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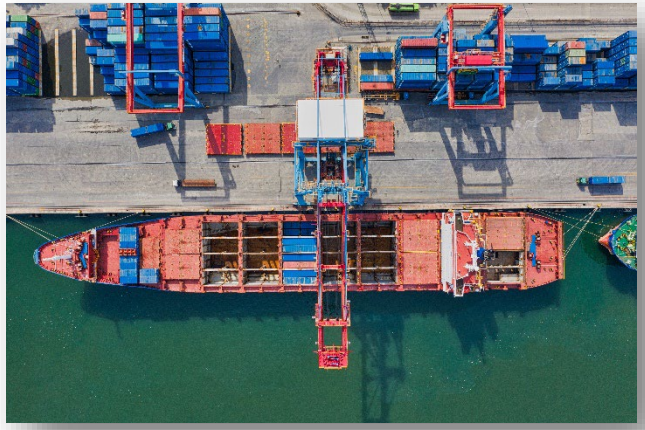
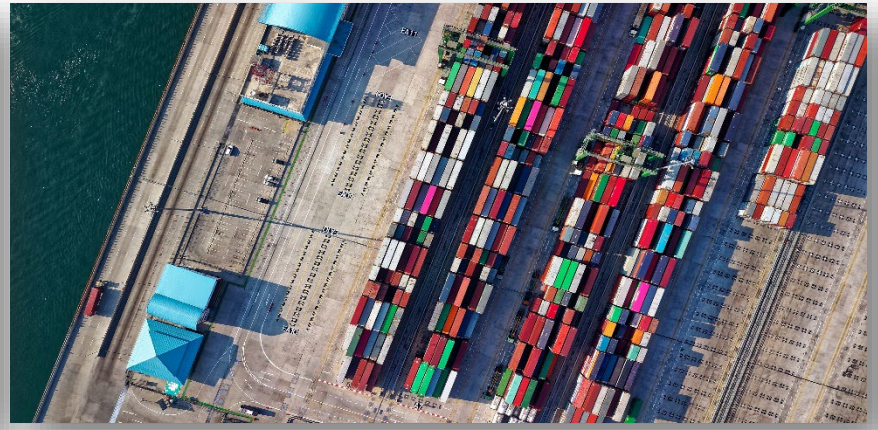




DANUBE COMMISSION
Working Group on the technical matters
The draft Road Map for Fleet Modernization

Petro Suvorov

Budapest, 13-15 of May2025

Main goals of the draft Road Map for Fleet Modernization:

The task of the European inland fleet modernization is based on the need to increase the sustainability and mobility of inland water transport (IWT) while achieving its climate neutrality, which is a political priority both at the national and international level.

The goal of transition to zero emissions inland fleet is expected to be achieved through a set of measures, including various actions for the targeted revision of the current and creation of a new regulatory framework concerning the IWT market and infrastructure, fleet modernization, new concept of its technical operation, the introduction of new digital technologies for fleet management and standards for the training of ship crew.

For implementation of fleet modernization the DC introduced the draft Road Map, focusing not only on environmental aspects, but also on competitiveness of Danube shipping.

The relevant policy background

As the main regulatory and policy documents, as well as the ones serving as an informational input for this work, for setting and solving the problems of the Danube fleet modernization, the following were used:

- NAIADES III Action Plan, *COM (2021) 324 final;*
- Directives (EU) 2016/2397, 2017/1629, ES-TRIN (2025) and ES-QIN (2024);
- the outcomes of the work conducted in CESNI/PT, CESNI/QP, CESNI/TI;
- Regulation (EU) 2016/1628;
- main outputs of the DTP GRENDEL project (2018-2020);
- main findings of the Horizon 2020 PLATINA3 project;
- the finalized draft of the DFND (2023);
- the Danube Commission draft Road Map for Fleet Modernization (updated version – September 2024, document for discussion);
- initiatives tackling fleet modernization reflected in the working documents of other organizations: CCNR, PA 1a EUSDR etc.
- CCNR Roadmap for reducing inland navigation emissions:

https://www.ccr-zkr.org/files/documents/Roadmap/Roadmap_en.pdf

The main objective of the draft Road Map for Fleet Modernization

The main objective of the draft Road Map is to develop and implement, within a certain time frame, specific organizational, technical and social measures, agreed within the framework of the Danube Commission, to ensure the transition of the Danube fleet to zero emissions in the exhaust gases of vessels engines according to certain scenarios, namely:

- consistent, according to the approved scenario, reduction of greenhouse gases (CO2, CH4 – methane, reduced to CO2) in the exhaust gases of engines during the vessel operation,
- consistent, according to the approved scenario, ensuring compliance with regulatory requirements to reduce the level of other harmful emissions (air pollutant gases: CO, HC, NOx and particulate matter - PM) in engine exhaust gases,
- finally ensuring the transition of the fleet to zero-emission operations in terms of greenhouse gases and other harmful emissions,
- improvement of the energy efficiency of inland shipping and reduction of conventional as well as alternative fuel consumption during the vessel`s operation.

These agreed activities will be recommended for inclusion in targeted national fleet modernization programs; they should not only ensure environmentally friendly shipping, but also increase the competitiveness of the Danube shipping.

Road Map of the DC: Fleet modernization transition scenarios

It is proposed to approve transition scenarios for the progressive modernization of the fleet, for example, similar to the CCNR Roadmap for reducing inland navigation emissions, published in 2022, in particular:

a) conservative, by 2035, targeting reduction of greenhouse gases and air pollutant gases and particulate matter by 35% compared to 2015 (conservative pathway),

b) innovative, by 2050, targeting reduction of greenhouse gases and air pollutant gases and particulate matter to a significant extent (up to 90%) compared to 2015 (innovative pathway),

c) business as usual scenario, operation of the existing fleet, which age doesn't allow modernization either from technical or from economic perspective even in accordance with conservative scenario by 2035.

The reduction of air pollutant gases and particulate matter is achieved by special methods of after-treatment of exhaust gases for vessels in operation, or by installing new engines with emission limits set by Regulation (EU) 2016/1628, Stage V.

Stage V emission limits (IWA, IWP):

Engine category	Power	Type of ignition	CO	HC	NO_x	PM	PN	A
	kW		g/kW*h	g/kW*h	g/kW*h	g/kW*h	g/kW*h	-
IWP-v-1 IWP-c-1 IWA-v-1 IWA-c-1	19 <P<75	все	5.00	($HC + NO_x \leq 4,70$)		0.30	–	6,00
IWP-v-2 IWP-c-2 IWA-v-2 IWA-c-2	75 <P<130	все	5.00	($HC + NO_x \leq 5,40$)		0.14	–	6,00
IWP-v-3 IWP-c-3 IWA-v-3 IWA-c-3	130 <P<300	все	3.50	1.00	2.10	0.10	—	6,00
IWP-v-4 IWP-c-4 IWA-v-4 IWA-c-4	P >300	все	3.50	0.19	1.80	0.015	$1x10^{12}$	6,00

Stage V emission limits (NRE):

Engine category	Power	Type of ignition	CO	HC	NO_x	PM	PN	A
	kW		g/kW*h	g/kW*h	g/kW*h	g/kW*h	g/kW*h	
NRE-v-3 NRE-c-3	19 ≤ P < 37	CI	5,00	(HC + NOx ≤ 4,70)		0,15	1×10^{12}	1,10
NRE-v-4 NRE-c-4	37 ≤ P < 56	CI	5,00	(HC + NOx ≤ 4,70)		0,15	1×10^{12}	1,10
NRE-v-5 NRE-c-5	56 ≤ P < 130	все	5,00	0,19	0,40	0,15	1×10^{12}	1,10
NRE-v-6 NRE-c-6	130 ≤ P ≤ 560	все	3,50	0,19	0,40	0,15	1×10^{12}	1,10

Information from the CESNI Committee on engine manufacturers that have received the above approval is available on the website:
https://listes.cesni.eu/2060-en.html

