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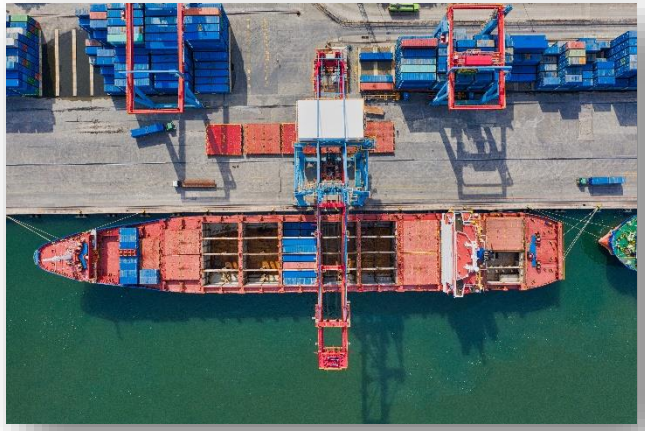
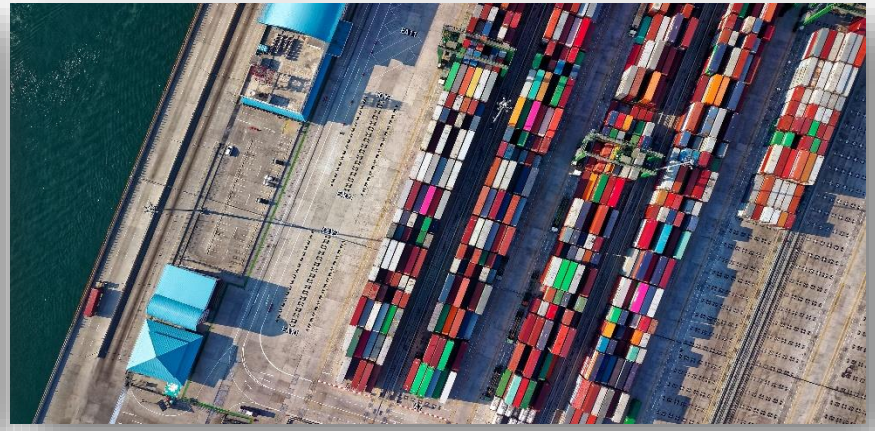


DANUBE COMMISSION

Working group on technical matters (WG TECH)

The Working Platform for Fleet Modernization

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Budapest, 12 - 13 October 2023

General structure of the DC`s Working Platform:

1. Policy and regulatory framework for the fleet modernization process
2. Main goals and objectives of the Working Platform
3. General framework of organizational solutions and possible technologies for improving energy efficiency of inland navigation vessels (the specific features of ensuring energy efficiency of the Danube fleet).
4. Choice of technologies for reduction (elimination) of other pollutants
5. Risk assessment: legal and regulatory issues in relation to the regulatory framework for low and/or zero-emission vessels
6. Legislative and regulatory issues
7. Main tasks of the Danube Commission

Main task of the European inland 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 main objective of the Working Platform for Fleet Modernization

The main objective of the Working Platform 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 navigation to zero emissions in the exhaust gases of vessels engines according to certain scenarios, namely:

- consistent, according to the approved scenario, reduction of the mass 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 (decrease) the level of other harmful emissions (air pollutant gases and particulate matter) 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.

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 (2023) and ES-QIN (2019);
- 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);
- 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

Main definitions and terminology

"Energy-efficient navigation": use of an energy efficiency indicator similar to the IMO EEOI index, g CO2/t km, i.e. in the form of specific weight of greenhouse gas emissions, reduced to CO2, per unit of transport work (ton-kilometer, t km) of the vessel,

$$EEOI = \frac{N_e \cdot SFC \cdot C_F}{Dw \cdot \upsilon}$$

- Ne - effective power of the main engine, kW;
- SFC – specific fuel consumption, g/kW per hour;
- C_F – CO2 emissions ratio (dimensionless conversion factor between fuel consumption and CO2 emissions), $C_F = T_{CO_2} / T_{\text{топлива}}$
- Dw – (Capacity) – cargo weight for cargo vessels, tons;
- υ - vessel`s speed, km/h;
- the numerator in this formula is CO2 emissions, the denominator is transport work in t·km.

To ensure energy efficiency of shipping, a set of management and technical solutions is used for optimal planning of the voyage fuel consumption (including alternatives to diesel), for training ship management and crews in methods of ensuring fuel efficiency of ship traffic.

Main definitions and terminology

“Reduction of other emissions": emissions of "air pollutant gases and particulate matter" such as CO, HC, NOx, PM in the exhaust gases of vessel`s engines as a result of the combustion process of diesel fuel. The reduction of emissions 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 emissions limits (IWP, IWA):

Engine category	Power	Type of ignition	CO	HC	NO_x	PM	PN
	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	All	5.00	(HC + NO_x<4,70)		0.30	—
IWP-v-2 IWP-c-2 IWA-v-2 IWA-c-2	75 <P<130	All	5.00	(HC + NO_x<5,40)		0.14	—
IWP-v-3 IWP-c-3 IWA-v-3 IWA-c-3	130 <P<300	All	3.50	1.00	2.10	0.10	—
IWP-v-4 IWP-c-4 IWA-v-4 IWA-c-4	P >300	All	3.50	0.19	1.80	0.015	$1x10_{12}$

In addition to the categories IWA, IWP, the categories NRE and Euro VI are also allowed.

