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EU Strategy for the Danube Region

Priority Area 1a – To improve mobility and multimodality: Inland waterways

Policy recommendation on fleet modernization: Discussion paper

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Version (date):

9th June 2021

EUROPEAN UNION
European Regional Development Fund

Federal Ministry
Republic of Austria
Climate Action, Environment, Energy, Mobility, Innovation and Technology

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MINISTRY OF TRANSPORT, INFRASTRUCTURE AND COMMUNICATIONS

Contents

1 Greening the inland fleet – Background

Inland waterway transport has been the most environmentally friendly mode of inland transport for decades, and in terms of transported volumes (emissions per tonne-kilometres) it still is. However, this advantage has steadily been eroding due to the rapid improvement of emission levels in other transport modes and the low modernisation rate of the inland fleet. There is an urgent need and at the same time significant potential for the inland waterway transport sector to reduce greenhouse gas and air pollutant emissions, in particular with regard to existing vessels.

PA1a published a first Strategy on fleet modernisation in December 2019. The present document builds on this strategy by elaborating two promising policy recommendations, namely the **creation of national aid schemes** and the **development of a strategic research agenda** including technology pathways. This elaboration is thereby mainly based on results from in-depth analyses and relevant reports published after December 2019. These primarily include the model state aid scheme developed by the GRENDEL project (November 2020) and the Strategic Research and Innovation Agenda (SRIA) for the Partnership on Zero-Emission Waterborne Transport (WATERBORNE, June 2021) and studies initiated by the CCNR.

The present recommendations are addressed to the public entities of the Danube riparian states and aim to provide guidance on possible short- and long-term measures to improve the environmental and economic performance of the Danube fleet.

Political and regulatory framework of fleet modernisation

In recent years the political objectives and legislation regarding emissions in the transport sector have become increasingly ambitious and stringent. The goal is no longer merely to reduce air pollutant emissions, in particular nitrogen oxides (NO_x) and particulate matter (PM), which have been the focus of political discussion for many years, but also to reduce greenhouse gases (CO_2), which have increasingly come into focus in recent times.

The UN Sustainable Development Goals and the COP21 objectives (Paris Climate Conference, December 2015) require action by all to reduce emissions of greenhouse gases and pollutants. This includes the transport sector and thus also the inland waterway industry. At the European level, the European Commission's “Green Deal for Europe” sets the clear and ambitious goal of achieving climate neutrality by 2050, including in the transport sector.

These challenging targets are also reflected by more stringent legal emission norms for the inland fleet. The publication of Directive 2009/30/EC, according to which sulphur-free fuel is mandatory since 2011, laid a foundation for the improvement of the environmental performance of inland navigation. Other regulations relating to the usage of fuel are the Clean

Fuels Directive 2014/94/EC and the Renewable Energy Directive 2009/28/EC, which foresee the deployment of (shore-side) infrastructure for alternative fuels (e.g. LNG) as well as electricity and promote the use of energy from renewable sources, respectively.

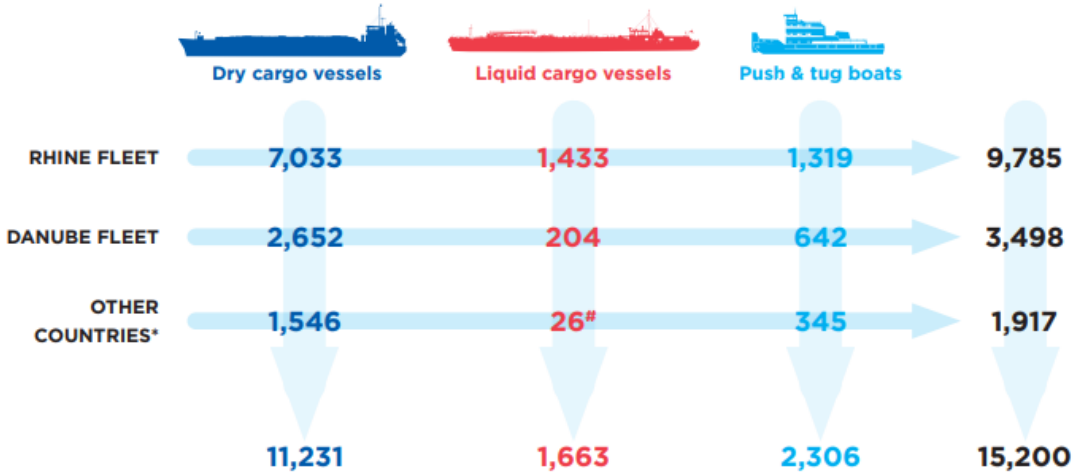
In 2016 the European Parliament and the Council adopted the Regulation on requirements relating to pollutant emission limits for non-road mobile machinery (Regulation (EU) 2016/1628, “NRMM Regulation”). The provisions of the NRMM Regulation define stringent emission limits for engines for different power ranges and applications. They also lay down the procedures engine manufacturers have to follow in order to obtain type-approval of their engines – which is a prerequisite for placing the engines on the EU market.