Available stage V engines (ICE) – 2024

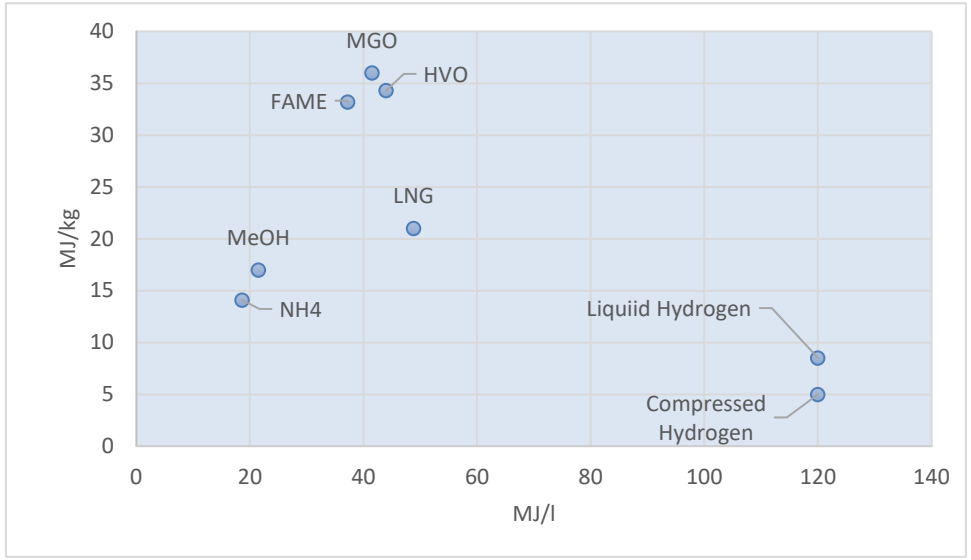
Family	Propulsion	Auxiliary	Power rating
IWP	Beta Marine, FTP Industrial S.p.a., Volvo Penta, Anglo Belgian Corporation (ABC), MAN Truck and Bus SE, Perkins Engines Co. Ltd., DAMEN, Wartsila, AGCO Power, Cummins Inc., Caterpillar Inc., Baudouin, Koedood Dieselservice B.V., Steyr Motors, Yes B.V. Greenpower	-	Up to 4000 kW
IWA	-	Hatz Motorenfabric GmbH, Baudouin, John Deere, Cummins Inc., Koedood Dieselservice B.V., JCB Power Systems Limited, FTP Industrial S.p.a.	From 19-125 kW
NRE	LOMBARDINI SRL, Deutz AG, SCANIA, Caterpillar Inc., Cummins, Yanmar Co. Ltd, John Deere, AB Volvo Penta, FTP Industria b.p.A		From 19 up to 522 kW
Euro VI	DAF/Paccar; Weichai Power Co Ltd		From 220 up to 530 kW

Criteria and sub-criteria considered in the selection of alternative fuels:

Main criterion	Sub-criterion
Economic	Investment cost for propulsion
	Operational cost
	Fuel price
Technical	Available infrastructure
	Reliable supply of fuel
Environmental	Climate change
	Acidification
	Health impact
Social	Safety
	Upcoming legislation

Maritime fuels included in the analysis

Fuel	Gravimetric Lower Heating Value [MJ/kg]	Volumetric Lower Heating Value [MJ/liter]	ICE/FC
MGO	40.5 - 42.8	35.8 – 37.0	ICE
LNG	48.6 – 49.1	20.8 – 21.2	ICE
Methanol	20.0 - 22.9	15.8 - 18.2	ICE, FC
HVO	44.0	34.3	ICE
FAME	37.2	33.2	ICE
Liquid Ammonia	18.6	14.1	ICE (-35%)
Liquid Hydrogen	120.0	8.5	ICE (-252^{O}C), FC
Compressed Hydrogen	120.0	5.0	ICE (350 bar), FC
Lithium-ion Battery	-	1.15	-



Propulsion type:

ICE – internal combustion engine; **FC** – fuel cell

Fuel type:

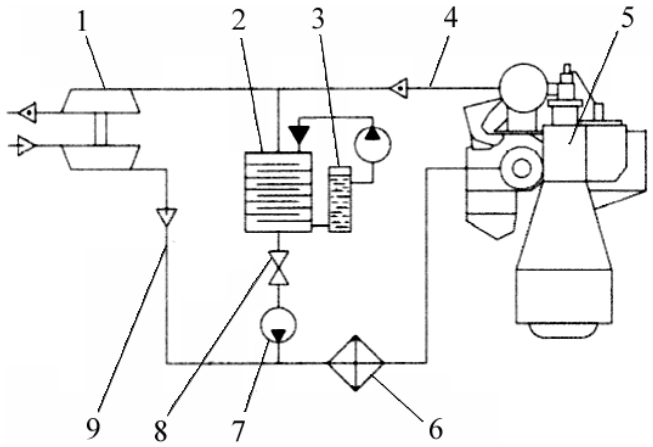
MGO – Marine gas oil;
LNG – Liquefied natural gas;
MeOH – Methanol;
HVO – Hydrotreated vegetable oil;
FAME – Fatty acid methyl ester;
H2 – Hydrogen;
NH3 – Ammonia.

Emission reduction potential per technique/fuel

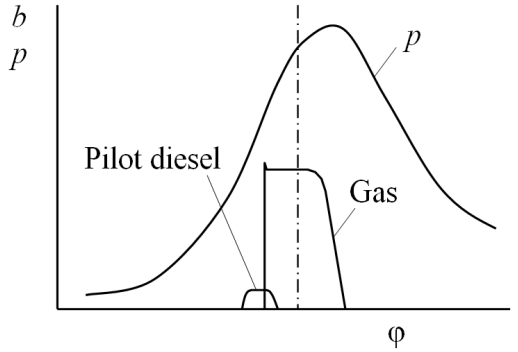
Technology	GHG / CO2e	NOx	PM
CCNR 2 and below	0%	0%	0%
CCNR 2 + SCR	0%	82%	54%
Stage V, Diesel	0%	82%	92%
Stage V, HVO	100%	82%	92%
LNG	10%	81%	97%
LBM	100%	81%	97%
Battery	100%	100%	100%
H2 FC	100%	100%	100%
H2 ICE	100%	82%	92%
MeOH FC	100%	100%	100%
MeOH ICE	100%	82%	92%

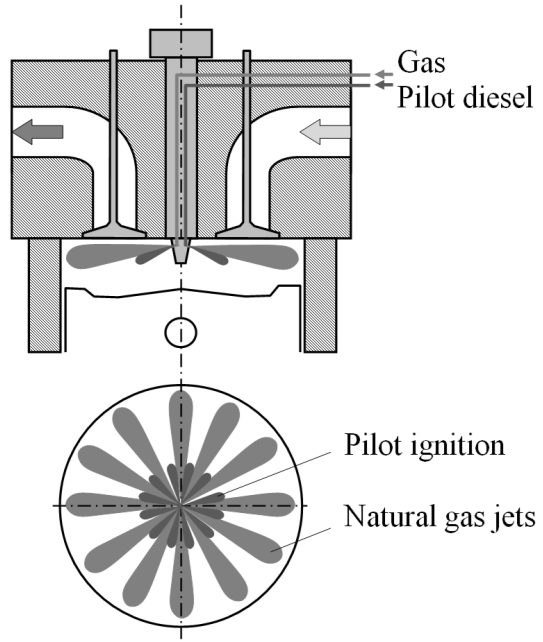
Source: CCNR
https://www.ccr-zkr.org/files/documents/EtudesTransEner/Deliverable_RQ_C_Edition2.pdf

Modernization of exhaust gas treatment system by means of EGR (2-3):

