Ministry of Infrastructure and Water Management

CCNR
CENTRAL COMMISSION FOR THE NAVIGATION OF THE RHINE

Schweizerische Eidgenossenschaft
Confédération suisse
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STUDY ON FINANCING THE ENERGY TRANSITION TOWARDS A ZERO-EMISSION EUROPEAN IWT SECTOR

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Study consortium:

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July 2021

Study on Financing the energy transition towards a zero-emission European IWT sector

Deliverable – Research Question A

Final report

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Client: Central Commission for the Navigation of the Rhine

Lead partner for this deliverable: Panteia

Zoetermeer, The Netherlands
Document date: 21-7-2020

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Definitions

ARA: Abbreviation for Antwerp, Rotterdam and Amsterdam. In inland shipping, the ARA-region is a navigation area interconnected with the Rhine, Meuse and Scheldt basins, comprising generally short transport distances over waterways with high CEMT-classes.

CAPEX (CAPital EXpenditure): Capital expenditures are for major purchases that will be used in the future. The life of these purchases extends beyond the current accounting period in which they were purchased. Because these costs can only be recovered over time through depreciation, companies ordinarily budget for CAPEX purchases separately from preparing an operational budget.

DPF (Diesel Particulate Filter): This is a component in the exhaust system of an internal combustion engine for filtering of soot and particulate matter from the exhaust gases. A DPF component is usually applied For reaching Stage V emission levels of internal combustion engines using diesel with power over 300 kW.

Mortgage: A mortgage is a debt instrument, secured by the collateral of specified property, that the borrower is obliged to pay back with a predetermined set of payments. Mortgages are also known as "liens against property" or "claims on property." If the borrower stops paying the mortgage, the lender can foreclose to recover the loan.

OPEX (OPerational EXpenditures): Operating expenses are the costs a company incurs for running their day-to-day operations. Companies report OPEX on their income statements and can deduct OPEX from their taxes for the year in which the expenses were incurred. OPEX are therefore short-term expenses and are typically used up in the accounting period in which they were purchased.

Pay-per-use: Metered services, also called “pay-per-use”, are any types of payment structure in which a customer has access to resources but only pays for what the customer actually uses. The pay-per-use business model is often combined with a subscription model. In the energy sector it is also known as “Energy as a Service” or “EaaS”. EaaS addresses the support to clients to choose between the variety of energy-related options. Eaas is intended to provide guaranteed (lower) energy costs, higher reliability and resiliency, sustainability solutions and optimised operations without the need for the client to have capital expenditures or additional staff.

SCR (Selective Catalytic Reduction): This is a component in the exhaust system of an internal combustion engine for the conversion of nitrogen oxides, also referred to as NOx, with the aid of a catalyst into diatomic nitrogen (N2) and water (H2O). A gaseous reductant, typically anhydrous ammonia, aqueous ammonia or urea, is added to a stream of flue or exhaust gas and is adsorbed onto a catalyst. SCR components are usually applied to internal combustion engines using diesel in order to reach Stage V emission levels.

Ship operator: The operator is the person who operates the vessel on his behalf and at his risk, holding the operator’s certificate. If the vessel is operated for more than one entity, the operator shall be the person who actually operates the vessel and is authorised to take decisions concerning the vessel's economic and commercial management.1

Ship owner: owner of the ship, holding the certificate of belonging, which may or may not be also the operator of the ship.

Executive summary

The main question of research question A is:
What are the possible triggers and financial drivers to enable a positive investment decision by shipowners to invest in technologies contributing to zero-emissions performance?

It is important to have a thorough understanding on the revenues and expenditures of shipowners as a basis for answering this research question. For this purpose, four research questions were identified, for which the main answers are presented below.

The identification of the elements in the business economic considerations of shipowners is essential, which can be sensitive to technologies contributing to zero-emission performance. This concerns both revenues and expenditures, for example the possible increase of revenues and/or more certain income due to clean vessels might motivate shipowners to prefer clean vessels over polluting vessels. Next to this, it concerns for example the role of banks in relation to providing loans and it concerns the impact of ports and terminals on the business economics. Furthermore, it concerns the impact on the expenditures.

Question A1: What revenue-generating elements of an IWT company can be identified to promote the use of technologies contributing to zero-emissions? What is the role of shippers and brokers in this respect, what are their requirements? What measures will lead to more revenues?

IWT entrepreneurs in freight transport generate revenues based upon agreements with their clients. A large part of their revenues is generated by transport performance. These transports can be arranged by means of a voyage charter (spot market), where a price per tonne or a lumpsum price is agreed for a single-transport between A and B. Other options include a time charter (number of days times a tariff) or long-term contract (a fixed tariff for a transport between A and B, for a certain time period).

Some income (maximum 10%) is generated through demurrage in the dry cargo sector. This applies when the loading and unloading processes of vessels at terminals take more time than the times stated in various (non-binding) national laws. In liquid freight shipping, income from demurrage can account to 1/3 of the overall turnover of a vessel. Large differences can occur between ARA-shipping and Rhine shipping, as well as the different markets in liquid bulk shipping.

From interviews, it can be concluded that greener ships do not receive higher freight rates. However, there is a tendency to enter into longer contract periods, up to 10 years, with greener ships. There are multiple drivers behind this tendency: greening, which requires longer contracts to acquire loans from banks, and low water problems in 2018 that emphasized the need of long-term contracts to secure transport capacity. The number of shippers that apply such long-term contracts, is still very low. Mainly larger multinationals, involved in the B2C-markets, tend to agree on such contracts at the moment. Green technologies are rather imposed – through strict conditions to be allowed to carry out the transport –as opposed to be achieved through price mechanisms. It thus works as a ‘license to operate’.

Government tenders generally do not include benefits for vessels with better environmental performance. This is based on an analysis by Panteia of a large number of Dutch, Belgian and German tenders from waste companies, transport of (bulk) road salt and infrastructure works, including pre-taxes and sand beds. In almost all cases, the reasoning behind selecting on the lowest price, is that the contracting authority believes that there are a lot of providers on the market with the same quality. To this end, in many cases it is decided to award the contracts to the company that can offer the lowest transport price. A reason for this could be the fact that governments see the choice of IWT over other modes of transport as a factor contributing to greening. Good examples are the tenders of waste transport from The Hague to the Afval Verwerking Rijnmond (AVR) in Rotterdam and the tender for the transport of shipborne waste in the Port of Antwerp. The first tender explicitly includes the requirement that the material used must be Stage V (equivalent) in terms of emissions, the second tender awards points for cleaner vessels.

Question A2: What elements in expenditures can be identified in relation to the powertrain and emission and energy performance? What cost parameters can be identified and what proportion of overall operating costs do they represent (e.g. capital costs, energy costs, port dues, maintenance costs)?

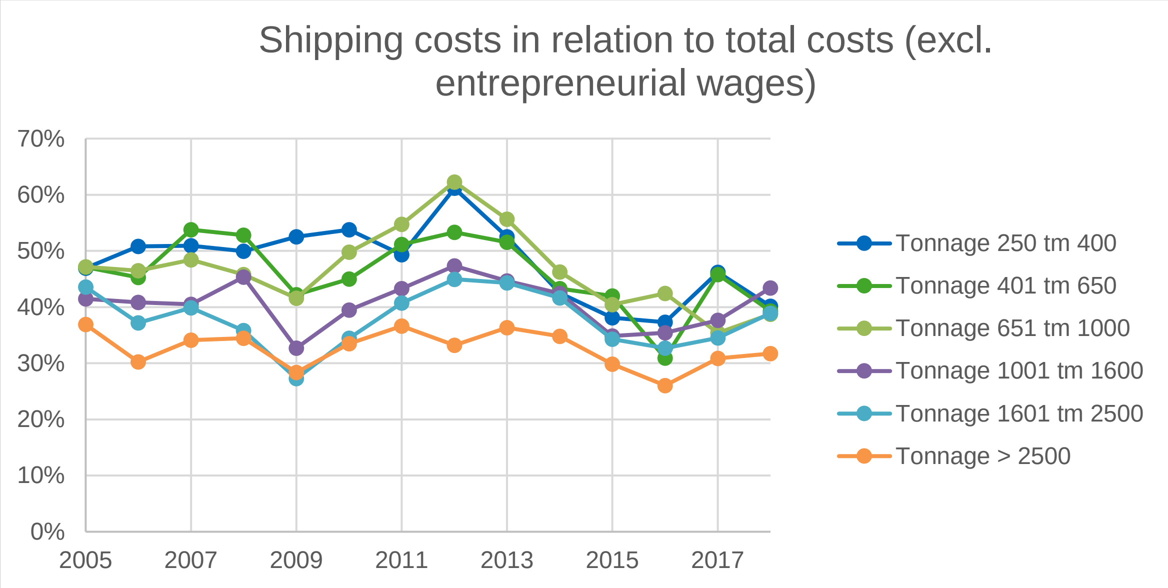
Barge operators have to deal with a large number of cost items: fuel costs and port dues[1] (which together are the direct shipping costs), personnel costs, repair & maintenance costs, depreciation, interest charges, insurance costs, administration costs, car costs and other costs. Fuel costs can directly be related to the powertrain, emission and energy performance. These costs account some 30% to 45% of the total costs of IWT companies in 2018. Port dues are generally related to the cargo carrying capacity of vessels, but an increasing number of ports are offering discounts of up to 15% on port dues for vessels equipped with clean engines. Port dues, however, have a very limited share of total operating costs.

Lastly, investments in the powertrain also affect the value of a vessel and therefore the capital costs. The extent to which this happens differs from vessel to vessel. Generally, it can be stated that engine reflects some 15% of the capital value of a new build vessel. However, for older vessels it can be the case that the hull is completely depreciated and a new engine set is installed. From recent engine renewals, it can be noted that the engine can reflect some 40% of the vessels value (and therefore, also depreciation).

The figure below shows the shipping costs in relation to the total costs of a barge operator. Doing so, a cross-section has been made of dry cargo shipping by ship size class.

[1] Port dues generally are taxes by local governments. Port dues are applied in all European seaports. Dutch ports, Rhine ports and Danube ports. No port dues have to be paid on the Belgian and French waterway network or along the Moselle river; here canal fees apply. On the German waterway network and the tributaries of the Rhine, canal dues were applied up to 2018.

Figure 1: Percentage of shipping costs to the total costs



Source: Panteia (2020), based upon Stichting Abri database. The data has been validated by representatives from Banks and industry associations from Belgium, France, Germany and Danube countries.

The figure shows that the smaller ships have on average more direct sailing costs than larger ships. This is related to the book value of the ships. Smaller ships are usually older, have a lower economic value and in many cases have already been written off for tax purposes. Moreover, in the case of smaller ships (everything smaller than 1600 tons), there is in most cases no or limited staff costs, because these ships operate in a husband-wife business, or with an entrepreneur as captain, with a (light) sailor as employee. Earnings to the entrepreneur are derived from the gross operating margin of the company.

Engines are depreciated within 10 years in line with the Inland Waterways Tax Covenant[2]. Banks from other countries stated that depreciation periods in other countries are alike the Dutch situation. There is still no differentiation according to components. With diesel-electric, this causes disproportionately high depreciation costs on the electrical components. The depreciation of the vessel hull is generally the same as the duration of the mortgage.

Green drivetrains do not necessarily lead to a cost-reduction. According to interviewees from engine manufacturers, the CCR-2 engines consume some 8% more fuel as compared to CCR-1 or CCR-0 engines. These engines thus lead to higher operational expenses (OPEX). Stage V engines are expected to result into lower fuel expenses than CCR-2 engines; however, urea is needed as a supplement. Therefore, the OPEX of a CCR-2 engine and a Stage V engine are expected to be at the same level. Diesel-electric drivetrains can lead to significant savings of operating costs in some cases. However, in other cases this leads to higher fuel consumption. This is highly dependent on the sailing profile. According to the interviewees, savings on OPEX for LNG were insufficient so far to recover the higher CAPEX, as a result of the decline of oil prices.

[2] See https://www.belastingdienst.nl/wps/wcm/connect/bldcontentnl/themaoverstijgend/brochures_en_publicaties/convenant_binnenvaart

Port charges consist in a very small share of the operating costs. Therefore, they cannot constitute a sufficient incentive or deterrence to support the transition towards greening. Just a small number of ports are willing to give a discount and the discount percentages that the ports do give are marginal – generally in the range of 5 to 15% of the tariff. Channel costs are often passed on to the shipper. They have to be paid in Flanders, France and on the Moselle. There is no differentiation of the rates per emission class.

At present, interest rates by commercial bank financing are in the range of 2.0 to 2.25% in inland shipping[3]. This financing can only be provided if the financing application matches with the lending policy of the bank. For old ships it generally applies that, at most, banks are willing to provide only financing up to 40% of the appraisal value of the ship cost as defined by the Bank as a loan. For new-build vessels this can go up to 70% and in exceptional circumstances – long-term contracts – up to 80%. The duration of financing is shorter for older ships – usually 7 or 8 years – and can be extended to around 15 years for a newly built.

Question A3: What are the current financing mechanisms in the IWT sector for powertrains and how does this relate to the financing of the ship as a whole?

Commercial bank financing is the current conventional way of financing for powertrains. State-guarantees however can cover a significant part of the risks on loans provided by commercial banks. In some cases, financing for new powertrains has been organised entirely through own capital. Alternative sources, such as crowdfunding or subsidies, are not used.
Representatives from Dutch, French and German banks use the following scale for barge operators to determine whether there is a sufficient base to finance:

- Ship younger than 15 years: 70% of the market value of the vessel;
- Ship between 15 and 30 years old: 60% of the market value of the vessel;
- Ship between 30 and 50 years: 50% of the market value of the vessel;
- Ship older than 50 years: 40% of the market value of the vessel;

These data have been validated with stakeholders from Belgium, France and selected Danube countries.
For older inland vessels – generally the smaller barges in the fleet, this means that a large amount of financing must be obtained from other sources, including own contribution, subordinated loans from family, shippers or charterers or a second mortgage from a crowdfunding platform. The duration of the financing period varies from 7 to 8 years for older ships to 15 or even 20 years for new-build vessels. Banks nowadays finance for between 2.0% and 2.5% in interest, whereas the average interest rate for crowdfunding platforms is 7.0%.

For new-build, banks are prepared to support innovative techniques through adjusted financing durations, higher financing contributions and limited interest discounts. This is supported by the increased assumed residual value of the ships.

Question A4: What is the current financial profile of IWT companies based on information from the balance sheet, profit and loss accounts, and what does this mean for the ability to acquire capital for investing in technologies contributing to zero-emissions?

The income in the dry cargo segment has increased sharply since 2015. Revenues in 2018 were at the highest level ever, even higher than before the 2009 financial crisis. Low water levels in the recent years over the summer period were the main cause. However, it should be noted that profits rose sharply, in particular, for barge operators. On the other hand, inland shipping

[3] In the Danube region, slightly higher interest rates apply

companies that are also active as logistics service providers lost extra money due to the low water levels mentioned earlier.

The development of the turnover of IWT companies can be described in the following manner:

- The year 2018 was good for ship operators. However, parties that operated more as a logistics service provider had less good results. For them, low water had a strong cost-increasing effect. The downside of 2018 was that cargo packages, whether temporary or not, shifted towards other transport modes. In particular, container transport in 2019 was disappointing due to the shift of cargo from IWT to other modes. This shift came along with some longer term contracts and therefore, some volumes were lost. It is not yet sure to what extent these volumes will be lost permanently.
- Hence, the income from inland shipping companies declined in 2019. The internal IWT market reached another equilibrium; Favourable low water surcharges as well as a (for IWT entrepreneurs) more favourable ratio between cargo supply and capacity were abolished. Reduced cargo supply to IWT, because of the shift of cargo packages (mainly containers and to a lesser extent also dry bulk) to other modalities, resulted in revenue and profit ratios to the likes of the years 2011-2014, in which earnings of IWT companies were insufficient for major investments.
- 2020 is likely to result into negative results for many IWT companies and especially the river/cruise sector, which is in part prompted by the nitrogen and PFAS[4] problems in the Netherlands, the loss of coal volumes in Germany, and tensions in the world market and, of course, the COVID-19 pandemic.
- The financial result, including the wage of the entrepreneur on ships smaller than 1000 tons is insufficient for sustainable business operations. Maintaining the status quo with these ships is quite possible, but there is no good basis for greening from a business perspective.

Income in the liquid bulk and passenger sector have been very good in the past years. These companies generally have decent financial figures and are able to provide a significant amount of own means in greening.

The table below shows financial figures for different size classes in relation to the required investment in a Stage V engine and the maximum percentages a bank is willing to finance. The figures have been derived from the Stichting Abri Cost database and draft inputs from Research Question C. It can be seen that the average grants are the highest for vessels between 400 to 1000 tonnes. Here, grants equalling more than 40% of the initial investment are needed to bridge the gap between the own capital that can be brought in and commercial bank financing. For vessels between 250 and 400 tonnes, a grant of approximately 33% is needed; for vessels between 1000 and 1600 tonnes grants of 30% are needed and for vessels larger than 1600 tonnes, a grant of 39% is needed.

[4] Per- and polyfluoroalkyl substances (PFASs, also perfluorinated alkylated substances) are synthetic organofluorine chemical compounds that have multiple fluorine atoms attached to an alkyl chain. In the summer of 2019, the Dutch government had forbidden transports of sand, gravel and ground that contained over 0.1 µg/kg. This has led to a serious cut in the sand- and gravel volumes in the Inland shipping markets.

