with and monitored, but they are minimum requirements. While these frameworks establish minimum standards, industry participants worry that new GHG measures may inadvertently compromise onboard working conditions if ship design shifts in response to regulatory pressures.

## 1.1 Aim and problem formulation

A well-designed onboard work environment should address physical, cognitive, and ergonomic factors to avoid excessive workloads and to maintain safety and health standards. Given the existing concerns and the need for knowledge to ensure a good and sustainable working environment at sea, this report explores the potential impacts of these new regulatory thresholds, particularly the 5 000 GT limit, on ship design and onboard working environments. The EU ETS and FuelEU Maritime introduces specific requirements for ships

above 5 000 Gross Tonnage (GT), which could incentivize shipping companies to use smaller vessels to avoid these regulations. This research explores two primary questions:

(i) Do restrictions based on gross tonnage (GT) impact the working and onboard living conditions of seafarers?

(ii) Does the 5 000 GT threshold risk lowering the quality of seafarers' working and living conditions onboard?

This study was conducted in collaboration between IVL Swedish Environmental Institute and VTI Swedish National Road and Transport Research Institute. It was initiated by Lighthouse and financed by Stiftelsen Sveriges Sjömanshus.

# 2 Methodology

This chapter outlines the methods used throughout this study and gives an outline of the materials gathered. Three primary data gathering methods were used: a review of regulation, semi-structured interviews, and an analysis of LinkedIn discussion on the topic. In addition to this, a calculation example is used to show the potential economic incentive between a vessel above or below 5 000 GT.

A literature review was performed where the Maritime Labor Convention, ILO, the Work Environment Act, the Swedish Work Environment Authority's regulations on organizational and social work environment, AFS 2015:4 were summarized to investigate the minimum requirements and conditions for work on board.

Interviews were made with trade union representatives, employee representatives, the Swedish Maritime Industry Association, shipping company representatives and the Swedish Maritime Administration to study how they believe the new regulations/instruments will affect the industry.

In total, 11 respondents were interviewed, from five different types of institutions: Research institute, Government agency, Coordinating organization/Research funder, Industry organization, and Trade unions. Characteristics of the interviewed stakeholders are presented in Table 1. The interviewees were informed about the purpose of the interview before accepting. No monetary compensation was given nor were there incentives. All interviewees gave consent to being recorded and were informed that their participation was fully voluntary and that they could withdraw their participation at any point. All gathered data was pseudonymized and treated in accordance with the General Data Protection Regulation.

*Table 1 Interviewees*

| Interview | Role | Organization type | Date | Length (hours) |
|---|---|---|---|---|
| 1 | Educator | Government agency | March 2024 | 2 |
| 2 | Legal expert | Research institute | March 2024 | 1.5 |
| 3 | Project manager | Government agency | March 2024 | 1.5 |
| | Project manager | | | |
| 4 | Director | Competence Centre | March 2024 | 1.25 |
| 5 | Communication Officer | Trade organization | March 2024 | 1.5 |
| 6 | Skills supply, competencies, and staffing | Trade organization | March 2024 | 1.5 |
| 7 | Ombudsman, Regional Safety Officer | Trade union organization | March 2024 | 1.5 |
| | International Trade Union Confederation Inspector | | | |
| 8 | Researcher | Research institute | March 2024 | 1.5 |
| 9 | Pilot | Government agency | April 2024 | 1.25 |

Two authors and one or two representatives from each organization participated in each interview. One author acted as the primary interviewer, while the secondary author took notes, actively listened, and added supplementary questions. The interviews were conducted through video conferences between March 2024 and April 2024. The audio recordings were transcribed into text and analyzed.

The interviews were coded using the theoretical framework "Reflective thematic analysis", as presented by Braun and Clarke (Braun & Clarke, 2006) and further developed in Braun and Clarke (2019) and Braun and Clarke (2021). The analysis and interpretation of the qualitative data has been an iterative process of moving back and forth between data collection and analysis to gather rich data and interesting findings.

# 3 Legislation and policy

This chapter outlines the key legislative aspects identified in this study. The material is primarily targeted to two areas: Climate regulations and regulations of social welfare at sea. As most interviewees are from the Swedish legislative context, also some relevant Swedish legislation is summarized to give a more comprehensive picture of the findings.

## 3.1 European climate regulations

The FuelEU Maritime (European Commission, 2023b) and EU ETS legislations (European Commission, 2023a) represent the EU's most ambitious efforts to date in decarbonizing the maritime sector. The overarching goal of FuelEU Maritime is to create a stable and predictable regulatory environment that incentivize investments in low-emission fuels.

**FuelEU Maritime** target the greenhouse gas (GHG) intensity of fuels used in the shipping sector (European Commission, 2023b). The regulation sets targets to lower the carbon footprint of maritime fuels, mandating reductions in GHG intensity over time. FuelEU Maritime establishes binding targets that reduce the allowable GHG emissions per energy unit of fuel over specified periods. The reduction requirements in GHG intensity are shown in Figure 1. These targets incrementally tighten to reduce reliance on conventional high-emission fuels and promote the adoption of alternative fuels such as biofuels, hydrogen-based fuels, and synthetic fuels. The phased approach means that starting in 2025, shipping companies calling at EU ports will need to use increasingly cleaner fuels or otherwise demonstrate compliance with GHG intensity limits.

Shipping companies which fail to meet the GHG intensity targets will face penalties, designed as a deterrent and as an incentive for compliance. Revenues from penalties are expected to support further research and development in clean maritime technologies. The penalty is designed to meet the cost of renewable and is set to 2400 euro per metric tonne of very low sulfur fuel oil (European Commission, 2023b).

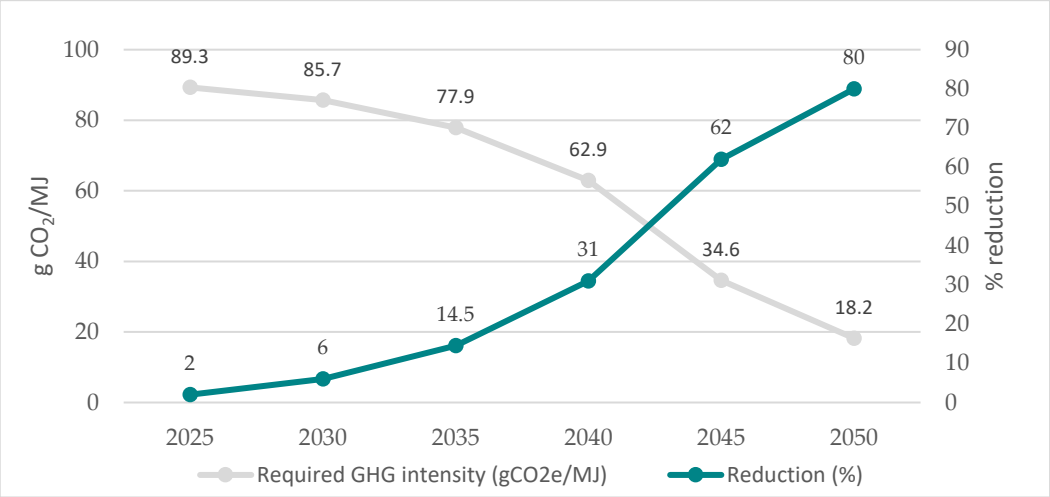


*Figure 1 The GHG intensity requirement levels and equivalent reduction targets stipulated in the FuelEU Maritime regulation. The calculation is done on well-to-wake basis and its upstream emissions(well-to-tank) is synced with the Renewable Energy Directive.*

The **EU Emissions Trading System** (EU ETS) (European Commission, 2023a) is the EU's carbon pricing mechanism, first launched in 2005. The system operates on a "cap-and-trade" model, which sets a limit on the total amount of GHG emissions allowed from sectors covered by the system and allocates or auctions emission allowances. These allowances can then be traded on the carbon market, creating an economic incentive for companies to reduce their emissions.

