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STUDY ON FINANCING THE ENERGY TRANSITION TOWARDS A ZERO-EMISSION EUROPEAN IWT SECTOR

CCNR Member States:



Study consortium:



ECORYS



In partnership with:



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

Final overall study report

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This report consists in intermediary findings and does not consist in the final conclusions from the study project.

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Introduction

Addressing the issue of **climate change** is a political **priority** both nationally and internationally. The Paris Agreement, which aims to slow down the pace of climate change (with i.e. a maximum increase in the global average temperature to well below 2 °C above pre-industrial levels by 2100) by reducing CO₂ emissions, is definitely one of its key components. In their Declaration signed in Mannheim on 17 October 2018, the transport ministers of the Member States of the Central Commission for the Navigation of the Rhine (CCNR - Germany, Belgium, France, Netherlands, Switzerland) also reasserted the objective of **largely eliminating greenhouse gases and other pollutants by 2050**.

To further improve the environmental sustainability of inland navigation on the Rhine and inland waterways, the Mannheim Declaration tasked the CCNR to develop a roadmap to:

- reduce greenhouse gas emissions by 35% compared with 2015 by 2035,
- reduce pollutant emissions by at least 35% compared with 2015 by 2035, and
- largely eliminate greenhouse gases and other pollutants by 2050.

The aforementioned Declaration also tasked the CCNR to take the initiative in developing new financial instruments to achieve the said objectives,

To accomplish this task, it was decided to launch a preparatory study, which was carried out by EICB (Expertise- en InnovatieCentrum Binnenvaart) in first half of 2019 and involved many stakeholders.

Building on the question “how to finance the energy transition of the IWT sector?”, the preparatory study was to identify a series of key research questions, based on interviews with as many stakeholders as possible (profession, EU institutions, financing institutions, national administrations, etc...):

- A. What are the possible triggers and financial drivers to enable a positive investment decision by shipowners to invest in technologies contributing to zero-emission performance?
- B. What can we learn from other transport modes?
- C. Which greening techniques fit into zero-emission development of IWT and what are the impacts?
- D. What is the potential of pay-per-use and leasing schemes for the IWT market?
- E. What is the potential of joint procurement?
- F. What can be expected from national and European programmes and products providing funding and financing?
- G. What is the potential for polluter pays schemes in IWT?
- H. What are the requirements and boundaries considering level playing field and modal share?
- I. What is the added value of a new European funding and financing scheme for IWT and how could this work?
- J. What accompanying measures and follow-up steps are needed?

On the basis of the results of the preparatory study and the research questions collected, the CCNR's plenary session in May 2019 was an important first step in the implementation of the Mannheim Declaration by deciding to launch an in-depth CCNR study on the "Financing of energy transition towards a zero-emission European inland navigation sector".

Two other parallel studies, supported by the Netherlands and Switzerland, were to accompany this main study and deal respectively with:

- i. the polluter-pays principle in the IWT sector and
- ii. the economic and technical assessment of technologies to achieve the zero-emission objective for IWT by 2050.

These three complementary studies form part of the overarching CCNR study project and should not be considered as stand-alone studies.

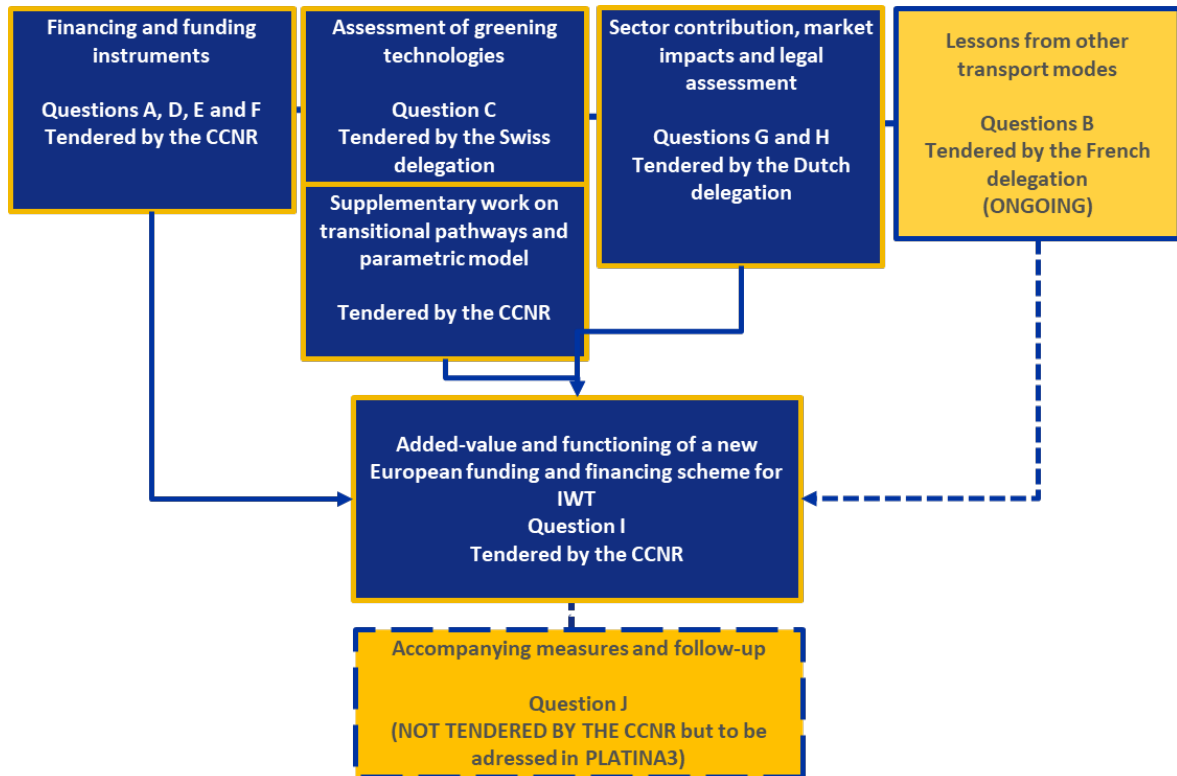
The main **objectives** of this overarching study project read as follows:

- **assessing the financing needs** for the energy transition of the IWT sector,
- **securing support and acceptance** of the study results with close cooperation with the relevant stakeholders,
- formulating recommendations for the development of a **European financing and subsidy scheme** to support this transition,
- providing inputs to the **discussions at the Rhine, European and international levels**, and
- paving the way for a **political decision**

This overall study report presents an overarching view, summarising the findings and results that are presented in the different deliverables, each relating to a specific research question.

The **overall study structure** can therefore be illustrated as follows:

Figure 1: overview study



This structure was designed with two objectives in mind:

- allow the running in parallel of the different research aspects in order to maximize efficiency and diversity among the institutes realising them.
- ensure that all the results from those parallel studies can come together in the conclusion part “question I” on the added value of a new European funding and financing scheme for the energy transition towards a zero-emission inland navigation sector.

Three studies were therefore conducted in parallel, forming part of the overall CCNR study project on energy transition towards a zero-emission inland navigation sector, and relating to:

- possible financial instruments for inland navigation tendered by the CCNR and carried out by a project consortium including EICB, Rebel, Pro Danube and Panteia.
- polluter-pays schemes and corresponding market impacts and legal aspects tendered by the Dutch Ministry of Infrastructure and Water Management and carried out by a project consortium including EICB and Ecorys.
- technical and economic assessment of the technologies already available or expected to become available for the transition of the IWT sector towards a zero-emission European inland navigation tendered by the Swiss Federal Office of Transport and carried out by DST (Edition1). Supplementary work on transitional pathways and a parametric model was tendered by the CCNR and carried out by DST and EICB (Edition 2).
- Two research questions identified in the preparatory study are not covered in this report:

- **Research question B** about the developments (technological, financial, policies, etc.) in other transport modes and lessons that can be learned from other sectors for the transition in IWT. Some work is currently ongoing.
- **Research question J** about the accompanying measures and the follow-up. This study will depend on the results of the overall conclusions and recommendations provided in the deliverable for research question I. The European project PLATINA3 is expected to deliver action plan for the further development of a European grant and funding instrument and to refine a proposal for such an instrument.

This final report therefore addresses the following research questions:

- **Research Question A:** What are possible triggers and financial drivers to enable a positive investment decision by ship-owners to invest in technologies contributing to zero-emission performance?
Status of the related deliverable: final
- **Research Question C:** Which greening techniques fit into zero-emission development of IWT and what are the impacts?
Status of the related deliverables (Editions 1 and 2): final
- **Research Question D:** What is the potential of pay-per-use and leasing schemes for the IWT market?
Status of the related deliverable: final
- **Research Question E:** What is the potential of joint procurement?
Status of the related deliverable: final
- **Research Question F:** What can be expected from national and European programs and products providing funding and financing?
Status of the related deliverable: final
- **Research Question G:** What is the potential of polluter pays schemes in IWT?
Status of the related deliverable: final
- **Research Question H:** What are requirements and boundaries considering level playing field and modal share?
Status of the related deliverable: final
- **Research Question I:** What is the added-value of a new European funding and financing scheme for IWT and how could this work?
Status of the related deliverable: final

The following chapters 1-7 provide a short summary for each of the completed research questions building on the available findings and results in the respective deliverables. Chapter 8 presents

the next steps as seen by the CCNR. In addition, in the Annex, a more extensive summary is provided for the findings and conclusions obtained for research questions A, D, E, F, G, H and I.

1. Final results research question A

The main question of research element A is:

A: “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?”

Research question A showed that the status quo as regards financing and funding in IWT is characterized by mortgage financing from commercial banks, which is the conventional form of financing in the IWT sector and by temporary grant schemes at European level or national/regional level.

The results from research question A also show that only a very limited part of the IWT sector can finance the electrification of a vessel by own means (own capital and/or bank financing). There is a lack of financial capacity and also the incentives (business case) are not available to make greening their powertrain an economical choice for the shipowner/operator. There is no return on investment at the current framework conditions, it only adds additional costs which are not paid for by the client (shippers/forwarders).

The assessment only concerns the electrification, i.e. making a vessel “electric ready” for future fuel cell and battery pack applications. It did not take into account the more expensive investments in the fuel cells and batteries itself. The latter may be provided by third parties to the IWT sector by means of pay-per-use schemes (see research question D).

The electrification of a vessel was chosen just as an example to illustrate the difficult financial task an inland vessel owner would face. However, this difficulty will also apply to other technologies for the transition towards zero-emission, such as investing in a clean combustion engine in combination with using renewable fuels.

2. Final results research question C¹

The main question of research element C is:

C: “Which greening techniques fit into zero-emission development of IWT and what are the impacts?”

2.1 Edition 1

The first step was to summarise the status quo of the European fleet and its emissions for the year 2015 on the basis of data available from the CCNR, the Danube Commission, assessments

¹ Edition 1 has been executed by DST and finalised in October 2020. Edition 2 was executed by EICB and DST together and was finalised in May 2021. Edition 2 provided amongst others complementary information on the Business As Usual scenario and the TCO and CAPEX impact for two transition pathway scenarios.

performed within the H2020 project PROMINENT and several other sources. Afterwards, a set of energy carriers and energy conversion technologies with their basic characteristics were described and assessed regarding applicability in the inland navigation sector. For each solution cost figures and predictions for the next 30 years were collected, filtered and compiled to optimistic, moderate and pessimistic scenarios. Other technological options like lithium-air batteries, LOHC, formic acid (hydrozine) or the use of green ammonia with appropriate crackers in combination with fuel cells or internal combustion engines might play significant roles in later stages of the energy transition. However, they have not yet reached sufficient TRL and well-founded cost figures to recommend the widespread implementation and are, therefore, not considered in the calculations.

The fleet families defined in the PROMINENT project were expanded slightly and the suitability of technologies was rated for twelve ship types. For each family a representative ship was described with a possible zero-emission system and the related investment and operational costs. Afterwards, several exemplary chains of measures for each segment of the fleet were iteratively chosen to meet the emission reduction goals by 2035 and 2050. The related investment costs for advanced drive trains were calculated for the three cost levels mentioned above. It was assumed that the age distribution in each fleet segment remains constant. Therefore, both newbuilt ships and conversions of existing vessels are considered. Especially retrofitting zero-emission technologies to older vessels is complex and requires major conversions in most cases. At the same time, it can be a cost-effective approach which need to be weighed in the light of the remaining lifespan of each vessel. Nevertheless, as it is not realistic that the fleet will be completely renewed by 2050 this aspect has to be part of the concept.

The chains of measures for 2050 were elaborated for different ambition levels of emission reduction by at least 80 %, 90 %, 98 % and complete avoidance of air pollutants and CO₂ in a tank-to-wake perspective. Air pollutants can be avoided to a large extent with combustion engines and modern aftertreatment systems. A fleet fully equipped with Stage V IWP/IWA engines would emit 79 % less NO_x and 97 % less particles compared to the 2015 baseline. With NRE or Euro VI truck engines NO_x emissions were reduced by approximately 95 % and particles by 99%. A future emission regulation going beyond the Stage V limits would allow further reductions also for large IWP engines.