The so-called Stage V emission standard of the NRMM Regulation includes limit values for emissions of carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x) and ultrafine particulate pollutants (PM). However, the NRMM Regulation has only a limited effect on the modernisation of the European inland navigation fleet, as these standards only apply to newly built inland vessels operated in the European Union as well as to vessel engines that are exchanged. The existing – the so-called legacy – fleet as well as revised engines are not affected by the regulation.

It is clear that inland navigation must also make the transition to zero emissions and that the current emission limits will not be the last, but that the limits will also be adjusted in the future. With a business-as-usual scenario or by extrapolating current developments, the current political goals regarding emission-free inland navigation cannot be achieved. A combination of different policy, regulatory and financial instruments as well as further research and development on new technologies is necessary to maintain the traditional environmental advantages of inland navigation and its environmentally friendly position compared to road transport.

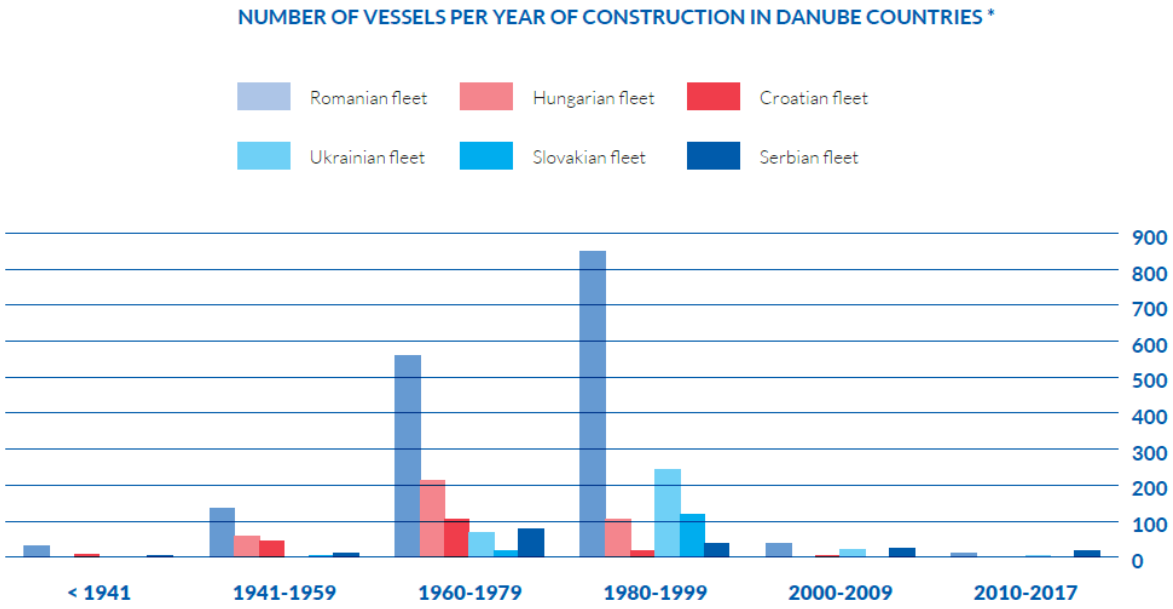
Challenges for the Danube fleet

The Market Observation Report by the CCNR (2020) contains an overview of the structure and size of the European inland fleet. The figure below shows the number of dry and liquid cargo vessels (self-propelled vessels and barges) and the number of push and tug boats per macro-region in Europe. The Danube fleet is about one-third the size of the Rhine fleet.



Source: CCNR (2020), data on Danube fleet from Danube Commission

The European inland fleets also differ in terms of their age. The Danube fleet contains a high number of rather old vessels. 62 percent of the Danube fleet was built between 1971 and 1990 (viadonau, 2019). The average age of all cargo units was 41 years in 2018 and since the year 2000 not many new cargo vessels were built for the Danube (viadonau, 2019). The picture for passenger vessels is completely different: In 2017, the average age of the 170 active cruising vessels on the Danube (capacity of 28,100 passengers in total) was 10 years, whereby around nine new vessels entered service every year over the last few years (viadonau, 2019). The severe economic impacts of the COVID-19 crisis on passenger transport is however expected to have a dampening effect on the modernisation rate in the cruising sector.



Source: CCNR (2019), data on Danube fleet from Danube Commission
**included are dry and liquid cargo vessels as well as push and tug boats*

Inland navigation vessels as well as their engines are very durable and engines are usually replaced several times during the vessel's service life. The average age of a ship's engine before its replacement is around 15 to 20 years. Compared to the average service life-time of truck engines, which is five to ten years, it becomes obvious that it will automatically take much longer to fulfil more stringent emission standards in inland navigation than in the road sector (viadonau, 2019). Only very few new-built vessels have been put in operation in the Danube region in the last 20 years and modernisation as well as greening measures have been implemented only to a limited extent. Currently, the majority of inland waterway vessels operates with CCNR stage II engines (from year 2007), with CCNR stage I engines (2003-2007) or even unregulated engines (before 2003).