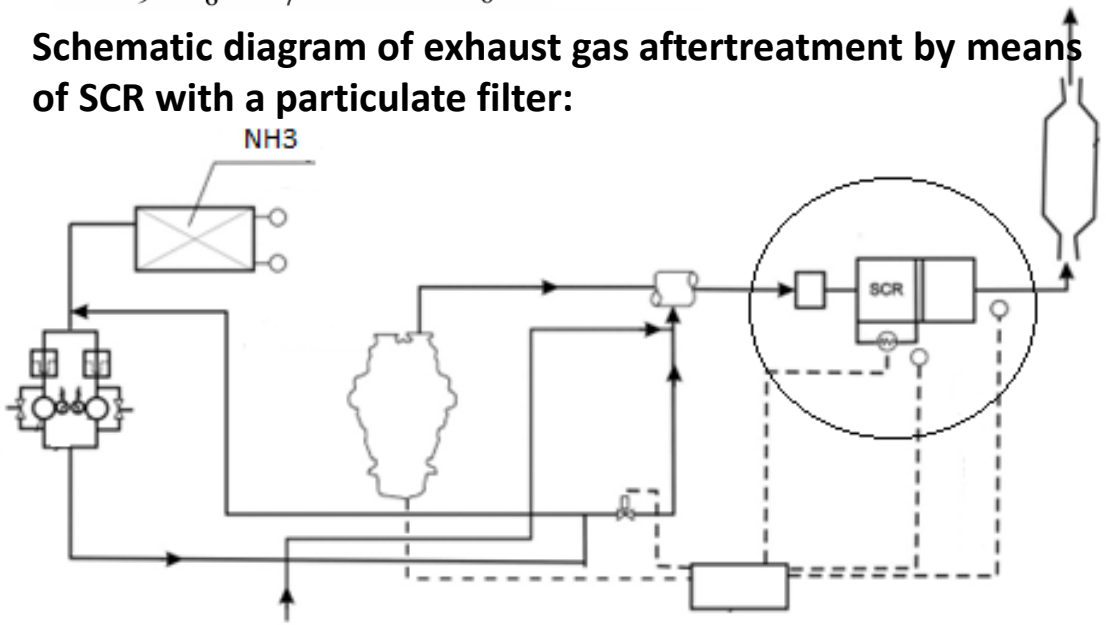


Schematic injection of "dual fuel":





Schematic diagram of exhaust gas aftertreatment by means of SCR with a particulate filter:



Main tasks

The transition to energy-efficient and environmentally friendly shipping ("eco-navigation"), both in conservative and innovative scenarios, should be supported by relevant projects on the main aspects of the Danube navigation development targeting:

1. ***Infrastructure:***

- proper fairway maintenance by the national waterway administrations through the implementation of new hydrotechnical projects that will create sustainable and balanced navigation conditions on all sections of the Danube River;
- ensuring the safety of navigation and conditions for seamless transportation along the Rhine-Danube Corridor by eliminating unnecessary administrative barriers.

2. Fleet:

- assessment of the possibility of step-by-step modernization or replacement of existing engines to achieve minimum requirements of emission standards;
- facilitate the financing of pilot projects for vessels using new technologies, as well as the exchange of know-how regarding the practical use of alternative fuels.

Main tasks

3. Crew and vessel operation:

- improving the professional training of boat-masters (Directive (EU) 2017/2397) for European inland waterways (competences in "eco-naviation") with an emphasis on the full use of RIS (River Information Services) in operational management (navigation level);
- active use of modern RIS systems for traffic forecasting in voyage planning (determining the vessel`s speed, type of convoys) and tracking the current traffic for voyage planning, thereby introducing a system for monitoring energy efficiency and environmental safety for shipping companies.