CO₂ emission reduction is therefore the most challenging part. They can be primary reduced by decreasing the energy demand with improved utilization of the vessels, slow and smart steaming with less waiting times at locks and efficient integration of IWT in seaports. Secondary, alternative drop-in fuels with sustainable feedstock and upstream chain can play a major role to reduce the carbon footprint. In the study HVO and PTL were considered as carbon-neutral fuels which is in line with the IPCC assumptions². However, the availability of these fuels and the related bunkering costs are hard to predict. If other transport modes are prioritized to use these advanced biofuels, the resources may be insufficient for predominant use in the inland shipping sector. Costs and sustainability depend on feedstocks and green electric energy. With the efficiency measures, approximately 15 % of the energy demand may be covered by fossil fuels in 2050 to achieve 90 % CO₂ reduction.

² DNVGL, "2019 ENERGY TRANSITION OUTLOOK A global and regional forecast to 2050," 2019.

Decarbonisation without conventional combustion engines comes with significant challenges for energy storage and much higher costs. Today the authors consider it too early to decide for one or few technologies. There is no silver bullet, but rather a mix of different fuels and technologies seems likely. Further technology-neutral developments and pilot applications are required. Multiple research and development projects are running or planned. Their success regarding sustainable zero-emission solutions at feasible costs cannot be foreseen as of today.

Since IWT is a relatively small sector decisive technological leaps are unlikely to happen internally. Therefore, the developments in other sectors like long-distance road haulage and seagoing transport should be monitored. On a midterm basis, electric drives with modern combustion gensets, potentially already including a battery and/or fuel cell to avoid emissions in ports and urban areas and future proof power management can be considered as a precursor for the later implementation of affordable zero-emission power sources. Since the retrofitting of existing vessels often requires extensive and costly conversions, the focus for advanced drivetrains should be on newbuilds. To equip many vessels with clean systems in a relatively short time, it is recommended to prepare for and use standardized systems, e.g. battery containers or fuel cells and hydrogen storage in containerised modules.

When an engine needs to be replaced on an existing ship, some of these vessels will not operate until 2050 and the environmental performance is significantly increased with a right-sized Stage V engine ready for the use of drop-in fuels. A long-term roadmap for the implementation of these second and third generation biofuels, PTL fuels and blends is required. Engine suppliers have to include them in their fuel directives and production capacities need to be increased.

2.2 Edition 2

A number of extensions and revisions have been made compared to the 1st version of the Research Question C as presented in the previous paragraph (2.1). The following are most important:

- Development of the Business as Usual (BAU) scenario taking into account the available grant schemes and other assumptions, based on the current regulatory framework.
- Development of two transition pathways allowing to reach the 2035 and 2050 emission reduction objectives foreseen in the Mannheim Declaration, one conservative and a more innovative one. The conservative pathway refers to a pathway in which mainly alternative fuels and techniques are considered which are relatively easy to implement and cost efficient at the short term. The innovative pathway takes a more innovative approach with less internal combustion engines into account. The innovative pathway includes fuels and techniques which are currently still in their infancy stage (TRL 5-7) and are significantly more expensive as compared to advanced biodiesel and LBM
- Emission performance assumptions have been refined for the internal combustion engines.
- Estimation of the quantitative development of the fleet families for the period 2020-2050 including the number of vessels, their engines types and emission performance in the Business As Usual scenario as well as for the Conservative Pathway and the Innovative pathway to reach the emission targets for 2035 and 2050.
- Research regarding emissions in the upstream chain of alternative fuels and the possible future availability of these fuels for IWT.
- Updates and extended cost calculations:

- Additional costs due to time loss and loss of payload is taken into account for alternative energy solutions.
- Cost assumptions have been updated for fuels and technologies
- OPEX and TCO calculations for the BAU scenario and the pathways have been added as well as the related gap analyses between the BAU scenario and the pathways.
- Updated and further expanded views about no-regret investments have been included

Based on the further elaborations, the following conclusions can be made:

- The uncertainty of prices and availability of fuels and development of technologies is still quite substantial which is also reflected in the calculations. The uncertainty is especially large for the zero-emission technologies. Therefore, it is needed to regularly update the calculations and to follow closely the developments.
- The TCO gap with BAU is roughly a factor 2 higher for the innovative pathway compared to the conservative pathway (bandwidth 1.6 – 2.9). This illustrates that the conservative pathway would be most cost efficient to reach the 90% emission reduction objective for 2050 compared to 2015. Also, the required investment (CAPEX) is substantially smaller for the conservative pathway compared to the innovative pathway.
- The main economic challenges and financial gaps arise from 2030 on-wards for the conservative pathway and the innovative pathway as soon as expensive zero-emission technologies are assumed to be applied at increasing growth rates (e.g. fuel cell systems and batteries). Clearly the economic challenge is the biggest for the innovative pathway. aggregated TCO costs for the drivetrains for period 2020-2050 for the conservative pathway are 8% higher than BAU while for the innovative pathway it is 23% higher.

3. Final results research question D

The main question of research element D is:

D “What is the potential of pay-per-use and leasing schemes for the IWT market?”

The potential of pay-per-use and leasing schemes for the European IWT market in the context of the transition towards a zero-emission fleet in 2050 will be rather limited on the short and medium term based on current conditions. Leasing potential for complete powertrains is very limited as such schemes cannot be combined with mortgage financing of vessels.

The situation is bit more beneficial for pay-per-use schemes for exchangeable containerised energy systems (e.g. power packs using batteries and/or fuel cells). It is foreseen though that the potential will be, especially at first instance, limited to just a few hundred vessels. However, the current potential of just a few hundred vessels can evolve depending on future developments to change framework conditions or new vessel concepts, possibly triggered by autonomous sailing.

Moreover, the parties developing pay-per-use solutions are larger companies and these companies have better ability to use existing financing and funding instruments, such as CEF Blending and possibly also the DG CLIMA Innovation Fund. However, such instruments are not suitable for financial support of wider roll-out of technologies and they do not provide a solution for the vast majority of small individual vessel owners to electrify their vessels. It is important to

keep in mind that the need for support for funding and financing is especially high and challenging for these type of vessel owners.

4. Final results research question E

The main question of research element E is:

What is the potential for joint procurement in the European IWT sector?

In general, joint procurement in the IWT-sector could lead to cost reduction, stimulation of market development and innovation. Furthermore, joint procurement could also lead to an increase in standardisation. The cost reductions which can be achieved by joint procurement are due to economies of scale, since larger orders will lead to lower prices for parts and is expected to increase efficiency.

Joint procurement is a theoretical possibility within the IWT-sector. There are no legal constraints that make joint procurement impossible. However, due to the limited economies of scale and other (cultural) settings within the IWT sector, only a very small impact is expected on reduced costs for the transition of IWT sector towards zero emission. In case of IWT, the financial benefits of joint procurement would be limited, in the order of 1 – 5% of total investment costs.

5. Final results research question F

The main question of research element F is:

F: “What can be expected from national and European programs and products providing funding and financing?”

Current grant schemes, either at the national or European level, are providing some stimulus for greening in the IWT sector. However, at the European level this mainly concerns financial support for the first few pilot vessels to demonstrate innovative techniques. Consequently, EU funding (grants) does not support large-scale uptake of greening techniques. Roll-out of technology for mobile equipment is not in the scope of existing funding schemes.

On the national level, the available grant schemes have limitations in duration and funding rate. The Netherlands however recently decided to invest larger funds into greening the fleet (€92 million until 2030) mainly to overcome the nitrogen emission problems in Natura2000 areas. However, there is no consistent and coherent approach in Europe on national level and no certainty for the longer term. As a result, it is not expected that existing grant schemes will provide sufficient and stable stimulus in the transition towards getting a zero-emission fleet by 2050.

The price uncertainty of alternative fuels and energy compared to conventional fuel (diesel) is another bottleneck which hampers the business case. Therefore, hedging alternative fuel/energy risks was studied in research question F. It was concluded that despite being commonly used in sea shipping, it is not common practice in the inland waterways. For individual vessel owners

working in the spot market, current hedging possibilities are cumbersome, potentially costly and not suitable to secure the price advantages in the long term.

6. Final results research question G and H

The main questions of research elements G and H are:

G “What is the potential of polluter pays schemes in IWT?”

H “What are requirements and boundaries considering level playing field and modal share?”

In IWT, there is a pollution chain in which multiple involved actors in the logistics chain are together responsible for the pollution. Due to the complex structure and the strong fragmentation in the supply side of the sector it is not possible to single out one polluter only. Despite this complexity, there are possibilities to introduce a scheme based on the theory of the polluter pays principle. The potential scheme consists of earmarked “contributions” from the sector which are in turn used for greening the fleet when accompanied by public grants.

The analysis allowed to conclude that a contribution of 4 and to a lesser extent 8 cents per litre of fuel seems to be bearable by the IWT sector and is not expected to lead to significant market disruptions. Assuming a European wide contribution of vessel operators to a greening fund, ranging from an average contribution of 4-8 cents per litre of bunkered fuel, the possible revenues would be between €52million and €106million per year. Assuming a system for contributions would start in 2025 and continue until 2050, the total revenues within this period would be in the range €1.3 billion to € 2.6 billion.

IWT industry clearly states that **grants from public bodies are demanded in parallel to fill the funding gap**, this is a pre-requisite for them. A second pre-requisite from the legal perspective is that **international regulation is needed** to underpin such scheme with contributions by the sector based on the fuel/energy consumption. The geographic scope is the **connected waterways in Europe** to provide a solid basis for such an instrument. This to ensure level playing field.

7. Final results research question I

The main question of research question I is:

I “What is the added-value of a new European funding and financing scheme for IWT and how could this work?”

In general, the answer to the main question is that with the adoption of the appropriate legal framework **there is an added value for a new European funding and financing scheme**. The IWT sector cannot make the investments on its own, due to the **lack of the business case** for (near) zero-emission technologies as well as the lack of own resources and incentives.

A new European funding and financing scheme would therefore focus on providing grants (non-repayable funds) to close the gap in the business case. In addition, the following financial instruments, pay-per-use and leasing schemes, joint procurement and fuel hedging can have

some added value. However, they are expected to have only a relatively small contribution on closing the gap. **A European funding and financing scheme based primarily on providing grants to vessel owners shall give the major contribution to close the gap between ‘business as usual’ and the transition pathways³ for the European IWT fleet.**

In particular, such a **new scheme could introduce a contribution by the sector** to support its energy transition. Since it is unrealistic that the public sector will provide the full volume of resources needed to provide grants, a contribution by the IWT sector would provide⁴ a substantial amount of private resources. This could take the form of a dedicated contribution taking into account the emission performance of the vessel. A differentiated approach also provides an additional incentive and follows the principles of the ‘polluter pays’. Such a fund-raising scheme can be based for example on the fuel consumption for a longer period, 2025- 2050. Introducing such a fund-raising mechanism is however **prohibited within the current Rhine legal regime** and requires **a careful examination by the CCNR which is competent on this issue⁵.**

Assuming that the legal framework can be arranged, the result would be a mix of public and private funds provided as resources for the new funding and financing scheme. Subsequently, these resources are to be used primarily as grants **to compensate the vessel owner for the higher total costs of ownership (TCO)** of using powertrain equipment and more expensive fuels which contribute to reaching the emission targets for 2035 and 2050. The private resources brought together by the sector with an earmarked purpose are to be **co-financed by public parties** (e.g. national governments and EU). It can be linked to multiply the grants for vessel owners in order to close the gap.

Preferably the scheme would be a **‘one-stop-shop’ approach** for the beneficiary (vessel owner) to ease the process as much as possible. In such a case, the vessel owner would only need to submit his request for funding and financing to one organisation which will take the request into account. The organisation would take care of both the funding (grants) and financing (loans) needed, taking into account the estimated total costs of ownership compared to using the conventional drivetrain using fossil fuel. Furthermore, in advance of submitting a request, this vessel owner could contact the organisation to get technical assistance and guidance in choosing the right techniques/fuel given the type of vessel and the operational profile of the vessel. The organisation could also provide assistance and guidance in the application procedure.

The geographic scope of such a scheme is **European (connected waterways in Europe)** and therefore goes beyond the European Union and includes non-EU Member States, such as

³ For the purpose of this study, it has been requested to identify two transition pathways towards zero-emission in 2050, a conservative one and a more innovative one. The conservative pathway refers to a pathway in which mainly alternative fuels and techniques are considered which are relatively easy to implement and cost efficient. The innovative pathway takes a more innovative approach with less internal combustion engines into account.

⁴ See also deliverable for RQ G and H for more information as regards the earmarked contribution.

