



Ministry of Infrastructure
and Water Management



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

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

CCNR Member States:



Study consortium:



ECORYS



In partnership with:



LIABILITY DISCLAIMER

The conclusions presented in this study and the associated reports, as well as the opinions expressed, are those of the authors and do not necessarily also represent the position of the Central Commission for the Navigation on the Rhine (CCNR), the Advisory Hub, the European Investment Bank or the European Commission on the subject in question. Use of the knowledge, information or data contained in this document is at the user's own risk. The CCNR shall in no way be liable for use of the knowledge, information or data contained in this document or any ensuing consequence.

July 2021

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

Deliverable – Research Question E

Final report

Disclaimer: the conclusions presented in this report, as well as the opinions expressed, are those of the authors and do not necessarily also represent the position of the Central Commission for the Navigation on the Rhine (CCNR) on the subject in question. Use of the knowledge, information or data contained in this document is at the user's own risk. The CCNR shall in no way be liable for use of the knowledge, information or data contained in this document or any ensuing consequence.

Client: Central Commission for the Navigation of the Rhine

Lead partner for this deliverable: REBEL

Rotterdam, The Netherlands

Document date: 22-07-2020

Table of Contents

Definitions	6
Executive summary.....	9
1. Introduction	12
1.1 Joint procurement of vessels.....	12
1.2 Joint procurement of energy infrastructure.....	12
2. Methodology.....	13
3. Characteristics of joint procurement	14
3.1 Why joint procurement?	14
3.1.1 <i>Cost reduction</i>	14
3.1.2 <i>Stimulation of market development</i>	14
3.1.3 <i>Stimulation of innovation</i>	14
3.1.4 <i>Potential for standardisation</i>	14
3.2 Forms of joint procurement	15
3.2.1 <i>Joint procurement by independent vessel owners</i>	15
3.2.2 <i>Joint procurement by cooperatives</i>	15
3.2.3 <i>Joint procurement by Special Purpose Vehicle (SPV)</i>	16
3.3 Critical success factors for joint procurement.....	17
4. Analysis: drivers and barriers for joint procurement	18
4.1 Standardisation of specifications are important to achieve benefits of scale	18
4.1.1 <i>Fleet renewal and re-motorisation: small numbers per annum</i>	19
4.1.2 <i>Greening techniques: no definitive choices on greening techniques are made</i>	20
4.2 Interview results: SWOT analysis.....	21
4.2.1 <i>Strengths</i>	21
4.2.2 <i>Weaknesses</i>	22
4.2.3 <i>Opportunities</i>	22
4.2.4 <i>Threats</i>	22
4.3 Legal aspects.....	23
5. Benefits of economies of scale	24
5.1 What are economies of scale?.....	24
5.2 What extend of economies of scale are expected?	24
5.2.1 <i>Main points for economies of scale in the IWT</i>	24
5.2.2 <i>Economies of scale estimated to be between 1 and 5%</i>	24
6. Conclusions	26
6.1 Are there possibilities for joint procurement/ financing through a cooperative or another collaborative organization to reduce investment costs?	26

6.2 What are the potential bottlenecks, for example in terms of liability? Can these bottlenecks be removed and how? 26

6.3 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.? 28

Definitions

Asset company: In the context of this study, these are companies owning the assets such as containerised energy systems and provide these to vessel owners as a service.

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

Collateral: Collateral is an asset that a lender accepts as security for extending a loan. If the borrower defaults on her loan payments, the lender may seize the collateral and sell it to recoup some or all of his losses. Collateral can take the form of real estate or other kinds of assets, depending on what the loan is used for.

Component: leasing or pay-per-use can apply to an asset (e.g. a car or truck to be leased). In this study the focus as regards leasing and pay-per-use is mainly on the powertrain of a vessel and to a lesser extent on the entire vessel. Therefore the word 'component' is more appropriate in this report. An example is a containerised power pack (e.g. Lithium-ion battery container) which can be put on board for providing energy.

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

Economies of scale: Economies of Scale are cost reduction that can be attained by a higher production output or improving their production efficiency to essentially lower the cost per unit

LCOE (Levelized Costs Of Energy): also called levelized cost of electricity (LCOE), can be defined as the average net present value of the cost of produced energy by, for example, the powertrain of a vessel. It is usually expressed in units of eurocents per kilowatt hour (kWh), considering the economic life of the powertrain and the costs incurred in the purchase, service, repair, maintenance and the energy costs. It is basically the same principle as the TCO, however, in addition, the LCOE divides the TCO figure by the amount of energy.

Leasing: Leasing is in principle a form of renting. However, contrary to rental agreements, a leasing agreement covers in general a longer time span, usually for periods longer than one year, and with specific provisions regarding the responsibilities of both the lessee and lessor during the lease period, in order to ensure that both parties are protected.

An operational lease provides a contractual arrangement calling for the lessee (user) to pay the lessor (owner) for using an asset. Property, buildings and vehicles are common assets that are leased. Industrial or business equipment is also leased. The lessor is the legal owner of the asset; the lessee obtains the right to use the asset in return for regular rental payments. The lessee also agrees to abide by various conditions regarding their use of the property or equipment.