4. Digitalization:

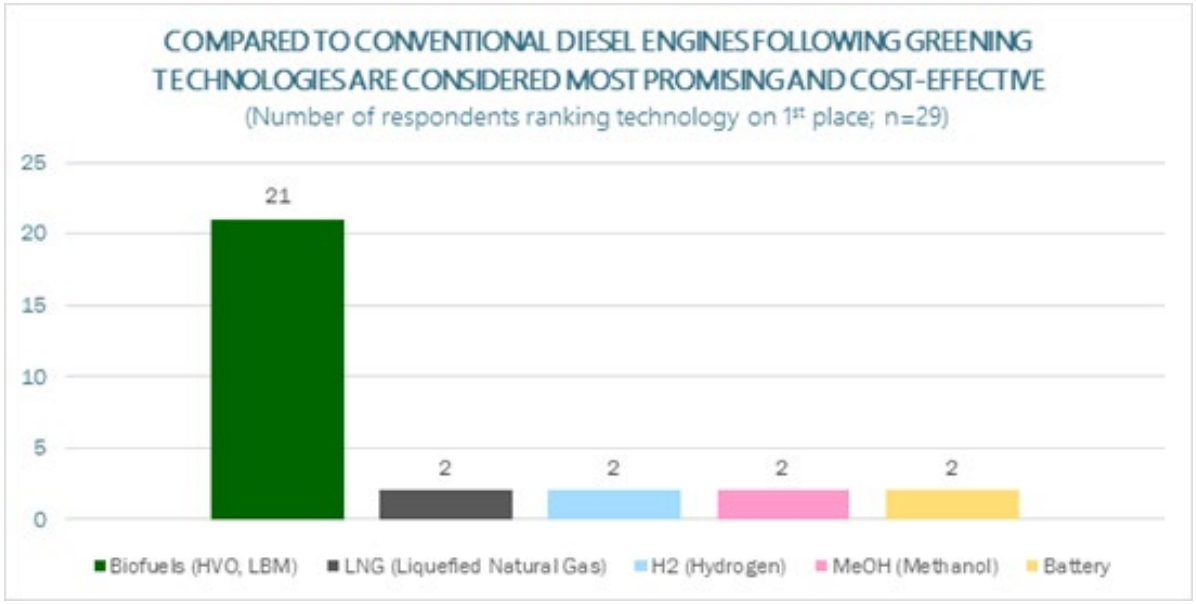
- digitalization of technological and administrative processes of fleet traffic management,
- "greening" of the Danube ports and creating a framework for alternative fuels supply.

Risks and barriers

When evaluating the possibilities of implementing the proposed energy efficiency scenarios and technologies to reduce emissions in exhaust gases, it is necessary to consider the existing risks and barriers:

- status quo of the Danube shipping market and its potential development during the period of the proposed scenarios (forecasts for traffic volumes, freight rates, the cost of fuel, etc.),
- affordability and portfolio of vessel engines and available technologies,
- readiness of IWT infrastructure to provide alternative fuels bunkering and to maintain new technological systems on board the vessel,
- the level of crew competence to operate new types of vessels and to deploy the principle of "eco-navigation",
- readiness of a legislative framework in inland navigation, as well as approved rules and standards for low and / or zero emission vessels.

Questionnaire for updating the DC Roadmap



Source: Expert survey at the occasion of the Danube Commission / PA1a Workshop "Roadmap and actions towards zero-emission Danube fleet" of 8th October 2024

The objective of the questionnaire was to provide an update of the DC Roadmap for the modernization of the Danube fleet based on the outcomes of the 1st Joint Workshop **"Roadmap and actions towards zero emission Danube fleet"** organized by the Danube Commission and the EUSDR PA1A on 8 October 2024. The expert survey conducted in the framework of this workshop collected the opinions of the representatives of the Danube shipping sector experts, while the questionnaire addressed the DC Member States.

The questionnaire's **methodology** was based on the following topics: fleet, Infrastructure (ports), digitalization, and crew.

The questionnaire aimed to confirm the assumptions made during the workshop regarding biofuels as the most realistic and rational type of alternative fuel for the Danube fleet.

As of the 1st of May 2025, the Secretariat has received responses from Austria, Germany, and Slovakia.

Questionnaire for updating the DC Roadmap for the modernization of the Danube fleet

Question 1: Is the technology of using biofuels of the HVO type (hydrotreated vegetable oil) the most suitable alternative energy source for Danube shipping at the moment?

Question 2: The questionnaire presented an indicative scenario for the transition of the Danube fleet to alternative fuels in the course of a conservative scenario.

Question 3: What is the current tax rate on HVO biofuels (HVO25, HVO50, HVO100) in the DC Member States?

Question 4: Have EU Member States included adequate information on inland navigation in their RED-III roadmaps, particularly specific targets for the share of inland navigation fuel supply from renewable energy sources for 2026-2030?

Question 5: How is the issue of creating an alternative fuel infrastructure being addressed in this aspect?