⁵ See Article 3 of the Mannheim Act of 17 October 1868 – *‘In application of Article 3 of the Mannheim Convention, the Member States must refrain from imposing any toll, tax, duty or charge based directly on the fact of navigation.’* <https://www.ccr-zkr.org/11020100-en.html>.

Switzerland, Serbia and Ukraine. This is important to ensure effectiveness and level playing field and thus to ensure sufficient acceptance and support for the new instrument.

A possible funding and financing scheme could take the form of a public-private partnership, with a multilateral framework. For consolidating earmarked contributions at a European level, a new international convention would be needed to extend the scope of the initiative to non-EU Member States as well. **In addition, an agreement would be necessary to amend the Belgrade Convention and the Mannheim Act in order to allow raising funds from the vessel operators, particularly earmarked contributions that flow back to the sector.** Last, a multilateral framework is also needed to align all the (EU and non-EU) member states as regards their public contribution (grants) to the funding scheme.

8. Next steps envisaged by CCNR

On 3 June 2021, during its Spring plenary session, the CCNR adopted the resolution prescribing the publication of the final study results. Those results do not prejudge the Central Commission's and its Member States' position.

While the energy transition is an existential challenge for Rhine and European navigation, it is however accompanied by technological uncertainties and considerable costs, currently estimated at several billion euros, which cannot be borne by the profession alone.

In this context, the CCNR has noted the findings of the study, conducted in consultation with the principal actors within the sector. In particular, the CCNR is currently evaluating the role that a European funding and financing instrument, combining public and private means, could play to support the inland navigation sector's energy transition. Such a mechanism should be accessible on the same conditions to all CCNR member state vessel owners.

Possessing as it does a European dimension, the CCNR considers this study to be a major step towards the implementation of the Mannheim Declaration, in particular the development of its roadmap, and welcomes its pioneering role on discussions related to the financing of the energy transition.

The conclusions of the study represent an influencing input to the commencement of discussions at Rhine, European and international level regarding a European subsidy and financing mechanism for the energy transition. The CCNR reiterated its willingness to participate in these important exchanges, in conjunction with the profession, European institutions, financing institutions and national administrations, and also in the context of the PLATINA 3 project.

As a follow-up of this study, the CCNR wishes that the project PLATINA3, on the basis of the study's findings, will deliver an action plan for the further development of a European funding and financing instrument and will refine a proposal for such an instrument. Such an action plan should identify in particular the actions to be deployed, how they should be deployed, by which actor and what role they should have. This work will contribute to answering research question J about the accompanying measures and the follow-up.

In addition, the study results contribute to the CCNR roadmap for reducing inland navigation emissions, as envisaged by the Mannheim Declaration, which is currently under development. This roadmap aims to be the main CCNR public policy tool for climate change mitigation and for

giving effect to the energy transition to reduce Rhine and inland navigation emissions. With this roadmap, the CCNR aims to lay the foundations for a shared vision of the energy transition and associated challenges within the inland navigation sector. It is planned to be adopted by the CCNR in December 2021.

Regarding research question B, about the developments (technological, financial, policies, etc.) in other transport modes and lessons that can be learned from other sectors for the transition in IWT, some work is currently ongoing. Once some results will be available, it should be considered how to integrate those in the overall reflection towards the development of a new European instrument for supporting the transition of the IWT sector towards zero emission.

9. Annexes – full summaries from finalised research questions

9.1 Final results research question A

The main question of research element 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, five sub-questions were identified:

- 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?
- 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)?
- 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?
- 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?
- 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, ...)?

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.

Summarising, the following answers to the sub-questions are concluded based on desk research and interviews.

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 dues⁶ (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

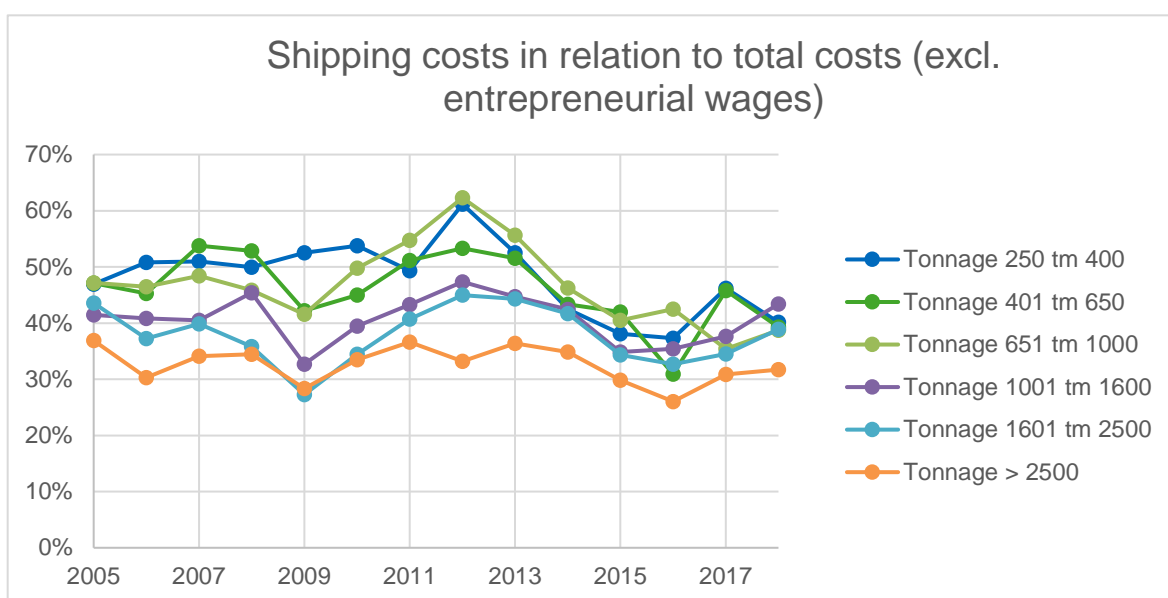
⁶ Port dues generally are taxes by local governments. Port dues are applied in all European seaports. Dutch ports, Rhine ports and Danube ports. No port dues have to be paid on the Belgian and French waterway network or along the Moselle river; here canal fees apply. On the German waterway network and the tributaries of the Rhine, canal dues were applied up to 2018.

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).

Figure 1 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.

Figure 2: 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 Covenant⁷. 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

⁷ See

https://www.belastingdienst.nl/wps/wcm/connect/bldcontentnl/themaoverstijgend/brochures_en_publicaties/convenant_binnenvaart

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.

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 shipping⁸. 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%.

⁸ In the Danube region, slightly higher interest rates apply

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 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 PFAS⁹ 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.

Table 1 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

⁹ 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.

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.

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.

Table 2 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 shipping¹⁰.

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.

9.2 Final results research question D

The main question of research element D is:

What is the potential of pay-per-use and leasing schemes for the IWT market?

The main focus for these schemes will be the powertrain of the vessel and to a far lesser extent the entire vessel itself. The potential of pay-per-use and leasing schemes is being analysed through research work for the following three sub-questions:

- D1: What are the characteristics of such schemes and how do they fit with current financing mechanisms in the IWT sector?
- D2: What are the drivers and barriers for the widespread implementation of such schemes?
- D3: What is the potential market for 'pay-per-use' and leasing schemes?

¹⁰ Panteia (2017), Vlootverklaringsmodel voor een tiental sluizen, *assigned bij Rijkswaterstaat*

Summarising, the following answers are concluded based on desk research and interviews.

D1: What are characteristics of such schemes and how do they fit with current financing mechanisms in the IWT sector?

Leasing and pay-per-use schemes are really different as compared to the current traditional way of financing in the IWT sector. The traditional way consists of the vessel owner obtaining mortgage financing from a commercial bank. In case of need for a new (clean) engine or other retrofit works for the powertrain, the vessel owner usually requests an additional loan from the commercial bank, which is then added to the existing mortgage. It is estimated that around 70%-80% of the fleet is till covered by mortgage financing.

With leasing and pay-per-use, the user of the asset has to pay fees for the time or usage of the asset to the owner. The user of the asset therefore avoids the capital expenditure and the uncertainty of a low residual value. An additional characteristic of pay-per-use and leasing schemes is that the asset is generally taken back by the owner after the expiration of the lease term or after the asset is being fully utilised.

The current traditional way of financing (mortgage financing) poses a bottleneck for applying leasing and pay-per-use, specifically as regards leasing powertrain components. The bottleneck relates to the legal risk (property rights) for the owner of the components. More specifically, the owner of the component can lose his property right in case the vessel owner goes bankrupt. In case of bankruptcy, the holder of the mortgage (usually a commercial bank) has the first right to claim the property value of the vessel, including all fixed components attached on the vessel. The fact that the majority of vessels is covered by mortgage financing (conventional way of financing) has an impact on the opportunities for leasing and pay-per-use financing.

D2: What are the drivers and barriers for the widespread implementation of such schemes?

There are a number of interrelated factors at play, which can act as a driver or barrier in the implementation of pay-per-use and leasing schemes for the greening of the fleet. Most importantly, there should be a real economic and/or financial benefit for the vessel owner and lender to conduct a leasing or a pay-per-use agreement. This could be a significant CAPEX (CAPital EXpenditures) reduction and risk reduction for a vessel owner who wants to invest in a clean powertrain, since leasing and pay-per-use schemes remove the upfront investment barrier. Access to capital is expected to be easier for large companies who take the role as lessees or asset companies. In addition, economies of scale could be expected for them from joint procurement (see research question E deliverable). However, such schemes can only make business sense if the advantage they generate is not cancelled out by the significantly higher OPEX for the vessel owner resulting from the new propulsion system.

In addition to the bottleneck as regards property right, there is also a lack of standardisation in the IWT sector. Vessels are mostly customised, which also applies to the equipment on board of the vessel. Providers of leasing or pay-per-use schemes prefer to provide a standardised asset with a properly estimated residual value, an asset that can be traded relatively easily as a second-hand object. And it should be possible to remove standardised assets in a relatively practical way

from a vessel for use in other vessels or other applications. The current nature of the existing fleet however, allows this only to a very limited extent. Hence, the high share of traditional mortgage financing and the lack of standardisation therefore are big constraints to the application of leasing and pay-per-use financing models.

Concluding, in order to enable economies of scale and mitigate the risk of losing ownership for the owner of the component, the component to be put on board through a leasing or pay-per-use scheme needs to be a standardised product with a standardised interface enabling a relatively practical exchange with other vessels or use in other applications. In addition, the component should have a high uptime, work in an appropriate manner and be reliable. Preferably, this would be a transferable containerised energy providing system with the required shore infrastructure in place. Components which are being permanently attached to the vessel (e.g. clean engine or fixed hydrogen-electric or battery-electric installations) and become part of the vessel from a legal point of view are therefore considered not appropriate for leasing and pay-per-use for the existing fleet.

D3: What is the potential market for 'pay-per-use' and leasing schemes?

In general, it can be concluded that the market potential of leasing in the context of the transition to zero-emission is very marginal. This form of financing is just marginally being applied in IWT, there are significant barriers for leasing especially as regards leasing powertrains or related equipment such as engines. Neither are there any ongoing or foreseen initiatives aiming to overcome these barriers and apply leasing as a financing instrument for investments in greening. It is therefore expected that lease constructions will not play a noteworthy role in the transition towards a zero-emission fleet in 2050.

The situation however may change if in the future new and large players would enter the market, for example planning to build a larger number of standardised identical new vessels, using a high level of autonomous navigation to make a business case compared to conventional ships. In case of such a breakthrough, there may be options for renting or leasing such standardised/autonomous equipment to other parties.

The expectations are different for pay-per-use schemes. There are some slight differences between leasing and pay-per-use schemes. From a very basic point of view, with leasing the user pays for the time the asset is rented whereas with pay-per-use one merely pays for the specific use of the asset. The pay-per-use concept fits relatively better in the current day's 'servitization' trend. There is also a widely known initiative in the IWT sector aiming to utilise the pay-per-use concept on a large scale and foster the deployment of zero-emission techniques in IWT. In June 2020 the company Zero Emission Services¹¹ BV (ZES) was launched, with large industrial parties behind it (Wartsila, Engie, ING Bank, Heineken, Port of Rotterdam) which targets the first commercial applications of pay-per-use schemes in IWT for zero-emission powertrains.

The market potential relates to a specific category of vessels and operational profiles. Pay-per-use

¹¹ <https://zeroemissionservices.nl/en/home-english/>

concepts can best be combined with standardised containerised energy systems. The ideal target group for such containerised energy systems, both from a technical and operational point of view, are dry cargo vessels carrying containers in a rather structural way. Based on expert opinion, this category consist in total of just a few hundred vessels almost exclusively concentrated on the Rhine countries and mostly in The Netherlands, Germany and Belgium.