In 2024, the EU ETS extended to cover the maritime sector, marking a significant regulatory shift for shipping companies operating within EU waters. Shipping companies will need to purchase and surrender allowances equivalent to their verified emissions. This plan phases in over three years, covering 40% of emissions in 2024, 70% in 2025, and 100% in 2026.The inclusion of shipping in the EU ETS will cover $CO_2$, $CH_4$ and $N_2O$ emissions ($CH_4$ and $N_2O$ from 2026) from vessels that arrive at, depart from, or operate within EU ports. This measure applies to intra-EU voyages, as well as to 50% of emissions from extra-EU voyages, reflecting a commitment to holding operators accountable for a substantial portion of their emissions footprint. The legislation applies for cargo and passenger vessels over 5 000 GT, and from 2027 also for offshore ships above 5 000 GT.

Revenue generated through the sale of allowances in the maritime sector will be allocated to the sector through the European innovation fund. The intent is for the revenues to fund climate action initiatives, including investments in cleaner maritime technology and infrastructure. This reinvestment model aims to support the sector's transition by addressing key barriers to decarbonization, such as high costs and limited availability of alternative fuels and technologies.

## 3.2 Legal requirements on social welfare and their implementation

Below follows a summary of the identified and reviewed international and national regulations which guards social welfare at sea. We primarily highlight how the regulation interacts with potential space requirements onboards.

International shipping is primarily regulated through a combination of international conventions, national laws and regulations, industry standards, and best practices (Stopford, 2009). The International Maritime Organization (IMO) operates as a specialized agency of the United Nations responsible for regulating international shipping. The IMO is based in London and deals with everything to do with shipping and maritime safety, such as ship design, equipment, cargo handling and manning, as well as requirements for the competence and training of ships' crews.

### 3.2.1 The Maritime Labour Convention

The Maritime labour conventions is the result of several separate initiatives to establish minimum working and living standards for seafarers. This convention aims to ensure decent working conditions for seafarers and to establish fair competition in the market. Sweden ratified the Maritime Labour Convention (often referred to as MLC, 2006) in 2012, and it came into force on 20 August 2013, mandating that all ships engaged in international voyages hold an MLC certificate. In Sweden, the Convention is largely incorporated into existing laws, regulations, and collective agreements, although some adjustments to Swedish legislation have been necessary for compliance.

The shipowner is ultimately responsible for meeting MLC requirements, even when the seafarer is employed by/recruited through a recruitment and placement service. It mandates flag States to conduct maritime labor inspections twice every 5 years to ensure that shipowners fully comply with living and working conditions, and to investigate and resolve complaints made by seafarers promptly.

The regulation stipulates a range of minimum requirements, such as access to warm and cold water, there being sleeping quarters for the crew, and standards for noise and light. Particularly title 3 and 4 in the regulation are relevant for this report. Title 3 covers accommodation, recreational facilities, food, and catering, with 3.1 specifically addressing accommodation and recreational facilities. Title 4 addresses health protection, medical care, and social security protection.

There are no special aspects for vessels below 5 000 GT, but there are several exceptions for ships below 3 000 GT, for example are they exempted from having a day room/sitting room and do not have a minimum requirement for floor space in a cabin.

The MLC is very strict and clear regarding, for example, the design of cabins, their placement on board in relation to various locations such as the engine room. It is also strict about, for instance, dining room furnishings. However, when it comes to access to rights to communication such as good internet, it is not as strict. This is included in the guidelines as follows:

> *"Guideline B3.1.11 – Recreational facilities, mail, and ship visit arrangements*
>
> */.../ 4. Consideration should also be given to including the following facilities at no cost to the seafarer, where practicable:*
>
> */.../(j) reasonable access to ship-to-shore telephone communications, and email and Internet facilities, where available, with any charges for the use of these services being reasonable in amount."*

The MLC also specifically covers reporting related occupational accidents, injuries, and diseases:

> *"Guideline B4.3.5 – Reporting and collection of statistics*
>
> *1. All occupational accidents and occupational injuries and diseases should be reported so that they can be investigated, and comprehensive statistics can be kept, analyzed, and published, taking account of protection of the personal data of the seafarers concerned. Reports should not be limited to fatalities or to accidents involving the ship."*

Guideline B4.3.6 specifies this further and states that:

> *"1. The competent authority should undertake investigations into the causes and circumstances of all occupational accidents and occupational injuries and diseases resulting in loss of life or serious personal injury, and such other cases as may be specified in national laws or regulations."*

However, when discussed in the interviews the consensus seems to be that this interpreted in praxis as physical health and safety only and that the investigations of reasons often lack in depth. With this we mean that "human error" is said as the reason when any form of decision making is in play, even if the cause might be fatigue or inadequate/lack of facilities needed for rest or a good work environment etc.

### 3.2.2 International Convention for the Safety of Life at Sea

The International Convention for the Safety of Life at Sea (SOLAS) (Solas, 2003) sets out minimum standards for the construction, equipment, and operation of ships to ensure their safety. It is primarily enforced by flag states to ensure compliance by ships under their flag through various certificates. In Sweden, parts of SOLAS are integrated into national legislation, part under the Civil Contingencies Agency, which falls under the Ministry of Defense. SOLAS imposes various safety requirements, including specific life-saving appliances, fire protection measures, and navigational equipment for ships at or above 5 000 GT but also include other size cut-offs, such as 300 GT for specific safety requirements.

The main purpose of SOLAS is to establish essential safety requirements onboard ships, focusing on construction, equipment, and operational standards. While its primary aim is safety rather than social sustainability, certain chapters are relevant:

Chapter III Life-saving appliances and arrangements: This chapter includes requirements for life-saving appliances and arrangements, including requirements for lifeboats, rescue boats and life jackets according to type of ship. The International Life-Saving Appliance (LSA) Code gives specific technical requirements for LSAs and is mandatory under Regulation 34, which states that all life-saving appliances and arrangements shall comply with the applicable requirements of the LSA Code.

Chapter XI-1 Special measures to enhance maritime safety: The chapter clarifies requirements relating to authorization of recognized organizations (responsible for conducting surveys and inspections on administrations' behalves); enhanced surveys; ship identification number scheme; and port state control on operational requirements.

These chapters ensure that ships meet specific technical and operational criteria to enhance safety at sea, although their focus is on regulatory compliance rather than broader social sustainability goals.

### 3.2.3 International Safety Management Code

The International Safety Management (ISM) Code (Moore & Roberts, 1995) was developed by the IMO and has been incorporated into Swedish legislation through an EU regulation. For ships not covered by this regulation, simplified documentation requirements apply according to TSFS 2009:1. The ISM code deals with safety at sea and aims to prevent harm to people, the environment or property. The code applies to safety on board, including the working environment. However, companies' quality assurance of production and the

environment in general is voluntary and can be carried out under different systems. The ISM Code applies to all shipping companies operating at sea. Each shipping company must have an organization that develops and maintains the safety organization both within the company and on the ships.

### 3.2.4 The Swedish Working Environment Act

The Working Environment Act applies to virtually all work carried out by employees on behalf of employers. It applies, for example, to sole traders, to family businesses and to pupils and conscripts in training. As of 2003, the Working Environment Act also applies to ships and ship work.

For personnel on Swedish ships, except for fishing vessels, there is a law on rest periods. It states that the rest period may not be less than 10 hours in any 24-hour period, nor less than 77 hours in any 7-day period (SFS 1998:958 §4). The master is responsible for ensuring that there are rules of procedure on board the ship. It shall contain details of the seafarers' duty schedule at sea and in port and of rest periods. The duty roster shall be posted in an appropriate place on board. A record of working hours must also be kept on the ship. Exceptions to the provisions of the Act may be made by collective agreement.

The Swedish Work Environment Authority's regulations (AFS) puts requirements on various aspects which are not addressed in the MLC and is a requirement to follow for ships under Swedish flag.

For Swedish-flagged vessels, employers must ensure that managers and supervisors have the knowledge and practical skills to address unhealthy workloads and bullying effectively, which includes setting health-promoting organizational goals and integrating these into all levels of the organization. Crew members should actively participate in and understand these goals, which are supported by a comprehensive work environment policy.