Table 2: Capability of vessels to invest in a Stage V (compliant) engine

Tonnes	Own capital	Bank financing	Amount needed	Gap	% Grant needed
250 - 400	€ 23,070	€ 40,971	€ 94,653	€ 30,611	32.3%
400 – 650	€ 47,369	€ 40,116	€ 146,068	€ 58,583	40.1%
650 -1000	€ 43,593	€ 63,559	€ 192,431	€ 85,279	44.3%
1000 – 1600	€ 100,492	€ 98,516	€ 284,572	€ 85,563	30.1%
1600 -2500	€ 138,976	€ 124,203	€ 432,567	€ 169,388	39.2%
> 2500	€ 85,055	€ 360,577	€ 722,409	€ 276,776	38.3%

Source: Panteia (2020), based upon Stichting Abri database and Research Question C inputs

It can be observed that two of the smaller vessel categories (250-400 tonnes and 1000-1600 tonnes) need the least grants. This is primarily due to the fact that most of these vessels nearly paid of their mortgages, allowing for significant shares of bank financing. It should however be noted that a large share of the own capital of these vessels is needed to modernize the vessel to meet the technical requirements of CESNI and not all of the money can be used for a new engine. The latter is different for vessels greater than 2500 tonnes, in which the mortgage is still significant. Despite higher loan (mostly 70% as opposed to 40-50% for the smaller categories) percentages due the more recent years of construction, still some 40% grants are needed to meet the Stage V requirements. However, as these vessels are generally technically up to date, most of the private capital can be used for engine replacements.

The table below shows the capability of different vessel size classes to work towards zero-emission technologies. Zero-emission transport can be achieved in different ways, such as fuel cells, batteries, drop-in fuels and after treatment and other alternative clean fuels. For the sake of this analysis, the focus is on zero-emission through electrifying the drivetrain of a vessel by means of an electrical motor and corresponding equipment/installation. As such, the focus is purely on the electrification of a vessel, i.e. making a vessel “electric ready” for future fuel cell and battery pack applications.

Table 2: Capability of vessels to invest in technologies that work towards zero emission.

Tonnes	Own capital	Bank financing	Amount needed	Gap	% Grant needed
250 – 400	€ 23,070	€ 119,884	**€ 373,713**	€ 230,759	61.7%
400 – 650	€ 47,369	€ 97,244	**€ 390,045**	€ 245,432	62.9%
650 -1000	€ 43,593	€ 122,237	**€ 404,772**	€ 238,942	59.0%
1000 – 1600	€ 100,492	€ 150,885	**€ 434,040**	€ 182,663	42.1%
1600 – 2500	€ 138,976	€ 147,539	**€ 481,051**	€ 194,536	40.4%
> 2500	€ 85,055	€ 264,484	**€ 573,118**	€ 223,579	39.0%

Source: Panteia (2020), based upon Stichting Abri database and Research Question C inputs

The overview above only takes into account the costs of electrification and thus not the future investment costs in the power provider itself, such as battery packs, hydrogen fuel cells/storage or generator sets. These future costs will, based on today’s information, strongly increase the investment costs and possibly also the OPEX. It can be observed from the table that the smaller vessel categories need the largest grants to work towards zero-emission technologies by getting the vessel “electric ready”. This is mainly due to the highly assumed one-off costs for electrification of the vessel. For the largest vessel size class, working towards zero-emission technologies will need less grants than installing a Stage V engine.

Question A5: What other issues play a role in making investment decisions (economic outlook, age of the owner, age of engine and vessel, structure and stability of the market, type of contract, ...)?

From the discussions with interviewees it became clear that it is important to distinguish between the behaviour of small companies (owning and operating one vessel, often a family business) and the shipping companies. Many shipping companies are active in niche markets (tanker shipping, container shipping, pusher shipping) and look more rationally at investment decisions. Personal circumstances do not play a role in this, which however can be important for family businesses. Think for example of the succession of the company and the age of the skipper/owner.

Age and family composition can also determine investment behaviour. Older skippers who do not have a successor are less inclined to invest in a new ship than young skippers or skippers with a successor within the family. Many skippers find it difficult to find a successor. The new influx in IWT finds transport with smaller vessels of little interest. It is not an appealing product. Larger ships appeal much more to young employees. Younger boatmasters tend to prefer the 2 weeks on, 2 weeks off schedules, while transport with smaller ships is mostly day-time shipping[5].

Moreover, the age of the vessel and the related technical condition often force entrepreneurs to decide whether it is responsible to invest (heavily) in repair and maintenance. Skippers who are confronted with high costs (e.g. engine replacement) often choose to purchase a larger vessel and scrap or sell the smaller vessel.

[5] Panteia (2017), Vlootverklaringsmodel voor een tiental sluizen, *assigned bij Rijkswaterstaat*

1. Introduction

The main question of research question A is:
What are the possible triggers and financial drivers to enable a positive investment decision by shipowners to invest in technologies contributing to zero-emissions performance?

It is important to have a thorough understanding on the revenues and expenditures of shipowners as a basis for answering this research question. The identification of the elements in the business economic considerations of shipowners is essential, which can be sensitive to technologies contributing to zero-emission performance. This concerns both revenues and expenditures, for example the possible increase of revenues and/or more certain income due to clean vessels might motivate shipowners to prefer clean vessels over polluting vessels. Next to this, it concerns for example the role of banks in relation to providing loans and it concerns the impact of ports and terminals on the business economics. Furthermore, it concerns the impact on the expenditures.

Research question A on the triggers and financial drivers for the vessel owner can be seen as the starting point for all three subprojects. Its results will therefore be relevant and feed into all subsequent research questions. The paragraphs below will clarify the specific approach per sub research question in question A, to be answered in this study.

The rationale for focussing on freight transport is that previous research proves[6] that commercial freight transport operators are mainly seeking to minimise total cost of ownership for the powertrain in the vessel, while shippers are in general not willing to pay more money for clean vessels. However, in passenger transport, the situation is different. These vessels operate locally, and cities may impose more strict requirements on the emission limits of such vessels. In addition, there is a direct relation with the consumer, the passenger or tourists on board and these clients are more demanding as regards the emissions compared to shippers in freight transport. Consequently, there are other drivers for the development towards zero-emission transport in passenger transport compared to freight transport. The deliverable for research question G and H obtained the following relevant finding:

"It is found that consumers (in normal market situations) are willing to pay more if they know that the ship is of low/zero emissions. 'Green' is experienced to be a marketing tool. The extent to which greening remains a marketing tool is uncertain"

The total cost of ownership is much more important in freight transport, while in passenger transport there are other drivers from the local authorities and the clients. Another element is that a large share of freight transport concerns cross-border operations on international waterways, while passenger transport operations (e.g. day-trip vessels) are for a large extent taking place on local waterways.

The following research questions will be answered:
- What revenue-generating elements of an IWT company can be identified to promote the use of technologies contributing to zero-emissions? What measures will lead to more revenues, what is the role of shippers and brokers in this respect, what are their requirements?
- What elements in expenditures can be identified in relation to the powertrain and emission and energy performance? What cost parameters can be identified and what proportion of

[6] Panteia (2017), Vlootverklaringsmodel voor een tiental sluizen, *assigned bij Rijkswaterstaat*

overall operating costs do they represent (e.g. capital costs, energy costs, port dues, maintenance costs)?

- What are the current financing mechanisms in the IWT sector for powertrains and how does this relate to the financing of the ship as a whole?
- What is the current financial profile of IWT companies based on information from the balance sheet, profit and loss accounts, and what does this mean for the ability to acquire capital for investing in technologies contributing to zero-emissions?
- What other issues play a role in making investment decisions (economic outlook, age of the owner, age of engine and vessel, structure and stability of the market, type of contract, ...)?

2. Methodology

2.1 Research question 1: Revenue-generating elements of IWT companies

Inland navigation entrepreneurs provide transport services to shippers. The value chain in the inland navigation freight segment generally can be described as from shippers via brokers to IWT companies. However, this is different for passenger transport (both hotel cruises and day-trips, more customer related) and container vessels (in which shippers pay an intermodal operator, that either directly charters inland ships or uses brokers to charter inland ships). Overseeing this, one can conclude that the business model of inland shipping entrepreneurs only consists in creating revenues by selling a transport service, mostly in an indirect manner via brokers, to shippers.

A study conducted under the framework of Platina 2[7] gives insights in the contracting and pricing in the inland navigation sector. Multiple options are available for contracting and pricing in inland navigation, i.e. long-term contracts (€ / tonne), long term charters (€ / day), spot market (€ / tonne or lumpsum). The spread of these options differs according to the different market segments (building materials, agribulk, containers, liquid bulk, metal products, etc.). Panteia has kept track of freight rates in Rhine and ARA-shipping for decades and the evolution of these rates are annually published in the market observation reports by the CCNR[8]. Within the category of shippers, also two groups can be distinguished: private parties and public bodies. Public bodies use inland shipping to ship building materials to building sites, to dredge waterways or to transport municipal waste to incinerators. Public bodies are of special interest, since they can enforce the use of green shipping methods in their procurement.

In order to answer this question, information of the value chain of inland shipping must be collected. Interviews with inland waterway entrepreneurs, shippers and brokers, have been conducted, each representing a different contracting and pricing method and a different commodity. The Platina 2 study (2014) is used as a starting point to further deepen the insights gained on contracting and pricing, with particular interest in the incentives provided by forwarders and/or shippers for cleaner vessels. Interviews have been carried out with the following parties:

- Danser shipping line and Interstream Barging
- Navrom and Trading Line in the Danube basin
- ELV as an inland waterway cooperative
- Shipper (Heinz)

Moreover, public tenders from Belgium, the Netherlands and Germany relating to transport by barge were analysed. This includes transport of waste to incinerators, dredging works, supply of building materials for the purpose of road construction works and supply of salt to keep the roads free of ice. By doing this, insights in how public bodies (i.e. regional or national governments) support the use of cleaner vessels by enforcement (knock-out criterium) or incentives (higher value for money) were gained.

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[7] Report accessible through the following link: http://www.naiades.info/repository/public/documents/Downloads/119_Market_Transparency_Study_2015_Jan.pdf

[8] https://www.ccr-zkr.org/files/documents/om/om19_I_en.pdf

2.2 Research question 2: Expenditures related to the powertrain

2.2.1 Data used

The main data source with regards to the cost developments are bookkeeping reports published by Stichting Abri (300 vessels on an annual basis, of which some 95% are dry cargo vessels (incl. pushed convoys) and the remainder liquid bulk tankers) and a dataset (of 1000 vessels) retrieved from the Dutch Banks. Cost developments are published for all vessel types and commodity classes, and therefore they present a sound basis for this research question.

In the current cost databases for inland navigation, costs related to the powertrain are allocated to the capital costs (depreciation of the main and auxiliary engines), rental costs (financing of the powertrain), maintenance of the powertrain and running the powertrain (operational expenses). However, costs related to construction and maintaining the vessel hull are also included under these cost parameters. Therefore, it is necessary to distinguish between the cost parameters of the powertrain and the cost parameters related to the hull of the vessel. To do so, the share of costs allocated to the powertrain for the different cost parameters was analysed. For this purpose, the bookkeeping databases and interviews with banks[13][9] (financing sources) and engine manufacturers/suppliers (Koedood and PON) were relied on.

Another cost parameter in IWT are port dues. In the development process of the Blauwe Golf Twentekanalen project[10] Panteia has built a database concerning all port and canal dues within the European waterway network. This way, incentives in the port dues framework for clean vessels, for instance via the Green Award Scheme, were identified. Apart from port dues, a vessel classified with a Green Award might also benefit from lower interest rates from banks.

Eurostat data

Data about the economic performance of IWT enterprises is also available through Eurostat. A thorough review of the data led to the conclusion that the data is not suitable to answer or even support the answers on the research questions for this study. The following reasoning was used to discard the data:

- There is no data available for financial indicators in the Netherlands – referred to 'low reliability' in Eurostat.
- According to Eurostat, the turnover for German companies decreased with 18% in 2016 as compared to 2016. The number of IWT companies increased with 22 (+3%) meanwhile. From 2016 and onwards, the turnover levels for German companies were alike the turnovers in the financial crisis (2009 and 2010).
- A part of the decline could be explained by a reduction in fuel prices. The average value of the CBRB gasoil index decreased from € 56.82 (including CDNI surcharges) per 100 litres, to € 49.21 (incl. CDNI surcharges).
- A break in time series has been reported for Belgium in 2018.

2.2.2 Data validation and representativeness

Data and conclusions from the data were validated by international stakeholders, i.e. the German Bank for Schifffahrt, the French bank Credit Maritime and the Belgian ITB institute. For passenger

[9] Interviews have been carried out with the Dutch banks (ING, ABN-Amro, Rabobank), Deutsche Bank für Schiffahrt, the French bank Credit Maritime and crowdfunding platforms (Geldvoorelkaar and CollinCrowdfund). Moreover, results have been validated by companies active on the Danube river.

[10] See: https://www.panteia.com/news/development-of-blue-wave-twente-canals-starts/ and https://www.panteia.nl/nieuws/havengeldtarieven-in-nederland-stijgen-met-gemiddeld-3-1/

shipping, data from several companies along the Rhine river has been used. Interviews were held with French daytrip vessel operators to validate the data on passenger vessels.

2.3 Research question 3 and 4: financing mechanisms and financial profiles of IWT

2.3.1 Data used

First, the financial profile of IWT companies was assessed by collecting data on their economic and financial performance. For this, the Stichting Abri bookkeeping database was used, as well as a database from Rabobank. This database was updated to the most recent years (2009-2018), showing year-to-year evolutions of relevant indicators about the financial performance of IWT entrepreneurs. These indicators can be, amongst others, the current ratio, solvability, the ratio between own capital and financial capital, etc. Insights into the financial profiles of many ships were given, differentiated according to size classes, year-of-build and the state-of-art of the powertrain. These indicators give insights on the possibilities and likelihood for Dutch inland shipping entrepreneurs to acquire capital from banks to invest in zero-emission technologies. Interviews with stakeholders (banks, companies) from Belgium, France, Germany and Danube countries validated the data from Dutch companies.

Using these financial indicators, inland shipping entrepreneurs can be ranked according to their financial performance. This is likely to lead to the image of a small group of frontrunners with good financial ratios, a large group of domestic entrepreneurs with an average number and a small group lagging behind. This analysis was based on the assumption that the group of financial frontrunners has enough financial means to deal with the greening challenge and the required own contributions. It is assumed that access to capital is therefore not a bottleneck for the frontrunners. The latter is more likely to need externalf financing from banks (foreign capital). Therefore, it seemed more appropriate to focus the case-studies on the groups of inland shipping entrepreneurs that perform at an average level and the group that lags behind on the financial performance. For this reason, the database was used to filter operators performing at 25% of their group average, the 1st quartile ratio's (in other words: 75% of the operators in their group does perform better).

2.3.2 Data validation and representativeness

In order to assess the likelihood of financing institutions (banks and crowd funding platforms) to fund zero-emission technologies, insights in the current financing mechanisms applicable in inland navigation were derived from interviews. The decision trees used by financing institutions in inland navigation (banks and crowd funding platforms) were also assessed. With the financial institutions, the parameters influencing the decision whether to finance investments in vessels and/or powertrains were discussed. In this perspective, state aid or state guarantees can also help the investment decisions. Case studies, which were derived from the bookkeeping databases, were also conducted.

The consortium has selected four case studies for the freight market, two from the Rhine sailing basin and two from the ARA region. For the ARA region we intend to select one case from Belgium and a case from The Netherlands. These case studies form a representative sample of the financial situation in inland shipping. Within those case studies, viable options to work towards zero-emission were presented. A discussion with banks was held to define the impact of the financial performance of the selected representative case studies on the banks' willingness to finance these investments.

2.4 Research question 5: other issues that play a role in making investment decisions

In order to get an overview on all the issues that play a role in making investment decisions for inland shipping entrepreneurs, first, the investment decisions that deal with powertrains were identified. Three possibilities are described:

- Powertrain overhaul
- Powertrain renewal (retrofit in existing vessel)
- Vessel renewal, including powertrain.