There are a number of factors which could influence the market potential in the coming years though, such as the deployment of new vessels designed according to the containerised energy system concept making it more suited for the concept as compared to existing vessels from a technical point of perspective. Another factor could be technological advancements in the battery industry, enabling relatively lighter and compact batteries, which in turn broadens the scope of possible applications with, for example, vessels carrying dry bulk or push boats. Furthermore, also the development of green hydrogen and fuel cell technology and the related costs is highly relevant as this may also fit in a containerised powerpack to provide energy for electric vessels.

Seen the first results for parts of research question C (technologies and their economic assessment), it can be concluded that in particular battery and fuel cell technologies to be applied on new vessels are promising for a pay-per-use concept. However, at the current framework conditions, these technologies are expected to be much more expensive compared to application of internal combustion engines with renewable fuels (for example Stage V with HVO). The total costs of ownership for the vessel owner/operator is expected to remain decisive for the larger scale uptake. Therefore, it will also depend on the ambition level of governments and the level of public support (grants) for further promotion of full zero-emission technologies promoting full electrification of vessels (e.g. fuel cell/ battery technologies) and how this is reflected in the financial scheme for IWT in the future. With new financial schemes, the business case can be improved by means of funding for the investment costs and incentives on the operational side.

9.3 Final results research question E

The main question of research element E is:

What is the potential for joint procurement in the European IWT sector?

To be able to answer this question, three sub-questions were derived:

- E1: Are there possibilities for joint procurement/ financing through a cooperative or another collaborative organization to reduce investment costs?
- E2: What are the potential bottlenecks, for example in terms of liability? Can these bottlenecks be removed and how?
- E3: What economies of scale can be achieved by means of joint procurement and financing, given certain techniques/ technologies, number of investments, type of vessels, etc.?

Summarising, the following can be concluded based on desk research and interviews.

E1: Are there possibilities for joint procurement/ financing through a cooperative or another collaborative organization to reduce investment costs

Joint procurement is a method that has the potential to speed up the development of mass production and therefore, increase the benefits of economies of scale and reduce the costs per

unit. Furthermore, it can stimulate innovations in the IWT for greening techniques and can be a driving force for standardisation.

We have defined three main scenarios of joint procurement which are separated by the three classes of possible owners, namely: vessel owners, cooperatives and a Special Purpose Vehicle (SPV). To choose a joint procurement strategy from these scenarios, decisions preferences needed to be made based on 5 parameters (level of organization, ownership of vessels, responsibility for the procurement procedure, responsibility for financing and responsibility for maintenance).

Based on desk study, our expert opinion, and interviews with stakeholders, we found that joint procurement is possible. However, the following critical success factors are necessary for joint procurement to be successfully implemented in the IWT:

1. Insights should be gained in the order sizes that deliver the largest economies of scale. This will be further looked into under research question E3.
2. A limited set of proven technologies should be available. Every technique requires investments with the potential of not being earned back
3. Specifications need to be as identical as possible. The more identical they are, the larger the potential benefits.
4. For techniques that require large changes in energy infrastructure, the issues concerning this infrastructure should be addressed.
5. It is critical that vessel owners see the benefits of joint procurement and are therefore willing to give up some autonomy. Since this autonomy is deeply rooted within the IWT sector, benefits need to be substantial in order to persuade vessel owners to cooperate in a joint procurement scheme.
6. Order sizes should be in such amounts that the shipbuilders find a benefit in having recourse to joint procurement for instance in the form of increasing efficiency and purchasing power. However, only a limited number of new vessels are built annually / undergo remotorization what could be a bottleneck.

E2: What are the potential bottlenecks, for example in terms of liability? Can these bottlenecks be removed and how?

There is a need for standardisation to attain economies of scale. However, due to the large number of vessel types and engines used within the IWT, standardisation is challenging.

Within the inland waterway transport sector, there are two moments when vessel owners have the ability to reconsider the engine specifics of their vessels. These are the moment of commissioning a new vessel and the moment of re-motorisation of an existing vessel. In order to gain insights in the potential for joint procurement an insights were gained on the number of new vessels that were taken into operation in 2018 and the amount of vessels that underwent re-motorisation in the last years and that is expected to be outfitted with a new engine in the next decades. Since these number are small (less than 50 new vessels in 2018 and less than 100 new engines expected annually in the next decade) the market for joint procurement is slim. A joint procurement scheme with 20 vessels would make up 40% of the total number of new vessels build in 2018.

In this research, the scope of greening techniques was limited to a number of techniques as identified in the draft results from research question C. These techniques come with different possibilities and limitations and are all in different levels of technical and economical readiness. This makes it challenging for vessel owners and Original Equipment Manufacturers (OEMs) to take an investment decision in specific techniques, leading to a certain degree of inertia in the market

that holds parties back from taking the next steps in investing in greener technologies in the IWT. This in turn limits the level of standardization and overall opportunities and chances of joint procurement.

To assess the further drivers and barriers for joint procurement, a SWOT analysis was performed through a desk study and interviews with stakeholders, the result of which can be available in the full deliverable E report.

E3: What economies of scale can be achieved by means of joint procurement and financing, given certain techniques/ technologies, number of investments, type of vessels, etc.?

The greening of the IWT sector is characterized by a higher CAPEX. To limit the increased CAPEX, joint procurement can be used to increase economies of scale. In this research the possibilities of joint procurement are assessed and a SWOT analysis is performed. In order to gain insights into the expected economies of scale, OEMs were questioned regarding their expectations on economies of scale.

Currently, OEMs are unable to give a clear indication regarding the expected benefits of economies of scale due to the high uncertainty in terms of order sizes and the development of greening technologies. However, if favourable conditions are met, OEMs expect the cost reduction from economies of scale for joint procurement in the IWT to be in the range of 1% and 5% when procuring 10-20 vessels.

In the future, different techniques will potentially yield different levels of economies of scale. However, at present, due to the fact that promising techniques are just starting to be developed in the IWT with supply chains that are not yet mature, it is impossible to give a more secure estimated. Therefore, periodically monitoring the state of affairs concerning zero emission techniques in the IWT is needed to assess the potential for economies of scale when more critical success factors are met.

Overall, it can be stated that joint procurement is possible in the IWT sector and that there are even opportunities and benefits to be attained. However, due to the low off take volumes and multiple critical barriers which needed to be taken (uncertain technology outlook and low standardisation), we conclude in this study that joint procurement can only play a limited role in reducing investment costs for zero emission of near zero emission techniques at this moment in time.

9.4 Final results research question F

The main question of research element F is:

What can be expected from national and European programs and products providing funding and financing?

To be able to answer this question, eight sub-questions were derived:

- F1. What **funding schemes** are expected in the next few years from the EU level and what are their characteristics?
- F2. What **financing schemes and products** with EU financial backing are expected for projects related to greening and innovation?
- F3. What funding and financing schemes and products would be suitable to support **pay-per-use / energy-as-a-service** solutions?

- F4. Is it possible to make the programs and products more **accessible and visible** for the IWT sector, dominated as it is by very small companies, in order to help them invest in greening technologies?
- F5. Are **national and regional governments** prepared to provide financial support for the transition towards zero-emissions IWT?
- F6. To what extent is it possible to **combine the different EU and national and regional funds**? Can they be combined with financing schemes and products; what is the scope for **blending**
- F7: Is it possible to secure a price advantage on a European level **between conventional diesel fuel and cleaner fuels**, for example by a hedge?
- F8: Would it be possible to develop a **specific programme, financial instrument/product or facility specifically for the IWT sector** and investments in greening with relatively simple procedures, low requirements and/or relatively high funding rates?

Multi-annual Financial Framework (MFF) 2021-2027

In the course of elaborating the answers to the above research questions, the preparations for the Multiannual Financial Framework (MFF) – having the utmost impact on the future funding schemes – have been continuously followed by the consortium. Whereas, the agreement on the MFF 2021-2027 is still pending (status May 2020). Therefore, the exact financial allocations to funding programmes (like Horizon Europe, LIFE or CEF) as well as to InvestEU (framework bringing together several EU financial instruments currently available under one roof in 2021-2027) are still not finalised. The current proposal, as presented by the Finish Presidency¹² from December 2019, reduced the budget for CEF which can have an impact on transport related projects funded through CEF. The budgets of other programmes seem to be maintained or figures are not available.

The IWT industry called upon the Member States to allocate sufficient budget to the programmes supporting the energy transition in waterborne transport, like Horizon Europe for research and innovation actions or Connecting Europe Facility where investments into alternative fuels infrastructure go hand-in-hand with investments into mobile equipment. The official negotiations on the EU level towards the MFF 2021-2027 have been suffering delays due to the effects of the COVID-19 crisis in Q1 and Q2 of 2020, whereas in order to provide financial support for relevant stakeholders, the European Commission and some Member States are proposing / offering recovery funds. Thus, neither the MFF is final when delivering this report, nor it is possible to analyse and evaluate the additional EU / Member State proposals and their potential effects.

F1: What funding schemes are expected in the next few years from the EU level and what are their characteristics?

The study offers an in-depth analysis of the most relevant funding programmes and financing instruments of the planned new multi-annual financial framework (MFF) 2021-2027 which are relevant for actions addressing energy transition towards a zero-emission European IWT. As stated above, the MFF 2021-2027 negotiations suffer delay, thus it is not possible to assess it in its final version when delivering this report. The funding programmes described in this report are expected to pursue climate resilience and energy transition related objectives. Besides the future oriented content, the study provides examples of projects and certain specifics of funding programmes and financing instruments known from the previous multi-annual financial frameworks.

¹² Multiannual Financial Framework (MFF) 2021-2027: Negotiating Box with figures

The energy transition requires deployment of new innovative, green and energy efficient technologies and solutions. In order to cover the high costs of these technologies, lower profitability and the higher technological risks of associated projects, the key vehicle to deliver the support and to create a business case will still remain grants. Non-repayable grants will continue to be a main driver to create a business case for deploying innovative greening technologies and reaching the break-even point at which the financing, due to the high financial gap and high risks of projects, will be possible through financing instruments and products (even those instruments and products backed by EU).

At EU level, the investments into energy transitions actions towards a zero-emission European IWT sector can be funded by major funding programmes depending on the stage of the innovative technology life cycle, such as:

- **Horizon Europe** for research and innovation actions with co-financing rates up to 70% / 100% depending on the nature of action and type of beneficiary
- **LIFE programme** for actions including testing, demonstrating and piloting the effectiveness of new technologies, approaches or policies as methods for policy implementation with co-financing rates up to 60%
- **Connecting Europe Facility (CEF)** for large-scale roll-out and deployment actions with general co-funding rates are up to 50% for studies and up to 30% for works
- **Innovation Fund** for actions supporting the commercialisation and roll-out of highly innovative and sufficiently mature low-carbon technologies and processes, with co-financing rates up to 60% of capital costs and up to 60% of operational costs over up to 10 years

All the above schemes together with other opportunities (such as Cohesion Fund and blending operations) are described in detail later in this document.

F2. What financing schemes and products with EU financial backing are expected for projects related to greening and innovation?

Sub-optimal investment situations are presently (MFF 2014-2020) addressed through a diverse portfolio of EU financial instruments; they are centrally managed under programmes like the CEF, Horizon 2020, Competitiveness of Small and Medium-Sized Enterprises (COSME), Creative Europe or the Employment and Social Innovation Programme (EaSI) on one hand, and the European Fund for Strategic Investments (EFSI) on the other.

In the next financial period, a main objective is to *simplify the future EU investment support* by constructing a *single framework* that would help to reduce existing complexity. This will be done via the setting up of the **InvestEU Fund**, the successor of EFSI for the post-2020 period.

Integration of financial instruments within a single framework providing **loans, guarantees and risk sharing instruments** and defining **blending rules** with EU grants. This will allow mainstreaming of the EU financing along the four different EU main policies, the so called “**policy windows**” in InvestEU:

- Sustainable Infrastructure
- Research, Innovation & Digitisation
- SMEs
- Social Investments and Skills

Further, the InvestEU Programme shall provide a possibility to operate complementary to grant financing (e.g. Horizon Europe, CEF, etc.) through blending operations. The programme will be complementary with the European Structural and Investment Funds (e.g. ERDF, ESF+, Cohesion

Fund, etc.) operating under shared management. The foreseen complementarity enables easier facilitation of the deployment through financial products, as the Member States can rely in the InvestEU Programme and its simple set of rules applying in all cases.

The detailed overview of the current and expected future schemes, demonstrating the development framework and its staging towards a Greener Europe, is presented in this document. The lessons learned from questions F1 and F2 have been used in the consolidation of the current status and drafting the recommendations for the future, in particular for the research questions F3 related to funding and financing suitable to support pay-per-use business models, or F6 which specifically addresses the blending as well as F8 assessing the possibilities to develop a specific programme (financial instrument/product or facility) specifically for the IWT sector and investments in greening.

F3. What funding and financing schemes and products would be suitable to support pay-per-use / energy-as-a-service solutions?