Generally speaking, the shipping community is aware of and committed to achieving full decarbonisation or zero-emission of inland waterway transport by 2050 (WATERBORNE, 2019a). The challenges are clear and the long-term objectives are shared among both policy makers and the industry sector. However, the required actions to achieve these objectives in the short- and the long-term are subject to discussion.

The following recommendations describe measures that should lead to an effective increased modernisation of the fleet in the short- and the long-term.

2 Résumé of PA1a fleet modernisation strategy 2019

The PA1a fleet modernisation strategy of 2019 started with an analysis of underlying issues causing a slow modernisation rate of the Danube fleet. The main issues identified included:

- Long economic life-time of inland vessels and engines
- High investment costs and a lack of business cases
- Small and specific market for inland vessels and engines
- Lack of investment capital
- Emission regulations not affecting legacy fleet
- Incomplete alternative fuelling infrastructure

Based on this analysis of key issues a list of possible instruments was provided, whereby the transition to a significantly greener Danube fleet requires the application of a combination of different instruments. The main categories of instruments were:

- Policy and regulatory instruments (e.g. clear and ambitious emission target setting)
- Financial instruments (e.g. national grant schemes)
- Research and development (e.g. creation of strategic research agenda)

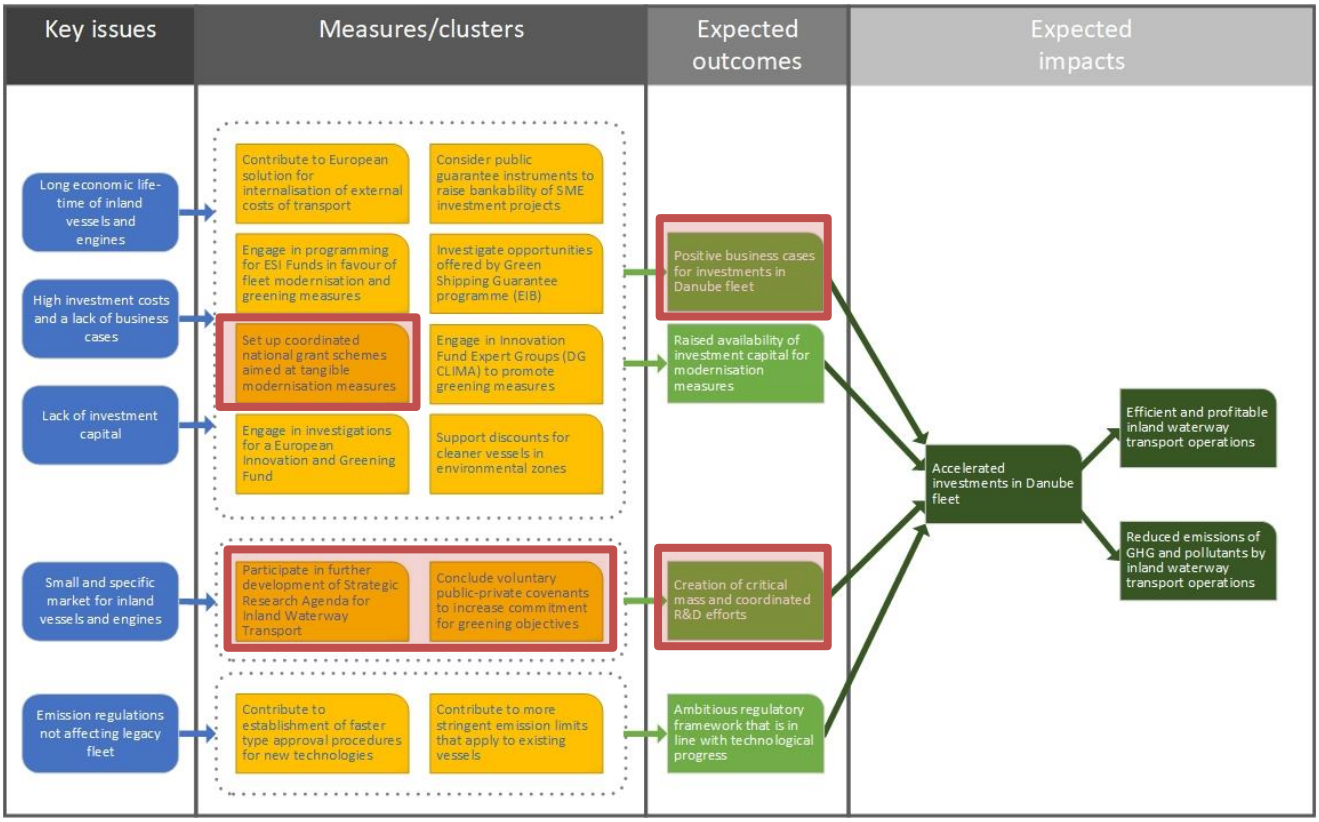


Figure 1: PA1a Fleet modernisation strategy – focus of this report

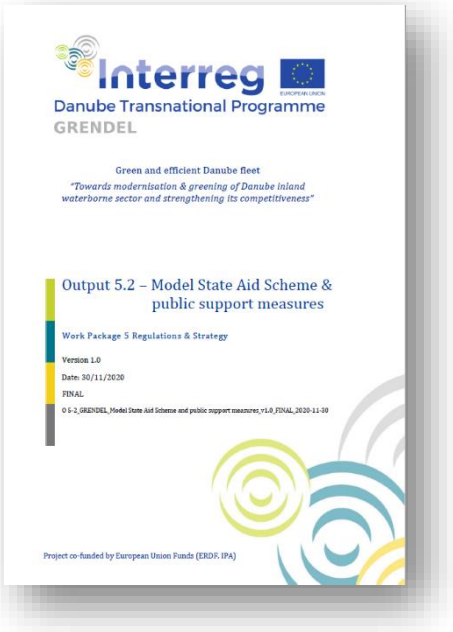
Since December 2019 two strands of action have been elaborated in detail by the GRENDEL project and the WATERBORNE technology platform respectively:

- The creation of national aid schemes (contributing to positive business cases for investments in the Danube fleet) in the framework of the GRENDEL project (2020b); as well as
- the development of strategic research agendas including technology pathways (creating critical mass and investment security for both vessel operators and equipment manufacturers) in the framework of the Strategic Research and Innovation Agenda (SRIA) for the Partnership on Zero-Emission Waterborne Transport (WATERBORNE, 2021).

The results of these initiatives (annexed to this document) will be briefly summarised in this document. The status quo as well as the way forward regarding the implementation of these two fields of action in the Danube Region will be inquired in the framework of the PA1a Steering Group.