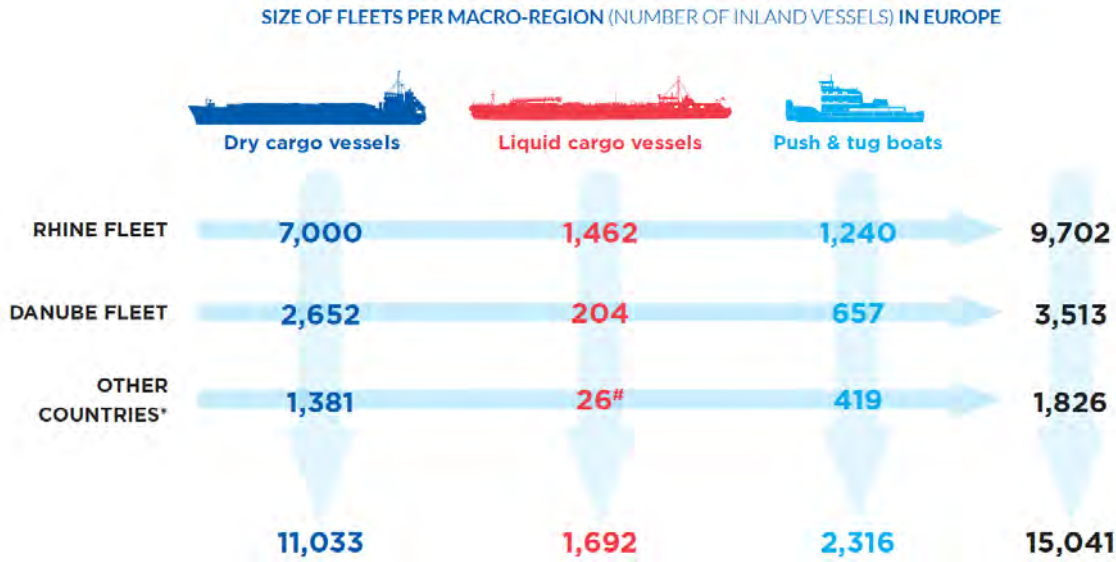
A literature study has been conducted. The literature review allowed to identify the parameters relevant for investment decisions mentioned above. The results from the literature review have been discussed with stakeholders, such as ESO (including their members) and banks.

3. Market structure

3.1 Amount of vessels

In 2018, more than 15,000 cargo vessels were registered in Europe; 65% of the fleet were found in Rhine countries, 23% in Danube countries, and the remaining 12% in other European countries with inland waterways (Poland, Czech Republic, Italy, UK, Lithuania).

Figure 3: number of dry cargo vessels per macro region in Europe



Source: CCNR Market Observation Annual Report 2019

When we look at the current situation in IWT, we see that the fleet of the Rhine countries comprises about 7,000 dry cargo and 1,400 liquid cargo vessels and 1,240 push and tug boats. The Danube fleet comprises about 2,650 dry cargo, 204 liquid cargo vessel and 657 push and tug boats. [11]

3.2 Size classes

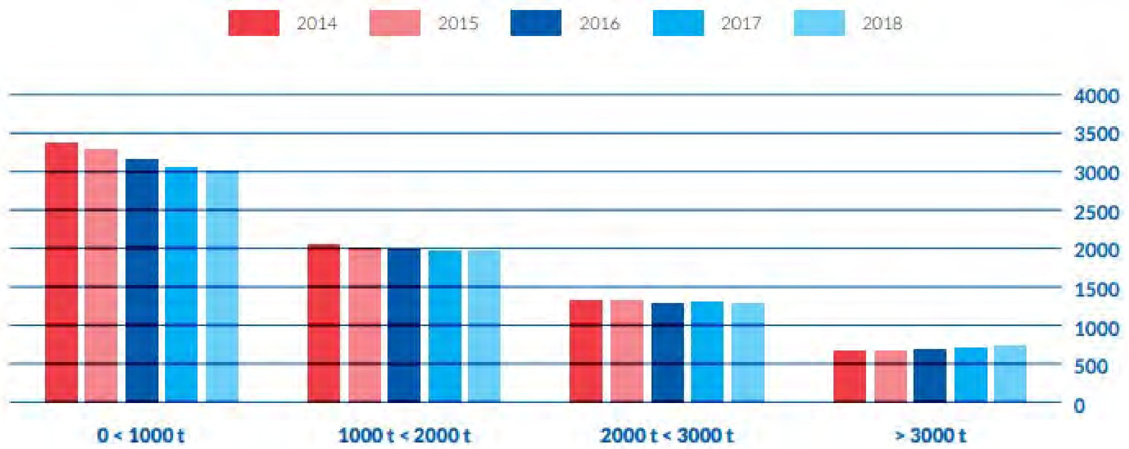
3.2.1 Rhine Fleet

Dry cargo

The number of vessels belonging to the loading capacity class (0 < 1,000 t) is falling, although the results differ somewhat from one country to another. While the number of Belgian, Dutch and French small vessels has fallen since 2014, it has remained rather constant in the German fleet.

[11] Data taken from Inland navigation in Europe, market observation 2019, CCNR

Figure 4: number of dry cargo vessels per tonnage class in Rhine countries*



Source: CCNR based on national sources.
** Rhine countries = Belgium, France, Germany, Luxembourg, the Netherlands, Switzerland. Data for Germany for 2018 are from 2017, as the German fleet data for 2018 were not yet available.*

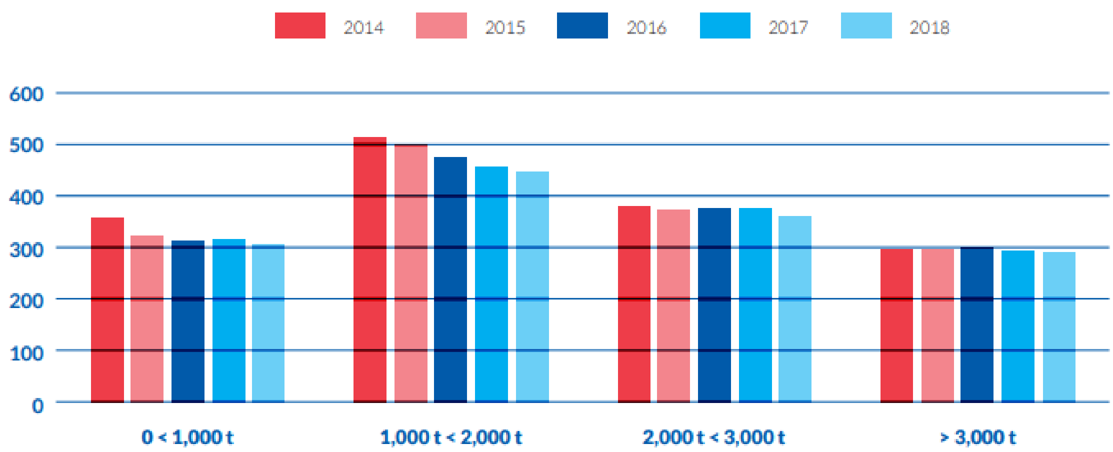
When the dry cargo vessel fleets of Rhine countries are compared with one another, it can be observed that the size class of the largest vessels (> 3,000 t) is present in the Belgian and Dutch fleet, but almost absent in the French and German dry cargo fleet. In France the share of the size class (0 < 1,000 t) is the highest of all Rhine countries. This share was 72% (in terms of number of vessels) in 2014 in France but decreased to 67% in 2018.

Liquid cargo fleet

The overall evolution of the number of vessels per size classes shows that the rather small tanker vessels (0 < 1,000 t; 1,000 < 2,000 t) have decreased in number since 2014. In 2018, the number of vessels in the two smallest tonnage size classes (0 < 1,000 t; 1,000 < 2,000 t) was 761 in Rhine countries, compared to 873 in the year 2014. This means a decrease of 112 vessels over a period of only four years.

There is one remarkable common point with the dry cargo fleet. Also, for liquid goods vessels, the number of vessels in the size category (> 3,000 t) is quite significant in the Dutch and Belgian fleet, and again at a quite low level in the French and German fleets.

Figure 5: number of liquid cargo vessels per tonnage class in Rhine countries*



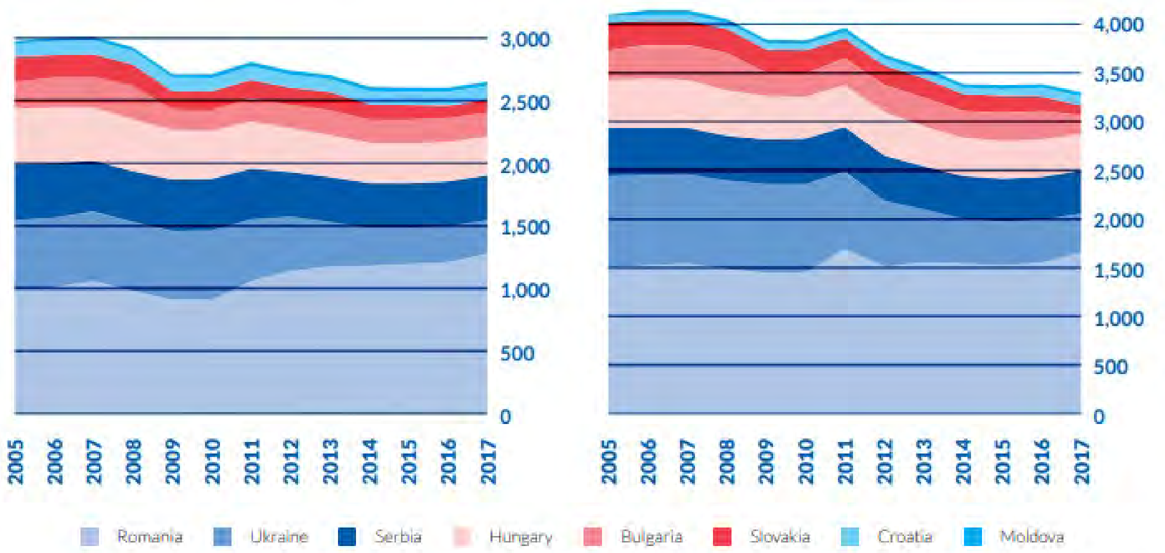
Source: CCNR based on national sources.
** Rhine countries = Belgium, France, Germany, Luxembourg, the Netherlands, Switzerland. Data for Germany for 2018 are from 2017, as the German fleet data for 2018 were not yet available.*

3.2.2 Danube fleet

Dry cargo

The following figure contains the series regarding dry cargo vessels (self-propelled vessels and barges, but without push & tug boats) in Danube countries. Both the number of vessels and the loading capacity has decreased since 2005. The decrease in loading capacity of the dry cargo fleet was more than the decrease in the number of vessels; which implies some scale decrease (smaller vessels on the Danube).The Romanian dry cargo fleet is the largest in the Danube area with a share of around 48% of all dry cargo vessels.

Figure 6: Development of the Danube dry cargo fleet according to country of origin

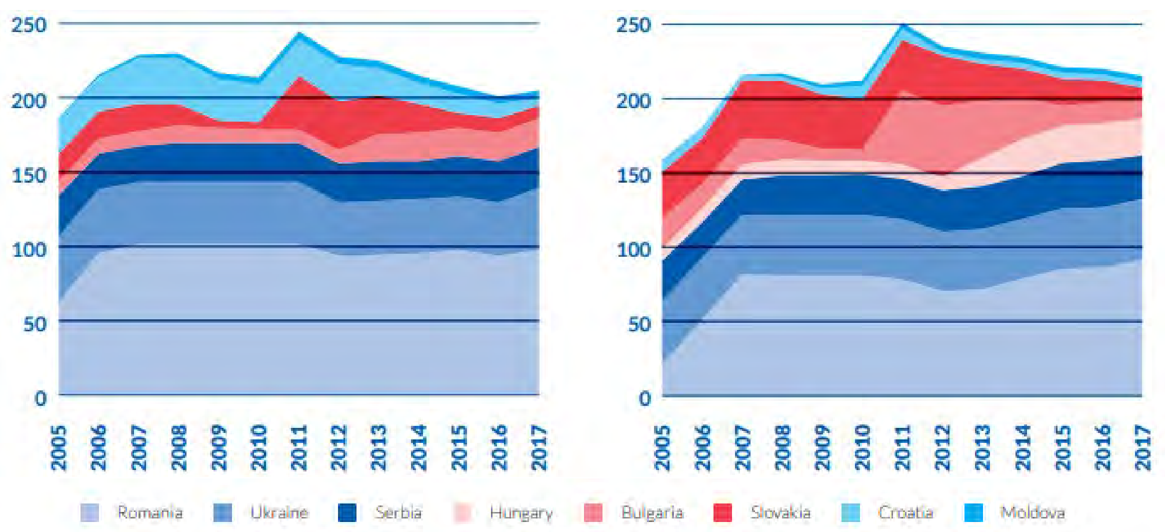


Source: CCNR based on national sources.

Liquid cargo

The number of liquid cargo vessels in the Danube basin has decreased slightly from 250 in 2011 to 200 in 2017. The same trend can be observed for the loading capacity. For the liquid cargo fleet, Romania also has the largest share in the Danube area with around 47% of all tanker vessels.

Figure 7: Development of the Danube liquid cargo fleet according to country of origin



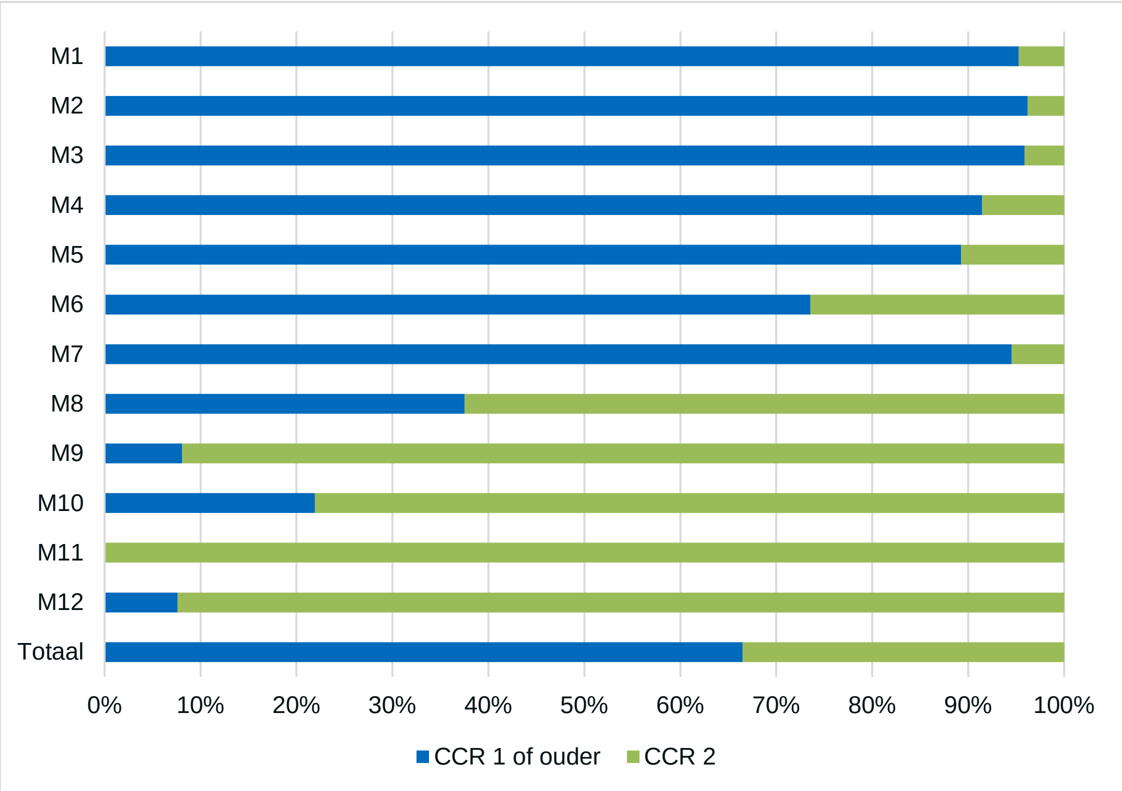
Source: CCNR based on national sources.

3.3 Engines

At present, approximately two out of three inland navigation engines do not yet meet the CCNR-2 emission requirements. Ships must meet these requirements by 2025 if they wish to load and/or unload cargo in the port of Rotterdam. It is therefore important to gain insight into the number of ship engines that currently meet the CCNR-2 emission requirements. In order to gain insight into this, the Prominent data have been further supplemented with engine changes in the years 2016, 2017 and 2018. The data was obtained via the yearbooks of the Vereniging 'De Binnenvaart'.

There are major differences between the ship size classes. Where the larger units (M8 or larger) largely comply with CCNR-2 engines, the majority of small vessels still have an unregulated engine or a CCNR-1 engine on board. This means that considerable investments will have to be made in new engines in the coming years. As of 2019, for power ratings below 300 kW, this already means an engine in accordance with NRMM Stage V; as of 2020, this also applies to larger engines. Manufacturers may still install CCNR2 engines until two years after the deadline, provided these engines have been produced before 2019/2020. Interviewees stated that many ship owners also invested in 2019 in new CCNR-2 engines to avoid having to purchase a more expensive Stage V engine while still being allowed to enter Port of Rotterdam area from 2025 onwards. 30 to 35% of the ELV members (~100 vessels) renewed their engines in 2019, whereas 4 engine renewals were normal.