Based on the current experience with funding and financing schemes supporting investments in capital expenditures, those financial products cannot be considered as suitable for the vessel owner / operator for supporting pay-per-use or energy-as-a-service solutions. Thus, possibly increased operational costs for the fleet owner are not eligible; however, additional investments in the infrastructure on shore or on the vessel, needed for the implementation of such a model, can be integrated into potential fundable projects. As regards the infrastructure deployment, the currently planned Innovation Fund initiative can / shall be followed by the stakeholders where both CAPEX and OPEX can be made eligible. The pay-per-use principle is described in detail under research question D.

F4. Is it possible to make the programmes and products more accessible and visible for the IWT sector, dominated as it is by very small companies, in order to help them invest in greening technologies?

Awareness

In the European IWT sector, funding and financing programmes and products are principally well-known thanks to different tools such as the EIBIP funding database. The general sector feedback in the respect of awareness, being satisfied with the existing level of information and the way it's channelled towards the targeted audience, is positive. For an additional increase of awareness and visibility within the sector, success stories shall be used as tools to share knowledge and lessons learned.

Accessibility

Many vessel owners / operators fall short when it comes to mobilizing in-house resources to elaborate a project application within the existing support schemes. Therefore, some decide to work together with consultants, others prefer to get advice directly from regional promotional entities or from branch organizations, associations, etc. In addition, project management practices and reporting requirements also require significant resources from the applicants. Therefore, a harmonization and simplification of all administrative processes is very much deemed as necessary and highly expected for a reduction of needed time resources. When looking from the project engineering perspective, one might advise that several applicants team up to create synergies when approaching a consultant and / or other providers for projects. Moreover, the sector stated, that for investments into greening technology a minimum of 50% funding rate is preferred. The availability of an initial financial contribution via the programme or by supportive financial institutions could also be an enormous advantage for the sector.

F5. Are national and regional governments prepared to provide financial support for the transition towards zero-emissions IWT?

In terms of existing financial instruments for greening IWT on national and regional level, several aspects are taken into consideration: total budget, funding rate, beneficiaries, timespan and whether the scheme supports roll-out or research / pilots / test etc. The overarching overview of all relevant support schemes for IWT in the specific European countries is **summarised in chapter Erreur ! Source du renvoi introuvable.** of the full deliverable F report.

In order to adequately respond to the formulated research question, various types of data were collected via a set of methodologies comprising desk research, an online survey of national authorities and the analysis of secondary data collected in the framework of the GRENDEL project (where a model state aid scheme is being drafted) and data elaborated within the official co-operation with the CLINSH initiative (where funds are available for greening of the vessels). This research question concludes that the degree of financial support provided for the transition towards zero emissions IWT differs per country and region significantly. While countries like the Netherlands, Belgium, Luxembourg, France, Germany and Switzerland provide the sector with numerous attractive IWT financing opportunities, countries like Austria, Hungary, Romania, Slovakia, Croatia or Bulgaria lack any kind of financing incentives related to IWT. The only Eastern European country currently having a state aid scheme for the modernisation of the inland fleet is the Czech Republic.

F6. To what extent is it possible to combine the different EU and national and regional funds? Can they be combined with financing schemes and products; what is the scope for blending?

Blending is the combination of grants with non-grant resources such as loans, equity and guarantees from financial institutions as well as commercial loans and private investments in order to achieve a leveraged development impact. The main benefits of blending are the leveraging effect of public money, hence the increased impact of support actions and the principle of returns for private investors.

All blending operations carried out under the described funding programmes, relevant for greening IWT (F1), shall be implemented in accordance with the InvestEU Fund (F2), comply towards the rules of the programmes under which the support is provided, and rules laid down in the Financial Regulation. It is planned to provide a possibility to operate complementary to grant financing (e.g. Horizon Europe, CEF, etc.) through blending operations. Moreover, the programme is complementary with the European Structural and Investment Funds (e.g. ERDF, ESF+, Cohesion Fund, etc.) operating under shared management, which enables easier facilitation of the deployment through financial products as the Member States can rely in the InvestEU Programme and its simply set of rules applying in all cases.

In regards of cumulation in funding products, an action may be financed jointly from separate budget lines by different authorising officers responsible; however, in no circumstances shall the same costs be financed twice. In order to gain a stronger impact with the existing resources, projects shall not be covered fully by a grant. Therefore, co-financing may be provided in the form of the beneficiary's own resources, income generated by the action or work programme, or via financial or in-kind contributions from third parties.

F7. Is it possible to secure a price advantage on a European level between conventional diesel fuel and cleaner fuels, for example by a hedge?

Research question C presented that for the greening technologies (such as LNG and electricity), significant savings on fuel costs can be obtained in comparison with conventional diesel fuel cost. This difference could potentially offset the additional investments (capital costs) for greening technologies. Furthermore, the price of diesel, LNG and electricity all fluctuate substantially. A hedge can be used to offset the price fluctuation of commodities and to secure the price advantage between the greening technologies and diesel. Hereby keeping energy costs within a predictable range to provide a more secure business case for investments into alternative green technologies in the IWT sector.

A hedge is an insurance on the price level of a commodity or different kinds of financial products and is used to offset the potential losses of fluctuating prices. A fuel price hedge can, therefore, be used to diminish the risk of potential losses of fuel prices unexpectedly increases. There are three main hedging strategies: future contracts, options contracts and price swaps.

Despite the commonly used principals of the different fuel hedging strategies in sea shipping, fuel hedging is not common practice in the inland waterways. For individual shipowners working in the spot market, current hedging possibilities are cumbersome, potentially costly and therefore not entirely suited for individual ship owners to secure the price advantages between commodities in the long term.

Hedging in terms of price swaps can be used by shipowners working on contracts for a longer period securing the price advantages of a greening technology. To be feasible, multiple shipowners need to be participating and cooperating in the swap. On a European scale, price swaps on a specific location could be an interesting opportunity to offer greening technologies for a fixed or maximum price cap to individual shipowners. However, the price fluctuation of conventional diesel is not taken into account with the price swap. Therefore, in order to stimulate the transition towards greening technologies, hedging is not a solution on its own.

F8. Would it be possible to develop a specific programme, financial instrument/product or facility specifically for the IWT sector and investments in greening with relatively simple procedures, low requirements and/or relatively high funding rates?

Considering the conclusions from the relevant sub-questions in F and the experiences from the business, the current funding and financing schemes are not suitable to achieve a large-scale greening of the European IWT fleet. Therefore – also taking into account the available information on the follow-up programmes – new ways of funding and financing solutions have to be identified and programmed in order to reach the objective.

As such, the need is high to have a possibility for the IWT sector where funding and / or financing is available with relatively simple procedures, low requirements and / or relatively high funding rates. This need is also derived from the different environmental requirements, whereas those can hardly be met by only using the own resources of the owners / operators. Thus coordinated, transparent and fair support is needed as well for the stakeholders.

In principle it is possible to develop a specific scheme for the IWT sector for greening the fleet, whereas, when it comes to the possibility of developing the scheme, the following principles have to be declared from the very first moment of planning:

- All applicable legislation have to be respected and applied.
- The scheme has to be transparent for all stakeholders, and as inclusive as possible.
- The scheme shall provide reasonable, well-justified and fair support to all stakeholders to qualify for that, ensuring a level playing field.

It shall be the overall goal of the scheme to support the IWT sector in arriving to zero-emission waterborne transport by 2050. In addition, the scheme shall collect all available resources in order to provide and further promote them to the stakeholders. The support of the newly developed scheme can be provided in the form of the following or their combination:

- non-repayable grant
- bank guarantees
- loans

A potential new element additional to the above list might be, if more Member States decide for national / regional schemes, such as dedicated state aids for greening the IWT fleet.

9.5 Final results research question G and H

The main questions of research elements G and H are:

G “What is the potential of polluter pays schemes in IWT?”

H “What are requirements and boundaries considering level playing field and modal share?”

The questions are, given their interconnectedness, analysed in one study. The respective study analyses the potential of a financial instrument based on the contribution by the IWT sector. In view of question ‘G’, this study analyses the potential of a financial instrument based on the contribution by the IWT sector. The theory of the ‘polluter pays principle’ as well as possible schemes for a contribution by the sector have been described and analysed. The potential market impacts of a contribution by the sector were assessed based on literature research (e.g. studies on price elasticities), further desk research and was complemented by interviews with shippers and vessel operators for eight representative case studies. Corresponding requirements and boundaries considering level playing field were also assessed in view of question ‘H’. Each main question ‘G’ and ‘H’ is broken down into sub-questions, i.e. G1 - G6 and H1 - H4. The questions are as follows:

- G1: Who is the polluter in IWT? What is a proper definition?
- G2: What are possible schemes which serve the polluter pays principle and on which basis?
- G3: What are legal barriers to implement such schemes across the European Union and including other relevant European IWT countries as Switzerland, Serbia and Ukraine?
- G4: What are the legal barriers and options as regards the Mannheim Act to enable polluter pays schemes for emissions to air?
- G5: What can we learn from the CDNI protocol, the scrapping fund and ‘old-for-new’ regulation in terms of the used approach and developed processes for solutions incorporating sector contributions?
- G6: What could be the revenues from a ‘polluter pays’ scheme?
- H1: What are potential market impacts of polluter pays schemes in relation to:
 - a. Costs for the shippers and their competitiveness
 - b. Competition between vessel types (new vs existing, large vs small)
 - c. Competition between IWT operators from different countries
 - d. Competition between transport modes, notably with road haulage, with respect to undesired reverse modal shift impacts
- H2: What is the effect of these measures on the modal share of IWT taking into account price elasticities for different type of markets in IWT?
- H3: What are limitations as regards State aid regulation in view of providing funding from public bodies?
- H4: What could be the contribution from the IWT industry itself to cover higher costs of ownership?

In this summary for each of the sub-question, the answer is provided.

G1: Who is the polluter in IWT? What is a proper definition?

The first action was to analyse the theory and basics of the Polluter Pays-Principle (PPP) and to assess what this means for inland waterway transport (IWT) with regards to a possible scheme based on sector contributions. An important element in this respect is the analysis of the market structure in IWT. This provides a view on the type of market players, the market segments to be distinguished as well as insights in how the market functions.

At first glance, the inland shipping company can be regarded as the physical polluter since the company operates the vessel and consumes the fuel/energy for the propulsion for transportation of goods or passengers with own and/or chartered vessel(s) on a professional basis. However, the inland shipping company is not solely responsible for the caused pollution. All involved actors in the chain are part of the pollution chain to certain extent. This mainly includes the shipper as the party to make the transport order to select the logistics service provider who selects the inland shipping company to carry out the work. As a result, it was concluded that in IWT there is a pollution chain in which multiple involved actors in the logistics chain are together responsible for the pollution. It is therefore concluded that due to the complex structure and the strong fragmentation in the supply side of the sector it is not possible to single out one polluter only. Not only are multiple parties involved, but also contractual relationships between shippers, brokers and inland shipping companies can frequently change in time. This is confirmed by the high share of contracts for inland shipping companies established on the spot market. In such case, applying the PPP in its purest form would mean that each responsible party in the chain needs to be charged pro rata with the cost for pollution prevention and control measures determined by the public authorities. This will simply become too complex and difficult with an extreme administrative burden for the involved parties. As a result, the study did focus on investigating possible schemes in which 'pollution is paid for' with support from all the actors involved in the pollution chain. In other words, *what is the potential for a contribution by the sector?*

G2: What are possible schemes which serve the polluter pays principle and on which basis?

In order to increase the understanding of 'polluter pays' schemes, four existing practical applications were reviewed. It was clarified how these schemes serve the PPP and on which basis. These existing applications are:

- the NO_x tax in Norway;
- the CO₂ tax in Sweden;
- EU Emission Trading System;
- CDNI convention.

Overall, the four practical existing applications of the PPP have their own set of advantages and disadvantages. A possible scheme for IWT should take note of these. The NO_x fund initiative- as applied in Norway- is in this respect a good practice example. This remains in contrast to introducing a stand-alone levy measure such as the initially presented NO_x tax (the NO_x fund was led subsequently to the NO_x tax) in Norway and the CO₂ tax in Sweden. A tax measure could be relatively easy implemented and administered at a national level, however on a European level this is more difficult. In addition, introducing a tax is mostly likely in conflict with the Mannheim Act. Furthermore, the introduction of a tax measure on its own will not sufficiently support the IWT sector in the transition towards becoming zero-emission in 2050 since stand-alone tax measures flow into the general budget of governments and only a part of the collected financial sources may be used for IWT in an indirect way.

Hence, earmarking needs to be applied to make sure that resources become available. This results in a budget neutral approach on sector level, i.e. financial resources originating from the sector flow back to the sector (i.e. used for the benefit of the sector). Resources provided by the sector will also become available for the sector for a specific goal to reach the 2050 ambition of (near) zero-emission performance. This also avoids the risk that the contribution will be interpreted as

finances by the IWT sector and/or a taxation on IWT operations, resulting in lack of acceptability by the industry and conflicts with legal frameworks (e.g. Act of Mannheim).