3 Results of GRENDEL project: model state aid scheme

The GRENDEL project ("Green and efficient Danube Fleet", INTERREG Danube Transnational Programme, 06/2018-11/2020) aimed at improving the environmental and economic performance of the Danube fleet, among others through the development of a more favourable regulatory framework as well as public support measures by introducing a model state aid scheme. The resulting model state aid serves as a guideline for Danube riparian countries to efficiently set up state aid schemes for fleet modernisation according to their national needs.



As most greening measures involve high investment costs and at the same time the re-investment capacity of Danube fleet operators is rather low compared to Western European fleet operators, it is necessary to create a business case for ship owners and to support their investments in greening technologies. National funding schemes are short-term measures that can provide targeted incentives for the Danube fleet operators to improve the environmental performance of their vessels. This model integrated investment priorities of the Danube inland waterway transport sector and results of exchanges with the European Commission (DG COMPETITION) and with representatives of public bodies of Danube States (GRENDEL, 2020a).

Overview of GRENDEL model state aid scheme

The model state aid scheme covers the five most important aspects of fleet modernisation:

- Priority 1 Improving environmental performance
- Priority 2 Better integration of IWT into logistic chains to increase multimodality of freight transport
- Priority 3 Modernisation of vessels leading to increased safety of inland water transport
- Priority 4 Renewal of actors in the sector
- Priority 5 Promote the emergence of innovative solutions

The model state aid scheme is conceived as a modular tool box, with building blocks that would need to be selected and/or adapted according to the specific national needs. It should ease

the setup of such national programmes especially for the multiannual financing period 2021-2027. Formal steps required for the actual implementation of the programme (notably impact assessments, possibly notification procedures) will obviously still need to be taken by the Member States concerned, but the GRENDEL model state aid scheme saves a whole range of preparatory activities by providing a menu with different elaborated options.

The GRENDEL model state aid scheme systematically lists which measures could potentially fall under the definitions of the General block exemption Regulation (GBER) and which normally require regular notification procedures.