In comparison to operational leases, there are also financial leases, which means that the ownership belongs to the user. The user has a loan for purchasing an asset in which the asset itself is the collateral for the loan. The consequence is that the equipment is in the financial books of the user, which affects the financial ratios of the company.

Another scheme is vendor leasing. In this scheme the supplier/seller of the equipment plays a role in establishing a leasing agreement or loan (financial lease) to sell the equipment. Vendors may have framework contracts with financial institutes providing the leasing schemes or have their own leasing companies. Therefore, it is basically a financial lease or operational lease, in which the marketing/sales of the leasing scheme is done by the vendor.

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

OEM (Original Equipment Manufacturer): An original equipment manufacturer (OEM) is a company that produces parts and equipment, for example engines for inland vessels.

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

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

Residual value: The residual value is the estimated value of a fixed asset at the end of its lease term or useful life. In lease situations, the lessor uses the residual value as one of its primary methods for determining how much the lessee pays in periodic lease payments. As a general rule, the longer the useful life or lease period of an asset, the lower its residual value.

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

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

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

Special Purpose Vehicle (SPV): A SPV is a legal entity which is created to separate and isolate financial risk and obligations from other entities. It can be used to reduce risk and stimulate the use of greening techniques as a vehicle for the investment, procurement, and maintenance of greener vessels

TCO (Total Cost of Ownership): It is a calculation that reveals the cost of owning and using products or services for a given period. The calculation therefore covers the total cost of acquisition and operation rather than just acquisition. Total cost of ownership helps to judge the viability of making an investment.

For example, instead of buying a powertrain solely on its sale price, a TCO assessment would include the cost of interests, depreciation, repairs and energy over the lifetime of the powertrain. The analysis might conclude that a powertrain with a higher price tag might have a lower total cost of ownership throughout the lifetime of the powertrain (e.g. due to lower energy costs).

Uptime: a period of time when something (as a machine or factory) is functioning and available for use.

Executive summary

The document answers research question E of the main study on financing the energy transition towards a zero-emission European IWT sector. The main research question that is being dealt with 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 following the 5 parameters (level of organization, ownership of vessels, responsibility for the procurement procedure, responsibility for financing, and responsibility for maintenance).

Based on the desk study, our expert opinion, and interviews with stakeholders, we found that joint procurement is possible. However, the following critical success factors are drafted 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 can find an optimum in increasing efficiency and purchasing power. However, only a limited of new vessels are built annually / undergo remotorization.

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 is limited to the 6 techniques following research question C. These six techniques mentioned 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 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 is performed through a desk study and interviews with stakeholders.

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 of 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 this moment, 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 or near zero emission techniques at this moment in time.

1. Introduction

The main research question of part E is:

What is the potential of joint procurement?

The specific sub-research questions are:

- 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.?

The answers on question E1 can be found in chapter 3, the answers on question E2 can be found in chapter 4, and question E3 will be answered in chapter 5.

1.1 Joint procurement of vessels

The possibility of joint procurement is a frequently raised question in the context of investments in greening techniques. As investments in green(er) powertrains are generally considered to be significantly higher than investments in traditional powertrains, parties look to ways to lower investment costs. Joint procurement could be a way to achieve this by improving economies of scale. Additionally, joint procurement can also be beneficial on a broader scale in the transition towards cleaning inland shipping through the stimulation of market development and innovation. These aspects are described in chapter 3.

Joint procurement, however, also raises questions on the structure/organization of such procurement cooperation. For instance, will the procurement be organized through one organization pooling all investments? How will the financing be structured in such cooperation? Which parties bare which liability? Are there other possibilities where shipowners bundle their procurement without giving up their own (financial) independence? These questions are addressed in chapter 4.

1.2 Joint procurement of energy infrastructure

Greening the IWT fleet not only requires substantial investments in green(er) vessels but also requires investments in energy infrastructure. In particular when looking towards a completely zero emission future where vessels are powered by hydrogen or electricity.

The joint procurement for energy infrastructure is not considered to be a part of the scope of this research.

2. Methodology

The analysis of the potential of joint procurement and the corresponding economies of scale for the IWT market is based on both desk research and interviews with experts in the field. Desk research includes literature on the principles. To get an understanding of the characteristics and the applicability of joint procurement for new and existing vessels, interviews were performed in particular with organisations involved in financing (providing loans), vessel owner representatives, OEMs, and sector experts. A number of interviews and consultations were carried out for this question with experts from the following organisations:

- ESO
- SCAT
- ELV
- Rabobank
- Koedood
- EBU
- Dolderman
- Kooiman

A questionnaire was developed which was used as a guide for the interviews. Furthermore, draft report versions were shared with experts with the request to validate and add information.

3. Characteristics of joint procurement

3.1 Why joint procurement?

Greening of the IWT sector requires the adaptation of new techniques. These techniques are generally characterized by higher CAPEX (and potentially lower OPEX). The higher CAPEX can be explained by their innovative character and their small-scale and therefore inefficient production.

3.1.1 Cost reduction

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 reducing the costs per unit. This can be the result of indirect cost reduction by, for instance, simply placing a larger order by a manufacturer or through indirect cost reduction through operational efficiencies. Furthermore, producers can purchase components from second-tier suppliers in larger quantities. These advantages can be significant when orders are large enough. In chapter 5, we will go deeper into the quantitative aspect of the benefits of economies of scale.