To protect crew welfare, employers are required to mitigate unhealthy workloads by adjusting staffing, task variety, and recovery opportunities, adapting tasks to the physical and cognitive demands of the job. This is particularly significant for smaller vessels, where limited crew size can intensify workloads and restrict division of labor. Employers must consider ergonomic conditions and carefully plan work hours, especially as health risks can arise from irregular schedules and long working hours often seen in shipping. A robust framework for handling bullying is also mandatory, with clear procedures and unbiased investigations to safeguard crew health. Overall, these requirements underscore the importance of adapting work environment standards not only to vessel size but to the

unique operational challenges within the maritime context, supporting crew welfare regardless of vessel capacity.

The regulations place responsibility on employers but provide limited mechanisms for monitoring compliance aboard vessels at sea. This gap means that ship owners and operators may not be held accountable as rigorously as land-based employers, especially in international waters where oversight is more challenging.

# 4 Effects of GT based regulations

GT does not directly correlate with a ship's power or its environmental impact, such as its carbon emissions or fuel efficiency. Gross tonnage (GT) is based on the total enclosed volume of the ship, while net tonnage reflects the volume of the cargo spaces, with adjustments for passenger capacity.

While gross tonnage provides insight into a vessel's internal volume, it does not account for key parameters like the ship's carrying capacity or structural efficiency. A ship may have a high gross tonnage due to a large volume of non-cargo spaces such as accommodations, crew facilities, and other enclosed areas designed to enhance safety, comfort, and compliance with social standards. These features can increase the gross tonnage without affecting the deadweight tonnage (DWT), a more traditional and weight-based metric used to measure how much cargo a ship can carry. Deadweight tonnage is often considered a more relevant parameter when assessing a vessel's economic capacity and operational efficiency (Stopford, 2009).

There are no legislative precedents of a 5 000 GT threshold at the IMO or in the EU before of the introduction of the Monitoring, Reporting, and Verification (MRV) regulation. IMO climate policies pre 2018 all targeted vessels exceeding 400 GT: the Energy Efficiency Design Index (EEDI), the Energy Efficiency Existing Ship Index (EEXI), and the Ship Energy Efficiency Management Plan (SEEMP) (Transport & Environment, 2022). European Union (EU) legislation has drawn different lines, with rules on ship recycling and port facility security applying to ships over 500 GT. Moreover, the EU's statistical regulations for maritime transport offer exemptions for vessels under 100 GT, further reflecting the varying thresholds used for different regulatory objectives. The EU Commission is also tasked with investigating, by 2026, whether the 5 000 GT threshold in the Emissions Trading System (ETS) needs to be adjusted.

*Table 2 Examples of current regulations which include a GT based cut-of threshold*

| **Examples of GT based exceptions in regulations** | |
|---|---|
| Regulation | GT threshold (GT) |
| the Energy Efficiency Design Index (EEDI) | 400 |
| the Energy Efficiency Existing Ship Index (EEXI) | 400 |
| the Ship Energy Efficiency Management Plan (SEEMP) | 400 |
| the EU Monitoring, Reporting, and Verification (MRV) regulation | 5 000 |
| the EU ship recycling | 500 |
| the EU's statistical regulations for maritime transport | 100 |
| the EU Emission trading system | 5 000 |
| FuelEU Maritime | 5 000 |

The measurement of tonnage is governed by the International Convention on Tonnage Measurement of Ships, a standard established by the International Maritime Organization (IMO) in 1969 and enforced from 1982 onward. This convention provides the methodology for calculating both gross and net tonnage, which is reflected in Swedish legislation, specifically the Förordning (1994:1162) om skeppsmätning (Regulation on Ship Measurement).

When introducing the size cut-off, the European Union argued that the administrative burden for including a larger part of the vessel fleet would be too great. The justification was that 45% of the vessel fleet would be excepted but only 10% of the emissions. However, the amount of GHG emissions from maritime traffic below 5 000 GT is not fully understood yet. The actual estimates vary depending on sources, where for example Transport & Environment (2022) investigated the emissions from all vessels under 5 000 GT from 2019 and found that ships under 5 000 GT generate $CO_2$ emissions up to 19.7 $MtCO_2$ within the scope of the European union, which is more than half of the yearly $CO_2$ emissions of for example Sweden. Ships below the 5 000 GT cut-off are also shown to have higher average emissions per ship and transport work than ships above the threshold (Transport & Environment, 2022). Fridell et al. (2022) had a similar scope and estimated that vessels below 5 000 GT accounted for 20% of emissions in European waters.

In the Hope project, the analysis showed that for the Swedish region the largest emitter of GHG emissions for vessels below 5 000 GT is for general cargo (see Figure 2), where most GHG emissions are from this segment. Styhre et al (2024) estimated the total share of $CO_2$ eq. emission (well-to-wake) of general cargo ships below 5 000 GT calling Swedish ports was 13% in 2022. This segment of ships made most general cargo port calls during the period (73% of the total general cargo fleet calling to Swedish ports).

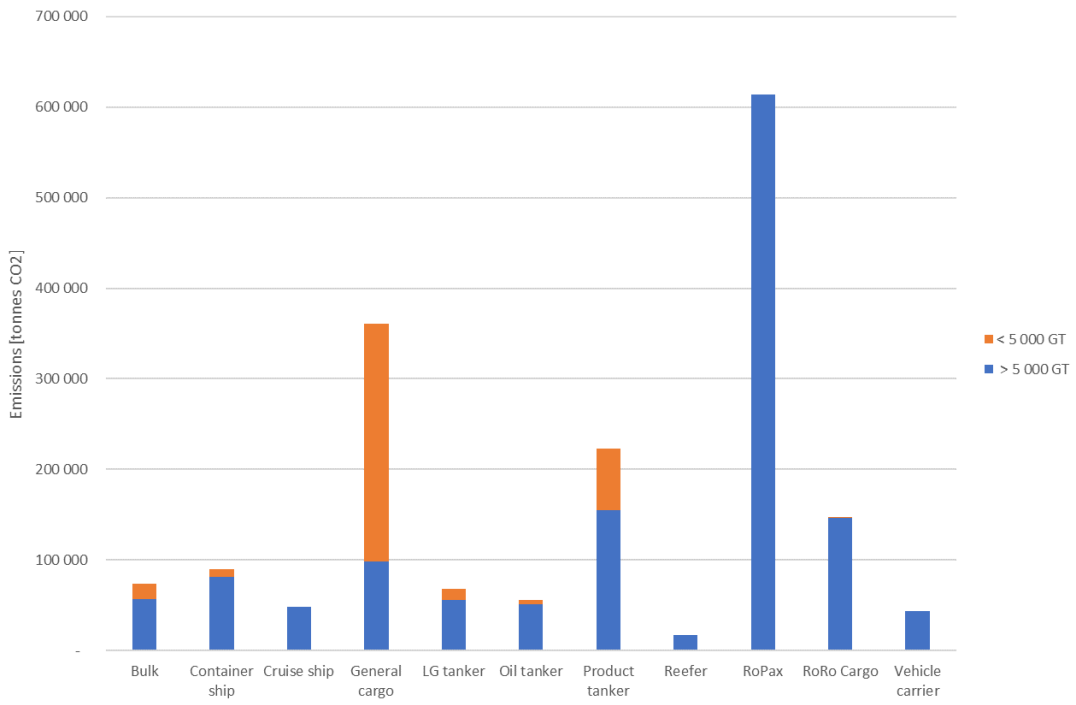


*Figure 2 Emissions of $CO_2$ equivalents per vessel category, divided on vessels below and above 5 000 GT.*

## 4.1 Interviews

The respondents' familiarity with the new EU ETS regulatory framework varied. Some were very familiar, while others had only a vague idea of what it contains. When asked about it, some were more focused on the effects the regulations will have on fuel type and the difficulty in knowing what technical solution to go with, while others talked about effects on social spaces onboard. One respondent also reasoned that new types of fuel, which due to their density will take up more space, may compete with space for personnel on board.