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 – 2023

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.	-	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, Hatz Motorenfabric GmbH, SCANIA, Perkins Engines Co. Ltd., Ctaerpillar Inc., Cummins, Yanmar Co. Ltd, John Deere		From 19 up to 522 kW
Euro VI	DAF/Paccar		From 220 up to 530 kW

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.

Technology readiness levels and potential emissions reduction

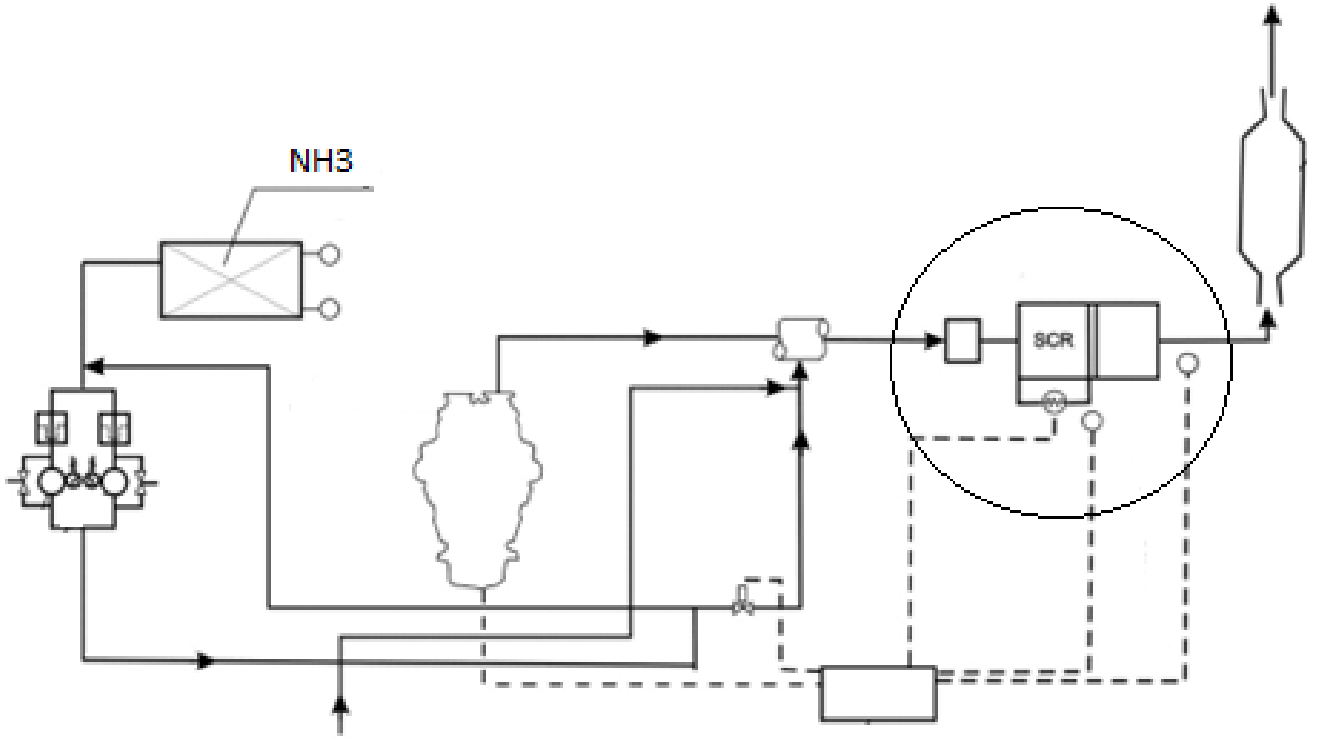
Technologies considered in the pathways	TRL (1-9) vessel application	TRL (1-9) fuel/energy production and supply	Emission reduction potential (in an ideal upstream chain)		
			GHG/ CO_{2e}	NO_x	Particulate matters
CCNR 2 or below, Diesel	9	9	0%	0%	0%
CCNR 2 + SCR, Diesel	9	9	0%	82%	54%
Stage V, Diesel	9	9	0%	82%	92%
LNG	9	9	10%	81%	97%
Stage V, HVO	9	9	100%	82%	92%
LBM	9	8	100%	81%	97%
Battery	8	7	100%	100%	100%
H_2, FC	7	7	100%	100%	100%
H_2, ICE	5	7	100%	82%	92%
MeOH, FC	7	6	100%	100%	100%
MeOH, ICE	5	6	100%	82%	92%

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

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

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



Fleet modernization transition scenarios

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

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

b) innovative, by 2050, for example, 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

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 other harmful 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.

The main activities of the DC including participation in international projects

Rules and standards developed within the accepted scenarios should take into account the international nature of the IWT sector, ensure a level-playing-field between different Member States and allow:

- to reduce risks for shipowners wishing to invest into a new fleet (support for shipping companies to plan their investments),
- to reduce costs (initial investment, operating costs and insurance costs),
- to promote the adoption of new technologies by reducing risks to safety and the environment,
- to stimulate market structuring and promote wider adoption of technologies and clean energy types.

Development of the Danube fleet modernization roadmap?

Thank you for your attention!

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