Figure 8: Emission certification of the IWT engines according to size class for dry cargo and liquid cargo vessels



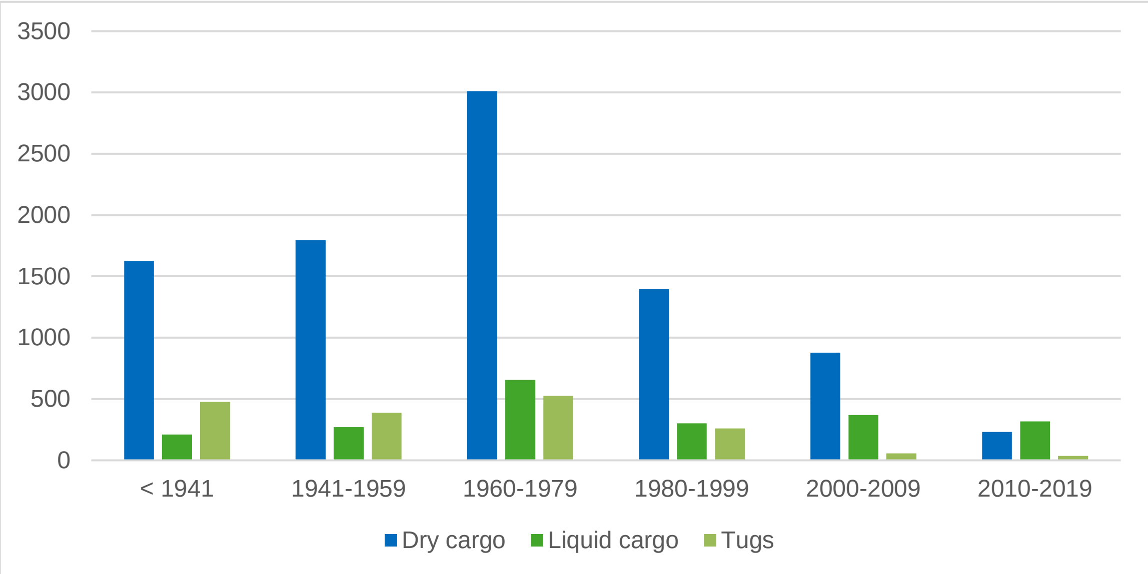
Source: Panteia (2018), based upon data from Prominent (2015) and Vereniging 'de Binnenvaart'

3.4 Year of construction

3.4.1 Western European fleet

For inland waterway vessels, the western European market is characterised by a relatively old fleet. Half of the active fleet in Germany, Netherlands and Belgium and 80% of the French fleet was built more than 50 years ago. 15% of the European fleet has been built more than 75 years ago, in particular in the Netherlands. Switzerland is the country with the newest fleet (87% of the fleet was built in the last 35 years), which can be explained by its large share of cruise ships. The Luxembourg fleet is also fairly modern (65% of the fleet was built in the last 35 years), resulting from its large share of modern tank vessels.

Figure 9: Number of vessels per year of construction in the Rhine countries.

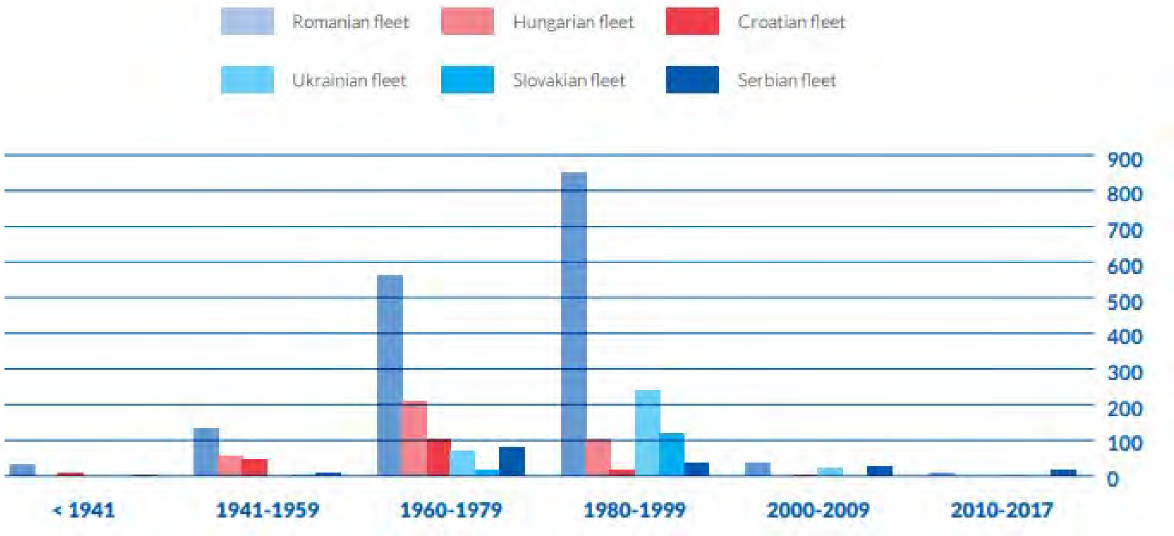


Source: Panteia (2018), based upon data provided by the CCNR

3.4.2 Danube fleet

In the eastern European market some differences can be found between countries characterised by an older fleet (Croatia, Moldova, and Hungary - a majority of vessels built between 1961 and 1980) and countries with a newer fleet (Bulgaria, Romania, Ukraine and Slovakia - a majority of vessels built after 1981). The Danube fleet has a high number of vessels that were built between 1960 and 1990. Since the year 2000 not many new vessels were built for the Danube.

Figure 10: Number of vessels per year of construction in the Rhine countries.



Source: CCNR Market Observation, annual report 2019

3.5 Ownership

The logistics, fleet and ship level form a functional chain that as a whole forms the IWT service. All of these levels are not necessarily combined within one company. In Western Europe, there is a high number of owner-operators. These parties restrict themselves to the operational functions at ship level. Only a very limited number of shipowners/operators manage the functions at the upper levels themselves such as sales, marketing and making contracts directly with shippers.

Larger companies such as shipping lines also still exist in Western Europe and mainly operate larger vessels with hired staff such as push convoys, large container vessels and large motor tankers. In particular, if vessels need to operate on a 24/7 basis, hired/employed staff is needed to comply with the staff and working time regulations. Some medium-sized and large companies operate at the logistics and fleet levels but use the ships of the owner-operators instead of their own vessels, as it was the case in the past. The number of shipping lines operating at all three levels is very limited. Examples are Danser and Contargo, intermodal container barge service providers of multimodal logistic services, which own and operate a number of vessels but also contract a substantial number of private vessel owners/operators to carry out the transport services for container transport on the Rhine. Similar situations are seen in tanker shipping, for example Interstream that has 31 own vessels and hires another 110 vessels from private owned vessels.

However, small companies owning/operating one vessel dominate the supply side structure of IWT in Europe. Larger companies and operators are predominant on the Danube. On the Danube single shipowner/operators are still the exception. The market structure in the Danube countries differs significantly from the one in the Rhine market. The market is being dominated by relatively big companies, previous state owned enterprises which are nowadays privately owned. About 14 large companies, with more than 20 vessels, dominate the IWT market. Whereas the Rhine market is characterised by a fragmented market with several small family companies owning or operating one or two vessels.

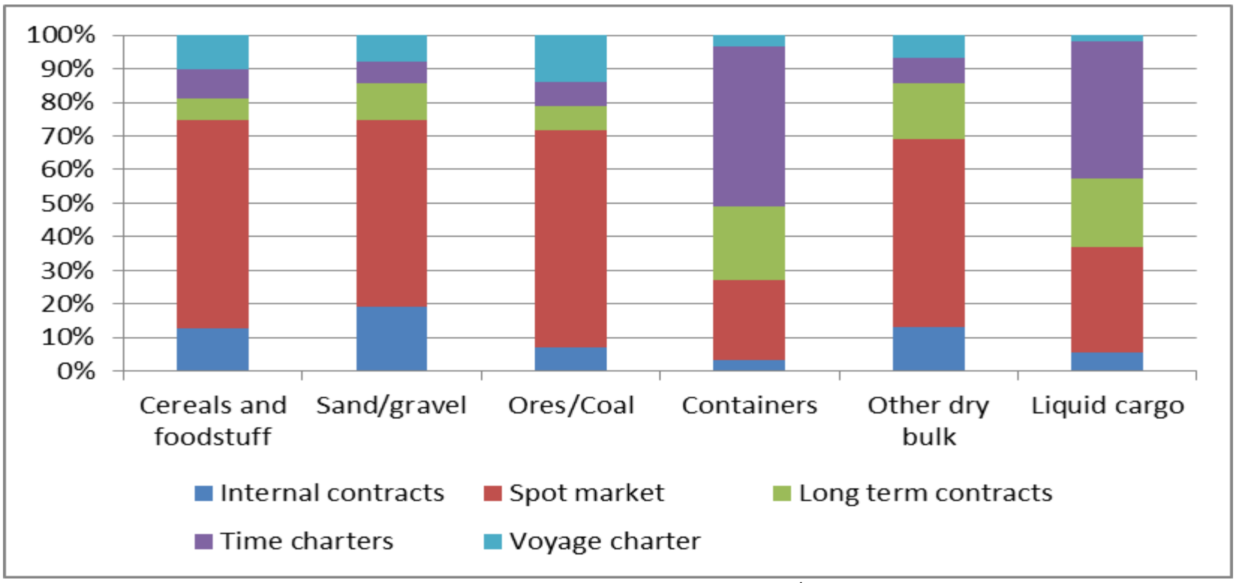
4. Revenues in IWT

4.1 Contracting and pricing

Extensive research has been carried out under the framework in Platina 2, in the D.1.5 report 'Analysis of Possibilities to Enhance Market Transparency and Synergistic Actions'.[12] The following conclusions can be drawn from this report:

- The spot market is dominating the dry cargo market, with the sole exception of the container market.
- The container market and the liquid cargo market rely much more on time charter work and long-term contracts than the other IWT market segments of cargo transport.
- Across all market segments, the spot market share is about 56%.
- In particular, the individual shipowner/operator is often in a weak position to negotiate about freight prices, as there is fierce competition between the individual shipowner/operators resulting in low prices and profit margins. Only when water levels are low or in a booming economy, there is a temporary improvement of income for the shipowner/operator.

Figure 11: Type of contracts in cargo contracting in various market segments



Source: Platina 2 D1.5, based upon a survey amongst West-European shipowners/operators

The purpose of the interviews was to update the conclusions of the 2014 Platina 2 study to the market circumstances in 2019. The following conclusions could be drawn from the interviews.

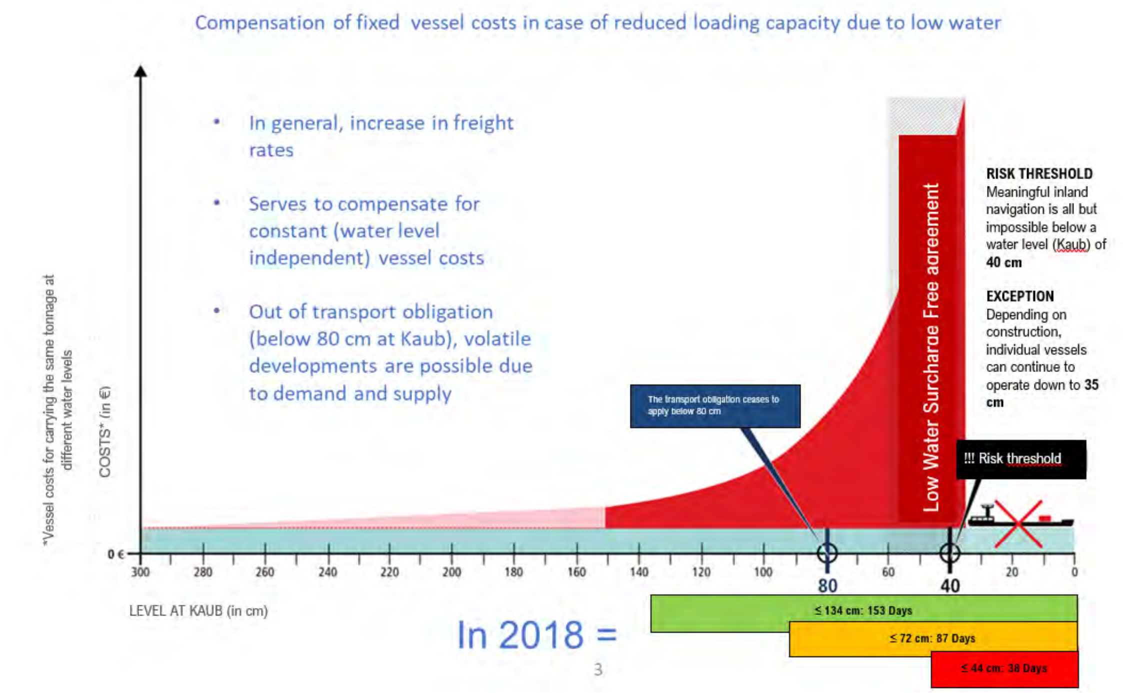
- Most barge operators are active in the spot market. Nonetheless, a slow shift is taking place from acquiring loads on the spot market to permanent contracts. However, this is mainly because of the different composition of cargo packages. For instance, coal transports show a decreasing trend since 2013. Coal is burned to provide energy to the grid. During winter periods, more energy is required than in summer. Therefore, the

[12] Report accessible through the following link: http://www.naiades.info/repository/public/documents/Downloads/119_Market_Transparency_Study_2015_Jan.pdf

amount of coal that needs to be transported differs from season to season. Hence, this cargo is transported via the spot market.

- When entering into contracts, it is indicated that they can easily be torn up. There are few guarantees on either side: shippers do not provide volume guarantees, whereas barge operators can cancel the contracts in case of low water levels (the transport obligation is cancelled). This can be seen in Figure 10:

Figure 12: Compensation of fixed vessel costs in case of reduced loading capacity due to low water



Source: RHENUS Logistics

- Different contract forms apply within the different commodities. Container transports are mainly organised by logistic service providers. In some cases, these logistic service provides both provide transhipment and transport services through a dedicated 'own' fleet. Whenever no own fleet is present, containers are often transported with longer-term contracts, whereby – depending on the type of operation – ships are either chartered for day rental. A combination of both is also possible. Under pressure from customers from B2C markets, longer-term contracts are also often in place in these markets.
- When transporting both dry (coal) and liquid products, there is a spot market where large cargo packages are traded periodically. These products are then distributed to the company's own fleet, associated vessels and the spot market.
- Longer term contracts (more than a single voyage) are generally still agreed for the duration of one year. Depending on the degree of familiarity by the shipping party with inland shipping, risks are shifted to the shipper or towards the logistics service provider. In the container market, contracts are more often entered into for longer periods.

With regards to pricing, the following pricing mechanisms can be seen:

- A fixed rate per transported tonne of cargo. This is mostly the basis for both spot market contracts as well as longer contracts.
- A lumpsum tariff for a single voyage. This is mainly the case if the transported commodity has a low specific density. In the spot market, these kinds of contracts are also used to mitigate the risks of low water levels.
- A time-charter, mostly agreed in a price per day for a certain time-period (i.e. a voyage, a month, etc.). For time charters, the OPEX-costs are generally paid by the client.

For transports with a fixed rate, surcharges on the price are made for the following options:

- Low water levels, mostly referred to the waterway gauges at Duisburg – Ruhrort, Cologne, Kaub or Maxau. Various schemes are available. Below, the Kaub-180 scheme is presented. This scheme is applied for the coal transports related to the plants of the EnBW.[13]

Figure 13: Compensation of fixed vessel costs in case of reduced loading capacity due to low water

Pegel Kaub		ARA → Neckar Tragfähigkeit des eingesetzten Schiffes	
von	bis	≤ 1.450 t	> 1.450 t ≤ 3.100 t
2,00 m	1,91 m		
1,90 m	1,81 m		
1,80 m	1,71 m		5,0 %
1,70 m	1,61 m		10,0 %
1,60 m	1,51 m	5,0 %	17,5 %
1,50 m	1,41 m	10,0 %	25,0 %
1,40 m	1,31 m	17,5 %	32,5 %
1,30 m	1,21 m	25,0 %	40,0 %
1,20 m	1,11 m	35,0 %	50,0 %
1,10 m	1,01 m	45,0 %	60,0 %
1,00 m	0,91 m	55,0 %	70,0 %
0,90 m	0,81 m	70,0 %	85,0 %
0,80 m	0,71 m	85,0 %	100,0 %

Source: Contract published by Weekblad Schuttevaer: https://www.schuttevaer.nl/download/ENbW.PDF

- Surcharges for gasoil expenses.

[13] EnBW Energie Baden-Württemberg AG, or simply EnBW, is a publicly traded electric utilities company headquartered in Karlsruhe, Germany. As its name indicates, it is based in and primarily serves the German state of Baden-Württemberg.

Example: *The freight rates are adjusted on a monthly basis depending on the gas oil price. The base value for the gasoil price is 70 € / 100 l for all transports. The CBRB / Rotterdam gas price is used to calculate the freight rate adjustment. In addition, if the respective gasoil price falls below the base value on the 1st of the month, a surcharge or discount on the agreed basic freight of 0.45% for each started 0.50 / 100 l becomes due for this month.*

4.2 Incentives for greening

Greener ships do not receive higher freight rates. However, there is a tendency to enter into longer contract periods, up to 10 years, with greener ships. This tendency applies both for IWT entrepreneurs and shippers. Greening requires longer contracts to acquire loans from banks, and low water problems in 2018 emphasized the need of long-term contracts for shippers to secure transport capacity. The number of shippers that apply such long-term contracts, is still very low. Mainly larger multinationals, involved in the B2C-markets, tend to agree on such contracts at the moment. Greening is rather imposed – through strict conditions to be allowed to carry out the transport – as opposed to be achieved through price mechanisms. It thus works as a 'license to operate'.