As a result, the focus is laid on a scheme that consists of a 'greening fund' filled with earmarked 'contributions' from the sector which are in turn used for the sector, i.e. goal based: reaching (near) zero-emission performance by 2050.

Furthermore, it should be noted that the concept of a greening fund filled with earmarked contributions, is still fundamentally based on the general principles of the polluter pays theory.

Based on this conclusion, the possible implementation of a greening fund filled with, amongst others, earmarked contributions from the sector is subsequently analysed. Based on comparison with examples in other sectors and a brainstorming session with the Steering Committee, nine different options were initially identified for a possible contribution from the sector towards a greening fund.

As a next step these options were qualitatively assessed based on four evaluation criteria. These criteria are:

- effectiveness;
- fairness;
- proportionality;
- technical feasibility.

Table S1 provides an overview of the options and their scores on the criteria:

Table S1: Options and qualitative scores for a contribution basis

Options for contribution basis	Effective	Fair	Proportional	Technical feasibility	Conclusion
Option 1 Fixed rate contribution for each active vessel.	---	---	+	+++	Not acceptable
Option 2 Contribution based on load capacity/length	--	--	+	+++	Not acceptable
Option 3 Contribution based on amount/number of transported freight/passengers (or per tkm/pkm).	-	-	+/-	+	Not acceptable
Option 4 Contribution per kilometre travelled	--	--	+/-	+	Not acceptable
Option 5 Contribution for new engines supplied to the market	--	--	+/-	+	Not acceptable
Option 6 Contribution based on a flat rate for the bunkered amount of fuel/energy	+	-	+	++	Selected for short list

Option 7 Contribution based on real-time measured emissions on board of vessels	+++	+++	--	---	Selected for short list
Option 8 Contribution based on emissions calculated	++	++	-	-	Selected for short list
Option 9 Contribution based on the emission Label/Energy Index combined with the bunkered amount of fuel/energy per vessel	++	++	+	+	Selected for short list

The last four options (6 - 9) could satisfy the effectiveness and/or fairness criteria in the path towards reaching the goal, i.e. realising the (near) zero-emission performance of the European IWT sector by 2050.

However, option 8 and especially 7 have a concern about the technical feasibility and might not be a feasible option for the short term. For option 7, This could change in the near future if sensors and measuring devices further develop and become cheaper. Out of the four options, option 9 would be the most feasible option based on the initial evaluation. This one is the contribution to a greening fund by each vessel operator based on the bunkered amount of fuel/energy per vessel. However, it would not be a flat rate contribution, but the rate would be differentiated by means of an emission Label/Energy Index. This means that vessels with a low emission per litre of fuel pollute less compared to vessels with a high emission profile.. Consequently, this gives an additional incentive and promotes cleaner vessels which ultimately results to a bigger score on effectiveness and fairness as compared to option 6.

G3: What are legal barriers to implement such schemes across the European Union and including other relevant European IWT countries as Switzerland, Serbia and Ukraine?

G4: What are the legal barriers and options as regards the Mannheim Act to enable ‘polluter pays’ schemes for emissions to air?

Before further elaborating the mentioned options 6-9, it is important to further assess whether the options could be introduced given the current legal framework. In other words, does the applicable legal framework allow for the introduction of a sector contribution based on the polluter pays principle?

The applicable legal framework for the inland shipping sector is complex since including not only legal regulations of national governments, which may hamper the introduction of a potential ‘polluter pays’ scheme, but also embrace international regimes, such as European legislation and river basin specific legislations. For each of those jurisdictions it is necessary to assess whether a sectoral contribution based on the PPP could be introduced.

EU law offers a legal framework to introduce a sectoral contribution based on the ‘polluter pays’ principle. The overarching PPP is laid down in Article 191(2) of the Treaty on the Functioning of the European Union (TFEU), which states that the Union shall adopt policy that aims to protect the environment. In this process, the Union has to consider several principles. Amongst those standards, the principle includes that the polluter should pay for the damage done to the environment. However, Article 191 TFEU does not disclose how this should be established and

what the PPP should entail. This means that the details of the PPP must be interpreted in additional legislation (e.g. in a specific regulation or directive). Currently, no such legislation exists for the IWT sector.

Whether a sectoral contribution can be introduced given the international regimes on the different rivers depends on the specific conventions. The following can be said:

- **On the Rhine:** Article 3 of the Mannheim Act explicitly *prohibits Signatory States to impose any kind of rights based directly on the fact of navigation*. This implies that States cannot charge the inland shipping sector for activities directly connecting to shipping as such. The Act opens the possibility for two exceptions: (i) non-shipping related duties, for instance VAT on goods, and (ii) retributions – compensation for delivered services (the CDNI disposal charge is such an example).
- **On the Danube:** The Belgrade Convention *does not allow for the collection of fees related to navigation*. Nevertheless, it should be noted that the Belgrade Convention is an older convention, which was drafted in 1948. Since then, the world changed considerably. Although some levies / taxes have been included within the scope of the Convention, no proposals for additional levies have been made so far. In case the eleven Signatory States to the Convention would agree on the introduction of a new levy, it is probably possible to introduce it.
- **On the Moselle:** The Moselle Convention *allows for the collection of tolls* (Articles 22 to 27). The initiative to introduce any new form of rights on the Moselle needs to stem from the three Contracting States. Jointly they need to decide to introduce a new right. If all agree, the new law could become part of the legal framework.
- **On the Sava:** The Protocol on the Navigation Regime *does allow for the collection of payments*. According to Article 10 vessels operating on the Sava River and its tributaries could be asked to pay a fee or toll. Nevertheless, the fee collected cannot be used freely as it should be spent on fairway maintenance or upgrading of the fairway. Based on the Protocol on water pollution it is possible to ask a contribution based on the polluter pays principle. However, this only relates to water pollution and has not been specified in practice yet.

G5: What can we learn from the CDNI protocol, the scrapping fund and 'old-for-new' regulation in terms of the used approach and developed processes for solutions incorporating sector contributions?

Three schemes for IWT were analysed, which all introduced a kind of sector contribution. The schemes analysed are:

- CDNI on oily and greasy waste;
- scrapping fund;
- old-for-new regulation.

When analysing the different schemes, some overall lessons can be learned, which will be of added value considering the introduction of sector contribution for the greening of the IWT fleet. The main lessons learned can be summarised as follows:

- The initiative needs to be *laid down in a legal act*. Otherwise, it will not be possible to ensure payment of the contribution and there will be no basis for enforcement. The scheme would be purely voluntary, making the scheme less effective.
- The initiative should be introduced *on an international level* and should be *as inclusive as possible*. Leaving some parts of the sector out of the scheme, will diminish the success of it. It also affects the level playing field within the IWT sector, which in turn decreases sector support.

- The initiative should have a *measurable objective* in order to be successful. The more concrete the objective, the easier it is to assess whether or not the objective is met. Also amending the initiative is easier when the objective is clear.
- The initiative should *not introduce a tax or any other form of right* as this can be prohibited under international law.
- The initiative should ensure *sector willingness*. Without active sectoral support, the sector will take no action or will look for ways to circumvent the new rules. Besides sectoral support also *government support* is needed. In case one or more governments do not support the initiative, the introduction of a sectoral contribution is difficult to realise.

H1: What are potential market impacts of 'polluter pays' schemes in relation to:

- a. Costs for the shippers and their competitiveness
- b. Competition between vessel types
- c. Competition between IWT operators from different countries
- d. Competition between transport modes, notably with road haulage, with respect to undesired reverse modal shift impacts

H2: What is the effect of these measures on the modal share of IWT taking into account price elasticities for different type of markets in IWT?

The study analysed (a) the potential market impacts of a possible scheme of earmarked contributions towards a greening fund, (b) a concept in principal based on the polluter pays principle, and (c) what the possible effects could be on the modal share of IWT.

From **literature research** the following findings are most relevant:

- A transport efficiency of -0.1 and -0.2 seems a realistic assessment: 10 to 20% of an initial cost increase can be offset by increasing 'transport efficiency'.
- The overall net elasticity in demand is estimated at a value of -0.15. This means that an increase of costs of 1% is expected to result in 0.15% less demand for IWT (tonkilometers).
- Research on real life examples in situations with high oil prices and low water levels conclude that atypical cost increases due to low water situation rarely results in a substantial drop in demand. The same principle applies for changes in the oil price. The oil price has shown to be quite volatile over the past decade. Yet, the number of tonnes transported via inland waterways has been quite stable.

The IWT sector consists of different market segments with their own characteristics and market dynamics, which makes it difficult to make general statements from a top-down view on how earmarked contributions related to the fuel consumption would impact the market. As a result, a more bottom-up approach was followed in addition to review of literature on studies about price elasticities and market responses to prices increases.

To complement the literature research, eight different case studies were identified and analysed. These eight cases together fairly represent the IWT market. Based on case studies, interviews with vessel operators and desk research, key indicators were identified that can provide direction on the expected market impact. These impacts can be categorised into market impacts within the IWT sector and impacts within the wider supply chain.

The findings show that when IWT operators are confronted with a new cost optimization problem due to earmarked contribution, they will most likely adapt their travel characteristics accordingly and to the extent that this is possible. The extent to which operators have the opportunity depends largely on the considered case and the (contractual) relationship with the shipper. The

more these actors collaborate, the more the actors are able to offset the initial cost increase. An example of such a collaboration would be if the shipper and operator engage in a long-term contract, allowing the IWT operator to invest in more fuel efficient vessels and greening technologies, limiting the earmarked contribution, hereby assuming an earmarked contribution based on options 7 - 9 as contribution basis. On average, it is expected that around 10-20% of the (initial) cost increase can be offset by changing transport characteristics such as fuel usage and changing shipment size.

Furthermore, within the IWT sector itself, an earmarked contribution will have varying effects depending on the specific vessel used by the operators. Based on a desk study incorporating a number of representative vessel categories, an average contribution of 4 eurocent results in a total cost increase per transported ton or passenger between 0.6% and 2.1%, whereas with 8 eurocents, the cost increase fluctuates between 1.1% and 4.2% (assuming an average fuel price scenario).

It was confirmed with interviews conducted with vessel operators for the case studies and with desk research, that the cost increase due to a possible earmarked contribution equal to 4 up to (and to a lesser extent) 8 eurocent per litre bunkered fuel (or expressed by a contribution for the emitted amount of emission), would not result in drastically disruptive effects and will not disturb the competition between vessel types.

The situation is slightly different with regards to the competition between operators in different countries. Assuming an average fuel price scenario, fuel costs make up a slightly larger share in the total costs of companies active in the Danube countries compared to the Rhine countries. These are the two main IWT markets in Europe, of which the Rhine market is by far the largest in number of vessels. Four vessel types were taken into account which are considered to be rather common for the Danube market. Fuel costs had on average a higher share in the total costs, approximately 3% up to 8% higher for operations involving the four vessel types in the Danube market as compared to the Rhine market. Hence, an increase in the costs related to the fuel consumption will have a relatively larger impact on the overall costs of those companies active in the Danube market.

On the other hand, the market structure in the Danube countries differs significantly from the one in the Rhine market. The Danube market is being dominated by relatively big companies, previous state-owned enterprises, which are nowadays privately owned. The Rhine market is characterised by a fragmented structure, mainly consisting of small family companies owning or operating one or two vessels. Large companies on the Danube may have better access to EU funding with higher funding rates from cohesion funds (currently being explored in the GRENDEL project).

Within the wider supply chain, vessel operators are hesitant to pass on cost increases further along the chain to actors such as shippers, as this might trigger shippers to select other vessel operators instead. On the other hand, the case studies found that most of the contracts include a 'bunker adjustment factor' (fuel clauses), enabling vessel operators to pass on higher fuel costs due to fuel price fluctuations. Furthermore, several case studies showed that the costs for the CDNI disposal charge is passed on to the shipper by the vessel operator, and subsequently these costs are covered in the overall supply chain costs.

The share of the transportation cost in the overall supply chain cost is another determinant in the potential market impact. The larger the transport cost component is in the overall cost function, the larger the market impact is expected to be. Hence, market segments such as the gravel and

sand sector are relatively more sensitive to cost increases due to earmarked contributions which are related to the fuel consumption, markets such as the wet bulk segment are less sensitive though.

In some cases, the shipper might be able to adapt the logistics chain. Hence, by moving production location which would lead to decreasing transport distances. For example, (i) by relocating factories, (ii) by importing goods via another seaports or (iii) by selecting another extraction site. For container and bulk transportation such as ore and coal, the risk of this impact is assessed to be low. In the gravel and sand sector however, there is a fear that cost increases would lead shipper to select other extraction sites.