> *"The thing is that every such limit becomes a threshold, a threshold effect. Those who are very close to it will choose to lay below the threshold. The first things you won't build is the squash hall, bridge wings, and other such spaces that don't generate revenue." Interview 6*

Respondents who weren't familiar with the new regulations still hade examples – both modern and from the past – of ships, or parts of ships, that had been designed to minimize the gross tonnage to get below certain thresholds. They also thought it as likely that this will happen for ship designs around 5 000 GT as well. Some of these examples were modern ships designed at 19 999 GT to avoid installing an inert gas system, ships at 2 998 GT sailing

in lake Vänern and on coastal tonnage during the 70's designed at 499 GT using shelter decks that were optimized on freight but, consequently, had problems with stability. Other examples mentioned where old ships with chimneys and masts designed in a U-shape to keep the gross tonnage down, or ships design with a cropped bow/stem to avoid having to use a tugboat in certain harbors.

> *"There are so many that are designed for 19 999 [gross] tons. Because otherwise they must install an inert gas plant. So, if there is another legislation- if they are in the vicinity, they will for sure reduce it, every day of the week. If new legislation costs money, and it does, to implement and build new or whatever. That's how they've always worked." Interview 9*

According to the respondents, the reason why this happens is to avoid extra costs that come with e.g. different classes or harbor fees based on gross tonnage or other size constraints. Several of the respondents say that when a ship is designed to stay under a certain gross tonnage limit, the spaces being deprioritized are those that would benefit the personnel. This since they are not thought of as something that brings in money. We outline the historical context of these exceptions further in the section 4.4.

> *"Some ships that might supply Lake Vänern with various things may be built to 2 998 gross tonnes. If you are at 3001, there are completely different qualification rules. Then you ask yourself "Should I build that crew compartment or bridge wings?" or if it encloses some kind of pipe tunnel. Because I can't reduce the load capacity. That's out of the question." Interview 6*

Aside from direct size cut-offs due to added legal requirements, the respondents also brought up examples of when costs scale depending on the GT of the vessel. The fees are often set based on GT, which is not a reflection of the cargo space or passenger number onboard the vessel and therefore leads to positive spaces for the crew to be removed. Port fees was the most frequently discussed:

> *"When they have built bigger gyms or separate cabins for everyone, you have to pay more in port fees. Port fees are based solely on GT." Interview 4*

Some respondents directly brought up competition between ships over and under size cut-offs and how the threshold might lead to more smaller ships with worse environmental performance and worse working conditions due to smaller or less personnel spaces being used.

> *"And then they say that 'Most ships are bigger'. Yes, but those who are there at 5 000 or 6 000, yes 6 000 for example, do not benefit from the fact that*

> *73 000 other ships are above the limit because their competitors are not there, but it is those who are smaller, or those who are in exactly the same size range." Interview 4*

> *"The smaller vessels that are under 5 000, but also perhaps the next limit if you now start to regulate down to 400 gross tonnage. Then you suddenly might have a competitive advantage for the ships that are smaller. I would say that these vessels have- it can be more difficult to achieve a good working environment on a small vessel and if you then regulate the larger ones and leave the smaller ones unregulated, you may then favor the smaller ones. And not only are they less energy-efficient and have a higher environmental impact, you may be favoring ships that have a poorer working environment on board, which feels a bit strange." Interview 8*

All interviewees agreed that there is a risk that personnel spaces are threatened, but to which extent varied. One respondent claim that for instance cabin size is clearly specified in MCL (Maritime Labour Convention) and therefore is not negotiable.

> *"There are requirements in the MLC on how big it should be, how big the cabin should be and how big the window should be. You can't get away from that." Interview 1*

Another respondent on the other hand describes that when building a ship you start at the top priority, which is the bridge, and then work your way from the captains' cabin down to what are considered less important spaces, such as the kitchen or other personnel spaces, and therefore the exact specifications and quality might suffer.

> *"When designing you often start with a bridge, because it's the most important. Then you work your way down; there must be a captain's cabin and a chief and stuff like that. And then what remains is the kitchen and where our employees work." Interview 7*

Another important aspect when looking at ship design is not only to look at the spaces in themselves but also how they connect and enable good workflows. Modern ships tend to use up more void space than before, which can cause problems for the staff working in them.

> *"Spaces that may not have been utilized before, it was just some void space, they are now starting to be used. And then you have to put a 300kg piece of machinery down there, and that poses quite a problem. I look at the boats a lot when I get the drawings, to make sure it's possible to transport things in a good way. And it hasn't gotten any better, but every tiny little bit of space on*

*board the ships today is utilized in a way that wasn't done in the past." Interview 7*

During the first interview, a question arose regarding the effectiveness of managing factors directly related to ship design, specifically whether regulations are rigorously followed. It was noted that issues requiring interpretation or those that manifest during the ship's operational phase are more challenging to address than ship design issues. Above, we see that internet quality is not strictly regulated, but it would also be difficult to control during the actual shipbuilding. Ensuring that people do not have to pay for using the internet is also difficult to control without conducting an impromptu inspection in the middle of the Pacific Ocean (i.e., not very likely).

When building areas for social interaction and leisure, such as common rooms, saunas, or gyms, as well as when covering the piping onboard a tanker to improve the work environment and reduce the risk of oil spill, these improvements increase the gross tonnage which already today is an issue as it leads to higher port fees.

*"Many times, the crew is a variable where you can influence your costs. Bunker, provisions, pilotage costs etc. are often constant. It's not something you can negotiate to any great extent - you can't haggle at the gas station. But the crew, there you can influence." Interview 7*

Social activities become important both for recovery and to have something resembling spare time, while they at the same time help build teams. However, there are big differences between different types of ships as well as how much shipping companies prioritize spaces to facilitate these types of spaces.

*"There are big differences within the global merchant fleet. It depends on how much you are prepared to invest. It's not the cost of building that is the big thing. Member companies reach out about this. You are penalized for it. Building a squash hall is difficult today. The enclosed area is calculated in gross tons. Port fees etc. are paid depending on gross tons." Interview 6*

*"It's very different on ships. On ferry services, there are often a lot of leisure areas, so you tend to slim down in offices. There you can see that people sit in hovels. On cargo ships it's often the other way around. If you want to move around, you just run on deck. I've seen boats where they put a small bathtub on deck that no one uses. The sailors get very creative. They put up basketball hoops with magnets to play basketball in cargo holds." Interview 7*

The Donsö shipping companies are described as prioritizing wellness spaces, such as gyms, day rooms and common rooms when designing their ships. Of these, Terntank is the most often mentioned example.

> *"Some invest money when they build the boats, others do not. There may be boats where the shipping company brings paintings and hangs them up. There may be boats where there are steel bulkheads in the interior. So there is no dampening sound, it's just steel. That's what you have in your everyday life all the time. Mechanically, it's very different. Some have good quality stuff that works all the time and some that you have to repair all the time. They have bought it for cheap then." Interview 9*

## 4.2 Design examples

We have identified historical cases where ships have been built just under a Gross Tonnage (GT) limit to avoid higher fees and regulations. Regulatory thresholds have historically shaped vessel designs to balance compliance with operational efficiency.

An inert gas system, for example, is a fire prevention measure that injects non-flammable gas (usually exhaust gas) into cargo tanks to prevent explosions. However, these systems are costly to install and maintain. Some tanker owners, particularly in the 1970s and 1980s, designed vessels just below the 20 000 GT threshold (e.g., at 19 999 GT) to avoid this requirement. This allowed them to operate larger vessels while avoiding the additional cost and complexity of an inert gas system, a strategy that optimized operational costs but sometimes compromised safety compared to larger, regulated vessels. In 2016, SOLAS was amended to require the newbuilt vessels from 8 000 dwt, and there are calls in the industry to include all tanker sizes in the requirement.

Lake Vänern, located in Sweden, has shipping routes that connect it to the sea via the Göta Älv. Regulatory requirements are typically stricter for ships above certain GT thresholds, often tied to environmental and safety standards. By designing vessels at 2 998 GT—just under a common regulatory limit of 3 000 GT—owners could operate relatively large vessels on the lake without incurring the additional regulatory burdens that come with the larger tonnage. This allowed them to move sizable cargoes more economically on inland waterways and maintain flexibility in operations without needing to meet stricter regulatory standards applied to slightly larger vessels.