Government tenders generally do not include benefits for vessels with better environmental performances. This is based on an analysis by Panteia of a large number of German, Belgian and Dutch tenders from waste companies, transport of (bulk) road salt and infrastructure works, including pre-taxes and sand beds. In almost all cases, the reasoning behind selecting on the lowest price, is that the contracting authority believes that there are a lot of providers on the market with the same quality. To this end, in many cases it is decided to award the contracts to the company that can offer the lowest transport price. A good example incorporating environmental performance is the tendering of waste transport from The Hague to the waste company Afval Verwerking Rijnmond (AVR) in Rotterdam. This tender explicitly includes the requirement that the material used must be Stage V (equivalent) in terms of emissions.

Trigger for barge operators to think about changing their powertrain to a new, more sustainable powertrains is:

- A new, preferably long-term transport contract with a fixed route and a known sailing profile, making the savings from an alternative power train 'secure' and calculating the business case;
- Legal requirements, e.g. the requirements in Rotterdam
- (c) An obligation on the part of the shipper or charterer to use a clean vessel for a particular transport.

In the absence of these triggers, inland shippers themselves will only start thinking about cleaner drivelines if a positive business case arises, given the uncertainty surrounding sailing profiles. It also applies that in many cases the existing engine will have to be fully depreciated.

4.3 Measures that will to more revenues and the role of shippers / brokers

The vast majority of shippers are currently not prepared to pay extra for green transport. As a result, no measures can be devised that will lead to more income for a green ship. The only control factor is the duration of contracts entered into, and therefore the degree of certainty (return on investment) a shipper can offer to a barge operator and their investors. Shippers who are committed to greening would do well to conclude contracts directly with inland shipping companies, rather than via brokers.

Brokers generally have no special requirements; they pass on the shippers' requirements to barges. If many shippers only want to use 'green' vessels for transport, it will become more interesting for chartering offices to use these green vessels on other routes as well. Brokers try optimise the deployment pattern of their vessels by eliminating empty shipping as much as possible. Vessels are usually used on several routes. This results in a more diverse sailing profile, which worsens the business case for alternative powertrains.

The only way to force more revenue for green ships is to include transport in the European Emission Trade System. CO_2 emissions in the supply chain will become important in this respect. Although it would be going too far for this study to work this out in detail, we would like to point out that the nature of the raw materials transported by inland vessels is such that the CO_2 emissions during the production process are of a considerably greater order than the CO_2 emissions during transport.

5. Expenditures in IWT

Barge operators have to deal with a large number of cost items: fuel costs and port dues[14] (which together are the direct shipping costs), personnel costs, repair & maintenance costs, depreciation, interest charges, insurance costs, administration costs, car costs and other costs. The figure below shows the shipping costs in relation to the total costs of a barge operator. Doing so, a cross-section has been made of dry cargo shipping by ship size class.

From interviews with engine manufacturers and barge operators, it can be concluded that the currently available green drivetrains do not necessarily lead to a cost-reduction. Interviewees have stated that CCR-2 engines consume some 8% more fuel as compared to CCR-1 or CCR-0 engines. These engines thus lead to higher operational expenses (OPEX). Stage V engines are expected to result into lower fuel expenses; however, urea is needed as a supplement. Moreover, there are additional maintenance costs for the DPF and SCR unit. Therefore, the OPEX of a CCR-2 engine and a Stage V engine are the same. Diesel-electric drivetrains can lead to significant savings of operating costs in some cases. However, in other cases this leads to higher fuel consumption. This is highly dependent on the sailing profile. Interviewees with LNG propelled vessels in their fleet mentioned that reduction of operating costs were less than expected for LNG-vessels, due to declining oil prices. As a result, the return on investment compared to diesel powertrains was reduced.

5.1 Operating costs

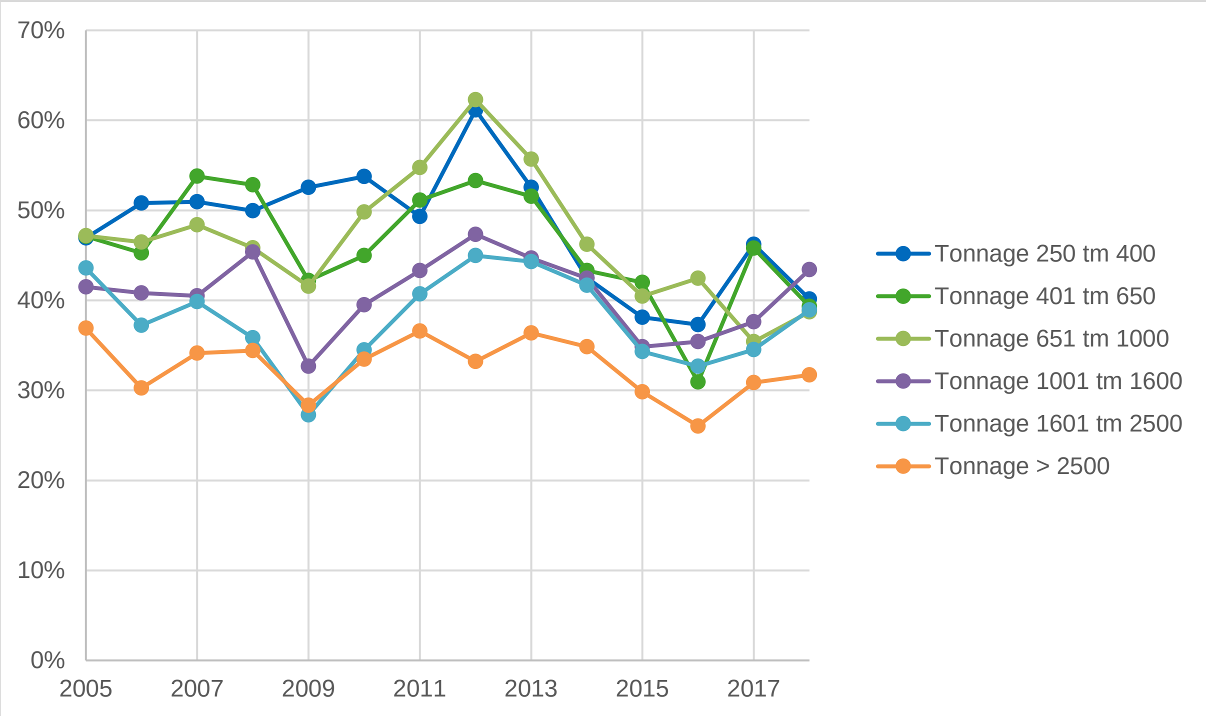
5.1.1 Dry cargo fleet

The database of Stichting Abri reveals that the smaller ships have on average more direct sailing costs than larger ships. This is related to the book value of the ships. Smaller ships are usually older, have a lower economic value and in many cases have already been written off for tax purposes. Moreover, in the case of smaller ships (everything smaller than 1600 tons), there is in most cases no or limited staff costs, because these ships operate in a husband-wife business, or with an entrepreneur as captain, with a (light) sailor as employee.

The conclusions were validated with French and German banks and the Belgian IWT institute, as well as stakeholders from the Danube river basin.

[14] Port dues generally are taxes by local governments. Port dues are applied in all European seaports. Dutch ports, Rhine ports and Danube ports. No port dues have to be paid on the Belgian and French waterway network or along the Moselle river; here canal fees apply. On the German waterway network and the tributaries of the Rhine, canal dues were applied up to 2018.

Figure 14: Evolution of the share of operating costs in relation to the total expenses



Source: Panteia (2020), based upon Stichting Abri database.

Port charges consist in a very small share of the operating costs. Therefore, they cannot constitute a sufficient incentive or deterrence to support the transition towards greening. Just a small number of ports are willing to give a discount and the discount percentages that the ports do give are marginal – generally in the range of 5 to 15% of the tariff. Channel costs are often passed on to the shipper. They have to be paid in Flanders, France and on the Moselle. There is no differentiation of the rates per emission class.

5.1.2 Liquid bulk

From the data from the Stichting Abri database, it could be concluded that in tanker shipping, the share of operating costs equals some 15%. These findings have been validated in interviews by stakeholders from Belgium, Germany, France en Danube countries. This is significantly lower than the dry cargo fleet. Reasons for this are:

- the higher market and book values of tanker ships as compared to the dry bulk fleet, and therefore higher capital costs
- Other legal forms of undertakings. In the tanker shipping sector, many companies operate as a private limited company, whereas in the dry bulk sector, the majority of even the larger vessels operate as partnerships. As a result, wage costs are higher because in the case of private limited companies, wages for the owner of the company are entered in the accounts. In addition, there are stricter training requirements for tanker shipping, resulting in higher collective labour agreements. Finally, precisely because of the higher capital charges, tanker shipping companies also operate more often in semi-continuous or continuous operation. As a result, there are more personnel on board.
- Another reason is the large share of ARA-shipping. Transport distances are short, queue times at terminals are long. In ARA shipping, only 10% of the total costs can be linked to fuel costs. For Rhine shipping, the operating costs amount to 30% of the total costs.

Alike the dry cargo sector, port charges consist in a very small share of the operating costs.

5.1.3 Passenger shipping

For the data samples received from German and French companies, it could be derived that operating costs for daytrip vessels equal approximately 10% of the total costs. This is mainly due to the fact that personnel costs in daytrip vessels form a major share (>50%) of the total operating costs.
Alike the dry cargo sector, port charges consist in a very small share of the operating costs.

5.2 Capital costs

Interest rates by bank financing equal 2.0 to 2.25% in inland shipping. This financing can only be provided if the financing application matches with the policy of the bank. For old ships it applies that at most a bank is willing to provide only forty percent of the appraisal value of the ship as a loan. For new-build vessels this can go up to 70% and in exceptional circumstances – long-term contracts - up to 80%. The duration of financing is short for older ships – usually 7 or 8 years and can be extended to around 15 years for a newly built. The vessel hull is depreciated

Engines are depreciated within 10 years in line with the Inland Waterways Tax Covenant. This convenant applies to situation in the Netherlands. Interviews with banks from Germany and France, as well as the Belgian IWT institute, confirmed that the situation in these countries is much alike. In the Dutch convenant, no differentiation is made to the different components of a power train. With diesel-electric, this could cause disproportionately high depreciation costs on the electrical components.

Lastly, investments in the powertrain also affect the value of a vessel and therefore the capital costs. The extent to which this happens differs from vessel to vessel. Generally, it can be stated that engine reflects some 15% of the capital value of a new build vessel. However, for older vessels it can be the case that the hull is completely depreciated and a new engine set. From recent engine renewals, it can be noted that the engine can reflect some 40% of the vessels value (and therefore, also depreciation).

5.2.1 Dry cargo shipping

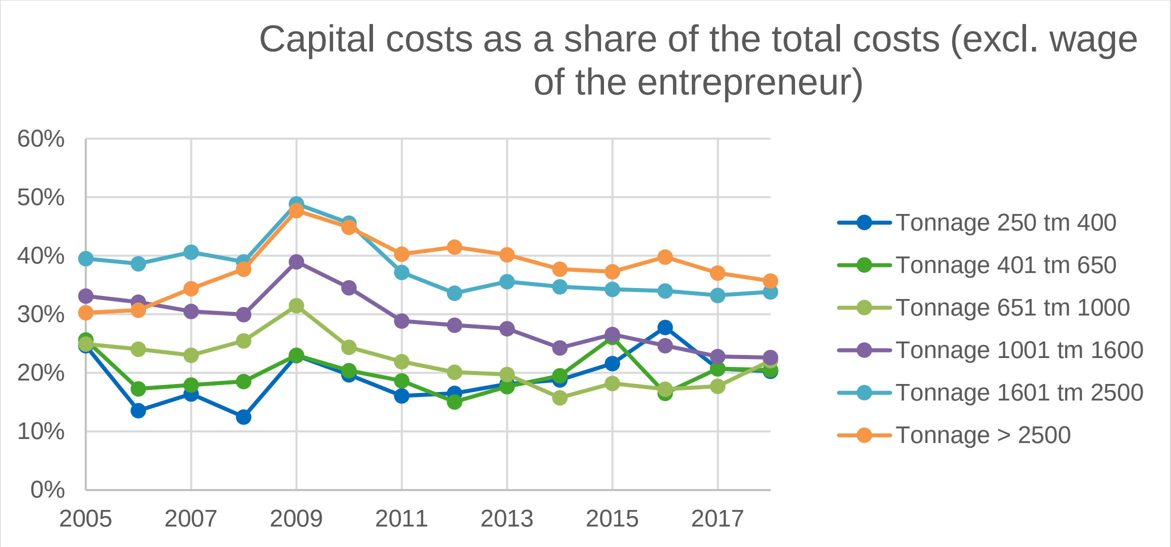
Figure 13 shows the share of capital costs in the dry cargo fleet according to size classes. It can be seen from the graph that the cost of capital (consisting of depreciation and interest charges) is highest for larger vessels (>1600 tonnes). Here the capital costs amount to approximately 35% of the total costs. For smaller vessels (up to 1600 tonnes), capital costs amount to only 20% of total costs. Figures from the French statistical institute support these percentages; for the total French fleet, the share of capital expenses equal 17.3% (excluding rental payments).[15]

The underlying reasons for the differences can be related to the age of the ships and the value of the capital good. Larger ships are generally also younger ships and represent higher values. Moreover, almost all of these ships still have an outstanding mortgage. This has been repaid more often - but certainly not always - in the case of smaller ships.

It is visible that the share of capital charges for larger ships has decreased since the economic crisis and has increased for smaller ships. There are two reasons for this. Larger ships, most of which were built around 2006-2007, have already written off a large proportion of their parts. It is therefore no longer possible to increase these costs. In the case of smaller vessels, an opposite trend can be seen. This is due to the banks' restrictive financing policy and, in particular, the higher interest costs that coincide with alternative forms of financing such as crowdfunding.

[15] INSEE ESANE 2016, Caractéristiques comptables, financières et d'emploi des entreprises - Principales caractéristiques au niveau groupe selon la tranche d'effectifs salariés

Figure 15: Evolution of the share of operating costs in relation to the total expenses



Source: Panteia (2020), based upon Stichting Abri database.

5.2.2 Liquid bulk shipping

From the data from the Stichting Abri database, it could be concluded that the share of the capital costs to the total costs equals some 25 to 30% of the total costs in liquid bulk shipping These findings have been validated in interviews by stakeholders from Belgium, Germany, France en Danube countries.

5.2.3 Passenger shipping

From data provided by the CCNR on daytrip vessels operating in Germany, it could be concluded that in passenger shipping, the share of the capital costs equals some 15% to 20% of the total operating costs. These findings have been validated in interviews with French passenger shipping entrepreneurs.

6. Financial profiles of IWT companies

6.1 Financial ratio's

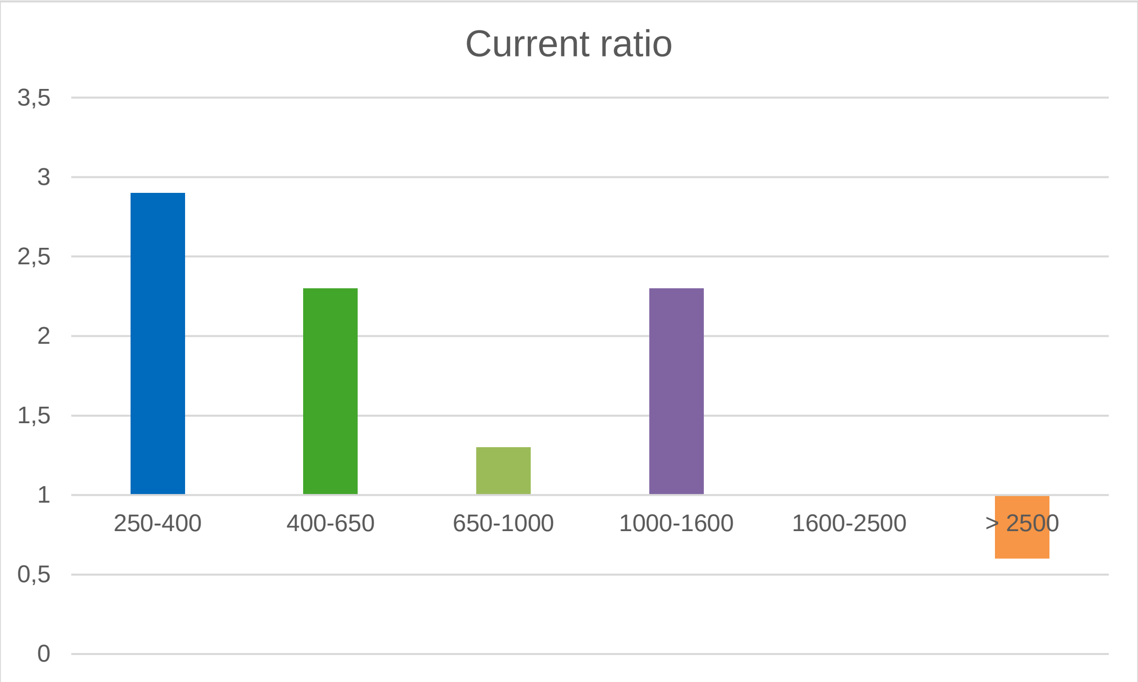
6.1.1 Current ratio to stress liquidity of a firm

The current ratio is an indication of a firm's liquidity. Acceptable current ratios vary from industry to industry. In many cases, a creditor would consider a high current ratio to be better than a low current ratio, because a high current ratio indicates that the company is more likely to pay the creditor back. Large current ratios are not always a good sign for investors. If the company's current ratio is too high it may indicate that the company is not efficiently using its current assets or its short-term financing facilities.