In general, the price elasticity on demand is low in IWT. An example is the low water level period in 2018 which showed that the price elasticity of demand was around -0.15. This implicates that a price increase of 1% results in a demand drop of 0.15%. However, based on the case studies, it appeared that a cost increase related to the fuel consumption of 4 up to (and to a lesser extent) 8 eurocent/litre fuel will be negligible and not result in a drop-in demand for IWT.

Concerning the thresholds for the contribution, an average cost increase of 4 cent per litre seems to be acceptable. A cost increase of 8 cent per litre seems to be problematic for market segments such as sand and gravel and agribulk. The exception is inland waterway transportation in the Danube region, where there is fierce competition from other modes. In the Danube region, it is felt that an earmarked contribution of 1-2 cent per litre would already have significant market impacts.

H3: What are limitations as regards State aid regulation in view of providing funding from public bodies?

The basic framework on State aid rules applicable to the majority of the inland navigation countries has been analysed. Article 107 of the Treaty on the Functioning of the European Union (TFEU) lays down that aid granted by a Member State or through State resources should not distort competition and trade within the EU by favouring certain companies or the production of certain goods. From a legal point, there are restrictions on State aid to companies, as it can lead to market distortion at national level, but also between various European countries. However, under certain conditions, it is allowed to provide aid. Providing aid for greening the inland navigation fleet may be covered by (i) measures which are already the subject of a Commission approval decision (notified measures) (ii) measures that can be qualified as the *De-minimis* rule (no aid), or (iii) measures that fall within the General Block Exemption Regulation (GBER) (block exempted measures). Of all exemptions, the last group seems the most promising as in those, explicit references to inland navigation and greening are made.

The European State aid rules apply to all 27 Member States. This means that State aid rules apply to all inland navigation countries that are EU members. However, these rules do not apply to those inland navigation countries that are not a member. In some of those countries national rules on governmental support do exist, while in others such rules are absent. For instance, Ukraine has recently implemented new law laying down rules under which conditions government aid can be granted. In principle, the law does allow for State aid to the inland shipping sector, as long as the relevant conditions are fulfilled. In Switzerland, currently no rules on State aid for the IWT sector are available. In case the governmental support would be required, new legislation should be drafted and implemented.

G6: What could be the revenues from a ‘polluter pays’ scheme?

H4: What could be the contribution from the IWT industry itself to cover higher costs of ownership?

For answering the questions G6 and H4, the potential revenues from a contribution by the IWT industry are calculated based on different sources:

- the results obtained in the PROMINENT project (closed in 2018)
- the options for a contribution which are considered feasible from desk research and interviews
- literature research on market impacts
- case studies and interviews with IWT companies indicating the acceptance for and possibility of a contribution from the sector itself.
- Analyses of the Reserve Fund

In order to easily express the acceptance and possibility for a contribution, four contribution scenarios were chosen linking to a contribution based on bunkered litre of fuel. Grounded on the fuel costs’ impact, one could quickly assess the effects on their operation and competitiveness. The interviewees were asked to elaborate on a contribution based on the bunkered fuel ranging from a contribution of 4 cents up to 32 cents per bunkered litre (4, 8, 16 and 32 cents per litre). Centred on these elements, an overview is provided of the possible revenues taking the four options for the contribution basis into account.

Assuming a European wide contribution of vessel operators to a greening fund, ranging from a contribution of 4 cents up to 8 cents per litre bunkered fuel, the possible revenues solely on the basis of these contributions would range from € 53mln up to €106mln on an annual basis. Over a period of 25 years the total revenues would range from approximately € 1.3 bln up to € 2.6 bln. Per year, this amounts to an average of € 4,319 to € 8,637 per vessel. A contribution based on the bunkered fuel and the emission label/energy index of the vessel would result in differentiated rates.

The contribution levels of € 53mln up to € 106mln on annual basis, whereas the prior scenario seems more feasible as compared to the latter, can also be translated to a contribution based on the calculated or real-time measured emissions. Table S2 provides an overview for the four contribution options, with the rates expressed per litre of fuel and expressed per emission type (NO_x, PM, CO_{2e}):

Table S2: Options for a contribution basis

Options for contribution basis	Contribution equal to 4 cent per litre on average (€ 53 mln per year)	Contribution equal to 8 cent per litre on average (€ 106 mln per year)
Option 6 Contribution based on a flat rate for the bunkered amount of fuel/energy	4 eurocent/litre bunkered fuel flat rate (not differentiated)	8 eurocent/ litre bunkered fuel flat rate (not differentiated)
Option 7 Contribution based on real-time measured emissions on board of vessels	0.79 euro/kg NO _x 3.12 euro/kg PM	1.59 euro/kg NO _x 6.25 euro/kg PM
Option 8 Contribution based on emissions calculated	1.62 euro/ton CO _{2e}	3.24 euro/ton CO _{2e}

Option 9 Contribution based on the emission Label/Energy Index combined with the bunkered amount of fuel/energy per vessel	4 eurocent/ litre bunkered fuel on average (differentiated)	8 eurocent/ litre bunkered fuel on average (differentiated)
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In addition, there is the Reserve Fund, also often called the ‘scrapping fund’. This is an European restructuring scheme consisting of a scrapping scheme and an ‘old for new’ scheme which was meant to (1) scrap redundant vessel capacity by giving the respective vessel owners a scrapping fee and to (2) prevent uncontrolled fleet expansion by means of a levy on new vessels. The updated regulation in 2014 specifically included provisions to address the emission reduction of the fleet and with a clear hint towards combining the Reserve Fund resources with other financial instruments (e.g. EIB, CEF). Taking into account the budget already allocated for the IWT Platform, there is a remaining fund of € 26.87 million available.

Recommendations in view of research question I

It is recommended to take into account for research question I (added value of a European funding / financing scheme) the sector contribution based on a contribution related to the fuel/energy consumption. It was proven that 4 and to a lesser extent 8 cent per litre of fuel is acceptable and realistic. Over the time span of 25 years (e.g. 2025-2050), this may result in revenues of € 1.3 - 2.6 billion. However, IWT operators active in the Danube market are more sensitive to price increases related to fuel consumption. The question is how and if operators in the Danube should be compensated. This is subject of research in research question F and I.

An earmarked contribution by the sector would need to be:

- implemented and collected on European scale in order to secure level playing field and acceptance;
- no general tax but earmarked and dedicated to reduction of emissions with a clear measurable objective (define ‘near’ zero-emission 2050 in a SMART way);
- based on a legal act, for example a European Union regulation and/or convention with Member States and third countries (non-EU Member States).

For such a scheme it is already clear that there is a need (added value) for a European fund with a proper governance to facilitate the contribution by the sector. A seat in the governance board for EBU, ESO and ESC is recommended to cover the interests of the vessel owners/operators, intermediaries, and shippers.

Moreover, the available financial resources in the Reserve Fund may be used as a kick-start, while there could be a need for pre-financing of the Fund (e.g. by EIB). It can be further discussed with EBU and ESO if this can lead to a unanimous proposal from their side.

9.6 Final results research question I

Research element I can be seen as the concluding part based on the findings from the reports on research questions A-H of the CCNR study on energy transition towards a zero-emission inland navigation sector. All these reports should be understood as a basis for a wide-ranging discussion process at Rhine, European and international level with the aim of:

- scoping the funding and financing requirements for the IWT sector's energy transition,
- making recommendations for the development of a European funding and financing instrument intended to support this transition, and,
- paving the way for political decisions.

It needs to be remarked that there are economic, technical, legal and practical feasibility questions which remain to be addressed with regards to the creation of a European funding and financing scheme.

The main question of research question I is:

- *What is the added-value of a new European funding and financing scheme for IWT and how could this work?*

Research element I is broken down into eight sub-questions. The main findings are summarised into three paragraphs explaining the need for a new European funding and financing scheme, the possible benefits and added value, and the recommended features and characteristics. **In the context of this study, a fund refers to a financial instrument.** The word 'scheme' refers to a broader set of measures which are combined and linked in order to create synergies in reaching the emission reduction objectives. This broader set of measures (scheme) can consist of:

- loans (financing);
- grants (funding);
- differentiated earmarked contributions from the private sector to feed the fund;
- accompanying incentives based on the emission/energy performance of the vessel;
- accompanying legal framework to enable the above-mentioned measures.

In general, the answer to the main question is that with the adoption of the appropriate legal framework **there is an added value for a new European funding and financing scheme.** It is clear that the IWT sector cannot make the investments on its own, due to the **lack of the business case** for (near) zero-emission technologies as well as the lack of own resources and incentives (as made clear in the report on research question A). The business-as-usual scenario will therefore not reach the emission objectives as stated in the Mannheim declaration from October 2018. **A new European funding and financing scheme would therefore focus on providing grants (non-repayable funds) to close the gap in the business case.** In addition, the following financial instruments, pay-per-use and leasing schemes, joint procurement and fuel hedging (analysed in research questions D, E and F) can have some added value. However, they are expected to have only a relatively small contribution on closing the gap. A European funding and financing scheme based primarily on providing grants shall give the major contribution to close the gap between 'business as usual' and the transition pathways¹³ for the European IWT fleet. This in order to

¹³ For the purpose of this study, it has been requested to identify two transition pathways towards zero-emission in 2050, a conservative one and a more innovative one. The conservative pathway refers to a pathway in which mainly alternative fuels and techniques are considered which are relatively easy to implement and cost efficient. The innovative pathway takes a more innovative approach with less internal combustion engines into account.

reach the intermediary and final objectives of the Mannheim declaration by 2035 and 2050¹⁴, as presented in research question C.

In particular, such a **new scheme could introduce a contribution by the sector** to support its energy transition. Since it is unrealistic that the public sector will provide the full volume of resources needed to provide grants, a contribution by the IWT sector would provide¹⁵ a substantial amount of private resources. This could take the form of a dedicated contribution taking into account the emission performance of the vessel. A differentiated approach also provides an additional incentive and follows the principles of the ‘polluter pays’. Such a fund-raising scheme can be based for example on the fuel consumption for a longer period, 2025-2050. Introducing such a fund-raising mechanism is however **prohibited within the current Rhine legal regime** and requires **a careful examination by the CCNR which is competent on this issue**¹⁶ (see report on research question G and H for a more in-depth analysis¹⁷).

Assuming that the legal framework can be arranged, the result would be a mix of public and private funds provided as resources for the new funding and financing scheme. Subsequently, these resources are to be used primarily as grants **to compensate the vessel owner for the higher total costs of ownership (TCO)** of using powertrain equipment and more expensive fuels which contribute to reaching the emission targets for 2035 and 2050. The private resources brought together by the sector with an earmarked purpose are to be **co-financed by public parties** (e.g. national governments and EU). It can be linked to multiply the grants for vessel owners in order to close the gap.

The geographic scope of such a scheme is **European (connected waterways in Europe)** and therefore goes beyond the European Union and includes non-EU Member States, such as Switzerland, Serbia and Ukraine. This is important to make sure that there is no loophole in the scheme. In order to ensure effectiveness, it must not be possible to circumvent or otherwise avoid the purpose of the scheme. Furthermore, there cannot be a significant negative impact on level playing field between IWT operators in Europe.

Preferably the scheme would be a **‘one-stop-shop’ approach** for the beneficiary (vessel owner) to ease the process as much as possible. In such a case, the vessel owner would only need to submit his request for funding and financing to one organisation which will take the request into account. The organisation would take care of both the funding (grants) and financing (loans) needed, taking into account the estimated total costs of ownership compared to using the conventional drivetrain using fossil fuel. Furthermore, in advance of submitting a request, this vessel owner

¹⁴ - Reduce greenhouse gas emissions by 35% compared with 2015 by 2035

- Reduce pollutant emissions by at least 35% compared with 2015 by 2035

- Largely eliminate greenhouse gases and other pollutants by 2050.

¹⁵ See also deliverable for RQ G and H for more information as regards the earmarked contribution.

¹⁶ See Article 3 of the Mannheim Act of 17 October 1868 – ‘*In application of Article 3 of the Mannheim Convention, the Member States must refrain from imposing any toll, tax, duty or charge based directly on the fact of navigation.*’ <https://www.ccr-zkr.org/11020100-en.html>.

¹⁷ [Deliverable_RQ_G-H_Oct2020.pdf \(ccr-zkr.org\)](#)

could contact the organisation to get technical assistance and guidance in choosing the right techniques/fuel given the type of vessel and the operational profile of the vessel. The organisation could also provide assistance and guidance in the application procedure. There are already today some examples of online research tools providing support to project owner looking for financial support, being general in their scope or targeting the inland navigation sector¹⁸.