Question 6: What are the capabilities of your country's ports to provide bunkering of the fleet with HVO fuel and HVO blends on the national stretch?

Question 7: What are the minimum distances, and what type of bunkering is most suitable for self-propelled vessels and large convoys?

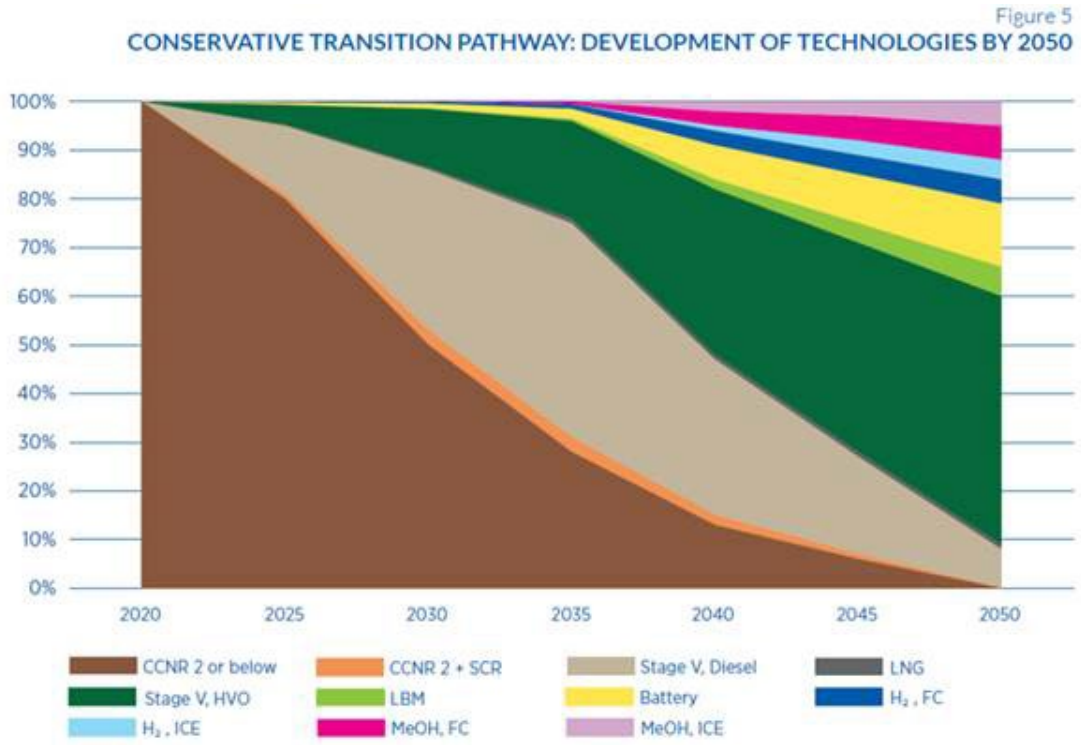
Question 8: Which new elements for crew training should be taken into account in Directive 2016/2397 and the ES-QIN Standard when introducing alternative fuels in IWT?