Measures[16]	Framework
Priority 1. Improving environmental performance	
1.1. Acquisition (purchase and replacement) of lower emission engines	Article 36[17] GBER
1.2. Measures to reduce air pollutant emissions (other than through lower emission engines)	Article 36 GBER
1.3. Measures to improve energy efficiency and optimise energy management on board	Articles 38[18] and 41[19] GBER
1.4. Measures to reduce noise emissions	Article 36 GBER
1.5. Measures to reduce and treat releases to water or waste	Article 36 GBER
1.6. Adapt vessels to improve their energy/fuel consumption performance through improved hydrodynamics	Article 38 GBER
1.7 Promotion of education and training in inland navigation	Article 31[20] GBER
Priority 2. Better integration of inland water transport into logistic chains to increase multimodality of freight transport	
2.1. Adaptation of vessels to attract new traffic or freight or perpetuate existing traffic or freight	Notification
2.2. Construction or acquisition of vessels to attract new traffic or freight	Notification
2.3. Construction or adaptation of vessels to serve maritime ports	Notification
2.4. Acquisition of instruments and software to help the navigation or operation of vessels/fleet	Notification
Priority 3. Modernisation of vessels leading to increased safety of inland water transport	
3.1. Measures to adapt equipment used for manoeuvring of inland vessel and related indicating and monitoring devices	Notification
3.2. Measures addressing vessel's safety equipment and fire protection systems	Notification
3.3. Measures addressing safety at work stations and crew safety	Notification
3.4 Measures addressing other safety related issues	Notification
Priority 4. Renewal of actors in the sector	
4.1 Acquisition of first vessel for new inland waterborne transport companies and new entrants	Notification
Priority 5. Promote the emergence of innovative solutions	
5.1 Development of innovative solution and experimentation with innovations	Articles 25[21] and 49[22] GBER

Figure 2: Overview of measures and possible applicability of GBER (GRENDEL, 2020a)

As state aid has the potential to distort competition on the common market and even affect trade between member states, it is in principle prohibited according to the Treaty on the Functioning of the European Union (TFEU, Article 107(1)). Generally speaking, state aid may also not be granted for investments needed to ensure compliance with EU standards. Given

the age of the Danube fleet, there are a number of vessels currently operating with a CCNR II, CCNR I or even an unregulated engine whose engines will need to be replaced in the coming years until 2030. Such replaced engines would have to comply with the Stage V standard and represent a significant investment. As state aid cannot be granted for investments necessary to meet current EU standards, fleet operators can only be financially supported if their timely investments in propulsion or after-treatment systems create a pre-emptive effect and meet current EU standards even though they are not (yet) required to do so. Thus, the primary target group for national funding schemes are those ship owners that would have to convert their engines to Stage V in the next few years and for whom a timely conversion would have a certain preferential effect.

By means of exemption to this general rule, the GBER allows to grant state aid without the need for notification to the European Commission, provided that conditions are fulfilled. Categories of aid that are exempted from the notification requirement and that could be used in the context of Danube fleet modernisation schemes include aids for research and development and innovation, environmental protection, training measures (valid until 31st December 2023). Only if higher funding rates than those foreseen in the GBER (40-60% of additional investment cost) are considered, the respective priorities/measures will also need to be notified. The measures listed under the priorities 2, 3, 4 are generally part of a notification process.

The GRENDEL consortium expects that most state aid schemes in the Danube Region could be financed from the Cohesion Policy funds, under the European Structural and Investment Funds (ESIF). In order to achieve this, the key topics of the state aid programme to promote innovation of inland waterway vessels in the Danube region should be also embedded into the respective Operational Programmes for EU Structural Funds. The latter funds qualify as state aid as they are managed and controlled by the Member States. 65% to 85% of ERDF and Cohesion Fund resources will be allocated to two priorities of the Cohesion Policy 2021-2027, namely “a Smarter Europe” and “a Greener Europe” (GRENDEL, 2020a).

Status of implementation in Danube countries

Towards the end of the GRENDEL project, the consortium made an analysis of the uptake of the project’s results by Member States. This implementation status of the measures varied from country to country (see Figure 3).

General overview of the supported measures as proposed by the GRENDEL State Aid Scheme for Fleet Modernisation	
Priority 1. Improving environmental performance	
1.1 Acquisition (purchase or replacement) of lower emission engines	**D, SK, HR**
1.2 Measures to reduce air pollutant emmissions (other than through low emmission engines)	**D, SK, HR**
1.3 Measures to improve energy efficiency and optimise energy management on board	**D, SK, HR**
1.4 Measures to reduce noise emmissions	**D, SK, HR**
1.5 Measures to reduce and treat releases to water or waste	**HR**
1.6. Adapt vessels to improve their energy/fuel consumption performance through improved hydrodynamics	**D, HR**
1.7 Promotion of education and training in inland navigation	**HR**
Priority 2. Better integration of inland water transport into logistic chains to increase multimodality of freight transport	
2.1. Adaptation of vessels to attract new traffic or freight or perpetuate existing traffic or freight	**HR**
2.2. Construction or acquisition of vessels to attract new traffic or freight	**HR**
2.3. Construction or adaptation of vessels to serve maritime ports	
2.4. Acquisition of instruments and software to help the navigation or operation of vessels / fleet	**D,HR**
Priority 3. Modernisation of vessels leading to increased safety of inland water transport	
3.1. Measures to adapt equipment used for manoeuvring of inland vessel and related indicating and monitoring devices	**D**
3.2. Measures addressing vessel's safety equipment and fire protection systems	**D**
3.3. Measures addressing safety at work stations and crew safety	
3.4 Measures addressing other safety related issues	**D**
Priority 4. Renewal of actors in the sector	
4.1 Acquisition of first vessel for new inland waterborne transport companies and new entrants	**HR**
Priority 5. Promote the emergence of innovative solutions	
5.1 Development of innovative solution and experimentation with innovations	**D**