If current liabilities exceed current assets the current ratio will be less than 1. A current ratio of less than 1 indicates that the company may have problems meeting its short-term obligations. Some types of businesses can operate with a current ratio of less than one, however.

The graph below shows the liquidity ratios in 2018 for different size classes of dry cargo vessels.

Figure 16: Current ratio for dry cargo vessels in 2018



Source: Panteia (2020), based upon Stichting Abri database.

6.1.2 Solvability to stress the long term liabilities

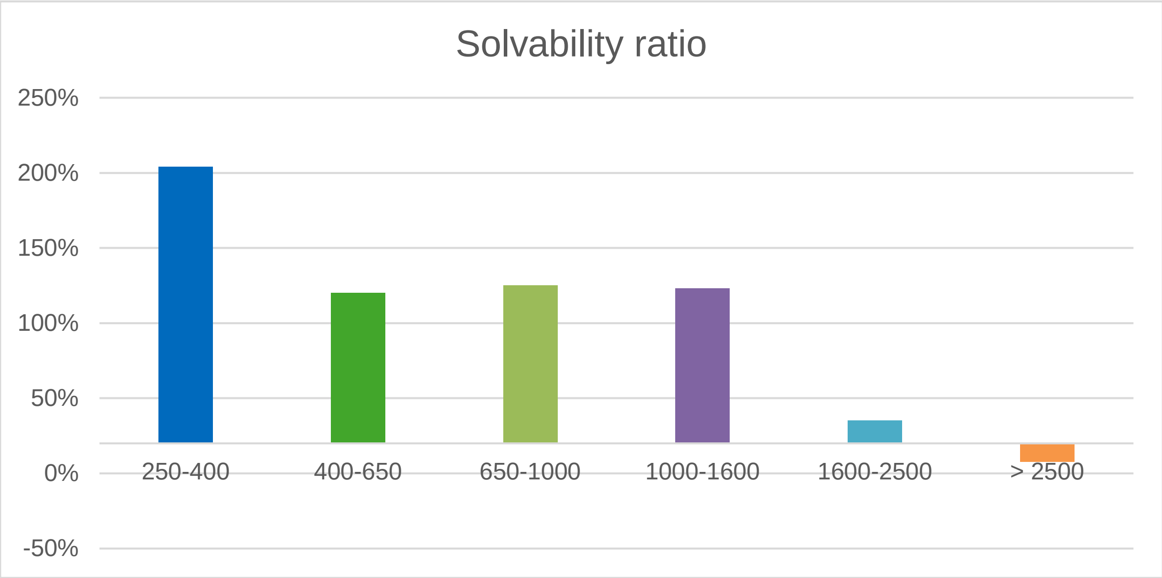
The solvency ratio is a key metric used to measure an enterprise's ability to meet its debt obligations and is used often by prospective business lenders. The solvency ratio indicates whether a company's cash flow is sufficient to meet its short-and long-term liabilities. The lower a company's solvency ratio, the greater the probability that it will default on its debt obligations.

The solvency ratio is calculated by dividing a company's after-tax net operating income by its total debt obligations. The net after-tax income is derived by adding non-cash expenses, such as depreciation and amortization, back to net income. these figures come from the company's income statement. Short-term and long-term liabilities are found on the company's balance sheet.

As a general rule of thumb, a solvency ratio higher than 20% is considered to be financially sound; however, solvency ratios vary from industry to industry. A company's solvency ratio should, rentherefore, be compared with its competitors in the same industry rather than viewed in isolation.

The graph below shows the liquidity ratios in 2018 for different size classes of dry cargo vessels.

Figure 17: Solvability ratio for dry cargo vessels in 2018



Source: Panteia (2020), based upon Stichting Abri database.

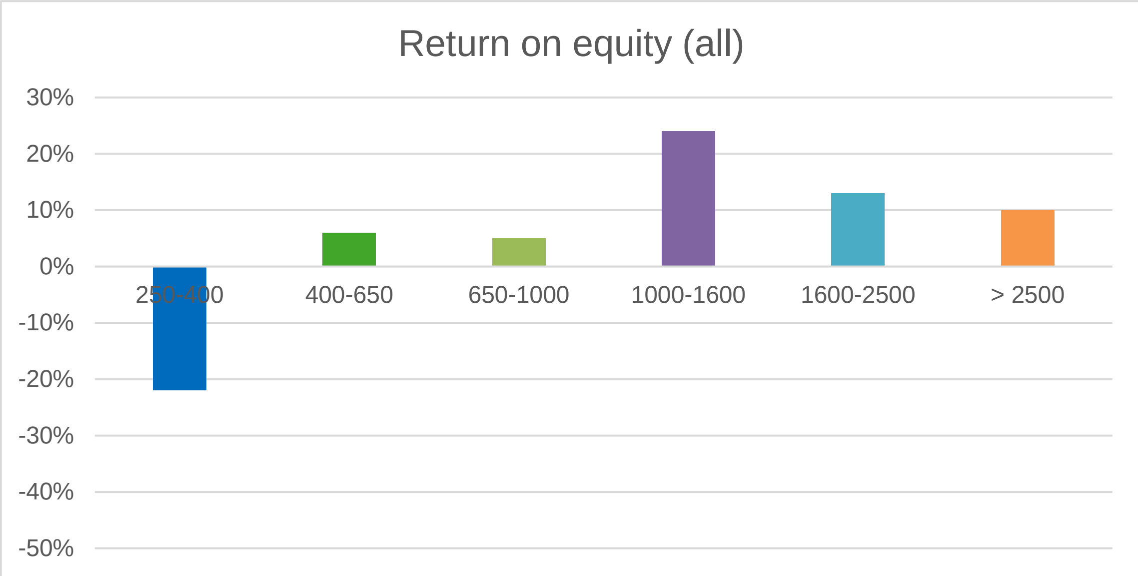
6.1.3 Return on equity

Return on equity (ROE) defined as the ratio between an income (profit) and the capital that this income has earned. Profitability is an important yardstick for long-term decision calculations.

In order to ensure the continuity of the company in the long term, the profit must be sufficiently large to enable the providers of capital (shareholders) to make desired distributions in the form of dividends or interest.

The graph below shows the liquidity ratios in 2018 for different size classes of dry cargo vessels.

Figure 18: ROE-ratio for dry cargo vessels in 2018



Source: Panteia (2020), based upon Stichting Abri database.

A special calculation is the return on the private equity. This reflects the capability of a company to return the private capital as profits.

Figure 19: ROE-ratio (private) for dry cargo vessels in 2018

Source: Panteia (2020), based upon Stichting Abri database.

6.1.4 Conclusions and remarks

The following conclusions and remarks can be drawn from the financial ratios:

- Smaller vessels tend to have positive liquidity and solvability ratios, which makes them relatively invulnerable to financial crisis. However, due to the fact that these vessels are mostly old; large investments are needed to keep the vessel up with modern standards. This can be seen as a short-term liability towards the vessel. Some entrepreneurs cannot make the necessary investments when the profits drop.

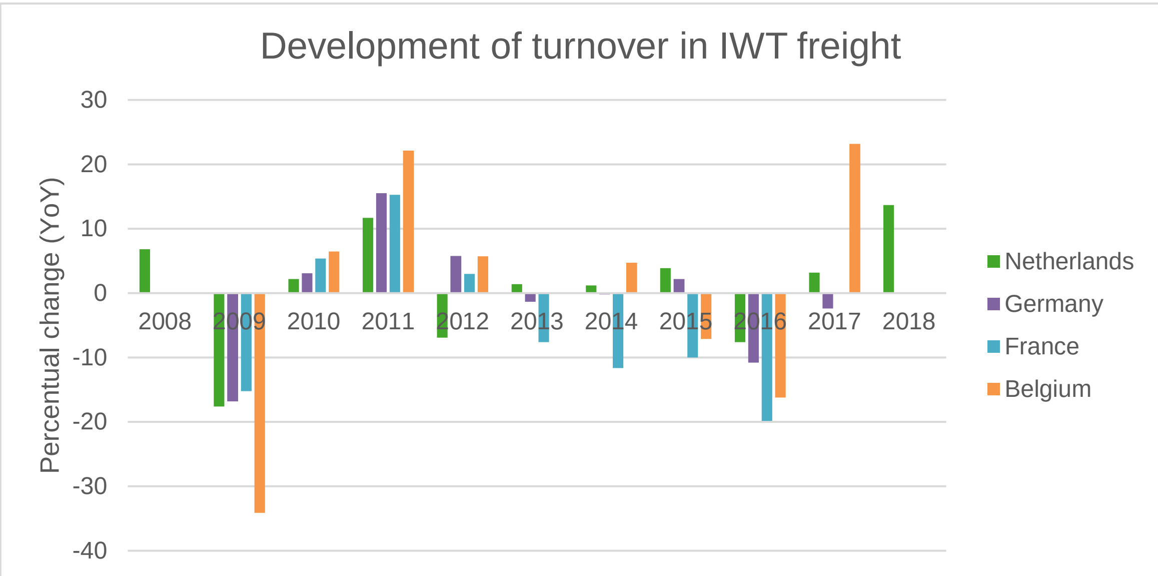
- The largest vessel category is, despite good years in 2017 and 2018, still vulnerable for bankruptcy. Both the liquidity ratio and the solvability ratio are below the thresholds. Contrary, 2018 showed decent performances with regards to Return on Equity; especially the return on private equity was high. This is mainly due to the fact that that the majority of equity is debt financing.
- The vessel categories smaller than 1000 tonnes show a negative return on private equity. The income generated with this vessels is not sufficient to return the own capital invested in the company.

6.2 Turnover

6.2.1 General statistics

The figure below shows the development of turnover in the inland navigation sector per country in Western Europe, based upon data from the national statistical institutes. The figure shows that the trends are not visible at country level, but at cluster level. If things go well in the Dutch inland navigation sector, this also applies to the inland navigation sectors of Germany and Belgium. Minor differences can occur due to the different compositions of the IWT fleet, most notably due to a different ratio of liquid bulk shipping versus dry bulk shipping.

Figure 20: Development of turnover of IWT (dry bulk + liquid bulk).



Source: Panteia (2020), based upon CBS, Destatis / BDB, Insee ESANE and BELSTAT.

The following conclusions can be drawn.

- The Belgian inland navigation generally reacts more strongly to shocks than the Dutch inland navigation sector. This has to do with the specific structure, which in Belgium is much more focused on small enterprises that operate to a greater extent on the spot market (source: ITB surveys).
- On the other hand, German inland navigation enterprises continue to react less violently to economic shocks. Here, too, the cause is to be found in the structure of the sector: on average, the enterprises in Germany are larger than in the Netherlands. There are also relatively many tanker shipping companies in Germany.
- The French inland navigation sector operates more independently of the other countries. This is due to the large river basins (Seine and Rhône-Saône) which are isolated from the rest of the European waterway network. As a result, revenue development in France shows a

different trend. The turnover development of the French inland navigation sector is highly dependent on agricultural production in the country and large construction projects near Paris.

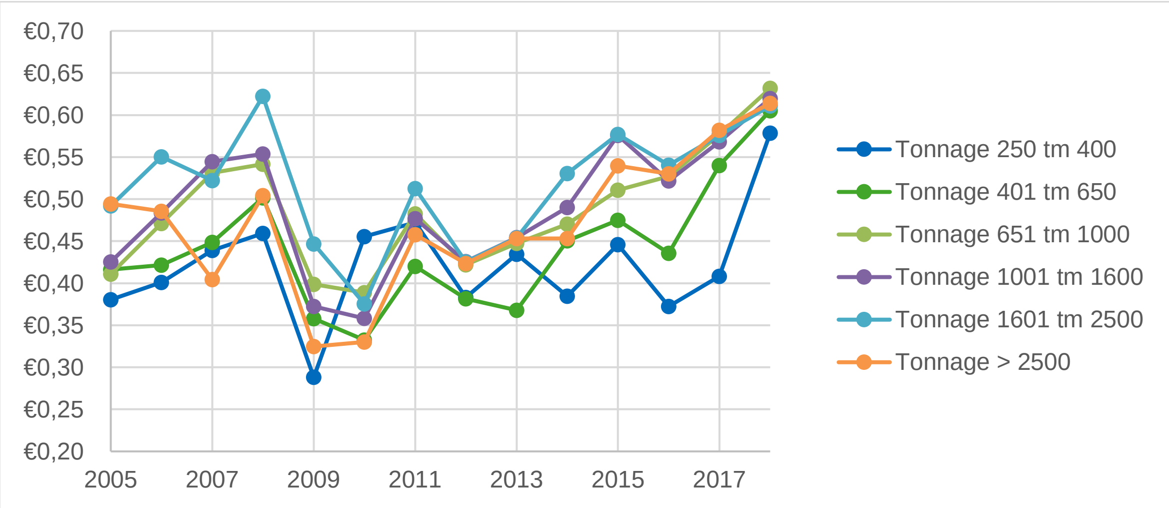
6.2.2 Insight in turnover development per vessel size class

IWT entrepreneurs in freight transport generate revenues based upon agreements with their clients. A large part of their revenues is generated by transport performance. These transports can be arranged by means of a voyage charter (spot market), where a price per tonne or a lumpsum price is agreed for a single-transport between A and B. Other options include a time charter (number of days times a tariff) or long-term contract (a fixed tariff for a transport between A and B, for a certain time period).

Some income is generated through demurrage. This applies when the loading and unloading processes of vessels at terminals take more time than the times stated in various (non-binding) national laws. In liquid freight shipping, income from demurrage can account up to 1/3 of the overall turnover of a vessel.

The turnover in the dry cargo segment has increased sharply since 2015, mainly because of low water levels in 2015, 2016 and 2018. Revenues in 2018 were at the highest level ever, even higher than before the financial crisis. Low water levels were the main cause. However, it should be noted that profits rose sharply in particular for barge operators. On the other hand, inland shipping companies that are also active as logistics service providers lost extra money due to the low water levels.

Figure 21: Turnover per tonne per day in IWT dry cargo according to size class



Source: Panteia (2020), based upon Stichting Abri database.

It should be noted that the subdivision by vessel size classes does not necessarily apply to the economic performance of inland waterway vessels in France. This is due to the specific characteristics of the network and the isolation (for large vessels) of the Seine and Rhône-Saône basins. The financial performance of vessels active in these regions are subject to regional economical developments which can affect volumes, and therefore turnover, to a large extent. Moreover, a very specific French vessel type, the Canal-du-Nord vessels (of the order of 800 tonnes) show much better financial figures, compared to vessels of equal tonnage. This is due to the fact that **1)** these vessels are able to transport goods between the Seine basin and the Rhine-Meuse-Scheldt basins and **2)** these vessels are able to ship relatively large amount of goods as compared to Freycinet vessels (250-400 tonnes). In addition, the French inland waterway transport market is subject to cabotage regulation, which limits this market to external influences.

6.3 Business perspective

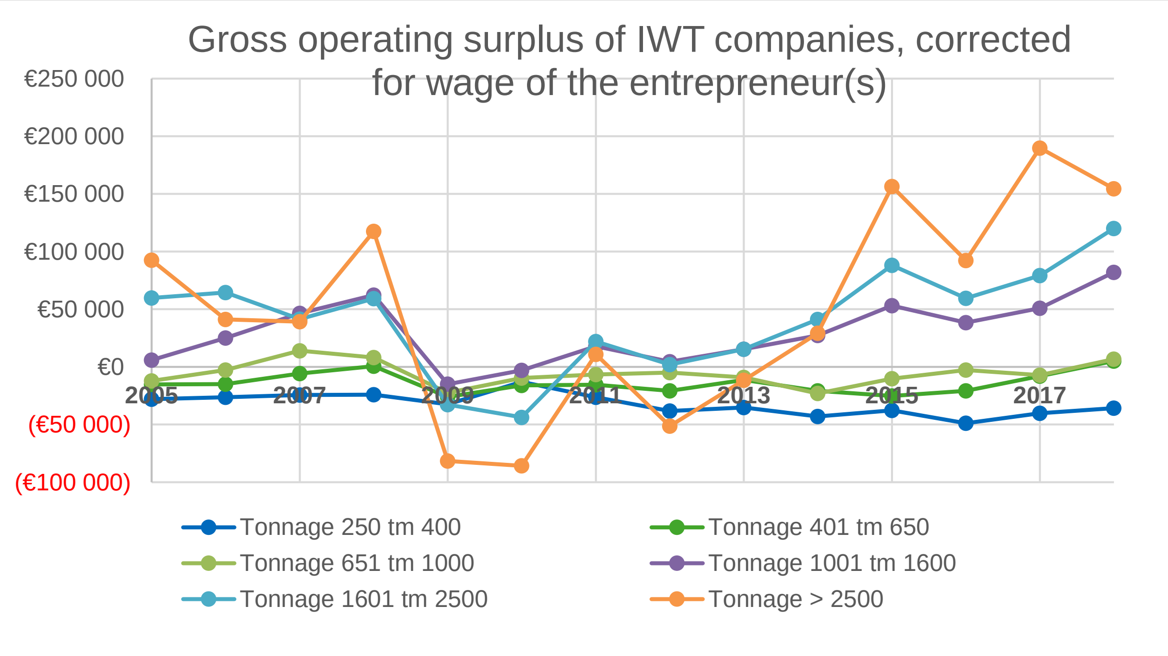
6.3.1 Dry cargo shipping

As of 2012 all companies in the database of Stichting Abri have been operating with profit. This means that the turnover was higher than the direct costs and capital charges. However, entrepreneurial wages are not included in the books, and need to be financed from the profits of the company. If we correct for this, the following observations can be made.