In Sweden during the 1950s and 1960s, vessels of 500 GT or more had higher crew requirements on the vessel than smaller ships. By designing ships just below the 500 GT threshold (e.g., at 499 GT) and using shelter decks, shipbuilders could increase the usable

cargo volume without exceeding the regulatory limit that would trigger stricter requirements (Bång et al., 2011). Shelter decks, which are additional partial decks typically enclosed with removable panels, were a common design feature used to effectively increase cargo space on these smaller vessels. This practice allowed coastal cargo vessels to maximize capacity while remaining under the 500 GT threshold, thus avoiding additional safety and operational requirements. Norway has also had similar effects due to size restrictions, where smaller boats have been built so that they don't exceed the length and depth requirement, resulting in almost square vessel designs.

Adaptations such as these reflect the tension between regulatory compliance costs and the economic interests of shipowners, demonstrating how regulations can lead to industry practices that creatively maximize flexibility within the legal framework.

## 4.3 Costs

The 5 000 GT threshold is not the only initiative with cut-off based on vessel size; there are multiple systems where interventions in ship design and construction can lead to discounts. We have identified the following drivers where costs for the vessel increase with higher GT or higher dwt:

- Increased safety requirements (for several thresholds)
- EU ETS (above 5 000 GT)
- FuelEU Maritime (above 5 000 GT)
- Increased personal costs due to additional requirements
- Increased port fees
- Increased administration fees
- Increased number of inspections
- Increased administrative demands

This list is likely not complete but reflects the findings of this study. However, there are also economic disadvantages to using smaller ships. One key drawback is their lower cargo capacity, which may require more trips to transport the same amount of goods. This can result in higher overall transport costs and a greater environmental impact. Additionally, larger ships benefit from economies of scale, meaning the cost per unit of cargo is generally lower for bigger vessels compared to smaller ones. The energy demand per cargo unit is lower as the vessels get larger. Certain markets and shipping routes may require larger ships to remain economically viable, particularly in long-distance shipping.

#### 4.3.1.1 Cost calculation

As the different motivations for when to adhere to a legislation appear to be driven primarily by cost, an example of how the costs for vessels above and below the 5 000 GT threshold is of interest. We use the general cargo segment as an example since this segment has a large share of the vessels below 5 000 GT today and might be able to have a more flexible shipping structure due to the variety of goods markets they can ship products from and on.

Four vessels of different sizes and built years were chosen to give an indication of the cost for EU ETS and FuelEU Maritime per vessel over time (shown in Table 2). The vessels are real life examples in use today in the northern European region. They were chosen to represent different vessel sizes and to have similar use cases; they are all used to primarily transport cargo at around 14 knots on open water routes. The data were gathered from MRV (the Monitoring, Reporting, and Verification database) and the database associated with the Clean Shipping Index. Data on the fuel consumption etc. of vessels below 5 000 GT are not as accessible, and the relationship between fuel consumption and vessel size is not linear (Vierth et al., 2022), but we assume a less efficient vessel per transport work. We assume the fuel consumption per tonne nautical mile travelled is 20% higher for the vessel under 5 000 GT than the most efficient vessel of vessel 1-3. Vessel 4 indicates the vessel below 5 000 GT (at 4 287).

*Table 3 Vessel data used for cost calculations gathered from the Monitoring, Reporting, and Verification database and the Clean Shipping Index database*

| | Vessel 1 | Vessel 2 | Vessel 3 | Vessel 4 |
|---|---|---|---|---|
| GT | 5 335 | 16 037 | 6 540 | 4 487 |
| DWT | 6 800 | 20 396 | 9 141 | 5 200 |
| Total fuel consumption [tonnes] | 1 700 | 2 350 | 2 200 | 1 700 |
| Annual Time spent at sea [hours] | 4 150 | 2 660 | 4 350 | 4 200 |
| Total $CO_2$ emissions [tonnes] | 5 420 | 7 520 | 7 120 | 5 500 |
| Fuel type | Marine diesel oil | Marine diesel oil | Ultra-Low Sulfur Fuel Oil | Marine diesel oil |
| Build year | 2008 | 2006 | 1999 | 2024 |

The assumed costs for EU ETS and fuel are given in Table 3. The future costs for EU carbon permits will increase, as this is a fundamental mechanism of the EU ETS system. We have assumed an increase in two steps: to 100 €/tonne $CO_2$ as an average in 2030, and to 150 €/tonne $CO_2$ as an average in 2040. The fuel cost is assumed to be constant, while other

studies show it rising in the future due to increased production costs (Solakivi et al., 2022). FuelEU maritime penalties were calculated based on the legislation's appendix I-V, where the penalty is set to 2 400 euros per equivalent metric ton of VLSFO (European Commission, 2023b).

*Table 4 Calculation assumptions*

| | Euro per tonne CO2 | MGO cost per tonne [€/mt] | ULSFO cost per tonne [€/mt] |
|---|---|---|---|
| 2025 | 60 | 644 | 506 |
| 2030 | 100 | 644 | 506 |
| 2035 | 100 | 644 | 506 |
| 2040 | 150 | 644 | 506 |
| 2045 | 150 | 644 | 506 |

The historical data for EU carbon permit costs are presented in Figure 3. As is shown in this figure, the EU ETS cost varies greatly and how it will develop is unknown. The same goes for fuel costs. The price of MGO varied between about €600 and €1 200/metric tonne during 2022 and the price of EU carbon permit varied between €65 and €100/tonne $CO_2$ over the same period (Flodén et al., 2024).


*Figure 3 Price development for EU ETS in euros per tonne of carbon dioxide emitted from 2006 until September 2024. Data from: https://tradingeconomics.com/commodity/carbon*

The results per year for the total cost per vessel is shown in Figure 4. However, these absolute numbers do not reflect the carrying capacity of the vessel, but instead show the total cost for using the vessel over a year. For 2025, the total costs of fuel, EU carbon permits and FuelEU Maritime penalty for Vessel 1 is less than the fuel costs alone for Vessel 2. The

bigger vessel, Vessel 2, which is more than twice the dwt and GT size of any of the other alternative vessels, have the highest total cost all individual years. The total added costs for EU carbon permits and FuelEU Maritime penalties are higher than the fuel costs for all vessels (excluding the vessel below 5 000GT) from 2040 and onward.