Figure 3: Uptake of GRENDEL results (status November 2020) (GRENDEL, 2020b)

According to this analysis, Germany would be most advanced in terms of available financial instruments to support fleet modernisation. Furthermore, preparations to support other fleet modernisation aspects (e.g. fleet safety measures, integration into logistics chains) would be ongoing. Concrete fleet modernisation activities in Slovakia and Croatia were also reported, especially when it comes to the improvement of environmental performance of the fleet. Croatia would also cover topics to boost the efficient integration into logistics chains and the renewal of actors of the sector. Austria is presently preparing a state aid scheme for greening and fleet modernisation, based on the Model State Aid Scheme as proposed by GRENDEL and experiences gained from Dutch and German programmes.

Further noticeable is the fact that the Bulgarian partner (BRCCI) has prepared a draft based on the model state aid scheme that is adapted to the specific needs of Bulgaria. The information received so far is that there might be funding available for issues covering human resources and safety issues.

The Czech Republic currently operates a state aid scheme for fleet modernisation and greening financed via the Cohesion Fund. Eligible items include among other thing engine renewal, remodelling the stern of vessels and modernisation of propulsion equipment. The aid intensity is maximum 75% for medium-sized companies and 85% for small companies. The programme contains 16 mln Euro budget until the end of 2021 (EICB et al., 2020).

Questions to PA1a Steering Group:

1. *To what extent have fleet modernisation and greening measures been anchored in Operational Programmes for EU Structural Funds or in other facilities such as the Recovery and Resilience Facility so far?*
2. *What is the current status of concrete fleet modernisation measures and programmes in your country? - Are any programmes in preparation or are they being implemented already?*
3. *What are the priority topics in these programmes?*

Example of Dutch programme

The Dutch state aid scheme "Temporary subsidy instrument for greening the inland fleet 2021-2025 ("Tijdelijke subsidieregeling verduurzaming binnenvaartschepen 2021–2025") is an example of a focused and pragmatic state aid scheme falling under the GBER. The range of eligible topics is confined to:

a. purchase and installation of an engine of type IWP, IWA or NRE, as referred to in the NRMM Regulation, or of an engine recognized as equivalent on the basis of that Regulation;
b. purchase and installation of an SCR catalytic converter for the engine already installed, insofar as this leads to a reduction in nitrogen oxide emissions by at least 60% of the standard set for an engine of comparable power with a CCR2 type-approval inspection;
c. purchase and installation of an electric drive engine; the purchase and installation of an electric drive engine is only eligible for subsidy if the electricity is generated by a battery or fuel cell or if the combustion engine can be easily replaced by a battery or fuel cell;
d. having a report drawn up by a recognized certification company.

The subsidy amounts to a maximum of 40% of the total investment costs up to a maximum of € 200,000 per vessel. In accordance with Article 36(7) of the GBER, the aid intensity can be increased by 10 percentage points for subsidies to medium-sized enterprises and by 20 percentage points for subsidies to small enterprises.

This example could also be used as a template for a state aid programme that could be implemented at relatively short notice under GBER conditions, provided that national budgets are secured already. The relatively low subsidy rates in the range of 40-60% on additional investment costs could however limit effectiveness of the programme.

In the Dutch programme air pollutant emissions (nitrogen oxides (NOx) and particulate matter (PM) are tackled by funding modern after-treatment systems. The bigger challenge, namely the reduction of greenhouse gas emissions (such as CO2), could generally be tackled by energy-saving measures such as installing driving support systems, improved traffic management and improved integration of inland navigation in logistics chains and/or by making

use of alternative energy sources and zero-emission propulsion technologies as an alternative to diesel. To ensure that the subsidies provided are actually claimed by vessel owners, a focus on relatively low-cost technologies that have a high environmental impact is recommended. Investments such as catalytic converters and particulate filters or new engines are a pragmatic approach.

Questions to PA1a Steering Group:

4. *Would a state aid programme such as the Dutch programme be an option for your country?*
5. *If not, what would be main barriers for implementation of such a programme in your country?*

4 Strategic Research Agendas and technology pathways

Although technology is constantly evolving and it is still too early to decide on one or more technologies that will ensure zero-emission transport in the long-term, there are several technologies and potential funding items whose use could have a significant impact on the vision to reach zero-emission navigation by 2050. The general insecurity as to which technologies will ultimately prevail creates a catch-22 situation: IWT entrepreneurs will be hesitant to invest in new and unproven innovations and equipment developers are reluctant to pursue innovations for a small market. Because no critical mass for innovations is emerging by itself, innovations either are not developed at all or – lacking economies of scale - remain too expensive to be attractive for IWT entrepreneurs.