- Despite the fact that revenues have increased, it is difficult for entrepreneurs with motor vessels smaller than 1000 tons to realise a sustainable entrepreneur's wage.
    - Insufficient entrepreneurial wages can be achieved over the entire period for ships between 250 and 400 tons. This implies that all profits from the company are spent on private expenses. No money can be set aside for necessary investments in fleet renewal.
    - The picture is the same for ships between 400 and 650 tons, were it not for the fact that a positive balance remained in the years 2008 and 2018. For these ships, too, almost all profits from the company are needed for the company's private expenses. No money can be set aside for necessary investments in fleet renewal.
- For companies with ships with sizes between 1000 tons and 2500 tons , there is enough income for the entrepreneur (s), except for the crisis years 2010 and 2011. This means that these companies do have room to reserve money for future investments. In recent years, and in 2018 in particular, profits have risen sharply.
- The crisis period has been longer for ships larger than 2500 tons. On top of that, there were also negative business incomes in 2012 and 2013. That means that only limited money could be drawn from the company for private income.

Conclusions of the business perspectives have been discussed with and validated by German and Belgian stakeholders.

Figure 22: Turnover per tonne per day in IWT dry cargo according to size class



Source: Panteia (2020), based upon Stichting Abri database.

6.3.2 Liquid bulk shipping

Financial overviews in the liquid bulk sector derived from the Stichting Abri database and the Rabobank database show a decent economic performance. These findings were validated by large shipping companies active in liquid bulk shipping and a cooperative.

There are four distinct markets in the liquid bulk sector:

- Dirty products
- Clean products
- Chemicals
- Edible oils

The market perspectives in the liquid bulk sector are generally good.

- By phasing out the single-hull tankers, the market perspective has improved. The market is volatile and is strongly driven by oil price developments. In recent years, oil prices have shown a stable and slightly upward trend, which generally has a positive impact on transport demand. The current fall in prices due to the corona crisis is creating additional demand for storage capacity.
- The chemicals market is driven less by oil prices and more by the consumer market. Here too, volumes have been stable in recent years. Due to the far-reaching specialisation of tankers, good economic earnings can be achieved. Specialisations are mainly related to physical factors, such as stability
- The market for bunker tankers transporting so-called 'dirty products' is declining. The use of fuel oil in deep-sea shipping is decreasing, because either low-sulphur fuels have to be used or scrubbers have to be installed. Many of these tankers are cleaned and prepared for other products. In the bunker sector, we see a greater diversity of products on offer.
- The edible oils market is a small and also very stable market. The demand for products has been constant for years, and so has the fleet. A limited number of players are active in this market and these companies are running solid economic results.

Generally speaking, the tanker shipping sector has good economic prospects. The fleet is modern and up to date. In many cases, engines already comply with the CCNR-2 requirements. The obligation to classify results into significant sufficient capital reserves for replacement investments.

6.3.3 Passenger shipping

Passenger shipping generates sufficient revenues. Although ships are generally young and still have a high book value (and therefore depreciation and financing charges are at a good level), sufficient profits are made in the sector. By operating in the business-to-consumer market, there is a stronger incentive to reduce emissions. Also, from the point of view of comfort, it is more desirable to reduce noise levels in this sector, in contrast to the freight value. Many ships are therefore already diesel-electric or hybrid and prepared for zero-emission technology.

7. Financing mechanisms and investment decisions

7.1 Financing a Stage V engine

Banks use the following scale for barge operators to determine whether there is a sufficient base to finance:

- Ship younger than 15 years: a maximum of 70% of the market value of the vessel;
- Ship between 15 and 30 years old: a maximum of 60% of the market value of the vessel;
- Ship between 30 and 50 years: a maximum of 50% of the market value of the vessel;
- Ship older than 50 years: a maximum of 40% of the market value of the vessel;

For older inland vessels – generally the smaller barges in the fleet, this means that a large amount of financing must be obtained from other sources, including: own contribution, subordinated loans from family, shippers or charterers or a second mortgage from a crowdfunding platform. The duration of the financing period varies from 7 to 8 years for older ships to 15 or even 20 years for new-build vessels. Banks nowadays finance for between 2.0% and 2.5% in interest, whereas the average interest rate for crowdfunding platforms is 7.0%.

For new-build, banks are prepared to support innovative techniques through adjusted financing durations, higher financing contributions and limited interest discounts. This is supported by the increased assumed residual value of the ships.

When financing the greening of ships, the bank also looks at the above-mentioned scale. The existing outstanding assets are taken into account at the bank: both the long-term debts (mortgage loan) and the current account. It is assumed here that 75% of the investment in greening – whether that means a cleaner main engine or after treatment– also benefits the market value. Crowdfunding platforms are just limited active in re-motorisation; mainly because a second mortgage cannot be established on the property through this route. To date, two cases have been known in which re-motorisation of the ship has been funded through crowdfunding.

The table below shows financial figures for different size classes in relation to the required investment in a Stage V engine and the maximum percentages a bank is willing to finance. The figures have been derived from the Stichting Abri Cost database and Research Question C inputs. The following assumptions have been made:

- 1 hp per 2 tonnes cargo carrying capacity (1.36 hp = 1 kW)
- € 425 / kW for a Stage V engine
- € 45.000 installation costs.

It can be seen that the average grants are the highest for vessels between 400 to 1000 tonnes. Here, grants equalling more than 40% of the initial investment are needed to bridge the gap between the own capital than can be brought in and commercial bank financing. For vessels between 250 and 400 tonnes, a grant of approximately 33% is needed; for vessels between 1000 and 1600 tonnes grants of 30% are needed and for vessels larger than 1600 tonnes, a grant of 39% is needed.

Table 3: Capability of vessels to invest in a Stage V (compliant) engine

Tonnes	Own capital	Bank financing	Amount needed	Gap	% Grant needed
250 - 400	€ 23,070	€ 40,971	€ 94,653	€ 30,611	32.3%
400 – 650	€ 47,369	€ 40,116	€ 146,068	€ 58,583	40.1%

650 -1000	€ 43,593	€ 63,559	€ 192,431	€ 85,279	44.3%
1000 – 1600	€ 100,492	€ 98,516	€ 284,572	€ 85,563	30.1%
1600 -2500	€ 138,976	€ 124,203	€ 432,567	€ 169,388	39.2%
> 2500	€ 85,055	€ 360,577	€ 722,409	€ 276,776	38.3%

Source: Panteia (2020), based upon Stichting Abri database and Research Question C inputs

It can be observed that two of the smaller vessel categories (250-400 tonnes and 1000-1600 tonnes) need the least grants. This is primarily due to the fact that most of these vessels nearly paid of their mortgages, allowing for significant shares of bank financing. It should however be noted that a large share of the own capital of these vessels is needed to modernize the vessel to meet the technical requirements of CESNI and not all of the money can be used for a new engine. The latter is different for vessels greater than 2500 tonnes, in which the mortgage is still significant. Despite higher loan (mostly 70% as opposed to 40-50% for the smaller categories) percentages due the more recent years of construction, still some 40% grants are needed to meet the Stage V requirements. However, as these vessels are generally technically up to date, most of the private capital can be used for engine replacements.

7.2 Working towards zero-emission technologies

The table below shows the capability of different vessel size classes to work towards zero-emission technologies. Zero-emission transport can be achieved in different ways, such as fuel cells, batteries, drop-in fuels and after treatment, and other alternative clean fuels. For the sake of this analysis, the focus is limited to zero-emission through electrifying the drivetrain of a vessel by means of an electrical motor and corresponding equipment/installation. As such, the focus is purely on the electrification of a vessel, i.e. making a vessel “electric ready” for future fuel cell and battery pack applications. Future costs for the power units such as generator sets, hydrogen fuel cells & storage and/or battery packs are not taken into account. However, obviously, based on today’s information (and confirmed by research question C), these parts will strongly increase the investment costs and possibly also the OPEX. On the other hand, for a minor share of the market CAPEX in the hardware can possibly be avoided by the vessel owner through ‘pay-per-use’ contracts conducted with asset companies such as the recently launched ZES (Zero Emission Services), see also research question D report.

The following assumptions have been made for the overview below based on draft results from research question C:

- € 350,000 costs for electrifying a barge drivetrain, regardless of the cargo carrying capacity.
- € 180 / kW for an electric engine
- 1 hp per 2 tonnes cargo carrying capacity (1.36 hp = 1 kW)

Table 4: Capability of vessels to invest in technologies that work towards zero emission.

Tonnes	Own capital	Bank financing	Amount needed	Gap	% Grant needed
250 – 400	€ 23,070	€ 119,884	**€ 373,713**	€ 230,759	61.7%
400 – 650	€ 47,369	€ 97,244	**€ 390,045**	€ 245,432	62.9%
650 -1000	€ 43,593	€ 122,237	**€ 404,772**	€ 238,942	59.0%
1000 – 1600	€ 100,492	€ 150,885	**€ 434,040**	€ 182,663	42.1%
1600 – 2500	€ 138,976	€ 147,539	**€ 481,051**	€ 194,536	40.4%
> 2500	€ 85,055	€ 264,484	**€ 573,118**	€ 223,579	39.0%

Source: Panteia (2020), based upon Stichting Abri database and Research Question C inputs

It can be observed from the table that the smaller vessel categories need the largest grants to work towards zero-emission technologies. This is mainly due to the highly assumed one-off costs for electrification of the vessel (€ 350,000 per vessel, independent on the cargo carrying capacity). For the largest vessel size class, working towards zero-emission technologies will need less grants than installing a Stage V engine.

7.3 Case Studies

7.3.1 Rhine case studies

Based upon the Stichting Abri database, the following case studies have been selected.

Case study: pushed convoy (Rhine)

Year of construction:	2005	**Contract:**	Time-charter	**Mortgage:**	€ 3.900.000
Length:	190 metres	**Market value:**	€ 5.000.000	**Other debts:**	€ 350.000
Width:	11.45 metres	**Book value:**	€ 3.300.000	**Own capital:**	-€ 1.000.000
Loading capacity:	5.200 t	**Turnover 2018:**	€ 1.000.000	**Available cash:**	€ 0
Engines:	2x1025 kW (CCR-2)	**Profit 2018:**	€ 100.000	**Requested funding:**	€ 725.000

The pushed convoy shows bad financial figures:

- The loan to value ratio of the vessel is above the threshold of the banks and equals 85%. In order to require bank funding for renewal of the engines, the mortgage repayments should increase in the next years. At the current repayment rate, financing engine renewal can take place in three years.
- The liquidity of the enterprise is poor. There is hardly available cash in the company, as opposed to some large (short term) debts. A few bad weeks in a year could result into the enterprise not being able to fulfil its financial duties.
- The solvability of the vessel is poor. The market value of the vessel is (currently) less than the value it was bought for. This, in combination with the high mortgage leads to a negative solvability. This decreases the chances of the enterprise repaying its debts.

As a result of the poor financial situation, a financial institution will **not** provide a loan for renewal of the engines. Aspects that might increase the possibility are a longer contract (i.e. 5 – 10 years). This can be justified by the fact that within three years – assuming the same income and profit levels – bank financing will be possible. A long-term contract would provide the bank enough assurance to close the deal.

Other factors that would strengthen the case are state guarantees on the loan provided towards in the IWT company and a subsidy. However, this would be alongside a solid contract with a longer term than the current contract.

The liquid bulk tanker shows solid financial figures.

Case study: liquid bulk tanker (Rhine)

Year of construction:	1995	**Contract:**	Contract (1y)	**Mortgage:**	€ 300.000
Length:	110 metres	**Market value:**	€ 2.500.000	**Other debts:**	€ 200.000
Width:	11.45 metres	**Book value:**	€ 900.000	**Own capital:**	€ 750.000
Loading capacity:	2.900 t	**Turnover 2018:**	€ 1.600.000	**Available cash:**	€ 350.000
Engines:	2x600 kW (CCR-1)	**Profit 2018:**	€ 100.000	**Requested funding:**	€ 450.000

- The loan to value ratio equals 20% and is way below the threshold of the bank (60%). Therefore, a large sum of money can be lent to the IWT enterprise.
- The liquidity of the company is very good. The company has got access to a significant amount of cash. The short-term liabilities of the company are only € 200.000. Therefore, there is a safe margin. The company is able to withstand a few months of economic turndown.
- The solvability of the company is very good. The total amount of debts equals €500.000, whereas there is an own capital of €1.100.000 available. Therefore, the chances that the company will be able to fulfil it loan repayment and rental duties are very high.

There wouldn't be any problem for a financial institution to provide loans for engine renewal for this company.

7.3.2 ARA-case studies

The large dry bulk vessel shows doubtful financial figures.

Case study: 110 metres dry cargo (ARA)

Year of construction:	2007	**Contract:**	Spot market	**Mortgage:**	€ 2.400.000
Length:	105 metres	**Market value:**	€ 3.750.000	**Other debts:**	€ 200.000
Width:	10.5 metres	**Book value:**	€ 2.700.000	**Own capital:**	€ 150.000
Loading capacity:	2.800 t	**Turnover 2018:**	€ 600.000	**Available cash:**	€ 35.000
Engines:	1000 kW (CCR-2)	**Profit 2018:**	€ 50.000	**Requested funding:**	€ 450.000

- The loan to value ratio of the vessel is just below (69%) the thresholds of the bank (70%). However, market perspectives for these kinds of vessels are deteriorating as a result of the energy transition. The market value of the vessel seems to be overestimated.
- The **liquidity** (18%) of the enterprise is bad. There is a little cash available in the company, as opposed to large short-term debts. There are high chances of this enterprise not being able to pay invoices to suppliers.
- The **solvability** (10%) of the company is troublesome. The company heavily relies on external sources of financing.

Because the ship is active on the spot market, the revenues are uncertain. As a result, together with the ship's high loan-to-value ratio, there is insufficient basis to grant a new loan. The situation will be different if the inland shipping entrepreneur manages to conclude a long contract with a charterer or shipper and the latter takes part in the financing demand on a risk-bearing basis.

The small dry bulk vessel, shows **doubtful** figures

Case study: 80 metres dry cargo (ARA)

Year of construction:	1950-1960	**Contract:**	Spot market	**Mortgage:**	€ 300.000
Length:	80 metres	**Market value:**	€ 600.000	**Other debts:**	€ 60.000
Width:	9,5 metres	**Book value:**	€ 300.000	**Own capital:**	€ 280.000
Loading capacity:	1.200 t	**Turnover 2018:**	€ 300.000	**Available cash:**	€ 90.000
Engines:	2x450 kW (CCR-0)	**Profit 2018:**	€ 50.000	**Requested funding:**	€ 300.000

- The loan to value ratio of the ship (60%) is above the threshold of the bank (40%). Therefore, a bank would not invest in this ship.
- The liquidity of the enterprise is good (150%). There is more money available in the short term than there are obligations. This increases the chances of the company being able to withstand an economical turndown.
- The solvability of the company is decent. The ratio between the own capital and the liabilities is balanced. Therefore, the chances that the company will be able to fulfil it loan repayment and rental duties are very high.

As a bank would **not** finance engine renewal for such a vessel, other solutions might work. This involves a combination of subordinated loans by charter offices and/or shippers and crowdfunding. However, bank financing is not possible, neither in the short term nor in the medium term. This is partly due to the fact that the ship is active on the spot market. This leads to uncertain revenues and therefore doubts whether the company will be able to repay its loan if the work is lost.

7.4 Other issues that play a role in making investment decisions

From the discussions it became clear that it is important to distinguish between the behaviour of private skippers (often a family business) and the shipping companies. Many shipping companies are active in niche markets (tanker shipping, container shipping, pusher shipping) and look more rationally at investment decisions. Personal circumstances do not play a role in this, which can be important for family businesses. Think for example of the succession of the company and the age of the skipper/owner.

The type of contract of an inland navigation company plays an all-important role in making investment decisions and whether or not the financier assesses the investment positively. The more certain an inland navigation skipper is about his income for the coming - preferably long - period, the sooner he will be inclined to make an investment decision. If a contract is entered into with a shipper, more certainty can usually be derived from this than if a time charter agreement is concluded with a charter office. And for companies that are active on the spot market, it is even more uncertain. These types of entrepreneurs look much more at the market structure (how many new ships are built, how many go for scrapping) and stability of the market (is there growth in cargo volume, or is it decreasing? What are the prices doing?).

The preconditions for investing in ships seem favourable at the moment. Interest rates are historically low and still falling. If there is sufficient perspective, new ship financing can be financed at low interest rates. On the other hand, banks are reluctant to enter into financing arrangements: entrepreneurs have to bring their own large sums of money. Despite the fact that new ships built more recently are considerably cheaper than ships built in boom times, banks make higher demands on the equity to be brought in; no 90-100% bank loan (pre-2008 levels), but approximately 40 to 70% bank financing. This leads to other forms of financing in inland shipping, such as crowd funding, venture investments, limited partnerships and foreign banks. The latter means that the ship also comes under a foreign flag. Combined financing is becoming more and more common. The contract duration and versatility of the ship are important in the assessment of the bank.