3.1.2 Stimulation of market development

Next to the goal of cost reduction, joint procurement can be used on a broader scale in the transition towards cleaning inland shipping through the stimulation of market development and innovation. By bundling market power in the form of demand, critical demand levels can be attained to attract manufacturers and suppliers to produce, supply or innovate in greening technologies. Due to larger orders, a supplier has the possibility to spend more funds on research and development and setting up new supply or production chains.

3.1.3 Stimulation of innovation

With the increase in market demand, new producers and suppliers will be attracted to the new greening technologies. This increased competition stimulates the entire supply chain to produce smarter and better, resulting in further innovations throughout the supply chain. These innovations will lower the cost and increase the quality of the product.

3.1.4 Potential for standardisation

By increasing the order size in the implementation of new technologies, there is a potential that this can lead to market standardisation. This could be specifically true for innovative techniques that require for instance standardisation between the vessel and the energy infrastructure. This standardisation can be facilitated by the creation of dedicated supply chains which also benefit and stimulate further production. Or the standardisation can be encouraged through external factors by, for example, using the same bunkering standard for greening technologies. In its turn, standardisation can lead to lower CAPEX.

3.2 Forms of joint procurement

There are many possibilities and forms in which joint procurement can be used. To select suitable types of joint procurement the involved stakeholders and the most applicable parameters for the IWT need to be identified. Based on joint procurement examples in different sectors and interviews, the following parameters are identified to be key for joint procurement within the IWT sector:

- Level of organization, from individual to centralized
- Ownership of vessels
- Responsibility for the procurement procedure
- Responsibility for finance
- Responsibility for maintenance

From these parameters, three scenarios of joint procurement are defined. These give a general insight into the possibilities of joint procurement. There are many alternatives possible between these different models where specific shifts can be made to suit the needs of specific parties for specific greening technologies. For the three scenario's we chose to make a distinction between the three classes of owners, namely individual vessel owners, vessel owners organized in cooperatives, and a Special Purpose Vehicle (SPV).

3.2.1 Joint procurement by independent vessel owners

In this joint procurement scenario, vessel owners join forces in order to put out an order for a larger number of vessels. The vessels will be build based on the specifications of the different vessel owners, however, the most benefits are attained when these specifications are as uniform as possible. The different owners have separate contracts with the shipbuilder and are separately responsible for arranging funding and maintenance contracts of the vessels.

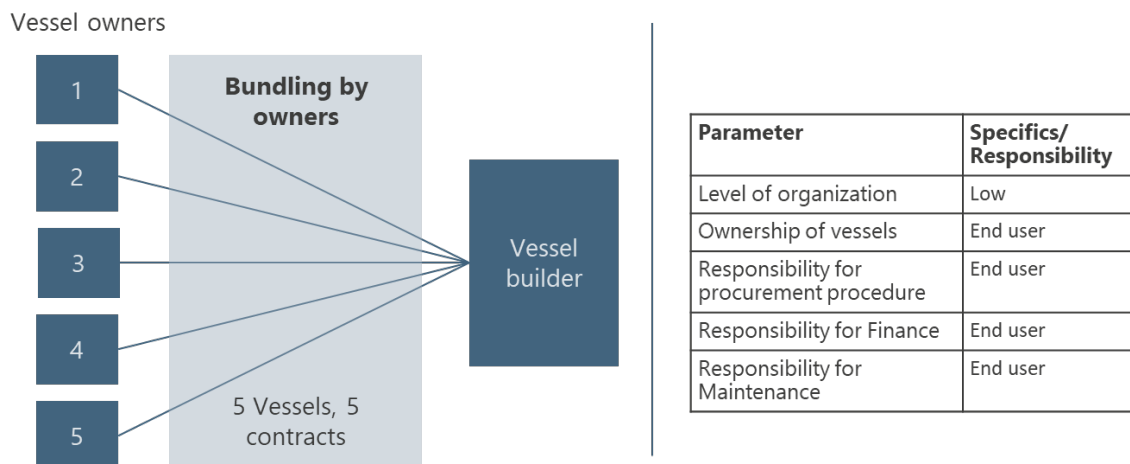


Figure E1: joint procurement by individual shipowners

3.2.2 Joint procurement by cooperatives

Cooperatives can play an important role in the bundling procurement of vessels. In this scenario, the shipowners will remain responsible for the final procurement contract, but the cooperative play an important role in managing the procurement.