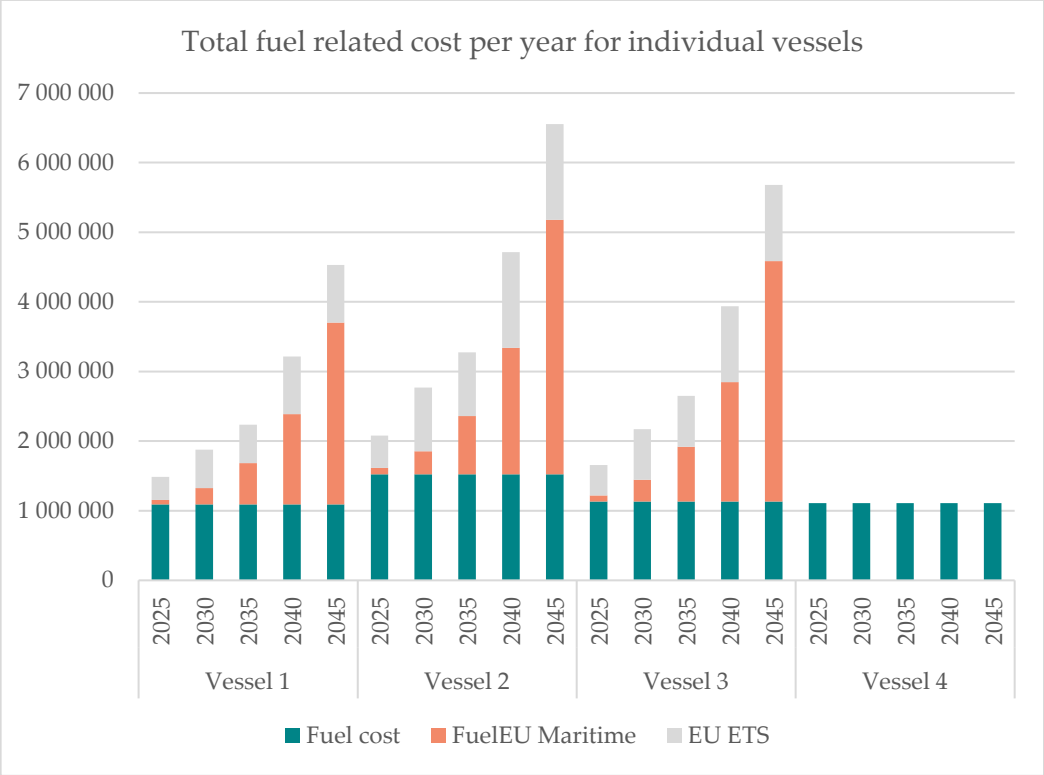


*Figure 4 Total costs of fuel, EU carbon permits and FuelEU maritime penalty.*

To investigate the cost difference between using a smaller and bigger vessel, we look at the performed transport work. We adjust per hours of operation and use GT as an indication of carrying capacity. This reflects the potential income for the ship as transport work. This assumption is, as argued in this report, not comprehensive but gives an indication of the relationship. The results are presented in Figure 5. As can be seen, Vessel 4 has one of the highest costs per GT and hours of operation in 2025. In 2030 the relationship starts to shift, and in 2040 the cost is twice as high for the vessels above 5 000 GT as for the vessel below. This is despite the higher fuel consumption but not including losses such as capacity factors. If the utilization rates on the smaller vessel is 70% and the larger vessels (especially applicable to the 20 000 dwt Vessel 2) have a higher utilization rate of 85%, the cost difference in the 2030 scenario is lower and Vessel 4 shows almost the same costs as for Vessel 3.

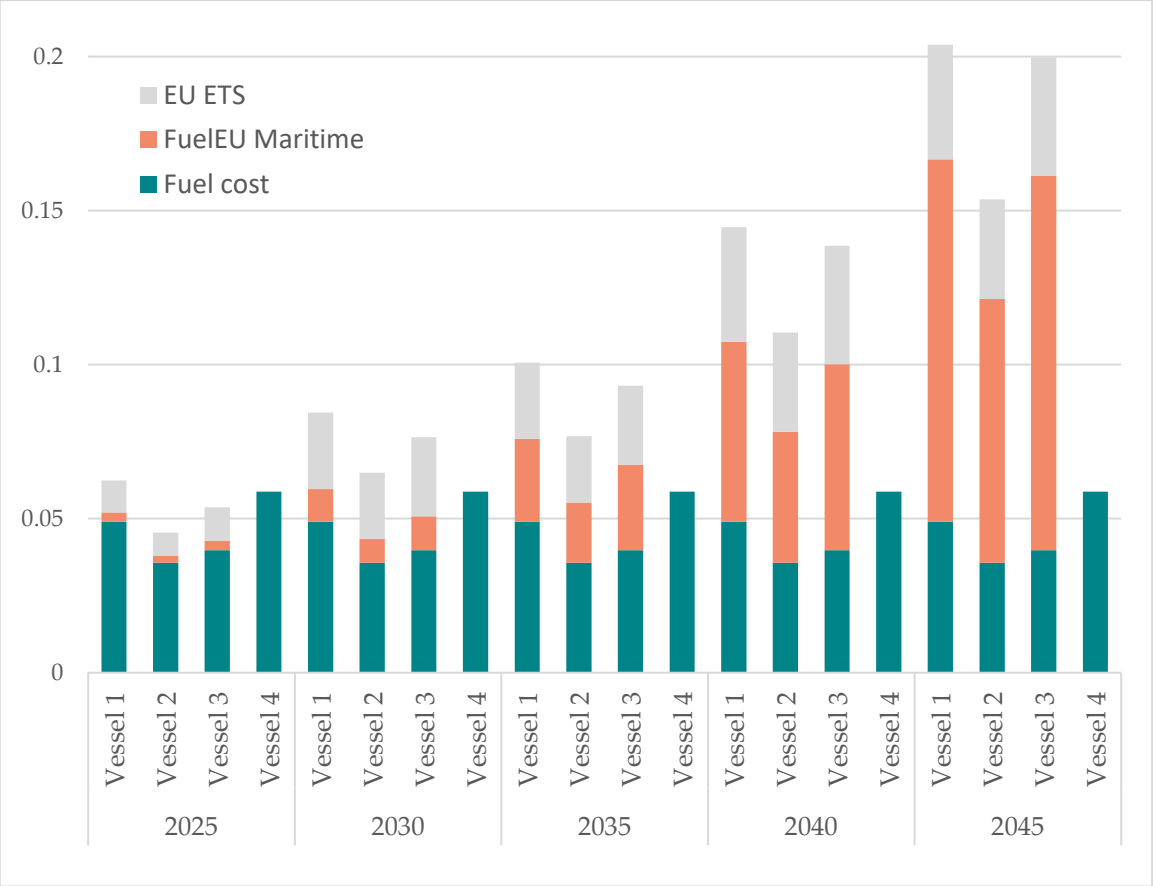


*Figure 5 Results of costs (€) per hour of operation and GT of the vessel*

Both figures show a much higher costs from FuelEU maritime penalty than EU ETS despite EU ETS covering all the fuel used from 2027 and FuelEU maritime only penalizing fuel used above a specific emission limits. One tonne of MGO used above the FuelEU maritime limit comes with a penalty of 2 580 €. The EU ETS cost for using of one tonne of MGO, with a conversion factor of 3.14 for the $CO_2$, is instead equivalent to 320 € at an EU carbon permit cost of 100 €. The marginal cost of exceeding the FuelEU maritime limit is therefore significantly higher than the additional costs from the carbon permit purchase.

The total costs of the penalties can be seen as a maximum cost to meet the regulations, as the vessels can choose to for example shift fuels to meet the FuelEU Maritime requirements and the EU ETS emissions levels. For example, using bio-methanol in an engine with a similar engine efficiency would lead to lower costs at 1 325 € per tonne fuel (assuming a lower heating value of 19.2 MJ/kg and drop in compatibility).

# 5 Discussion

This report touches on a wide range of factors which affect ship design. The parameters influencing ship design goes beyond technical optimization and includes cost aspects as well as social sustainability consideration. Figure 6 summarizes the key areas which were brought up during the work. There are several design choices which influence more than one of these aspects at the same time and can lead to goal conflicts, for example can greenhouse gas emission reductions lead to increased operations costs. The 5 000 GT size cut-off requirement and other size cut-offs do not have any direct positive effect on greenhouse gas emission reductions nor limit other environmental impacts, rather it is an administrative cut-off applied to limit the administrative burden on the industry. Through this report we have however showed how this cut off directly affects the operational costs of vessels and likely will impact the work conditions and crew satisfaction onboard. This leads to a goal conflict between the costs and seafarers' welfare. We have shown how there is a large economic incentive to use vessels below these cut-offs, which will also have an impact on the environment as greenhouse gases are continuously released by the smaller vessels. After 2035 there are clear and direct economic benefits of using vessels excluded from the EU ETS and FuelEU Maritime legislation where possible (see Figure 5).