Therefore, a possible funding and financing scheme could take the form of a public-private partnership, with a multilateral framework. For consolidating earmarked contributions at a European level, a new international convention would be needed to extent the scope of the initiative to non-EU Member States as well¹⁹. **In addition, an agreement would be necessary to amend the Belgrade Convention and the Mannheim Act in order to allow raising funds from the vessel operators, particularly earmarked contributions that flow back to the sector.** Last, a multilateral framework is also needed to align all the (EU and non-EU) member states as regards their public contribution (grants) to the funding scheme. However, it is important to note that the start-up costs of a fund are generally funded by public grants or other type of non-refundable contributions, and not by a loan. In such a case the EIB Group could not play this role, unless a mandate is provided to the EIB Group by the European Commission for instance. On the other hand, the actual fund financial resources (to be deployed to vessel operators via grants, loans etc.) must be provided partly upfront or at least in installments based on the expected disbursements of the funds over time.

Additionally, the EIB Group could also play a role in providing attractive loan facilities for the investments required in vessels (the part of investment possibly not covered by the grant).²⁰ In particular, a scheme aiming at reducing barriers for loans to vessel owners, using guarantees from EU and Member States as well as complementing loans could be explored. The EIF, given the characteristics of its business, appears better suited to servicing the needs of Small and Medium Enterprises. This possibility may include intermediated financing. It is also understood that the EIB would focus more on financing the infrastructure required for the supply of alternative fuels and energy, as typically larger investments are required in this case.

In this summary, answers are provided for each sub-question in a concise and structured way.

RQ I1: What could be the added value of a fund for the transition towards zero-emission IWT? & RQ I4: Which approaches can be joined together into a new scheme with European coverage?

The findings from research question C present the financial challenge to reach the emission targets as defined by the CCNR. The BAU scenario (Business as Usual) shows that the emission

¹⁸ Examples: European Investment Advisory Hub: <https://eiah.eib.org/find-support/wizard-page/index> ; research tool to help identifying financial support solutions for inland shipping activities set up by Netherlands Enterprise Agency (RVO) <https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/green-deal/instrumenten-duurzaam-binnenvaart-wssl>; EIBIP Platform: <https://eibip.eu/funding/>

¹⁹ See Annex I of this report for the relevant conclusion of deliverable RQ G-H on this aspect or consult the entire report which can be found on: https://www.ccr-zkr.org/files/documents/EtudesTransEner/Deliverable_RQ_G-H_Oct2020.pdf (p.68-69)

²⁰ The minimal ticket size of the EIB should be considered. The EIB usually works with a minimal ticket size of €50 mln.

targets for 2035 and 2050 are not achieved without intervention measures in addition to the current legal framework. The **main challenge is to create a positive business case for greening technologies** and the transition towards reaching the final 2050 objective (at least a 90% emission reduction compared to 2015 volumes of GHG emissions and air pollutant emissions (NO_x and PM). Research question C made clear that there is a significant gap in the TCO between the BAU scenario and both transition pathways, taking into account a bandwidth of price assumptions for technology hardware costs and energy/fuel prices.

In the **conservative pathway as compared to the BAU scenario** the TCO gap (total of 30 years, 2020-2050) is approximately:

- €2.43 bln in the minimum price scenario
- €2.67 bln in the average price scenario
- €6.38 bln in the maximum price scenario

In the **innovative pathway as compared to the BAU scenario** the TCO gap (total of 30 years, 2020-2050) is approximately:

- €5.26 bln in the minimum price scenario
- €7.80 bln in the average price scenario
- €10.19 bln in the maximum price scenario

It was concluded that the **financial capacity of the IWT sector is very limited** (research question A). Hence, only the owners of a few commercial freight vessels in the overall European IWT sector can bear the costs themselves. Moreover, **currently, grants by public organisations (both EU and national) are only certain for the short term and are not sufficient to close the financial gap to reach the emission targets in 2035 and 2050.**

Given the relevance of the IWT sector for sustainable transportation in Europe, it is recommended that policy makers **focus on developing the proper financial instruments to meet the energy transition challenge** rather than only imposing strict limits or bans for existing inland waterway vessels not meeting the emission limits. Focusing on the latter only, is expected to result in loss of market share of IWT and reverse modal shift resulting in higher external costs (more traffic jams, GHG emissions, noise, infrastructure cost, etc.). These effects are in contradiction with the policy goals.

Given the funding gap to be bridged to achieve the transition, **it is unrealistic to expect that the energy transition in IWT will be funded completely with public resources.** Therefore, **a significant contribution by the sector itself is expected.** As also reflected in the latest EU policy documents, each mode of transport shall take its responsibility and work on a fair and efficient system to create the right incentives to reduce the negative externalities and reaching the goals for GHG emission reduction and reduction of air pollutant emissions.

From the research for questions G and H, it became clear that a contribution by the sector would only be acceptable for the sector if **the collected resources from the private industry would be**

earmarked to be used effectively for supporting the vessel owners and operators to adopt and operate the greening technologies. Furthermore, **a pre-requisite for the sector representatives is the co-financing of the contribution by the private sector with funds from the public sector.**

Different options have been analysed in research question G and H on how to raise funds from the private sector taking into account the polluter pays principle. It was concluded that **raising earmarked funds based on the fuel consumption and the emission profile of the vessel is most appropriate and feasible option.** Other options such as ETS and a contribution based on transport performance or transport volume were concluded to be less feasible and effective. Moreover, the findings of questions G and H concluded that based on market conditions in year 2020, earmarked contributions of on average €0,04/l and to a lesser extent €0,08/l of fuel could be acceptable for the IWT sector. Such contributions would not be expected to lead to significant market disruptions²¹ or reverse modal shift. This could result in **total revenues collected from the IWT sector of €1.3 bln to € 2.6 bln within a time period of 25 year (2025-2050).** On the level of individual companies and vessels, the contribution could be differentiated. This could work as a bonus-malus system to provide an additional incentive. Vessel owners could be rewarded to make steps towards zero-emission performance. An energy index or emission label system could be an instrument for this differentiation.

Alongside other advantages that such a fund would represent, **a key one would be to enable and consolidate on a European level an earmarked sector contribution combined with a stable and long-term multilateral commitment of grants provided by public bodies** (budgets of national governments and EU) to ensure level playing field, effectiveness and acceptance. Such a European approach would enable a possible solution to feed the fund and provide incentives in order to close the financial gap in the TCO between the BAU scenario and the transition towards reaching the 2050 objective.

Such a scenario to compensate the vessel owners for the higher TCO as a result of the fund, would result in **synergies with other financial instruments** (analysed in research question D, E and F). In such a situation, **economies of scale** can be created due to the significant number of vessels to be retrofitted or newbuild, equipped with new and clean technologies. Such a wave of investment projects can be pooled together to profit from **joint procurement.** Moreover, when there is a business case because of compensation of the higher TCO with the new fund, more vessel owners will be willing to engage in a **pay-per-use scheme** for electric sailing, e.g. using swappable batteries from third parties.

In addition to financial support, it is important to note that regulatory solutions could be implemented additionally, in order to further decrease the operational advantage of conventional fossil fuels over renewable fuels/energy and thereby improving the business case for cleaner technologies.

²¹It needs to be noted that this study (research question A, carried out in Q4 2019 and Q1 2020) does not yet take into account the impact of the COVID-19 crisis, which probably has temporarily further reduced the financial capacity of the IWT sector.

RQ 12: How could a fund with European coverage be structured and what would be its characteristics? & RQ 13: How can such a fund be managed and what are the expected management costs? & RQ 18: What should the governance of such a new European scheme look like?

The fund should have a **long-term approach** to cover at least the period until 2050 and should have a full European coverage for the **connected waterways in Europe** (Rhine and Danube corridors) to prevent loopholes and to ensure level playing field. This scope therefore includes **also non-EU member states** directly connected to the waterways in the EU, such as Switzerland for the Rhine corridor and Serbia, Bosnia and Herzegovina, Ukraine and Moldova for the Danube and its tributaries. This inclusive scope will require the backing of international regulations and agreements and significant time might be needed to prepare these framework conditions.

A typical fund will have a **structure consisting of a number of 'roles'**, such as the fund initiator, manager, investment, administration, advisory and the beneficiaries. It is advisable to delegate the fund management (including the selection and due-diligence of actual investments) to a professional body such as a private-sector asset manager or a financial institution. The selection and oversight process of such a fund manager could benefit from the advice and experience of the EIB Group in selected financial intermediaries under different mandates. Similar mandates were for instance managed by EIF such as JEREMIE²² or debt funds under EFSI. The related fund management costs can be around 0.75%-1.50% of the total fund size depending on the exact fund size.²³

Assuming a substantial contribution by the private sector based on the fuel consumption, the **governance board** should include organisations representing the transport chain (shippers, forwarders, vessel operators and owners) such as EBU, ESO and ESC to cover the interests of the vessel owners/operators, intermediaries, and shippers.²⁴

RQ 15: What could be the share between funding and financing (loans)? & RQ 17: How would the funding be backed? What share by public bodies and what share by private sector, e.g. by means of 'polluter-pays' revenues?

The TCO gap and the limited financial capacity of the IWT sector itself illustrate the **very limited effect of repayable loans**. Loans will only be of use to the few entrepreneurs who can bear the costs themselves, i.e. with own capital and commercial financing. If there is no business case for a greening technology (no return on investment) there is no solid basis for a bank to provide a loan as it will be risky and uncertain if the loan can be repaid. However, assuming a significant share or grants to make the business case (at least a financial break-even situation for a longer time period, e.g. 10 years) loans can play a role. Loans can be used for financing the share of the investment costs that do not belong to the unprofitable top. The unprofitable top is determined by the additional TCO in comparison with the investment (CAPEX). The additional TCO is defined

²² http://www.eif.europa.eu/what_we_do/resources/jeremie/index.htm Joint European Resources for Micro to Medium Enterprises (JEREMIE)

²³ Based on own elaboration of Rebel.

²⁴ In case of a European fund without an earmarked contribution from the private sector, an Advisory Board with industry representatives is recommended.

as the difference with investing and operating state-of-the art technologies using fossil fuel. The assumption is that the TCO gap is compensated by means of a grant. The share of CAPEX which is left would therefore still need a financial arrangement. This part could be served by loans in case the vessel owner does not have or want to use own capital to cover this remaining part of the CAPEX.

Earmarked contributions of €0,04/l and to a lesser extent €0,08/l of fuel is deemed bearable for the IWT sector and is not expected to lead to significant market disruptions. This could result in total revenues of €1.3 bln to € 2.6 bln within a time period of 25 year (2025-2050). Again, for the sake of simplicity, this amounts to an average of €1.95 bln. of total revenues.

Assuming an appropriate legal framework is in place to ensure the effective collection of this contribution, the IWT sector could roughly provide for 37% of the TCO gap itself by means of the earmarked contributions linked to fuel consumption. The remaining part should then be covered with public grants to make the business case (closing the TCO gap).

RQ 16: How can pre-financing be arranged for such a scheme; what could be the role of EIB or InvestEU or others?

The fund would need a first pre-financing round to get through the start-up phase and fund the management of the fund as well as the first investments. The European Reserve fund for inland shipping could possibly provide a small contribution in this respect. The reserve fund contains currently €26.8 mln which would most probably cover the fund management costs and the first few investments in greening the fleet in the very first phase of the fund.²⁵

In general, it would be expected that the pre-financing would take place by means of a grant. However, it could also be further explored that an additional need for pre-financing could be covered by loans from organisations such as the EIB Group.²⁶ It should be considered though that such loans are often commercial with commercial rates. Furthermore, the need for pre-financing in the start-up phase may not be substantial. Most expenditures of the fund would probably taking place after 2035, assuming that clean fuels and technologies (e.g. H2, batteries) have become more affordable by then. It depends on the type of pathway. For innovative zero-emission like hydrogen fuel cell and battery electric technologies it makes sense to wait until they are cheaper and related infrastructure is available (e.g. recharging and bunkering of H2 carriers). In the meantime, the contribution by the sector could be operational (e.g. from 2025 onwards) which could result in a cash flow surplus.

As indicated, the role of the EIB Group, more specifically the EIF, could be to become involved in a dedicated investment platform to provide easier access to repayable loans for vessel owners for the part not covered by the grant. Guarantees for loans from EU or on national level could help to lower the threshold for acquiring loans for investments in green technologies.

²⁵ Conditions to use the Reserve Fund are analysed in the Deliverable for RQ G and H, specifically in chapter 8.4 of the report.

²⁶ In relation to EIB group financing, this would concern loans with attractive pricing and long financing terms that match the economic life of each project.

However, it is important to highlight that the provision of such loans depends on the ability of the vessel owner to repay it. In other words, that a competitive business case can be demonstrated. This requires that the total cost of ownership of the green technology is competitive with a conventional powertrain. Therefore, the majority of the challenge lies in the provision of grants and other economic incentives to create this business case and ensure access to such loans is possible in the first place. Lower interest rates for loans would only have a very modest contribution in reduction of the total cost of ownership in this respect.

Study consortium:



In partnership with:



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)
European Federation of Inland Ports (EFIP)
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)

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