Summary of the results of the questionnaire

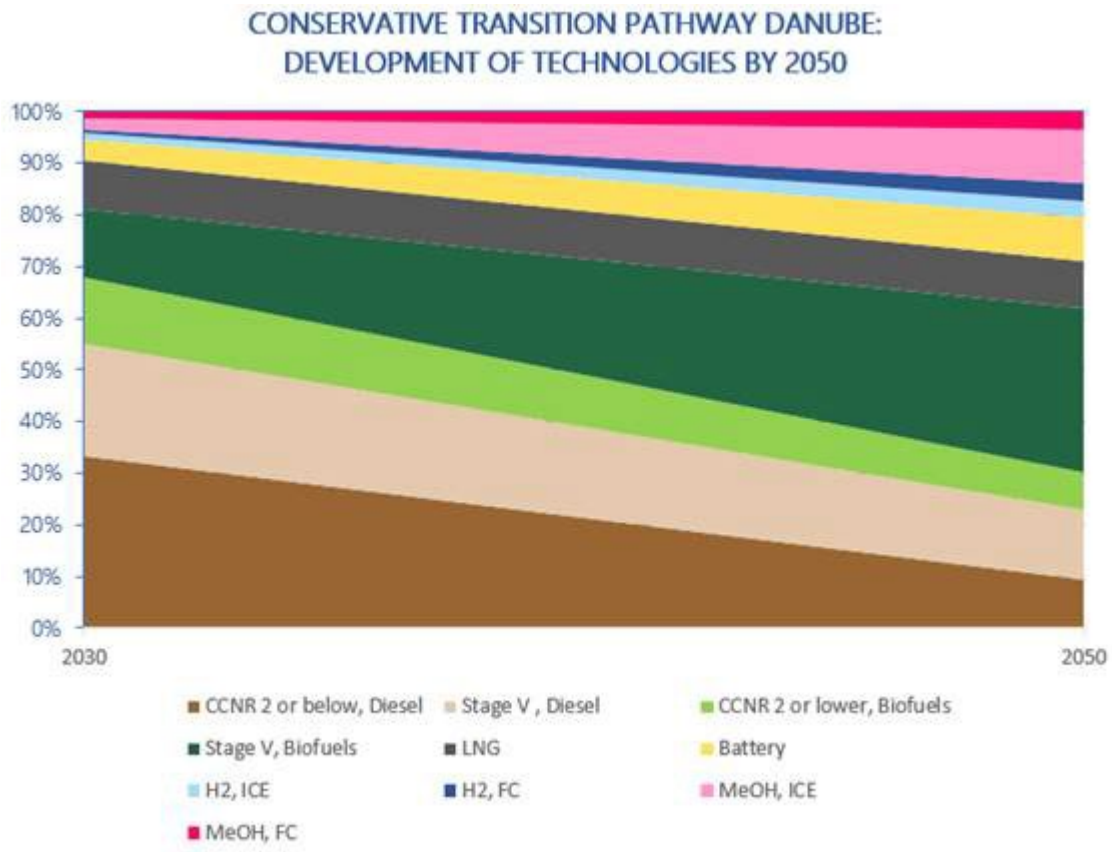
- The Member States agree that the biofuels of HVO type are the most suitable energy source to decarbonize the Danube fleet, but the research and accumulation of practical experience in the use of HVO should be continued.
- The Member States agree in principle with the scenario for the conservative transition pathway for the Danube, presented during the 1st Joint Workshop, but the current state of the Danube fleet and the financial capabilities of the shipowners have to be considered.
- HVO 100, like fossil diesel, is tax-exempt for IWT, as well as other alternative energy sources (methanol, hydrogen).
- The Renewable Energy Directive (RED III) is implemented in some of the DC Member States*, and in some it is under implementation.
- With regards to HVO bunkering infrastructure, it was emphasized that creating sufficient and effective infrastructure in ports (implementation of the AFIR at the national level) still requires time. In Austria and Germany, the number of HVO bunkering points, however, has already increased.
- The minimum distances and the type of bunkering suitable for self-propelled vessels and large convoys cannot be defined at the current moment, as they depend on local conditions, traffic on the particular stretches of the Danube, and port development options.
- The new requirements for crew still need to be defined based on the experience of the pilot projects following the work of CESNI/QP.

*meaning the DC Member States that are the Member States of the EU

Comparison of the CCNR Study assumptions with the expectations of Danube stakeholders



Source: CCNR Roadmap for reducing inland navigation emissions



Source: Expert survey at the occasion of the Danube Commission / PA1a Workshop "Roadmap and actions towards zero-emission Danube fleet" of 8th October 2024

Comparison of selected fuel characteristics for pure FAME and HVO

Baseline: Diesel	FAME	HVO
Energy content	Lower	Comparable
Cetane number	Comparable	Higher
Density	Comparable	Slightly lower
Viscosity	Slightly higher	Slightly lower
Material compatibility	Incomparable with certain materials	Comparable
Flash point	Higher	Comparable
Lubricity	Good	Poor
Cold flow properties	Poor	Good/Comparable
Storage stability	Poor	Good/Comparable

Thank you for your attention!

Secretariat of the Danube Commission

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