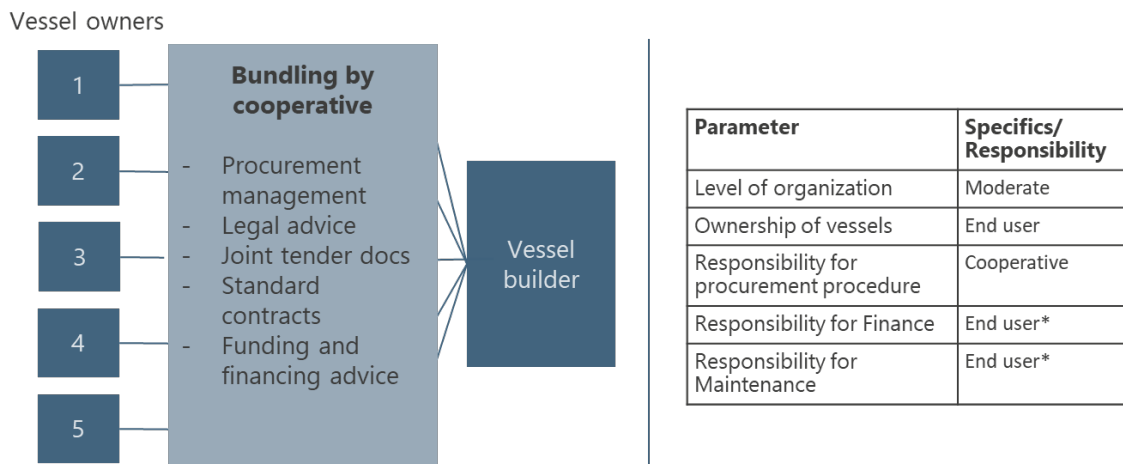


Figure E2: joint procurement by cooperatives.

* Although a stronger role for the cooperative can be possible by for instance bundling, combining, and negotiating finance and maintenance contracts for end-users, the vessel owners remain the responsible (and liable) party.

The cooperatives can, for instance, be responsible for the management of the procurement, drafting tender documents, drafting contracts, and provide advice on legal aspects, funding, and financing. If wanted by the vessel owners, the cooperatives could also play a role in keeping oversight during the construction period and act as an intermediate in case of any issues between shipbuilder and vessel owner. With the bundling of the organization, efficiency towards shipbuilders and more standardisation can be attained.

3.2.3 Joint procurement by Special Purpose Vehicle (SPV)

New greener vessels are expected to have a higher CAPEX and bring more business risk and uncertainty with them. The prospect of fully financing these investments and being responsible for all the risk concerned, might discourage vessel owners to make the transition. To limit these risks and uncertainties and eliminate the high CAPEX, a joint procurement scenario with a third party operated fleet owning entity can be initiated that leases vessels.

We refer to this entity as a Special Purpose Vehicle (SPV). The SPV acts as a vehicle for the investment, procurement, and maintenance of the vessels which takes all the risk from the previous vessel owners, now named 'end-users'. For this service end-users pay a monthly lease to the SPV and the vessels will be the property to the SPV. Through this, if an end-user is unable or unwilling to continue operating in the IWT sector, the SPV can lease out the vessel to another vessel operator. This process will keep green vessels in the market.

The main point for this scenario is the establishment of an SPV. The operator or manager of the SPV can be a financial party, which often already have established leasing offices. But also vessel operators/cooperatives or OEMs can be installed as managers of the SPV.

Through the SPV, current vessel owners need to concede ownership of the vessel and become end-users through financial or full operations lease contracts. This represents a very significant change in the business model for the current vessel owners, which take ownership and autonomy in high regard. Due to this significant change, this model might lead to a serious level of push back by vessel owners.

This type of joint procurement might also provide a good opportunity to integrate with the realization of new energy infrastructure. It will be difficult to secure the required minimal offtake

from individual shipowners for the realization of new energy infrastructure. With the SPV, end-users are bundled together with compatible vessels. With this joined market power, an agreement or possible collaboration between the infrastructure provider and the SPV will have a higher chance of a positive outcome.

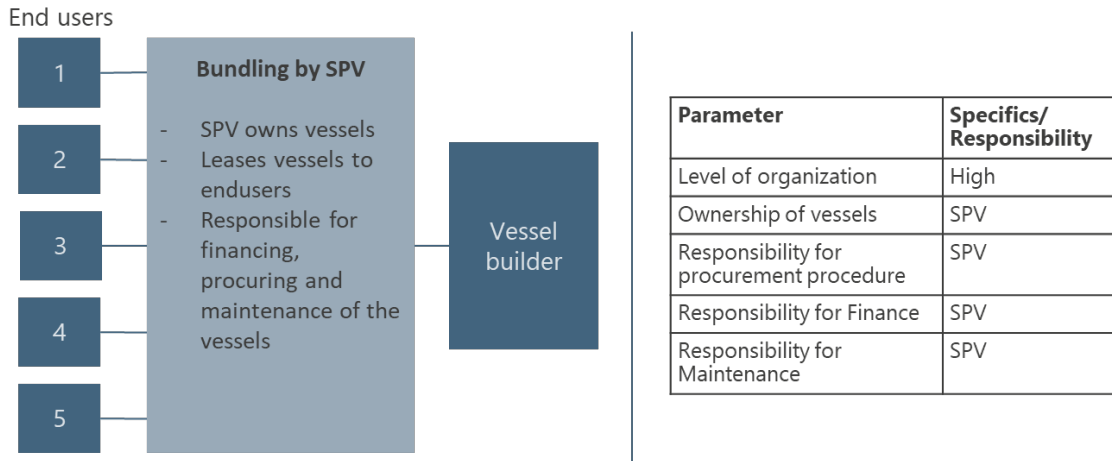


Figure E3: joint procurement by using an SPV

3.3 Critical success factors for joint procurement

Based on the desk study and our expert opinion, a number of critical success factors are drafted for joint procurement in the IWT. These critical success factors were discussed and further elaborated in the interviews performed in the scope of research question E.