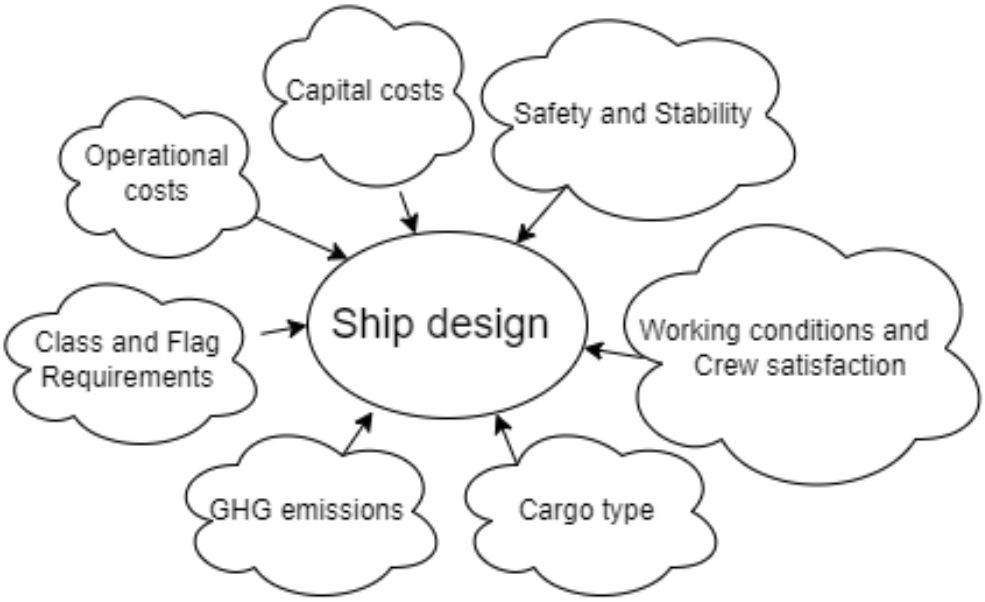


*Figure 6 Discussed aspects through the study which affects the ship design and can lead to goal conflicts if the optimal design differs between aspects*

Several other studies have recommended that the EU ETS should include vessels below 5 000 GT. Vierth et al. (2022) highlighted that exclusion of vessels can lead to a growing so called "carbon leakage", as stakeholders get increased incitement to use vessels below 5 000

GT as the legislative requirements increase. Transport & Environment (2022) made a similar recommendation.

Wang et al. (2015) modelled the economic impacts of an ETS on international shipping and the findings point to some segments facing greater challenges in adapting to ETS costs. They found that an ETS will decrease ship speed and fuel consumption for both the container and bulk sectors, but that the different sectors likely will be affected to different degrees. As the industry navigates these new regulations, understanding sector-specific impacts on welfare and safety could inform a more tailored approach, ensuring that regulatory costs do not compromise the well-being of seafarers across different shipping segments. The higher costs resulting from the inclusion of shipping in the EU ETS could lead to a shift in transport modes, particularly in the RoRo and RoPax sectors, which frequently compete directly with road and rail transport (Flodén et al., 2024).

Smaller vessels will lack incentives to adopt greener, often costlier, fuel alternatives. Vierth et al. (2022) showed that the EU ETS thresholds of minimum 5 000 gross tonnage and minimum 400 gross tonnage led to different adaptations in terms of vessel selection. Transport & Environment (2022) highlights that the use of vessel above and below the 5 000 GT threshold differs, and that engine size and other parameters are not necessarily in line with this. The study found that ships slightly under the threshold (4 500-5 000 GT) had on average higher engine power (4 447 kW) than those slightly above (5 001-5 500, and 4 259 kW), and emitted more greenhouse gas emission per year. Ships compete mostly with other ships in the same size range. Ships just below a threshold in size will benefit economically compared to a ship just above the threshold. The introduction of a threshold therefore might lead to use of smaller ships with worse environmental performance and worse working conditions due to smaller or less personnel spaces.

In this report we have identified several important actions for social welfare for seafarers which lead to increased GT of the vessel. These include for example:

- Ensuring there is enough room for varying tasks and providing opportunities for recovery.
- Relaxation and social areas for the crew.
- Providing areas where employees can work using different methods and techniques.
- Allocating space for additional staffing to handle increased workloads.
- Ensuring the layout accommodates the necessary technology that is adapted to the tasks at hand.

- Providing dedicated areas for managing shift work, night work, and allowing rest periods, especially if long working hours and constant availability are expected.
- Setting up specific spaces to handle and investigate bullying cases impartially and confidentially.
- Enclosing pipe tunnels on deck.
- Enclosing bridge wings.

Port fees and other economic incentives have already had a direct impact on design choices of vessels, and it is likely that also the 5 000 GT threshold in the EU legislation will have similar effects. We have identified cases where the space onboard is directly reduced to decrease costs. Some of ship design choices applied to directly decrease the GT of a vessel include removal of crew quarters and cut bow of the ship. This strongly indicates that social welfare is at risk when GT use is optimized to save costs. Ports can already today take initiative to address this by not issuing the port fee based on the vessel GT, or by excluding strictly work environment related additions from the GT.

The findings in this report indicate that the minimum requirements are currently not enough to safeguard the working environment onboard from the economic impacts from adapting to legislation. The Swedish national legislation (AFS 2015:4) do cover the psychosocial work environment, but they are too general and difficult to use it in a sensible way in the maritime work environment. MLC specifies sizes and placements of e.g. cabins when building ships. However, spaces are in the interviews described to be designed in order of importance (bridge first, then captain's cabin and so on) which leaves the kitchen or personnel spaces to last. Therefore, the exact specifications and quality of these might suffer. Also, when trying to use every tiny bit of space of the ships' interior, this might cause problems for the workflow or ergonomic conditions. Interviewees points to difficulties in performing random checks and inspections, the general language which opens for interpretations, and the strong hierarchy onboard as key hinders.

Social activities become important both for recovery and to have something resembling spare time, while they at the same time help build teams. However, there are big differences between different types of ships as well as how much shipping companies prioritize spaces to facilitate these types of spaces. As singular companies often specialize in one type of vessel/cargo, this might lead to large difference in quality between segments. In addition to the requirements highlighted in this report, classes also have requirements for the standard of vessels. These typically have stricter requirements on e.g. living standards. The type of vessel therefore impacts how concerning the result of this report is, as some classes are more regulated than others.

The EU Commission is tasked with investigating, by 2026, whether the 5 000 GT threshold in the Emissions Trading System (ETS) needs to be adjusted. It is expected that general cargo and offshore vessels between 400 GT and 5 000 GT will be included from 2027. The EU ETS and FuelEU Maritime legislations success will likely depend on how effectively the policies can be aligned with global regulations and standards, ensuring a level playing field in the highly competitive and internationally interconnected shipping industry. Both initiatives have implications beyond direct emissions reduction, as they may influence ship design, route selection, and operational behaviors within the shipping industry. The 5 000 GT threshold in EU ETS, for example, could lead companies to favor smaller vessels, potentially impacting vessel design choices and onboard accommodations for crew, as discussed in this report. Additionally, there are concerns about "carbon leakage," where activities could shift to regions outside EU waters to avoid regulatory costs, which underscores the importance of international collaboration through organizations like the IMO.

# 6 Conclusion

This report concludes that the current social sustainability legislation at sea falls short of adequately protecting seafarers from the economic pressures related to environmental regulations. While some national legislation, such as Sweden's AFS 2015:4, addresses the psychosocial work environment, its general scope limits its practical application in the maritime context. Although the importance of ergonomics and human-centered design has grown, comprehensive regulatory frameworks explicitly focused on usability in ship design remain insufficient. The interviewees clearly state concerns that size cut-offs related to GT directly impacts the social welfare onboard. The additional space requirements necessary to improve social welfare on board are often deprioritized to minimize costs, with design choices favoring smaller GT thresholds over crew comfort.

The results show that the current regulatory structure, including the EU ETS threshold of 5 000 GT, incentivizes the use of smaller vessels, potentially exacerbating carbon leakage and limiting the adoption of greener technologies. Our calculations show that the costs of applying to the EU Fit for 55 regulations in 2040 can double the fuel costs for a general cargo vessel between 4 000 and 6 000 GT. The findings indicate that several shipping companies strive to offer better conditions than the minimum regulatory requirements. However, achieving these improved standards often incurs significantly higher costs and may cause vessels to exceed the 5 000 GT threshold, highlighting a key challenge in balancing social sustainability with economic and regulatory constraints.

Moving forward, revisiting the 5 000 GT threshold, and aligning port fee structures to encourage social sustainability onboard could help create a balanced approach that promotes both environmental goals and the well-being of maritime workers. However, the decision to use smaller vessels will depend on a variety of factors including market needs, route length, and economic considerations.