One way to get out of this dilemma is to (publicly) finance research & development to overcome inhibitive development costs and risks for individual organisations. Another way is to contribute to Strategic Research Agendas including technology pathways, which shall provide a likely scenario and evolution process of emerging and prevailing technologies. A technology pathway maps the different technologies on a future timeline and contains – subject to uncertainties – information about their current and future cost and performance.

Summary of WATERBORNE Strategic Innovation and Research Agenda (SRIA)

The general objective of the Partnership on zero-emission waterborne transport is to provide and demonstrate zero-emission solutions for all main ship types and services before 2030, which will enable zero-emission waterborne transport before 2050. The largest share of the recently published Strategic Innovation and Research Agenda focuses on seagoing vessels, but greening technologies and innovations for inland vessels are also addressed. Comparably, inland waterway transport would thereby offer opportunities to more easily demonstrate innovative technologies (WATERBORNE, 2021).

According to the SRIA on zero-emission waterborne transport, the most promising modernisation approaches in inland waterway transport would be focused on **retrofitting** (e.g.

engine modifications, replacement of the entire propulsion system to battery electric or fuel cells), and usage of so called **drop-in bio-fuels**, such as HVO (Hydrotreated Vegetable Oil) and Bio-LNG (Liquefied Natural Gas). Furthermore, it is stated that newly built vessels could benefit from energy efficiency measures such as large diameter propellers, optimised hull design, air lubrication, as well as use of hydrogen. **Electrification** of the fleet is considered to be the most promising solution especially for inland vessels operating in a shorter range. The use of exchangeable battery packs could thereby be a feasible option (WATERBORNE, 2021).

Summary of Study "Assessment of technologies in view of zero-emission IWT"

A further study, commissioned by the CCNR, by DST also identified promising innovations and technologies for different classes and operational profiles of inland vessels ("fleet families") (DST, 2020). The fleet families that had originally been developed in the H2020 project PROMINENT are following:

- Motor cargo vessels (MCV) longer than 110 m
- Motor tankers (MT) longer than 110 m
- Motor cargo vessels (MCV) length 80-109 m
- Motor tankers (MT) cargo length 80-109 m
- Motor vessels (MV) < 80 m
- Push boats with propulsion power P4 < 500 kW
- Push boats with 500 < P < 2000 kW
- Push boats with propulsion power P > 2000 kW
- Coupled convoys
- Ferries
- Large cabin vessels (longer than 86 m)
- Day-trip and small cabin vessels (shorter than 86 m)

Given the different technical characteristics and the different operational profiles, there is no "one-size-fits-all" greening solution for all of the different fleet families. Innovation pathways will have to be differentiated according to their specific characteristics.

The same DST study (2020) also assessed the most promising technologies with regard to their zero-emission potential. Following technologies/fuels would be the main contributors towards reaching the zero-emission ambition by 2050:

- Hydrotreated Vegetable Oil (HVO) as a drop-in biofuel
- Liquefied Bio Methanol (LBM) as the more sustainable alternative to LNG
- Battery-electric systems especially for short-distance transportation (either fixed batteries or exchangeable battery systems)
- Hydrogen fuel cell (H2 FC) which could be widely applicable to almost nearly all fleet families.
- Hydrogen for classic internal combustion engine (H2 ICE) possibly in combination with SCR after treatment to reduce NOx
- Hydrogen fuel cell that extract hydrogen from methanol (MeOH FC)
- Methanol as fuel in classical internal combustion engine (MeOH ICE) possibly in combination with SCR after treatment to reduce NOx

Some of the techniques/fuel would have a 100% reduction potential for CO2, NOx and particulate matter (PM) compared to classic CCNR 2 engine (e.g. batteries, hydrogen in fuel cells, bio-methanol in fuel cells).

Summary of draft CCNR study on energy transition towards zero-emission emission in the inland navigation sector

The Central Commission for the Navigation of the Rhine (CCNR) is currently preparing a study on energy transition towards zero-emission in the inland navigation sector. Please note that the final report of this study will be published on 10th July 2021. In this section, therefore, we have briefly summarised the draft conclusions of this report, in order to pre-validate them with the PA1a Steering Group. For a full and final version of the report, please refer to the CCNR after 10th July 2021.

In the draft study, two transition pathways have been developed to reach the 2050 objective (reduction of greenhouse gas emissions by 90% by 2050 compared to 2015): a conservative and an innovative technology pathway.

- **Conservative pathway**: mainly applying drop-in fuels such as Hydrotreated Vegetable Oil (HVO) / biodiesel in conventional diesel engines or Liquefied Bio-Methanol (LBM) in gas engines.
- **Innovative pathway**: with a lower share of conventional internal combustion engines across the fleet families and a higher share of techniques that are partly still under development, such as fuel cells and battery-electric propulsion systems.