1. Insights should be gained in the order size(s) that deliver the largest economies of scale.
2. A limited set of proven technologies should be . For vessel builders, every technique they have to invest in comes with large investments that have the risk of not being earned back. Therefore, joint procurement will not be very attractive for vessel builders if this means investing in a technique when market demand after this initial joint procurement is unsure or unlikely.
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 in parallel and/or conjunction of the joint procurement of vessels.
5. It is critical that vessel owners see the benefits of joint procurement and are therefore willing to give up some level of 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 numbers that the shipbuilders can find an optimum in increasing efficiency and purchasing power. However, only a limited of new vessels are built annually / undergo remotorization.

4. Analysis: drivers and barriers for joint procurement

The previous chapter describes joint-procurement, its potential benefits, scenarios of implementation, and the critical success factors to be successfully implemented. In this chapter, additional insight is given into the drivers and barriers for joint procurement. To this goal, first the need and implication for standardisation is discussed and secondly, a SWOT analysis is performed for the use of joint procurement in the IWT. Our analysis is based on a desk study complemented with interviews.

4.1 Standardisation of specifications are important to achieve benefits of scale

As is indicated in the previous chapter, the benefits of economies of scale are more easily achieved if specifications of vessels and/or component are similar or standardized. The larger the differences, the more customization is required for building a new vessel or retrofitting an existing vessel with a new engine.

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

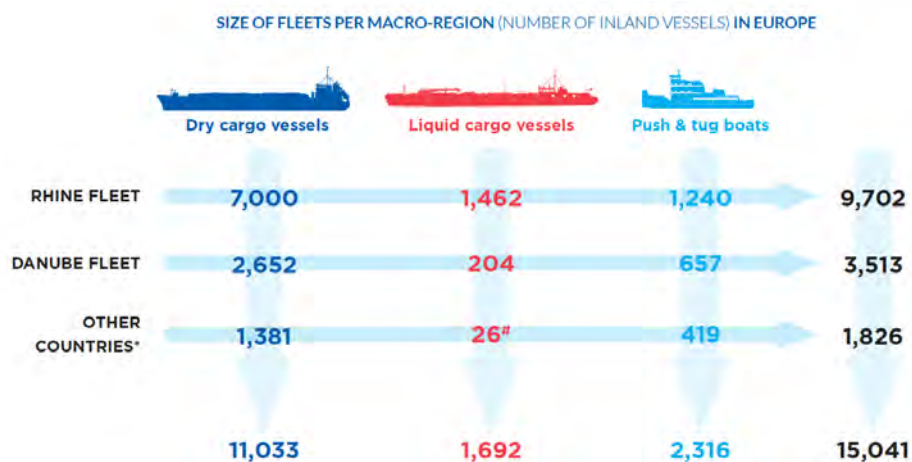


Figure E4: the size of fleets per macro-region in Europe, *Other countries = Poland, Czech Republic, Italy, United Kingdom, Lithuania. This figure comprises 9 tanker vessels in Poland, 1 in the Czech Republic and 16 in Lithuania. No data for the UK and Italy.

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

Within this fleet a large number of different vessel types and engine types are present. For instance, even though the Caterpillar 3500 series are popular in IWT we find these types of engines only in an estimated 1.200 vessels. There are also many other brands (ABC, Mitsubishi, Volvo Penta, Man, etc) and types commonly used. Moreover, even though engine rooms are

¹ Figure and data taken from Inland navigation in Europe, market observation 2019, CCNR

generally engineered with the same principles in mind, they tend to differ in size and configuration. In principle, it would be possible to fit an engine within every engine room (providing that the engine is not too big for the ship) re-motorisation generally requires welding and cutting to some extent.

The large number of vessel types and engines used within IWT makes standardisation difficult. This lack of standardisation will, in turn, hamper the cost efficiency effect of procurement in larger quantities since the benefits of buying, for instance, engines in larger numbers will be offset by the cost of additional customization of engine rooms.

Next to the engine room, it is important to note that the vessels are also often the homes of the shippers and their families. Therefore, personal preferences in the design and structure of different part of the vessel needs to be taken into account.

4.1.1 Fleet renewal and re-motorisation: small numbers per annum

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 figures E5 and E6 some insights are given in the total numbers of vessels that fall within one of these two categories each year.

NEWLY BUILT DRY CARGO VESSELS IN 2018 ACCORDING TO LOADING CAPACITY



Figure E5: newly built dry cargo vessels in 2018 according to loading capacity²

In 2018, a total number of 17 newly built dry cargo vessels were registered. As shown in figure E5, the loading capacity differs over four different categories.

NEWLY BUILT TANKER VESSELS IN 2019 ACCORDING TO LOADING CAPACITY



Figure E6: newly built tanker vessels in 2019 according to loading capacity³

In the same year, the total number of 28 newly built tanker vessels were registered. The division in loading capacity classes is visualised in figure E6.