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## Bilaga 1 – Originalcitat med översättningar

Some quotes have been adjusted to increase readability and/or strengthen anonymity. The adjustments have been made in collaboration with the corresponding interviewee.

| Interview Number | Translated quote | Original quote |
|---|---|---|
| 6 | The thing is that every such limit becomes a threshold, a threshold effect. Those who are very close to it will choose to lay below the threshold. The first things you won't build is the squash hall, bridge wings, and other such spaces that don't generate revenue. | Det är just det att varje sån gräns blir ett tröskelvärde, en tröskeleffekt. De som ligger väldigt nära där kommer välja att ligga under tröskeln. Det första man tar in på är squashhallen, bryggvingar, och andra såna här utrymmen som inte är betalande. |
| 9 | There are so many that are designed for 19 999 [gross] tons. Because otherwise they must install an inert gas plant. So, if there is another legislation- if they are in the vicinity, they will for sure reduce it, every day of the week. If new legislation costs money, and it does, to implement and build new or whatever. That's how they've always worked. | Det finns ju jättemånga som är designade på 19 999 ton. För att annars måste de installera en inertgasanläggning. Så kommer det en annan lagstiftning så- ligger de i närheten så kommer de att dra ner den absolut, alla dagar i veckan. Om en ny lagstiftning kostar pengar, och det gör det, att implementera och bygga nytt eller så. Så har de alltid jobbat. |
| 6 | Some ships that might supply Lake Vänern with various things may be built to 2 998 gross tonnes. If you are at 3 001, there are completely different qualification rules. Then you ask yourself "Should I build that crew compartment or bridge wings?" or if it encloses some kind of pipe tunnel. Because I can't reduce the load capacity. That's out of the question. | Vissa fartyg som kanske går och försörjer Vänern med olika saker kanske är byggda till 2998 bruttoton. Ligger man på 3001 är det helt andra behörighetsregler. Då är du ju här ”Ska jag bygga det där besättningsutrymmet eller bryggvingar?” eller om det innesluter någon form av rörtunnel. För jag kan ju inte minska lastförmågan. Det är uteslutet. |
| 4 | When they have built bigger gyms or separate cabins for everyone, you have to pay more in port fees. Port fees are based solely on GT. | När de har byggt större gym eller separata hytter till alla så får man betala mer i hamnavgift. Hamnavgifterna baseras enbart på GT. |
| 4 | And then they say that 'Most ships are bigger'. Yes, but those who are there at 5 000 or 6 000, yes 6 000 for example, do not benefit from the fact that 73 000 other ships are above the limit because their competitors are not there, but it is those who are smaller, or those who are in exactly the same size range. | Och då säger man att ”Merparten av alla fartyg är ju större”, ja fast de som ligger där på 5 000 eller 6 000, ja 6 000 tex, har ju ingen glädje av att 73 000 andra fartyg ligger över gränsen för deras konkurrenter är ju inte där, utan det är ju de som är mindre, eller de som är i precis samma storleksspann. |
| 8 | The smaller vessels that are under 5 000, but also perhaps the next limit if you now start to regulate down to 400 gross tonnage. Then you suddenly might have a competitive advantage for the ships that are smaller. I would say that these vessels have- it can be more difficult to achieve a good working environment on a small vessel and if you then regulate the larger ones and leave the smaller ones unregulated, you may then favor the smaller ones. And not only are they less energy-efficient and have a higher environmental impact, you may be favoring ships that have a poorer working | De mindre fartygen som är under 5 000, men även kanske nästa gräns då, om man nu börjar reglera ner till 400 grosstonnage. Då har man plötsligt en konkurrensfördel kanske för de fartyg som är mindre. De fartygen skulle jag säga har- Det kan vara svårare att få till en bra arbetsmiljö på ett litet fartyg och om man då reglerar de större och låter de mindre vara oreglerade så gynnar man då kanske de mindre. Och inte nog med att de är mindre energieffektiva och har högre miljöpåverkan så kanske man |

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| | environment on board, which feels a bit strange. | gynnar fartyg som har sämre arbetsmiljö ombord och det känns lite konstigt. |
| 1 | There are requirements in the MLC on how big it should be, how big the cabin should be and how big the window should be. You can't get away from that. | Det finns krav i MLC hur stort det ska vara, hur stor hytten ska vara och hur stort fönstret ska vara. Det kommer du inte undan. |
| 7 | When designing you often start with a bridge, because it's the most important. Then you work your way down; there must be a captain's cabin and a chief and stuff like that. And then what remains is the kitchen and where our employees work. | Vi pratade lite om fartygsdesign förut. Då börjar man ofta med en brygga för den är viktigast. Sen jobbar men sig nedåt, det måste finnas en kaptenshytt och en chief och sånt. Och sen det som blir kvar är ju kök och där våra medarbetare jobbar. |
| 7 | Spaces that may not have been utilized before, it was just some void space, they are now starting to be used. And then you have to put a 300 kg piece of machinery down there, and that poses quite a problem. I look at the boats a lot when I get the drawings, to make sure it's possible to transport things in a good way. And it hasn't gotten any better, but every tiny little bit of space on board the ships today is utilized in a way that wasn't done in the past. | Utrymmen som kanske inte utnyttjades förr, det blev bara nåt void space, de börjar utnyttjas nu. Och sen ska du tråckla ner någon 300 kg maskindel där och det ställer ju ganska stora problem. Det tittar jag mycket på på båtarna när jag får in ritningarna, att det går att transportera saker på ett bra sätt. Och det har inte blivit bättre utan man utnyttjar vartenda litet kråkutrymme ombord på fartygen idag som man inte gjorde förr på ett sånt sätt. |
| 7 | Many times, the crew is a variable where you can influence your costs. Bunker, provisions, pilotage costs etc. are often constant. It's not something you can negotiate to any great extent - you can't haggle at the gas station. But the crew, there you can influence. | Många gånger är besättningen en variabel där man kan påverka sina kostnader. Bunker, proviant, lotskostnader mm är ofta konstanta. Det är inget du kan förhandla dig till några stora- Du kan inte pruta på macken. Men besättningen där kan man påverka. |
| 6 | There are big differences within the global merchant fleet. It depends on how much you are prepared to invest. It's not the cost of building that is the big thing. Member companies reach out about this. You are penalized for it. Building a squash hall is difficult today. The enclosed area is calculated in gross tons. Port fees etc. are paid depending on gross tons. | Det skiljer sig oerhört mycket om man tittar i den globala handelsflottan. Det handlar väldigt mycket om hur mycket man är beredd på att satsa. Det är inte kostnaden för att bygga som är det stora. Medlemsrederier hör av sig om det här. Man straffas ju för det. Att bygga en squashhall idag är svårt. All innesluten volym är ju bruttoton. Hamnavgifter etc betalas efter buttoton.* |
| 7 | It's very different on ships. On ferry services, there are often a lot of leisure areas, so you tend to slim down in offices. There you can see that people sit in hovels. On cargo ships it's often the other way around. If you want to move around, you just run on deck. I've seen boats where they put a small bathtub on deck that no one uses. The sailors get very creative. They put up basketball hoops with magnets to play basketball in cargo holds. | Det är också väldigt olika på fartyg. På färjetrafiken finns det ofta väldigt mycket fritidsutrymmen så där brukar man banta på kontor. Där ser man att det är små kyffen där folk sitter. På lastbåtar är det ofta tvärtom. Om man vill röra på sig är det bara att springa runt på däck som gäller. Jag har sett båtar där man ställt någon liten badbalja utomhus som ingen använder. Sjömännen blir väldigt kreativa. Jag har sätt att de hängt upp basketkorgar med magneter för att kunna spela basket i lastrum. |
| 9 | Some invest money when they build the boats, others do not. There may be boats where the shipping company brings paintings and hangs them up. There may be boats where there are steel bulkheads in the interior. So there is no | Vissa satsar ju pengar när de bygger båtarna, vissa gör det inte. Det kan vara båtar där rederiet kommer med tavlor och hänger upp. Det kan vara båtar där det är stålskott i inredningen, alltså det finns inget dämpande |

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| | dampening sound, it's just steel. That's what you have in your everyday life all the time. Mechanically, it's very different. Some have good quality stuff that works all the time and some that you have to repair all the time. They have bought it for cheap then. | ljud eller- det är bara ren stål, det är det du har i din vardag hela tiden. Maskinellt är det väldigt olika, vissa har ju bra grejer och bra kvalitet som funkar alltid. Vissa har grejer som man måste laga saker hela tiden. De har köpt billigt. |



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*This report has been reviewed and approved in accordance with IVL's audit and approval management system.*

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Swedish Environmental Research Institute