Age and family composition can also determine investment behaviour. Older skippers who do not have a successor are less inclined to invest in a new ship than young skippers or skippers with a successor within the family. Many skippers find it difficult to find a successor. The new influx in IWT finds transport with smaller vessels of little interest. It is not an appealing product. Larger ships appeal much more to young employees. Younger boatmasters like the 2 weeks on, 2 weeks off schedules, while transport with smaller ships is mostly day-time shipping[16].

Moreover, the age of the vessel and the related technical condition often force entrepreneurs to decide whether it is responsible to invest (heavily) in repair and maintenance. Skippers who are confronted with high costs (e.g. engine replacement) often choose to purchase a larger vessel and demolish or sell the smaller vessel.

When looking at which type of ship an entrepreneur will switch when investing in a new ship, a number of things are important. Ships with a maximum length of 86 meters can be sailed by man/woman together. Many of these family businesses work this way and live off the proceeds of the voyage (cash flow). Usually no labour costs are passed on. When a larger ship is chosen, a third crew member is required, which in turn entails extra out-of-pocket costs. This means that the new ship must be significantly larger so that these extra costs can be compensated by higher turnover.

[16] Panteia (2017), Vlootverklaringsmodel voor een tiental sluizen, assigned bij Rijkswaterstaat

8. Conclusions

The research question is: What are the possible triggers and financial drivers to enable a positive investment decision by shipowners to invest in technologies contributing to zero-emissions performance?

- **Companies operating a single motor vessel with a cargo carrying capacity less than 1000 tonnes** have severe problems acquiring finance for investment decisions for (even) Stage V engines. Meeting the Stage V requirements will have the consequence that investments in technical modernizations cannot be met. Their financial situation will not allow for any step towards zero-emission without large grants of approximately 60 to 65%.
- Vertical integration with brokers and shippers and collaboration between shipowners might foster bank financing in these segments.
- **Larger dry cargo vessels** have more financial means to invest into greening technologies. However, even they need large loans from banks and support from governments to make the small step to Stage V. Working towards zero-emission technologies will be approximately just as expensive as invest in Stage V engines.
- In the **liquid barging segment**, more financial means are available to invest in technologies contributing to zero-emission.
- An important **trigger** to enable positive investment decisions in zero-emission technologies are **public tenders** related to building and construction works. This market segment accounts to some 15% of the transport performance in IWT. Currently, the majority of these tenders are awarded *solely* on the *lowest price criterium*.
- An important **driver** for positive investment decisions by barge operators would be more collaboration between shippers and barge operators. The more secure the income of an IWT company is, the more likely they are to invest in more sustainable drivetrains. Collaboration between shipper and barge operator will lead to a more accurate sailing profile and therefore a stronger and more secure business case for alternative powertrains.

Question A1: What revenue-generating elements of an IWT company can be identified to promote the use of technologies contributing to zero-emissions? What is the role of shippers and brokers in this respect, what are their requirements? What measures will lead to more revenues?

- Greener ships do not receive higher freight rates. Greening is rather imposed – by attaching strict conditions to the way in which the transport must be carried out –as opposed to be achieved through price mechanisms. It thus works as a 'license to operate'.
- IWT entrepreneurs in freight transport generate revenues based upon agreements with their clients. A large part of their revenues is generated by transport performance. These transports can be arranged by means of a voyage charter (spot market), where a price per tonne or a lumpsum price is agreed for a single-transport between A and B. Other options include a time charter (number of days times a tariff) or long-term contract (a fixed tariff for a transport between A and B, for a certain time period).
- However, there is a tendency to enter into longer contract periods, up to 10 years, with greener ships. There are multiple drivers behind this tendency: greening, which requires longer contracts to acquire loans from banks, and low water problems in 2018 that emphasized the need of long-term contracts to secure transport capacity. The number of shippers that apply such long-term contracts, is still very low. Mainly larger multinationals, involved in the B2C-markets, tend to agree on such contracts at the moment.

- Government tenders generally do not include benefits for vessels with better environmental performance. In almost all cases, the reasoning behind selecting on the lowest price, is that the contracting authority believes that there are a lot of providers on the market with the same quality. To this end, in many cases it is decided to award the contracts to the company that can offer the lowest transport price.

Question A2: What elements in expenditures can be identified in relation to the powertrain and emission and energy performance? What cost parameters can be identified and what proportion of overall operating costs do they represent (e.g. capital costs, energy costs, port dues, maintenance costs)?

Barge operators have to deal with a large number of cost items: fuel costs and port dues[17] (which together are the direct shipping costs), personnel costs, repair & maintenance costs, depreciation, interest charges, insurance costs, administration costs, car costs and other costs.

Fuel costs can directly be related to the powertrain, emission and energy performance. These costs account some 30% to 45% of the total costs of IWT companies in 2018. Port dues are generally related to the cargo carrying capacity of vessels, but an increasing number of ports are offering discounts of up to 15% on port dues for vessels equipped with clean engines. Port dues, however, have a very limited share of total operating costs.

Investments in the powertrain also affect the value of a vessel and therefore the capital costs. The extent to which this happens differs from vessel to vessel. Generally, it can be stated that engine reflects some 15% of the capital value of a new build vessel. However, for older vessels it can be the case that the hull is completely depreciated and a new engine set. From recent engine renewals, it can be noted that the engine can reflect some 40% of the vessels value (and therefore, also depreciation).

Engines are depreciated within 10 years in line with the Inland Waterways Tax Covenant. Banks from other countries stated that depreciation periods in other countries are alike the Dutch situation

Interest rates by bank financing equal 2.0 to 2.25% in inland shipping. This financing can only be provided if the financing application matches with the policy of the bank. For old ships it applies that at most a bank is willing to provide only forty percent of the appraisal value of the ship as a loan. For new-build vessels this can go up to 70% and in exceptional circumstances – long-term contracts - up to 80%. The duration of financing is short for older ships – usually 7 or 8 years and can be extended to around 15 years for a newly built.

Port charges consist in a very small share of the operating costs. Therefore, they cannot constitute a sufficient incentive or deterrence to support the transition towards greening. Just a small number of ports are willing to give a discount and the discount percentages that the ports do give are marginal – generally in the range of 5 to 15% of the tariff.

Question A3: What are the current financing mechanisms in the IWT sector for powertrains and how does this relate to the financing of the ship as a whole?

[17] Port dues generally are taxes by local governments. Port dues are applied in all European seaports. Dutch ports, Rhine ports and Danube ports. No port dues have to be paid on the Belgian and French waterway network or along the Moselle river; here canal fees apply. On the German waterway network and the tributaries of the Rhine, canal dues were applied up to 2018.

Commercial bank financing is the current conventional way of financing for powertrains. State-guarantees cover a significant part of the risks on loans provided by commercial banks. In some cases, financing for new powertrains has been organised entirely through own capital. Alternative sources, such as crowdfunding or subsidies, are not used. Banks use the following scale for barge operators to determine whether there is a sufficient base to finance:

- Ship younger than 15 years: 70% of the market value;
- Ship between 15 and 30 years old: 60% of the market value;
- Ship between 30 and 50 years: 50% of the market value;
- Ship older than 50 years: 40% of the market value;

When financing the greening of ships, the bank also looks at the above-mentioned ratios. The existing outstanding assets are taken into account at the bank: both the long-term debts (mortgage loan) and the current account. It is assumed here that 75% of the investment in greening – whether that means a cleaner main engine or after treatment– also benefits the market value. Crowdfunding platforms are just limited active in re-motorisation; mainly because a second mortgage cannot be established on the property through this route. To date, two cases have been known in which re-motorisation of the ship has been funded through crowdfunding.

For older inland vessels – generally the smaller barges in the fleet, this means that a large amount of financing must be obtained from other sources, including: own contribution, subordinated loans from family, shippers or charterers or a second mortgage from a crowdfunding platform. The duration of the financing period varies from 7 to 8 years for older ships to 15 or even 20 years for new-build vessels. Banks nowadays finance for between 2.0% and 2.5% in interest, whereas the average interest rate for crowdfunding platforms is 7.0%.

For new-build, banks are prepared to support innovative techniques through adjusted financing durations, higher financing contributions and limited interest discounts. This is supported by the increased assumed residual value of the ships.

Question A4: What is the current financial profile of IWT companies based on information from the balance sheet, profit and loss accounts, and what does this mean for the ability to acquire capital for investing in technologies contributing to zero-emissions?

As of 2012 all companies have been operating with profit. This means that the turnover was higher than the direct costs and capital charges. However, entrepreneurial wages are not included. The following statements can be made about dry cargo shipping, liquid bulk shipping and passenger shipping:

- The turnover in the dry cargo segment has increased sharply since 2015. Revenues in 2018 were at the highest level ever, even higher than before the financial crisis. Low water levels were the main cause, resulting into a more favourable balance between demand and supply for vessels. However, it should be noted that profits rose sharply in particular for barge operators. On the other hand, inland shipping companies that are also active as logistics service providers lost extra money due to the low water levels.
- The turnover in the tanker shipping sector is decent and the outlook for the sector is good in terms of economic prospects. The fleet is modern and up to date. In many cases, engines already comply with the CCNR-2 requirements.Shipowners have the obligation to classify, which results into significant sufficient capital reserves for replacement investments.
- Passenger shipping generates sufficient revenues. Although ships are generally young and still have a high book value (and therefore depreciation and financing charges are at a good level), sufficient profits are made in the sector. By operating in the business-to-consumer market,

there is a stronger incentive to reduce emissions. Also, from the point of view of comfort, it is more desirable to reduce noise levels in this sector, in contrast to the freight value. Many ships are therefore already diesel-electric or hybrid and prepared for zero-emission technology.

As of 2012 all companies have been operating with profit. This means that the turnover was higher than the direct costs and capital charges. However, entrepreneurial wages are not included. Correcting for entrepreneurial wages, it can be concluded that it is difficult for entrepreneurs with ships smaller than 1000 tons to realise a sustainable entrepreneur's wage.

- Insufficient entrepreneurial wages can be achieved over the entire period for ships between 250 and 400 tons. This implies that all profits from the company are spent on private expenses. No money can be set aside for necessary investments in engine renewal.
- The picture is the same for ships between 400 and 650 tons, were it not for the fact that a positive balance remained in the years 2008 and 2018. For these ships, too, almost all profits from the company are needed for the company's private expenses. No money can be set aside for necessary investments in fleet renewal.
- For companies with ships larger than 1000 tons, there is enough income for the entrepreneur (s), except for the crisis years 2010 and 2011. This means that these companies do have room to reserve money for future investments. In recent years, and in 2018 in particular, profits have risen sharply.
- The crisis period has been longer for ships larger than 2500 tons. On top of that, there were also negative business incomes in 2012 and 2013. That means that only limited money could be drawn from the company for private income.

The table below shows financial figures for different size classes in relation to the required investment in a Stage V engine and the maximum percentages a bank is willing to finance. The figures have been derived from the Stichting Abri Cost database and Research Question C inputs. It can be seen that the average grants are the highest for vessels between 400 to 1000 tonnes. Here, grants equalling more than 40% of the initial investment are needed to bridge the gap between the own capital than can be brought in and commercial bank financing. For vessels between 250 and 400 tonnes, a grant of approximately 33% is needed; for vessels between 1000 and 1600 tonnes grants of 30% are needed and for vessels larger than 1600 tonnes, a grant of 39% is needed.

Table 5: Capability of vessels to invest in a Stage V (compliant) engine

Tonnes	Own capital	Bank financing	Amount needed	Gap	% Grant needed
250 - 400	€ 23,070	€ 40,971	€ 94,653	€ 30,611	32.3%
400 – 650	€ 47,369	€ 40,116	€ 146,068	€ 58,583	40.1%
650 -1000	€ 43,593	€ 63,559	€ 192,431	€ 85,279	44.3%
1000 – 1600	€ 100,492	€ 98,516	€ 284,572	€ 85,563	30.1%
1600 - 2500	€ 138,976	€ 124,203	€ 432,567	€ 169,388	39.2%
> 2500	€ 85,055	€ 360,577	€ 722,409	€ 276,776	38.3%

Source: Panteia (2020), based upon Stichting Abri database and Research Question C inputs

It can be observed that two of the smaller vessel categories (250-400 tonnes and 1000-1600 tonnes) need the least grants. This is primarily due to the fact that most of these vessels nearly paid of their mortgages, allowing for significant shares of bank financing. It should however be noted that a large share of the own capital of these vessels is needed to modernize the vessel to meet the technical requirements of CESNI and not all of the money can be used for a new engine. The latter is different for vessels greater than 2500 tonnes, in which the mortgage is still significant. Despite higher loan (mostly 70% as opposed to 40-50% for the smaller categories) percentages due the more recent years of construction, still some 40% grants are needed to meet the Stage V requirements. However, as these vessels are generally technically up to date, most of the private capital can be used for engine replacements.

Preparation for zero-emission

The table below shows the capability of different vessel size classes to work towards zero-emission technologies. Zero-emission transport can be achieved in different ways, such as fuel cells, batteries, drop-in fuels and after treatment, and other alternative clean fuels. For the sake of this analysis, the focus is limited to zero-emission through electrifying the drivetrain of a vessel by means of an electrical motor and corresponding equipment/installation. As such, the focus is purely on the electrification of a vessel, i.e. making a vessel "electric ready" for future fuel cell and battery pack applications. Future costs for fuel cells and battery packs are not taken into account, but will obviously, based on today's information, strongly increase the investment costs and possibly also the OPEX. On the other hand, CAPEX in the hardware can possibly be avoided by the vessel owner through 'pay-per-use' contracts conducted with asset companies such as the recently launched ZES (Zero Emission Services).

The following assumptions have been made for the overview below:

- € 350.000 costs for electrifying a barge drivetrain, regardless of the cargo carrying capacity of the barge.
- € 180 / kW for an electric engine
- 1 hp per 2 tonnes cargo carrying capacity (1.36 hp = 1 kW)

Table 6: Capability of vessels to invest in technologies that work towards zero emission.

Tonnes	Own capital	Bank financing	Amount needed	Gap	% Grant needed
250 – 400	€ 23,070	€ 119,884	**€ 373,713**	€ 230,759	61.7%
400 – 650	€ 47,369	€ 97,244	**€ 390,045**	€ 245,432	62.9%
650 -1000	€ 43,593	€ 122,237	**€ 404,772**	€ 238,942	59.0%
1000 – 1600	€ 100,492	€ 150,885	**€ 434,040**	€ 182,663	42.1%
1600 – 2500	€ 138,976	€ 147,539	**€ 481,051**	€ 194,536	40.4%
> 2500	€ 85,055	€ 264,484	**€ 573,118**	€ 223,579	39.0%

Source: Panteia (2020), based upon Stichting Abri database and Research Question C inputs

It can be observed from the table that the smaller vessel categories need the largest grants to work towards zero-emission technologies. This is mainly due to the highly assumed one-off costs for electrification of the vessel (€ 350.000 per vessel, independent on the cargo carrying capacity). For the largest vessel size class, working towards zero-emission technologies (electrification of the vessel) will need less grants than installing a Stage V engine.

Question A5: What other issues play a role in making investment decisions (economic outlook, age of the owner, age of engine and vessel, structure and stability of the market, type of contract, ...)?

From the discussions it became clear that it is important to distinguish between the behaviour of private skippers (often a family business) and the shipping companies. Many shipping companies are active in niche markets (tanker shipping, container shipping, pusher shipping) and look more rationally at investment decisions. Personal circumstances do not play a role in this, which can be important for family businesses. Think for example of the succession of the company and the age of the skipper/owner.

Age and family composition can also determine investment behaviour. Older skippers who do not have a successor are less inclined to invest in a new ship than young skippers or skippers with a successor within the family. Many skippers find it difficult to find a successor. The new influx in IWT finds transport with smaller vessels of little interest. It is not an appealing product. Larger ships appeal much more to young employees. Younger boatmasters like the 2 weeks on, 2 weeks off schedules, while transport with smaller ships is mostly day-time shipping.

Moreover, the age of the vessel and the related technical condition often force entrepreneurs to decide whether it is responsible to invest (heavily) in repair and maintenance. Skippers who are confronted with high costs (e.g. engine replacement) often choose to purchase a larger vessel and demolish or sell the smaller vessel.

Ministry of Infrastructure and Water Management

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Study consortium:

DST ECORYS EICB Panteia Research to Progress pro DANUBE MANAGEMENT GMBH ABEL

In partnership with:

European Investment Advisory Hub
Europe's gateway to investment support

Throughout the project there were exchanges with the CCNR, the steering Committee composed of representatives of CCNR member States and a stakeholder group consisting of :

European Commission (DG MOVE)
Danube Commission
Mosel Commission
European Investment Bank (EIB)
European Investment Advisory Hub (EIAH)

Clinsh
European Barge Union (EBU)
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European Shippers' Council (ESC)
European Skippers Organisation (ESO)
IWT platform
Shipyards and maritime equipment association of Europe (SEA Europe)
Association for inland navigation and navigable waterways in Europe (VBW)

Imprint: July 2021

Published by the Central Commission for the Navigation of the Rhine (CCNR)
Palais du Rhin - 2, place de la République - CS10023 - F-67082 Strasbourg Cedex