² Source: Inland navigation in Europe, market observation 2019, CCNR

³ Source: Inland navigation in Europe, market observation 2019, CCNR

Next to newly built vessels, there is also a number of vessels that renew their engines every year. In 2017, 2018 and specifically 2019 there was a large peak in the amount of vessel remotorisations. This peak was caused by expected regulations for new engines in 2020, leading to a large number of new engines being installed just before the implementation of this new regulations. Due to this large peak in 2017, 2018 and 2019 it is expected that the number of new engines being deployed will be low (less than 100 per year) in the next decade.

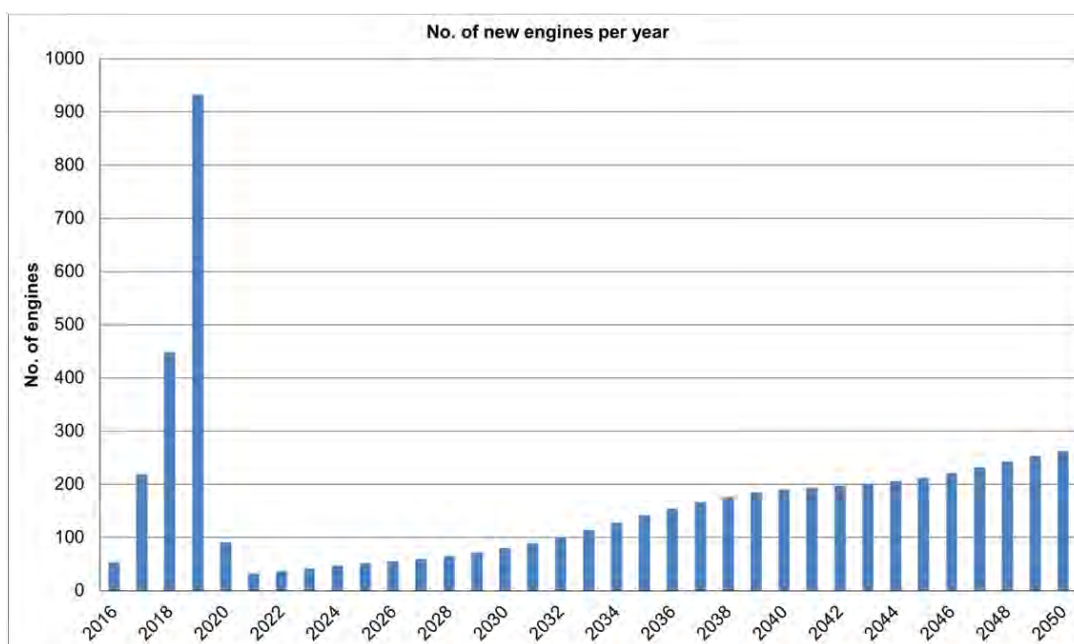


Figure E7: oversight of the number of vessels that are expected to renew their engines per annum⁴

Based on these numbers, it can be concluded that the market for newly-built vessels and re-motorisation is not extensive. When we combine these figures (a relatively small amount of new vessels and new motorisations as well as a large differentiation in the vessel and engine types), we can conclude that in terms of quantities the opportunities for joint procurement are not abundant.

4.1.2 Greening techniques: no definitive choices on greening techniques are made

In order to address drivers and barriers for joint procurement and also specifically the potential for economies of scale, it is important to define the specific techniques that are being considered for the greening of IWT.

Based on the results of research question C we limited the scope of our research to a number of techniques. These techniques are:

1. Stage V internal combustion engines (including marinized NRE and Euro VI engines);
2. Battery electric drivetrains (including hybrids that use generator sets based on internal combustion engines);

⁴ Data taken from 'Rapport inventarisatie milieuprestaties bestaande binnenvaartvloot West-Europa, eindrapport december 2015, STC-Nestra, Rebel and EICB.

3. Low-temperature proton exchange membrane fuel cell using compressed hydrogen and methanol as an energy carrier;
4. Hydrogen in internal combustion engines;
5. (Bio) Liquefied Natural Gas used in internal combustion engines;
6. Gas to Liquid / Hydrotreated Vegetable oil used in internal combustion engines.

More detailed information regarding these techniques and the potential and limitations of these techniques can be found in the research conducted under research question C.

The six techniques mentioned come with a number of different possibilities and limitations and are all in different levels of technical and economical readiness. This is a complicating factor, for vessel owners, for shipbuilders and for technology suppliers. From the perspective of vessel owners, the large number of potential future techniques makes it difficult to make a choice. Which techniques will be reliable and economically viable both in the (near) future? And how fast will the development of energy infrastructure go?

From the perspective of shipbuilders and technology suppliers a comparable situation exists. The development of techniques requires investments. These investments will generally only be done when there is a sufficient perspective of generating revenue with these investments. Therefore, builders and technology suppliers have to decide which technique or techniques they will invest in since it will be too costly to invest in all of them.

As long as there are too many techniques floating over the market, it will be difficult 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 for joint-procurement.