The draft conservative pathway resulting from the analysis is depicted in Figure 4.

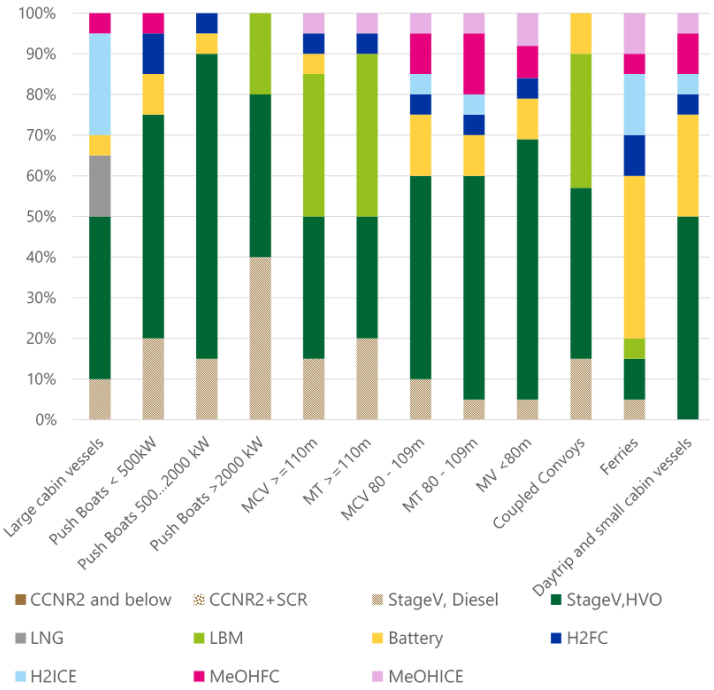


Figure 4: Fuels and techniques per fleet family in the conservative pathway in 2050
(source: draft CCNR study on energy transition towards a zero-emission)

In this conservative scenario, HVO and LBM would have a relatively high share in the fleet families that have high engine powers installed and that are operating on medium/long distances. Batteries would be less suited for these types of inland vessels and their fleet families. Emission reduction in this pathway for the main emission types analysed (CO2, NOx, PM) would at least reach 90% in this conservative pathway.

The draft innovative pathway (see Figure 5 below) would yield similar or even better emission reduction levels up to 91% reduction, but through the application of more innovative techniques and fuels across the different fleet families. Figure 5 shows that the mix of technologies focuses on battery-electric propulsion as well as hydrogen and methanol (both in fuel cells and internal combustion engines). Further development for these techniques/fuels would be needed to raise the Technology Readiness Level (TRL) and to reduce investment/operational costs in the long run.

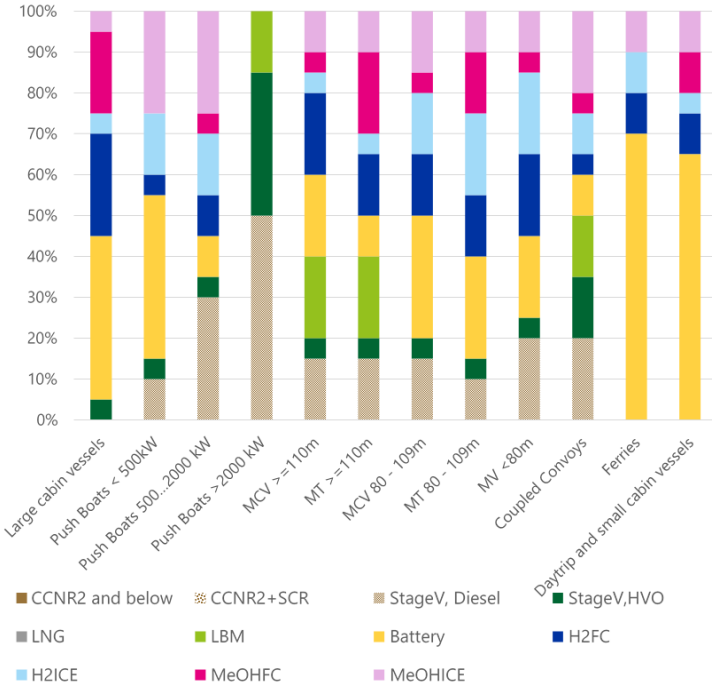


Figure 5: Fuels and techniques per fleet family in the innovative pathway in 2050
(source: draft CCNR study on energy transition towards a zero-emission)

Questions to PA1a Steering Group:

6. *Which technologies would you consider to be the most feasible considering the specific profile and situation of Danube navigation?*
7. *What would be main barriers for implementation of such technologies in your country?*
8. *What would need to be done first to set things in motion along this pathway towards 2050?*

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