4.2 Interview results: SWOT analysis

To assess the drivers and barriers for joint procurement, a SWOT analysis is performed through a desk study and interviews with stakeholders. Within this analysis, the different aspects of joint procurement are described in terms of strengths, weaknesses, opportunities, and threats. Strengths and weaknesses are considered to be internal factors. This means that they, to some extent, can be influenced by the parties within the IWT sector. The opportunities and threats are considered to be external factors and fall in general outside the span of control of the parties within the IWT sector.

4.2.1 Strengths

The strengths of joint procurement are characteristics that give joint procurement an advantage over traditional forms of procurement. The predominant strengths are:

- Joint procurement increases the size of procurement batches and therefore decreases prices due to economies of scale;
- Joint procurement pushes the market to increase the rate of development;
- Joint procurement pushes the market to increase the innovation rate.
- By using a form of joint procurement that integrates both the procurement of vessels and the energy infrastructure, supply and demand can be coordinated;
- Knowledge and skills of cooperatives can be used to professionalize the procurement of vessels;

- Mortgage providers do not see issues with joint procurement since mortgages are being granted based on the business case and personal characteristics of the vessel owner.

4.2.2 Weaknesses

Following the strengths, joint procurement also has a number of weaknesses. These weaknesses are considered to be characteristics of joint procurement that place this type of procurement at a disadvantage related to the traditional form of procurement. Based on the interviews and the desk study, we come to the following overview of weaknesses.

- There is a lack of standardisation within the IWT sector, both in terms of engines as in terms of vessels. This lack in standardisation requires a lot of customization that has a negative impact on the costs of newly built vessels and specifically on re-motorization.
- Due to the long lifetime of vessels and the large differentiation of the fleet, it is difficult to find a group of vessel owners that is interested in investing in vessels with comparable specifications within a limited time frame.
- There has been a limited number of tries over the last decades to set up a form of joint procurement in the IWT-sector. However, these attempts have not led to success. This might cause a negative association with new attempts, resulting in a diminishing possibility of success;
- Joint procurement requires to some extent a restriction in the autonomy of vessel owners when procuring new vessels. Within the IWT sector, this autonomy is deeply rooted by vessel owners and will, therefore, require substantial benefits to be given up;

4.2.3 Opportunities

Opportunities are elements in the environment that could be used as an advantage to join procurement. Based on the interviews and the desk study, we come to the following overview of opportunities.

- Legislation concerning low or zero emission zones within inner-city zones is a subject that is emerging in more and more cities within Europe. Enforcing these low or zero emission zones for IWT might lead to a speed-up of the transition towards greener technologies within a very distinct geographical area. This could provide an excellent opportunity for joint procurement of low emission/ zero emission vessels;
- The realization of new energy infrastructure might provide an opportunity to using this infrastructure for other modes of transport leading to larger take-off volumes and therefore lower energy prices, improving the business case.

4.2.4 Threats

Threats are elements in the environment that could be used as a disadvantage to join procurement. Based on the interviews and the desk study, we come to the following overview of threats.

- Technical solutions for greening the fleet, specifically when aiming for true zero emission options, are not fully matured in terms of technical and economical readiness creating large uncertainties for vessel owners, technology suppliers, and shipbuilders. These uncertainties can lead to a 'wait and see' attitude;
- Fluctuations in energy prices and specifically (current) lower oil prices might lead to a better business case for traditional engines.
- There does not seem to be a willingness by customers to pay higher prices for more sustainable transport. This might lead to a decrease in competitiveness for greening techniques

4.3 Legal aspects

In 2015, STC-Nestra and Maverick conducted research commissioned by the Dutch ministry of infrastructure and the environment called 'Strengthening the market structure in the IWT sector'⁵. Within this research, a chapter was dedicated to the room that is provided in the European competition law for commercial partnerships in the IWT sector. In this chapter joint procurement by vessel owners is addressed. It is stated that in many cases joint procurement would lead to lower prices and/or a better quality of products or services. Not until the parties have considerable market power on the purchasing market the risk emerges that they can force the supplier to limit the assortment or quality of products that they offer that can lead to competition limiting effects (e.g. quality reduction, diminishing of innovation efforts or eventually a less than optimal market supply. When the parties that participate in the joint procurement also have significant market power on the sales market, the lower purchasing prices that can be achieved due to joint procurement shall probably not be passed on to the consumers. Significant market power is generally not assumed until a market share of 30 – 40 %. This will not be achieved easily within a joint procurement for IWT enterprises. Therefore, legal aspects are not considered to be a threat for joint procurement.

⁵ <http://www.nestra.net/download/Rapport%20oversterking%20marktstructuur%20binnenvaart%20-%20commerciele%20samenwerkingsverbanden%20-%20versie%205Maart15.pdf>

5. Benefits of economies of scale

As stated before, 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 the previous chapters, 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.

5.1 What are economies of scale?

In general, the term economies of scale refers to the cost advantage a company has due to a higher number of products produced. These advantages arise due to the fact that there is an inverse relationship between the costs per unit and the quantity produced. The greater the quantity of output produced, the lower the per-unit costs. This inverse relationship can be true for fixed costs, due to for instance buying in bulk of components. It can also result in a fall in average variable costs due to operational efficiencies and synergies as a result of an increase in the scale of production⁶.

5.2 What extend of economies of scale are expected?

In order gain insights in the expected economies of scale, a number of ship builders was questioned regarding their expectations on economies of scale.

5.2.1 Main points for economies of scale in the IWT

Based on the interviews with OEMs a number of critical concerns and success factors for economies of scale in the IWT sector were derived.

1. Engine companies like Caterpillar and Wartsila are large companies that sell large quantities of engines. In order to profit from the advantages of buying in bulk, orders have to be relatively large. Clustering the purchase of 10 or 20 engines is not expected to result in significant financial advantages;
2. Most of the zero emission and near zero emission techniques (other than techniques using drop-in fuels) are at the start of the innovation curve. Value chains are only just starting to develop and they are a long way from being mature. This makes it very difficult to estimate the building costs of these new types of vessels, let alone provide information on economies of scale for larger quantities in a more mature setting.
3. Economies of scale are expected to be more challenging to obtain for retrofitting of existing vessels than for building new vessels. This is caused by the fact that the level of standardisation in the existing fleet is very low. Every vessel is different, leading to a lot of customisation in every build.
4. Standardisation is important in order to achieve economies of scale. New zero emission or near zero emission techniques might lead to standardisation but at this moment it is unclear which technologies will be dominant in 2050.

5.2.2 Economies of scale estimated to be between 1 and 5%

Currently, OEMs are unable to give a clear indication of the expected benefits of economies of scale due to the high uncertainty in terms of order sizes and the development of greening technologies.

⁶ <https://corporatefinanceinstitute.com/resources/knowledge/economics/economies-of-scale/>

OEMs expect the cost reduction of economies of scale for joint procurement in the IWT to be in the range of 1% and 5%. This is the expected range for joint procurement of a range of 10 – 20 vessels. This might not seem as a large number of vessels, but regarding the current situation in the IWT sector this level of aggregation is already considered to be a significant challenge.

6. Conclusions

In this chapter, we will answer the main research question based on answers of the three sub-research questions.

6.1 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 following the 5 parameters (level of organization, ownership of vessels, responsibility for the procurement procedure, responsibility for financing, and responsibility for maintenance).

Based on the desk study, our expert opinion, and interviews with stakeholders, we found that joint procurement is possible. However, the following critical success factors are drafted 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 can find an optimum in increasing efficiency and purchasing power. However, only a limited of new vessels are built annually / undergo remotorization.

6.2 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 numbers 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 built in 2018.

In this research, the scope of greening techniques is limited to the 6 techniques following research question C. These six techniques mentioned 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 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 is performed through a desk study and interviews with stakeholders.

Strengths

- Joint procurement increases the size of procurement batches and therefore decreases prices due to economies of scale;
- Joint procurement pushes the market to increase the rate of development;
- Joint procurement pushes the market to increase the innovation rate.
- By using a form of joint procurement that integrates both the procurement of vessels and the energy infrastructure, supply and demand can be coordinated;
- Knowledge and skills of cooperatives can be used to professionalize the procurement of vessels;
- Mortgage providers do not see issues with joint procurement since mortgages are being granted based on the business case and personal characteristics of the vessel owner.

Weaknesses

- There is a lack of standardisation within the IWT sector, both in terms of engines as in terms of vessels. This lack in standardisation requires a lot of customization that has a negative impact on the costs of newly built vessels and specifically on re-motorization.
- Due to the long lifetime of vessels and the large differentiation of the fleet, it is difficult to find a group of vessel owners that is interested in investing in vessels with comparable specifications within a limited time frame.
- There has been a limited number of tries over the last decades to set up a form of joint procurement in the IWT-sector. However, these attempts have not led to success. This might cause a negative association with new attempts, resulting in a diminishing possibility of success;
- Joint procurement requires to some extent a restriction in the autonomy of vessel owners when procuring new vessels. Within the IWT sector, this autonomy is deeply rooted by vessel owners and will, therefore, require substantial benefits to be given up;

Opportunities

- Legislation concerning low or zero emission zones within inner-city zones is a subject that is emerging in more and more cities within Europe. Enforcing these low or zero emission zones for IWT might lead to a speed-up of the transition towards greener technologies within a very distinct geographical area. This could provide an excellent opportunity for joint procurement of low emission/ zero emission vessels;

- The realization of new energy infrastructure might provide an opportunity to using this infrastructure for other modes of transport leading to larger take-off volumes and therefore lower energy prices, improving the business case.

Threats

- Technical solutions for greening the fleet, specifically when aiming for true zero emission options, are not fully matured in terms of technical and economical readiness creating large uncertainties for vessel owners, technology suppliers, and shipbuilders. These uncertainties can lead to a 'wait and see' attitude;
- Fluctuations in energy prices and specifically (current) lower oil prices might lead to a better business case for traditional engines.
- There does not seem to be a willingness by customers to pay higher prices for more sustainable transport. This might lead to a decrease in competitiveness for greening techniques

Finally, based on a previous study of STC-Nestra and Maverick in 2015, we determine that legal aspects are not considered to be a barrier or threat for joint procurement.

6.3 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 of 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 this moment, 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 estimation. 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 or near zero emission techniques at this moment in time.

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)

Imprint: July 2021

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

